Annex 494

Medium Term Debt Management Strategy: Fiscal Year 2023-2024 to 2025-2026, *Government of Barbados*

GOVERNMENT OF BARBADOS

MEDIUM TERM DEBT MANAGEMENT STRATEGY

Fiscal Year 2023-2024 to 2025-2026

DEBT MANAGEMENT UNIT. MINISTRY OF FINANCE, ECONOMIC AFFAIRS AND INVESTMENT

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LIST OF ABBREVIATIONS

ATM – Average Term to Maturity

ATR – Average Time to Re-fixing

BOSS Plus – Barbados Optional Savings Bonds Plus

CAF – Corporación Andina de Fomento

CBB – Central Bank of Barbados

CDB – Caribbean Development Bank

CCRIF – Caribbean Catastrophe Risk Insurance Facility

DMU – Debt Management Unit

DSA – Debt Sustainability Analysis

EFF – Extended Fund Facility

FX – Foreign Exchange

GDP – Gross Domestic Product

IADB – Inter-American Development Bank

IMF – International Monetary Fund

IR – Interest Rate

MFEI - Ministry of Finance, Economic Affairs and Investment

MTDS – Medium-Term Debt Strategy

NIB – National Insurance Board

PBL – Policy Based Loan

RSF – Resilience and Sustainability Fund

S1 – Strategy 1

S2 – Strategy 2

S3 – Strategy 3

S4 - Strategy 4

SDR – Special Drawing Rights

ST – Short Term

SOFR – Secured Overnight Financing Rate

T-Bills – Treasury Bills

T-Notes – Treasury Notes

MINISTER'S STATEMENT

In accordance with the Public Finance Management Act, 2018, the Minister responsible for Finance shall present a Medium-Term Debt Management Strategy with the Annual Budget to Parliament. The Medium-term Debt Management Strategy shall be consistent with the following fiscal responsibility principles:

(i) achieving and maintaining a prudent level of public debt;
(ii) managing fiscal risks in a prudent manner; and
(iii) pursuing macro-economic stability, inclusive growth and intergenerational equity.

In seeking to satisfy Government's financing needs, the MTDS evaluates the costs associated with various forms of available financing within a framework that is consistent with an acceptable level of risk. It is reflective of our commitment to reduce the debt-to-GDP ratio to 60 percent by 2035/2036 and the associated policy reform efforts articulated in the Barbados Economic Recovery and Transformation Plan 2022.

The publication of this MTDS seeks inter alia to continue enhance debt transparency and accountability, while providing greater context around Government's borrowing decisions. The Borrowing Plan for 2023-2024 capitalizes on the strong relationships built with official sector development partners, as well as domestic stakeholders.

Minister responsible for Finance

EXECUTIVE SUMMARY

The Medium Term Debt Strategy 2023/2024 to 2025/2026 is the Government of Barbados' plan aimed at achieving the desired composition of the debt portfolio over the stated period. Public debt ratios have returned to a downward trajectory following Government's policy response to address the weaker revenues and higher expenditure outlays resulting from managing the effects of the global pandemic COVID-19, as well as the impact from the natural disasters.

Barbados entered a three-year arrangement under a second Extended Fund Facility (EFF) with the IMF, building on the successful implementation of the Barbados Economic Recovery and Transformation Plan 2018. The new EFF combined with funding from the Resilience and Sustainability Facility will support the Barbados Economic Recovery and Transformation Plan 2022. To date, this has unlocked approximately USD465.0 million (SDR 336.2 million) in funding from the IMF.

At March 31, 2023, public debt stood at approximately BBD14,278.3 million, around 119.6% of GDP. The majority of domestic debt is held in stepped rate amortizing bonds while the external debt portfolio comprises primarily of multilateral loans and a sovereign bond.

The size of the debt is a source of vulnerability, as is the increased share of external debt. The majority of the external debt is owed to multilateral creditors at floating rates and thus exposed to rising global interest rates. While the 2018 and 2019 Debt Exchanges assisted significantly in mitigating some of the risks inherent in the debt portfolio at that time by extending out maturities, debt service costs have increased as repayment of these obligations commence.

The analysis considers four strategies that utilize all potential sources of funding. In light of significant increases in interest rates over the last year, shocks to interest rates were applied to the external variable rate debt in the portfolio, as well as to the external bond issuance in all strategies.

Strategy 1, which utilizes majority external official sector funding to meet gross financing needs, was considered as the preferred option. Though initially more costly, it capitalizes on already identified sources of financing, in addition to fulfilling Government's objective of reigniting the domestic securities market. The success of this strategy will be heavily dependent on the completion of the necessary reforms to satisfy the structural benchmarks and other conditions precedent to access the funding.

Overall, steady reform of the domestic economy and the generation of primary surpluses will be key to ensuring the success of the strategy in light of (i) the uncertainty in the global economy and (ii) the increasing vulnerabilities to contingent liability shocks due to natural disasters.

OBJECTIVES AND SCOPE

1. The principal objectives for debt management in Barbados are to:
   (i) ensure that the Government's financing needs and payment obligations are met on a timely basis;
   (ii) ensure that the Government's financing needs are met at the lowest possible cost;
   (iii) ensure that the Government's financing needs are met within a framework that is consistent with an acceptable level of risk;
   (iv) ensure that public debt levels are put on a downward trajectory towards sustainability with a long term debt to GDP target of 60 percent by 2035/2036; and
   (v) develop the domestic securities market.

2. This debt management strategy covers the period commencing fiscal year 2023-2024 to 2025-2026. The scope for coverage is public debt defined as Central Government debt, guaranteed debt and Central Government arrears. External debt is defined by currency.

LEGAL FRAMEWORK FOR DEBT MANAGEMENT

3. The Minister of Finance is the necessary and sole authority in respect of all public borrowings, the authority being delegated in accordance with the various pieces of debt legislation. The Constitution of Barbados (Section 111), the Public Finance Management Act and the Financial Management and Audit Act (Section 3 (2)) require that all public debt charges shall be a charge on the Consolidated Fund. The Constitution (Section 107) provides for the establishment of the Consolidated Fund.

4. Currently, there is not a consolidated piece of legislation in Barbados that deals with borrowing and debt management. There are various pieces of legislation governing and establishing limits[1] with respect to local and foreign borrowing, including the Financial Management and Audit Act; the Public Finance Management Act, 2019, the Local Loans Act Cap.98, Treasury Bills and Tax Reserve Certificate Act Cap. 106, the Savings Bond Act Cap. 104A, the Special Loans Act Cap. 105, the External Loans Act Cap. 94D, the Guarantee of Loans (Companies) Act Cap. 96 and the Central Bank of Barbados Act Cap. 323C.

[1] See Appendix 1

5. In addition, the Debt Holder (Approval of Debt Restructuring) Act 2018, the Debt Holder (Approval of Debt Restructuring) (Amendment) Act 2019 along with the Dematerialisation of Government Securities Act were passed in 2018 and 2019, respectively.

THE INSTITUTIONAL FRAMEWORK FOR DEBT MANAGEMENT

6. Various divisions of the Ministry of Finance, Economic Affairs and Investment and the Central Bank of Barbados (CBB) have customarily administered the debt management functions. Steps have been taken towards a more focused and coordinated approach to the administration of debt management with the establishment of a Debt Management Unit (DMU) within the Ministry and the formation of a number of Committees.

7. The Finance Division undertakes back, middle and front office functions, the Treasury Department back office operations and the Economic Affairs Division front office operations. The Central Bank provides advisory services as well as acts as fiscal, paying and subscription agent.

REVIEW OF DEBT MANAGEMENT STRATEGIES

8. Barbados' 2022-2023 to 2024-2025 debt management strategy that was predicated on an increased use of domestic and external commercial funding did not materialize as envisaged. The increase in domestic funding was realized through the offering of BBD200.0 million in BOSS Plus bonds. Although Barbados did return to international capital markets in 2022, it did so for the issuance of a landmark blue bond which financed a debt neutral repurchase of more expensive commercial debt. As concessional multilateral financing was readily available in 2022-2023 given Barbados' ongoing strong performance under the IMF program, the majority of the funding was sourced from multilateral sources.

9. Concerted efforts continue to be made to (i) avoid bunching of debt maturities, where possible, thus minimizing unnecessary pressure on either revenue or foreign reserves; (ii) make greater use of amortized debt payment schedules; (iii) seek to refinance debt at lower interest rates, where possible; and (iv) increase sources of official financing at extended maturities.

10. In addition, pandemic clauses have now been added to the natural disaster clauses introduced into new debt issuances. These clauses, under certain conditions and following the occurrence of certain events under Barbados' insurance contract with CCRIF, or the declaration of a pandemic by the WHO, gives Barbados the option to defer payments for a period of two years. Interest will be capitalized during the period.

RECENT DEVELOPMENTS IN PUBLIC DEBT

Debt for Nature Swap

11. In September 2022, Barbados completed a landmark debt for nature conversion deal, the proceeds of which will fund a domestic conservation fund and an endowment trust supporting durable large-scale conservation of the country's fragile marine environment and promotion of the sustainable blue economy for generations. The Barbados debt conversion is the first of its kind to make use of private and nonprofit sector capital under an innovative and efficient structure that maximises the savings generated for marine conservation purposes.

12. In executing the transaction, the Government repurchased USD77.6 million in aggregate principal amount of the Government of Barbados' 6.5% Notes due 2029 by means of a modified Dutch auction that was launched on 9 September 2022 and expired on 16 September 2022. The clearing price of the auction was set at USD92.25 per USD100 in principal amount of the Notes accepted for purchase. In parallel, the Government prepaid USD72.9 million equivalent of its Barbados dollar-denominated Series E 8% bonds due 2043.

13. The operation was funded through a dual currency USD146,518,800 equivalent term loan facility, or blue loan, that benefits from a 100% guarantee of up to USD150.0 million from the Inter-American Development Bank ("IDB") (75%) and The Nature Conservancy ("TNC") (25%), the non-profit's first such guarantee.

14. The interest rate savings from the differential between the repurchased debt and the blue loan are expected to be approximately USD50.0 million over a 15-year period.

15. In executing the blue loan the GOB extended its natural disaster clause to include pandemics, a first in international capital markets.

IMF Arrangement

16. In December 2022, Barbados entered into a second Extended Fund Facility (EFF) Program with the IMF. This new IMF-supported program builds on the achievements of Barbados' 2018-22 EFF and draws on the updated Barbados Economic Recovery and Transformation Plan 2022 (BERT 2022), including on efforts focusing on building resilience to natural disasters and climate change as well as reducing greenhouse gas emissions and

transition risks. The 36-month EFF gives Barbados access to USD113.0 million over the period.

17. Barbados also became the first country to reach an agreement to access the IMF's new Resilience and Sustainability Facility (RSF), which aims to provide long-term financing, 20-year maturity with a 10.5-year's grace period, to help build resilience against climate change. This refinancing provides an important extension of maturity against the previous IMF program during the debt strategy period.

18. The arrangement under the RSF will provide approximately USD189.0 million to assist in funding the country's climate change adaptation and mitigation efforts, as well as, supporting the goal of transitioning to a fully renewable-based economy by 2030. The RSF, combined with a broad set of identified reform measures, are expected to go a long way in unlocking financing from other international financial institutions and the private sector.

Climate Resilience Strategies

19. Barbados continues to proactively adopt a strategy of building climate resilience into its debt portfolio. In this regard, a suite of other climate resilience financing instruments has buttressed the natural disaster clauses first introduced into instruments in 2018. These include the IADB's Contingent Credit Facility for Natural Disasters, as well as the activation of the Principal Payment Option (PPO) for eligible and future IADB loans. These seek to mitigate financial risk to the Government in the event of certain natural disasters, in the short and medium (long) term by providing cost effective and quick access contingent financing to cover extraordinary expenditure during emergencies caused by natural disasters and a one-time two-year principal deferral, respectively.

BOSS Plus

20. Government sought to build on the success of its BOSS domestic security issuance, which was targeted to public servants and opened an issuance of BBD 200.0 million in BOSS Plus bonds which was expanded to include the general public.

Prepayment Series B bonds

21. Due to the Government's improved financial position, a partial principal repayment of up to BBD17,500 was made to individuals holding Series B bonds. This totaled approximately BBD74.8 million. This repayment was targeted to impact a maximum number of retail holders

of domestic debt and allowed the full repayment of [nearly half] of all individual holdings in the Series.

Multilateral Borrowing

22. In the last year, Barbados has increased its external borrowing by approximately BBD826.9 million, to assist inter alia with much needed budgetary support geared towards managing the residual health (human) and economic fallout from the effects of the global pandemic COVID-19, as well the country's efforts towards building climate resilience.

Credit Rating

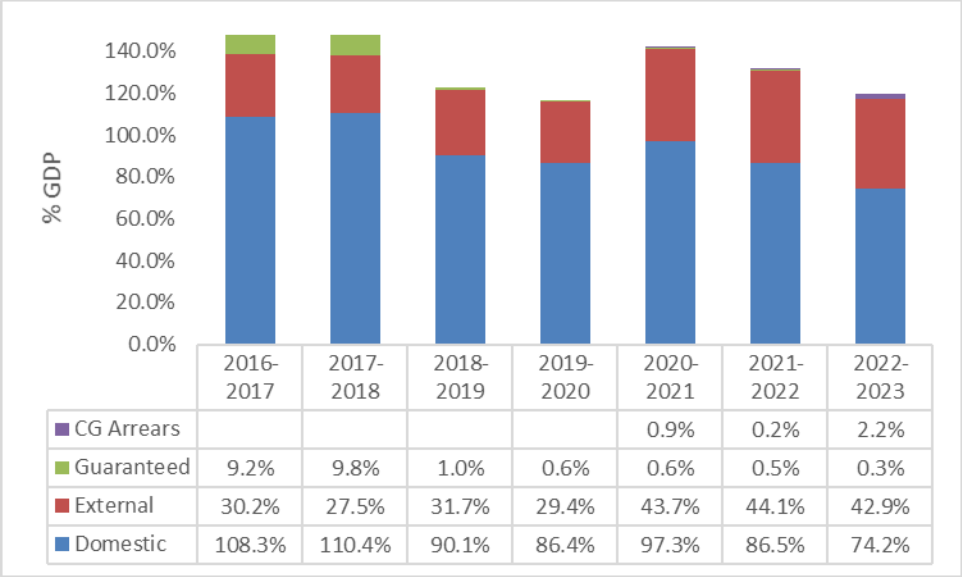
23. In November 2022, Barbados received a 'B' rating from Fitch Ratings (the agency's first rating of the country) for its long-term foreign currency denominated debt. Barbados' long- and short-term local currency and foreign currency ratings with Standard and Poor's remains currently B- with a stable outlook.

CHARACTERISTICS OF THE EXISTING DEBT PORTFOLIO

Central Government Debt

24. At March 2023, public debt stood at approximately BBD14,278.3 million compared to $13,356.1 million at March 2022 (see Table 1). This represents an increase of approximately BBD922.2 million or 7.7% of GDP when compared to the previous year. The increase is primarily attributed to an expansion in multilateral borrowing geared to assist in (i) mitigating residual impacts associated with the COVID-19 pandemic (ii) green and blue resilient recovery and macroeconomic support in accordance with the EFF.

Figure 1: Central Government and Guaranteed Debt (% of GDP)



	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
CG Arrears					0.9%	0.2%	2.2%
Guaranteed	9.2%	9.8%	1.0%	0.6%	0.6%	0.5%	0.3%
External	30.2%	27.5%	31.7%	29.4%	43.7%	44.1%	42.9%
Domestic	108.3%	110.4%	90.1%	86.4%	97.3%	86.5%	74.2%

Source: Ministry of Finance, Economic Affairs and Investment

25. Domestic debt (excluding arrears) increased from BBD8,801.4 million at March 2022 to BBD8,860.4 million at March 2023, a marginal increase of BBD59.0 million. Domestic debt accounted for approximately 62.0 % of total debt. The domestic debt portfolio is mainly comprised of securities, of which the NIB is the single largest holder (See Figure 2). Two categories of T-Bills resulted from the Domestic Debt Exchange, (i) a statutory reserve T-Bill[2] held by commercial banks and other financial institutions and (ii) a fixed rate T-Bill held by the CBB which is to be used to assist in recapitalizing the CBB and for monetary policy purposes. Each of these 90-days T-Bills are to be rolled over. A classification of public debt by instrument type is shown in **Table 1** below.

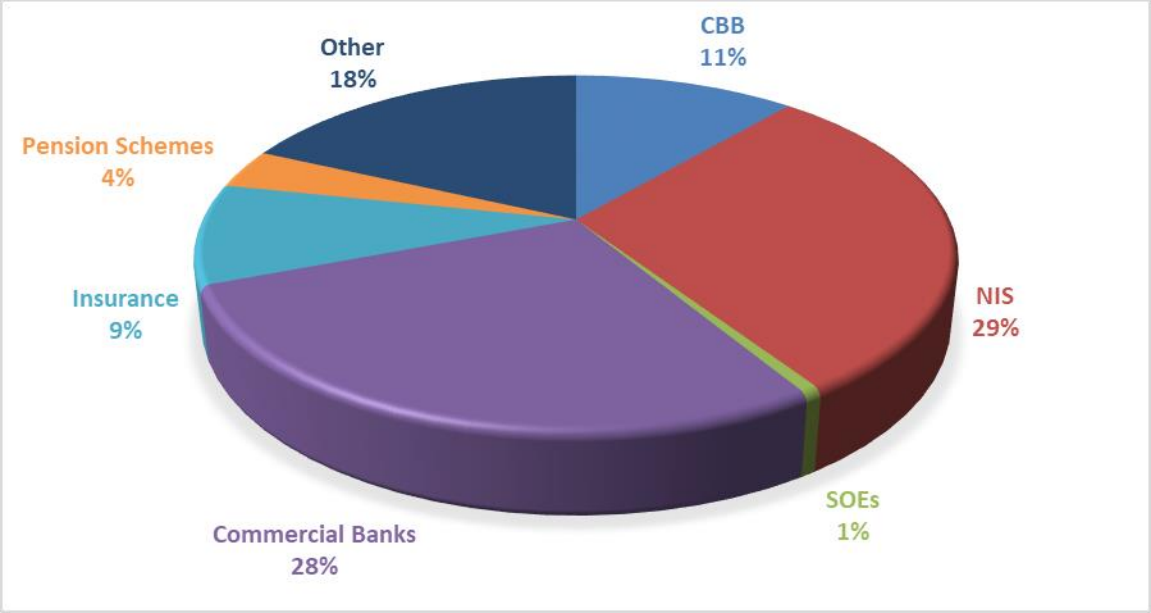
[2] The interest rate is fixed for the first 10 years and will be subject to market rates thereafter

Table 1: Total Debt Stock by Instrument Type

	Mar-22		Mar-23		Change
	BBD$M	% Total Debt	BBD$M	% Total Debt	BBD
External Debt	**4,486.1**	**33.6%**	**5,124.3**	**35.9%**	**638.3**
Bonds	*1,072.9*		*1,071.4*		
- Sovereign Bonds	1,072.9	8.0%	1,071.4	7.5%	(1.5)
Multilateral Loans	*2,882.3*	*21.6%*	*3,340.1*	*23.4%*	*457.8*
- CDB	493.5	3.7%	469.4	3.3%	(24.2)
- IADB	1,314.8	9.8%	1,499.6	10.5%	184.9
- EEC	22.9	0.2%	22.4	0.2%	(0.6)
- IBRD	245.7	1.8%	442.9	3.1%	197.1
- CAF	340.6	2.6%	357.4	2.5%	16.8
- IMF	464.8	3.5%	548.4	3.8%	83.6
Bilateral Loans	*312.6*	*2.3%*	*376.3*	*2.6%*	*63.7*
- EXIM Bank of China	234.6	1.8%	312.5	2.2%	77.9
- Citibank NA	78.0	0.6%	63.8	0.4%	(14.2)
Commercial Loans	*218.2*	*1.6%*	*336.5*	*2.4%*	*118.3*
- Barbados Correction Corp. (Prison Proj	218.2	1.6%	190.0	1.3%	(28.2)
-MTFA BB Blue DAC USD			*146.5*	*1.0%*	*146.5*
Domestic Debt	8,801.4	**65.9%**	8,860.4	**62.1%**	**59.0**
Securities	8,586.5	**64.3%**	8,546.7	**59.9%**	**(39.7)**
- Treasury Bills	495.1	3.7%	495.1	3.5%	-
- Bonds (Restructured)	7,942.6	59.5%	7,918.0	55.5%	(24.6)
-Other Bonds	101.3	0.8%	101.3	0.7%	0.0
- Savings Bonds & Tax Certificates	47.4	0.4%	32.3	0.2%	(15.1)
Temporary Borrowings (Overdraft)	215.0	1.6%	167.2	1.2%	(47.8)
Commercial Loans					
-MTFA BB Blue DAC BBD			146.5	1.0%	146.5
Guaranteed Debt (External)	**46.0**	**0.3%**	**36.2**	**0.3%**	**(9.8)**
- Multilateral Loans	14.9	0.1%	9.0	0.1%	(5.9)
- Bonds	31.1	0.2%	27.2	0.2%	(3.9)
CG Arrears	22.6	0.2%	257.5	1.8%	234.9
Total	**13,356.1**	100.0%	**14,278.3**	100.0%	922.2

Source: Ministry of Finance, Economic Affairs and Investment

Figure 2: Domestic Debt by Holder



Source: Central Bank of Barbados and Ministry of Finance, Economic Affairs and Investment

26. At March 2023 external debt stood at approximately BBD5,124.3 million, an increase of BBD638.3 million when compared to the period ending March 2022. This increase is primarily attributed to additional official sector borrowing, including PBLs aimed at providing budget support to offset the fallout from the COVID-19 pandemic and bolstering climate resilience. External debt accounts for approximately 36.0% of total debt. As is evident in Table 1 above, the majority of external debt is comprised of loans from official sources, like the Inter-American Development Bank, Caribbean Development Bank, CAF, IMF and Export Import Bank of China and sovereign bonds.

Central Government Arrears

27. At March 2023 Central Government's stock of domestic arrears stood at approximately BBD257.5 million, an increase of approximately BBD234.9 million from the previous year. The increase is attributable to legacy arrears discovered in the Barbados Revenue Authority's previous VAT VETAS system as the department transitioned to a new system.

Government Guaranteed Debt

28. External guaranteed debt stood at BBD36.2 million at March 2023, a decrease of BBD9.8 million from the previous year, due to scheduled amortizations.

COST AND RISK CHARACERISTICS OF THE EXISTING DEBT PORTFOLIO

29. There will be some degree of risks inherent in any debt portfolio and corresponding costs associated with addressing said risks. Active portfolio management requires, inter alia, identifying the risks and developing strategies, which have taken account of any constraints, in order to mitigate the risks. In doing so, any undue cost are avoided and potential losses minimized.

Box 1: Risk Definitions

Interest rate risk

Interest rate risk refers to the vulnerability of the debt portfolio, and the cost of Government debt, to higher market interest rates at the point at which the interest rate on variable rate debt and fixed rate debt that is maturing is being re-priced.

Refinancing (roll-over) risk

Refinancing risk captures the exposure of the debt portfolio to unusually higher interest rates at the point at which debt is being refinanced; in the extreme, when this risk is too high it may not be possible to roll over maturing obligations.

Foreign exchange rate risk

Foreign exchange risk relates to the vulnerability of the debt portfolio, and the government's debt cost, to a depreciation/devaluation in the external value of the domestic currency.

Source: Developing a Medium-Term Debt Management Strategy (MTDS) - Guidance Note for Country Authorities – IMF/World Bank.

Risk Indicators

Table 2: Cost and Risk Indicators as at March 31, 2023

	Mar-23	Mar-22	Change
Amount (in millions of BBD)			
Domestic	9,117.9	8,824.0	293.8
External	5,160.5	4,532.1	628.4
Total	14,278.3	13,356.1	922.2
Nominal debt as percent of GDP			
Domestic	76.3	86.7	(10.40)
External	43.2	44.6	(1.34)
Total	119.6	131.3	(11.74)
Cost of Debt			
Domestic			
Interest payment as percent of GDP	3.0	3.5	(0.42)
Weighted Av. IR (percent)	4.0	4.0	(0.01)
External			
Interest payment as percent of GDP	2.7	1.3	1.34
Weighted Av. IR (percent)	6.2	3.0	3.19
Total			
Interest payment as percent of GDP	5.7	4.8	0.92
Weighted Av. IR (percent)	4.8	3.7	1.13
Refinancing risk			
Domestic			
Average Time to Maturity (years)	12.0	13.1	(1.12)
Debt maturing in 1yr (percent of total)	4.9	3.2	1.63
Debt maturing in 1yr (percent of GDP)	3.7	2.8	0.91
External			
Average Time to Maturity (years)	6.8	6.9	(0.05)
Debt maturing in 1yr (percent of total)	4.3	4.5	(0.28)
Debt maturing in 1yr (percent of GDP)	1.8	2.0	(0.18)
Total			
Average Time to Maturity (years)	10.1	11.0	(0.87)
Debt maturing in 1yr (percent of total)	4.6	3.7	0.97
Debt maturing in 1yr (percent of GDP)	5.6	4.8	0.72

	Mar-23	Mar-22	Change
Interest rate risk			
Domestic			
Average Time to Refixing (years)	10.9	12.0	(1.08)
Debt refixing in 1yr (percent of total)	10.3	8.8	1.45
Fixed rate debt incl T-bills (percent of total)	100.0	100.0	-
T-bills (percent of total)	5.4	5.6	(0.18)
External			
Average Time to Refixing (years)	2.1	2.3	(0.17)
Debt refixing in 1yr (percent of total)	66.3	65.3	0.95
Fixed rate debt incl T-bills (percent of total)	35.1	36.1	(0.97)
T-bills (percent of total)	-	-	
Total			
Average Time to Refixing (years)	7.7	8.7	(0.97)
Debt refixing in 1yr (percent of total)	30.5	28.0	2.51
Fixed rate debt incl T-bills (percent of total)	76.5	78.3	(1.76)
T-bills (percent of total)	3.5	3.7	(0.24)
FX Risk			
FX debt (percent of total debt)	36.1	33.9	2.21
ST FX debt (percent of reserves)	6.8	6.8	0.02

The above cost/risk indicators do not take account of (i) BBD495M in Monetary Policy Treasury Bills, which are rolled, as agreed under the terms of the 2018 Domestic Debt Exchange and (ii) Government's overdraft at the CBB, which currently has a limit of BBD220.6 million. These were excluded to avoid artificially increasing the refinancing risk.

30. **The weighted-average cost of the overall portfolio is around 4.8%** (See Table 2). This is due largely to the increases in the SOFR, which is the benchmark reference rate for USD denominated debt. As the US Fed continued to increase its interest rates, SOFR, which is the Fed's overnight rate, has increased in parallel. During the financial year, the US Fed increased interest rates by 475 bps. This rate increase, combined with a greater share of external (multilateral) debt and contractual interest rate step-ups on domestic debt, resulted in the average cost of the portfolio increasing from the 3.7% at the end of FY 2022 to 4.8% at the end of FY 2023.

31. **Refinancing risk is relatively low** (Table 2). The portfolio average time to maturity is 10.1 years. Domestic debt has an average time to maturity of 12.0 years compared to 6.8 years for external debt. Approximately 4.6% of the total debt stock, BBD663.0 million will be refinanced in the next 12 months. Around 4.3% of external debt, approximately BBD220.0

million, will mature in the next 12 months. In contrast, 4.9 % of domestic debt, approximately BBD443.0 million will mature in the next 12 months.

32. The restructured T-Bills held by the Central Bank of Barbados, commercial banks and other financial institutions are designed to be rolled over every ninety days.

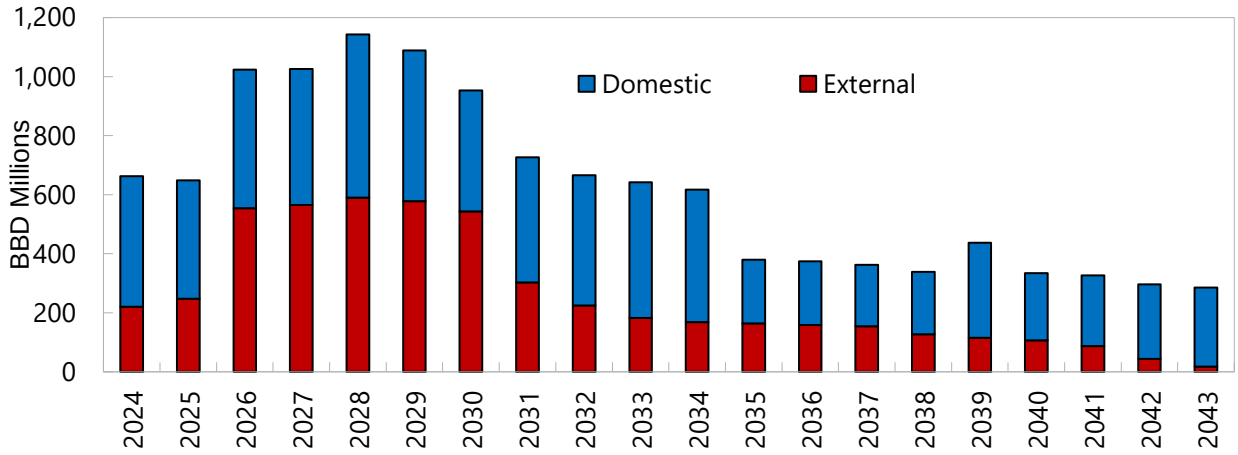
33. **Foreign exchange risk remains at a manageable level.** Currently, almost all of the external debt is denominated in US dollars. Since the international reserves and export receipts are also denominated in US dollars this acts as a natural hedge. The Barbados Economic Recovery and Transformation plan reduced pressure on the exchange rate by reducing fiscal deficits in the short term establishing an anchor for responsible fiscal policy over the medium term. The EFF continues to provide access to foreign exchange reserves and improved credibility with official and private sector creditors.

34. **Interest rate risk**. The increased multilateral debt in the portfolio carries variable interest rates, which results in 66.3% of external debt refixing in one year as at March 2023, compared to 65.3% at March 2022. The reference rate for the majority of the variable rate external loans is SOFR, given the market's transition away from LIBOR. Interest rates have increased significantly in the last year. Market projections of the US forward rates predict that rates will fall generally (see Appendix 4). However, overall the majority of the debt portfolio, approximately 76.5%, carries a fixed rate structure (Table 2, Figure 5). This is attributable mainly to the domestic stepped-up amortizing bonds and fixed rate T-Bills, as well as the fixed rate sovereign bond and external loan.

Redemption Profile of Total Public Debt

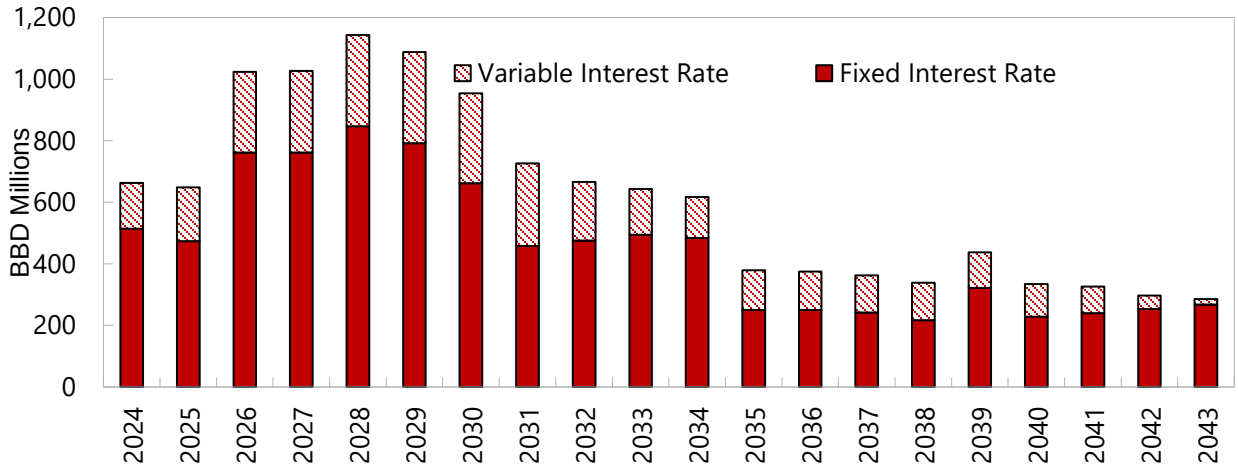
35. As evidenced in Figures 3 and 4, the repayment profile is somewhat skewed towards the front end with elevations between 2026 and 2030. These elevations are attributed primarily to the restructured external commercial debt, which commence repayment in 2026.

Figure 3: Redemption Profile as at March 31, 2023



Source: Ministry of Finance, Economic Affairs and Investment

Figure 4: Redemption Profile as at March 31, 2023 by Interest Rate Type



Source: Ministry of Finance, Economic Affairs and Investment

Profiles in Figures 3 and Figure 4 excludes BBD495.0 million in Treasury Bills, which are assumed to be rolled over each year as agreed under the terms of the 2018 Domestic Debt Exchange. The interest rates on these Treasury Bills are fixed for the initial 10-year period.

POTENTIAL SOURCES OF FINANCING

Official Sector

36. Barbados entered a second IMF Extended Fund Facility Program. In addition to the funding under the EFF and RSF programs, other sources of financing over the medium term are expected to continue to come primarily from multilateral sources, which will be combined with increasing levels of domestic financing. Barbados' major development partners for accessing finance include the IADB, IMF, CDB and CAF.

37. Policy based loans continue to be a major source of financing. Although support for Barbados' reform program remains strong, this type of support is expected to be gradually reduced over the medium term given the country's middle-income status. Disbursements from project loans will be buttressed with domestic financing as the Government makes a concerted effort to reengage the domestic securities market.

Domestic Creditors

38. Restarting domestic issuance will be a priority for Government during the strategy period. The Government plans to launch a comprehensive program in which investors are offered a lengthened set of maturity and trading options. This reengagement of domestic investors is expected to benefit from the forecast return to economic growth in the economy, continued engagement with the IMF and multilateral partners, and scheduled amortization of domestic securities. The Government intends to begin with limited volumes of Treasury Bills and Notes with maturities of 1-5 years; as confidence builds, larger volumes and longer maturities will be offered to meet the redemption profile of the existing debt stock.

Risks Associated with this Source of Financing

39. The significant rise in interest rates and projections for continued slower paced increases will prove costly for the portfolio's variable rate debt. Options will therefore have to be employed, where appropriate, to mitigate some of the increased debt service cost.

40. Issues in meeting some of the conditions precedent continue to affect the pace of disbursements on project loans, which in some cases have been somewhat slow to materialize. Recent measures have been implemented to foster more active project management.

41. Demand for domestic issuance is likely to increase as investor confidence grows and amortizations on the existing stock accelerate. This has been boosted by a show of confidence in the Government's domestic issuances by some commercial banks.

BASELINE PROJECTIONS AND KEY RISKS FACTORS

42. External financing, of which the majority was received in the last quarter of the fiscal year, along with the issuance of domestic securities assisted Government with the much-needed budgetary support in light of higher expenditure outlays mainly related to interest payments. Nonetheless, the lower debt-to-GDP ratio (11.8 percentage points below March 2022) stemmed from the gradual recovery of economic activity. In 2022, real economic growth was equivalent to 9.8 percent as a result of the rebound in tourist arrivals from the major source markets combined with increased domestic demand.

43. In line with the projected increase in global economic activity in 2023 and beyond, real growth over the next three years is expected to stabilize and average around 4.1 percent. Economic growth is forecasted to continue during 2023, following the implementation of tourism related investments and Government's capital work projects. However, risks to this forecast are linked to the supply chain disruption, significant geopolitical shocks and inflationary pressures.

44. Following the completion of both the domestic and external debt restructurings, debt levels began to stabilize. The objective of reducing debt levels was interrupted as borrowings to assist with the macro-economic fallout from the COVID-19 pandemic and natural disasters occurred during FY2021/22. Of note, with the positive forecast of economic growth anticipated, the debt-to-GDP ratio is projected to resume its downward path however, fiscal discipline and economic growth are key to the maintenance of debt sustainability into the medium term. Over the next two years forecast primary balances are equivalent to 3.5 and 4.0 percent of GDP, respectively.

45. As a net importer, Barbados is exposed to shocks in international commodity prices, and movements in these prices (which are difficult to determine over the medium term) predominate domestic inflation. Of recent, the elevated cost of freight following the disruption of supply chains globally, geopolitical tensions in Eastern Europe and the rise in energy and food prices which continued throughout 2022 has led to higher domestic prices. For 2023, forecast of oil prices are expected to average around US$79 per barrel, slightly lower than the price registered in 2022. The pressures of significant price increases and supply shocks

if continued can negatively impact economic activity. However, inflationary pressure on interest rates is expected to soften over the medium term.

46. International reserves were around $3.2 billion at the end of FY2022/23, compared to $3.0 billion at the end of the previous fiscal year and are expected to remain above $3 billion over the medium term. Any substantial hikes in oil prices and other unexpected external shocks can adversely impact reserve levels.

Table 3: Macro Economic Assumptions 2022/23 to 2025/26

	2022/23	2023/24	2024/25	2025/26
(BBD Millions)				
Public Sector revenue (including grants)	3,320.0	3,344.5	3,568.9	3,789.6
in percent of GDP	27.8	26.2	26.3	26.4
Public Sector Primary Expenditures	3,015.7	2,900.5	3,027.6	3,122.1
in percent of GDP	25.3	22.7	22.3	21.7
Public Sector Expenditure	3,564.9	3,552.6	3,702.6	3,743.2
in percent of GDP	29.8	27.9	27.3	26.0
Public Sector Interest Expenditure	549.2	652.1	675.0	621.0
in percent of GDP	4.6	5.1	5.0	4.3
Primary Fiscal Balance	304.3	444.0	541.3	667.5
in percent of GDP	2.5	3.5	4.0	4.6
Overall Fiscal Balance	-244.9	-208.1	-133.7	46.5
in percent of GDP	-2.1	-1.6	-1.0	0.3
Inflation rate	5.0	5.1	3.2	2.6
Gross International Reserves	3,216.6	3,304.3	3,449.8	3,491.1
in percent of GDP	26.9	25.9	25.5	24.3
GDP Nominal (fiscal year)	11,943.2	12,754.0	13,553.7	14,375.4

Source: Central Bank of Barbados

47. The above ratios are premised on a return to growth assumption, as well as the continuation of public sector reforms as articulated in the BERT Plan 2022.

Risks Affecting the Debt Portfolio

48. The fiscal and debt dynamics can be negatively impacted by adverse variations in the baseline macroeconomic and market variables. The risk to the debt portfolio is based on the probability of occurrence and the financial impact of the change. Below are select sources of potential risks and the related impacts on debt management.

RISK SOURCE	IMPACT	IMPLICATIONS	COMMENT
Weak Economic Activity	Taxes and revenues Lower GDP	Weakened debt repayment capacity Debt Sustainability	Economic forecasts factor in IMF DSA assumptions; EFF program requires fiscal adjustments in case of economic slowdowns
Fiscal Slippage	Primary balance	High financing needs IMF support fallout (Disbursement suspension)	Fiscal policy restricted under EFF; Government is committed to achieving the maximum correction and primary balance required until the debt target is met in 2035-2036
Natural Disasters	Increased fiscal cost	Higher financing needs	Inclusion of Natural Disaster Clauses in Issuance Contracts and activation of Principal Payment Options on eligible loans assist in mitigating.

MEDIUM TERM DEBT STRATEGY 2023-2026

49. The macroeconomic framework underpinning the Barbados Economic Recovery and Transformation Plan 2022 is anchored by a debt to GDP target of 60% by 2035-2036. It sets out a framework of fiscal adjustment and structural reforms geared towards creating conditions to place the debt on a downward trajectory.

50. The objective of the MTDS is to determine the most appropriate borrowing strategy for the Government within the context of a cost/risk tradeoff, taking into account the financing constraints.

Selected Strategy

51. The selected strategy, Strategy 1, maintains the status quo where over the medium term approximately 77.8% of gross financing needs will be met from external official sources, mainly multilateral. The remaining 22.2% of gross financing needs will be met from domestic security issuances.

52. While initially more costly, it capitalizes on readily available funding sources over the medium term, while gradually rebuilding the domestic market in the face of strong signs of increasing market confidence. The increased cost of multilateral borrowing, stemming from the variable rate benchmark, will need to be continuously managed with a view to mitigation through available liability management operations and switching to fixed rates based on a cost benefit analysis.

53. Table 4 below provides a comparison of the cost and risk indicators of the current portfolio relative to the selected strategy at the end of the period under review.

Table 4: Comparison of Cost and Risk Indicators - Current vs. Selected Strategy at end 2026

COST-RISK INDICATORS - Baseline Scenario			
Risk Indicators		2023	As at end 2026
		Current	S1
Nominal debt as percent of GDP		119.5	103.3
Interest payment as percent of GDP		5.7	5.6
Implied interest rate (percent)		4.8	5.5
Refinancing risk	Debt maturing in 1yr (percent of total)	4.6	7.2
	Debt maturing in 1yr (% of GDP)	5.6	7.4
	ATM External Portfolio (years)	6.8	8.0
	ATM Domestic Portfolio (years)	12.0	10.2
	ATM Total Portfolio (years)	10.1	9.2
Interest rate risk	ATR (years)	7.7	5.8
	Debt refixing in 1yr (percent of total)	30.5	37.9
	Fixed rate debt incl T-bills (percent of total)	76.5	67.6
	T-bills (percent of total)	3.5	3.6
FX risk	FX debt as % of total	36.1	43.4
	ST FX debt as % of reserves	6.8	16.2

54. **The weighted-average cost of the overall portfolio is expected to increase by 0.7% to 5.5%.** This is due primarily to the larger volume and associated higher interest rates on the external variable rate (multilateral) debt.

55. **Refinancing risk**. Debt maturing in the next 12 months is approximately 7.2%, an increase of more than 50%. The average time to maturity will decrease from 10.1 years to 9.2 years as a result of the increased issuance of more shorter term domestic debt.

56. **Interest rate risk.** Debt refixing in one year will increase to 37.9% primarily as a result the variable rate nature of the increase multilateral debt. The portfolio average time to refixing will decrease to 5.8 years, also driven by the higher share of variable rate multilateral debt.

57. This strategy, which meets gross financing needs with greater proportions of mainly external multilateral financing, capitalizes on already identified sources of financing over the medium term. As articulated in the Barbados Economic Recovery and Transformation Plan 2022, approximately BBD1.0 billion has been identified for direct budget support over this period, inclusive of the IMF's Resilience and Sustainability Facility and Extended Fund Facility. This will allow for the maintenance of adequate reserve coverage, while avoiding excessive reliance on expensive financing from capital markets much beyond roll-over needs. On the domestic side, it also aligns with the Government's overall strategy of restoring regular issuance in the domestic market.

58. This strategy will be further complemented by utilizing liability management options available in some of the multilateral contracts, to fix interest rates on eligible loan, where appropriate. This will assist in lowering the share of external debt re-fixing in a year. The new securities issued, except T-Bills, will contain natural clauses and pandemic to assist in further mitigating the risks associated with the impact of natural disasters on the portfolio.

59. The success of the strategy will be contingent on a number of factors, including meeting the conditions precedent to disbursement for the external loans and doing so in a timely manner. On the domestic side, the capacity of the domestic investors to absorb the increased issuance and their willingness to do so will also be key. To this end, Government will seek to provide additional mechanisms for domestic investors to trade, including reverse auctions.

60. Also critical to the success of the strategy and maintaining debt sustainability is to continue on a path of fiscal sustainability, maintaining primary surpluses over the medium-term to reduce the debt levels to the target by 2035/36. A primary surplus of 3.5% is targeted for FY2023/24 and 4.0%for FY2024/25. Thereafter, 4.6% is maintained for three years, before the fiscal effort is moderated as debt levels reduce.

GOVERNMENT BORROWING PLAN 2023-2024

61. The gross financing requirement for 2023-2024 is projected at approximately BBD903.0 million, approximately 7.1% of GDP. This sum is exclusive of BBD495.0M in T-Bills, which will be rolled over, as per the agreed terms in the 2018 Domestic Debt Exchange and BBD220.6M, which will be covered by Government's overdraft at the CBB. It will be financed from the following sources:

Table 5 - Financing Sources 2023-2024

	BBD Millions
Domestic Financing	**200.0**
T- Bills	24.0
Domestic Bonds	176.0
External Financing	**703.0**
PBLs	200.0
Investment Loans	276.0
IMF EFF	76.0
IMF RSF	151.0

APPENDICES

Appendix 1

Existing Debt Legislation and their respective Limits

Local Loans Act Cap.98	BBD10.5 billion
Treasury Bills and Tax Reserve Certificate Act Cap. 106	BBD1.5 billion
Savings Bond Act Cap. 104A	BBD250.0 million
Special Loans Act Cap. 105	BBD2.5 billion
Guarantee of Loans (Companies) Act Cap 96	BBD1.0 billion
External Loan Act Cap 94D	No limit specified
Public Finance Management Act, 2018	7.5% of net revenue to be collected for the year
Barbados Optional Savings Bonds Plus (Offer to the Public) Act, 2022	BBD200.0 million
Debt Settlement (Arrears) Act, 2021	

Appendix 2

Stylized Instruments

Instrument	Instrument Type	Fix/Var	Maturity (Y)	Grace (Y)	Currency Type	Description
USD_2	Multilateral_Var_USD	Var	25	5	FX	Multilateral loans from IDB, CDB IBRD, IMF RSF, etc.
USD_3	Other Multilateral _VAR_USD	Var	12	5	FX	Multilateral loans from CAF, IMF EFF and CDB (PBLs)
USD_4	Bilateral_Fixed_USD	Fix	20	5	FX	Bilateral loans, Citibank and EXIM
USD_5	Commercial Bank_Fix_USD	Fix	10	0	FX	Borrowing from commercial entities
USD_6	Ext Bonds_FIx_USD_10Y	Fix	10	5	FX	International Sovereign bonds
USD_7	Multilateral PBLs _VAR_USD	Var	7	3	FX	Policy Based Loans
BBD_8	Bonds_Series B&C Fixed_BBD_15Y	Fix	15	5	DX	Principally Amortizing Bonds
BBD_9	Bonds_Series D Fixed_BBD_35Y	Fix	35	15	DX	Amortizing Bonds
BBD_10	Bonds_Series E Fixed_BBD_25Y	Fix	25	5	DX	Amortizing Bonds
BBD_11	Bonds_Series J Fixed_BBD_4Y	Fix	3.5	0	DX	Amortizing Bonds
BBD_12	Bonds_Series G Fixed_BBD_50Y	Fix	50	15	DX	Amortizing Bonds
BBD_13	Bonds_ Fixed_BBD_5Y	Fix	5	4	DX	Amortizing Bonds, Savings Bonds, CBB Securities and BAICO bonds
BBD_14	Bonds_Fixed_BBD_10Y	Fix	10	9	DX	Amortizing Bonds, CBB Securities and BAICO bonds
BBD_15	Bonds_ Fixed_BBD_15Y Fix	Fix	15	14	DX	Amortizing Bonds, CBB Securities and BAICO bonds
BBD_16	Bonds_Fixed_BBD_20Y	Fix	20	19	DX	Amortizing Bonds, CBB Securities and BAICO bonds
BBD_17	W&M (Overdraft)	Fix	1	0	DX	Ways & Means
BBD_18	T-Bills	T-bills	1	0	DX	T-bills

Appendix 3

Technical Note on Modelling the MTDS

1. The Medium Term Debt Management Strategy for 2023-2024 to 2025-2026 is developed using the IMF/World Bank MTDS Analytical Toolkit. This Toolkit enables a quantitative assessment of the key cost and risk indicators of the debt portfolio at the end of the projection period. Central Government's debt, arrears and guaranteed debt was utilized for the analysis.

Baseline Assumptions and Shock Assumptions

2. Table 3 outlines the baseline assumptions of the Government's fiscal balance, as well as key macroeconomic variables used in the analysis. These were combined with the following assumptions. It should be noted that the rates for fixed rate instruments are based on the weighted averages of similar existing instruments in the portfolio.

Source of Financing	Interest Rates	Interest Rate Type
Multilateral	5.5% – 7.3%	Variable
Bilateral	2.5%	Fixed
Sovereign Bond	6.5%	Fixed
Bonds < 5 years	5.7%	Fixed
Bonds 5-10 years	7.3%	Fixed
T-Bills	2.5%	Fixed
Overdraft	3.5%	Fixed

Strategies

Using the MTDS Analytical Toolkit the four following strategies were assessed based on various characteristics and assumptions to determine the cost/risk tradeoffs at the end of the period under review:

> Strategy 1 (S1): Status Quo – 77.8 % of gross financing needs over the medium term will be funded from external multilateral and bilateral sources, approximately BBD703.0 million. On the domestic side, the 22.2% will be financed by way of limited T-bills and medium term issuances, approximately BBD200.0 million.

Strategy 2 (S2): Increase domestic borrowing. 60% of gross financing needs will be met from domestic sources, approximately BBD542.0 million. This strategy aims at gradually reducing the level of external debt and increasing engaging the domestic securities market. Domestic financing will be through the issuance of T-Bills and bonds with maturities up to 10 years. External financing of approximately BBD361.0 million will be from official sources.

Strategy 3 (S3): Sovereign bond issuance. 74% of gross financing needs will be met from external sources, approximately BBD668.0 million. However the borrowing from multilateral and bilateral sources will be complemented with an issuance in the international capital markets in year 1. Domestic financing of BBD235.0 million will be met through the issuance of bonds with maturities up to 5 years.

Strategy 4 (S4): Increased domestic and sovereign bond issuance. Assumes that 66% of gross financing need will be met from external sources in year 1 and equally from external and domestic sources in years 2 and 3. External borrowing will be from multilateral and bilateral sources, as well as an issuance in international capitals market in year 1 only. Domestic financing will be through the issuance of T-Bills and bonds with maturities up to 5 years in the first instance and increasing up to 10 years.

3. In all of the strategies, the financing mix percentage utilized represents new financing only and assumes that the existing stock of T-Bills, BBD495.0 million, is constantly rolled over.

Baseline Scenario: In the baseline scenario the reference rate for the variable rate external instruments are forecasted to increase marginally over 2023-2024 and 2024-2025. There are no exchange rate changes, in light of the fixed peg regime maintained with the USD.

Scenario 1: Interest Rate Shock

i. Moderate: A 100 basis points increase in the reference rate for variable rate external instruments and the external bond. The shock was applied to the projected baseline interest rate for each year of the strategy period.

ii. Extreme: A 200 basis points increase in the reference rate for variable rate external instruments and the external bond. The shock was applied to the projected baseline interest rate for each year of the strategy period.

ANALYSIS OF OUTPUT

4. Table 5 shows the risk indicators at the end of 2026 for the four strategies analyzed.

Table 6: Cost and Risk Indicators of the Debt Portfolio as at March 31, 2026

Risk Indicators		2023	As at end 2026			
		Current	S1	S2	S3	S4
Nominal debt as percent of GDP		119.6	103.3	103.1	103.3	103.2
Interest payment as percent of GDP		5.7	5.6	5.5	5.5	5.5
Implied interest rate (percent)		4.8	5.5	5.4	5.5	5.4
Refinancing risk	Debt maturing in 1yr (percent of total)	4.6	7.2	8.7	6.9	7.9
	Debt maturing in 1yr (% of GDP)	5.6	7.4	8.9	7.1	8.2
	ATM External Portfolio (years)	6.8	8.0	6.9	7.2	6.9
	ATM Domestic Portfolio (years)	12.0	10.2	9.6	10.1	9.9
	ATM Total Portfolio (years)	10.1	9.2	8.6	8.9	8.7
Interest rate risk	ATR (years)	7.7	5.8	6.1	6.1	6.1
	Debt refixing in 1yr (percent of total)	30.5	37.9	32.9	33.1	32.5
	Fixed rate debt incl T-bills (percent of total)	76.5	67.6	73.9	72.0	73.6
	T-bills (percent of total)	3.5	3.6	5.1	3.3	4.4
FX risk	FX debt as % of total	36.1	43.4	36.7	42.4	39.2
	ST FX debt as % of reserves	6.8	16.2	16.2	16.2	16.2

Risk to Baseline Projections for the Under Shock Scenarios

5. The maximum risk for select portfolio indicators under the four financing strategies are shown in Figures 5 and 6. Using the projected outturns for end of 2026, the maximum risk is determined by the largest impact on each of the indicators arising from the interest rate shocks at Scenario 1.

6. Interest cost to GDP is identical at 5.5% for S2, S3 and S4 and higher by 0.1% when compared to S1, which carries a greater share of higher cost, variable rate external debt. The maximum risk is only marginally lower by 0.1% in S2 compared to the other three strategies.

7. Total debt service cost to GDP is lowest under S3 due to the projected lower fixed rate on the external sovereign bond. S2 is the most costly strategy under this indicator, with a baseline outturn of 13.9%. However, the maximum risk is identical in all four strategies at 0.6%.

Figure 5: Sensitivity of Interest Cost to GDP to Shock As at end of 2026

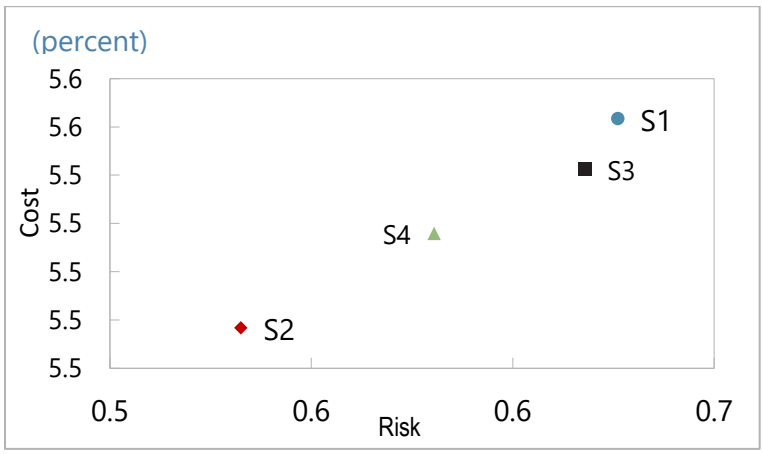
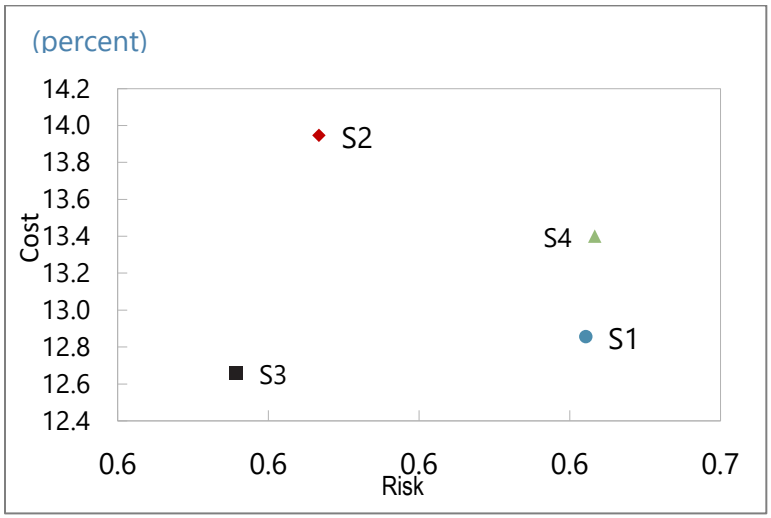
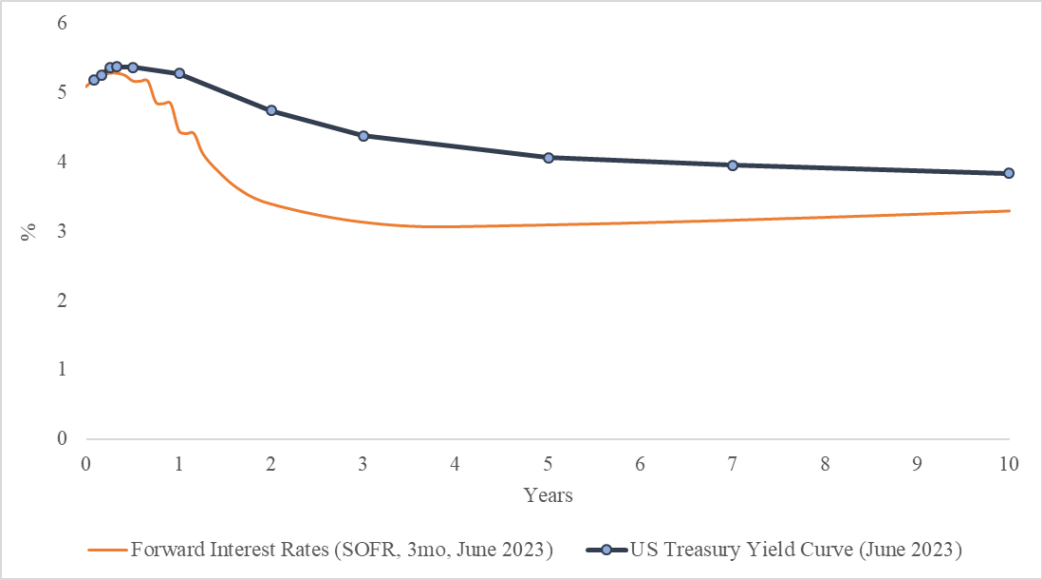


Figure 6: Sensitivity of Total Debt service to GDP to Shock As at end 2026



Appendix 4

Figure 7: Market Projections of Interest Rates



Source: Resource Center | U.S. Department of the Treasury

The market projects interest rates to fall generally, especially for shorter maturities, with the base SOFR rate charges by multilateral development banks expected to fall from just over 5% to 4.5% in a year's time and below 3.5% in two years' time before declining to just over 3% for the remainder of the next ten years.

Annex 495

Loan contract No. 5720/OC-BA between the Government of Barbados and the Inter-American Development Bank, 28 February 2023

LOAN CONTRACT No. 5720/OC-BA

between the

GOVERNMENT OF BARBADOS

and the

INTER-AMERICAN DEVELOPMENT BANK

Programme to Strengthen Public Policy and Fiscal Management in Response to the Health and Economic Crisis Caused by COVID-19 in Barbados II

LOAN CONTRACT

PART ONE

SPECIAL CONDITIONS

INTRODUCTION

Parties, Objective, Constituent Elements, Executing Agency

1. PARTIES AND OBJECTIVE OF THE CONTRACT

CONTRACT entered into between THE GOVERNMENT of BARBADOS (hereinafter referred to as the "Borrower") and the INTER-AMERICAN DEVELOPMENT BANK (hereinafter referred to as the "Bank") to cooperate in the execution of a program to Strengthen Public Policy and Fiscal Management in Response to the Health and Economic Crisis Caused by COVID-19 in Barbados II (hereinafter referred to as the "Program").

2. CONSTITUENT ELEMENTS OF THE CONTRACT AND REFERENCE TO THE GENERAL CONDITIONS

(a) This Contract consists of these Special Conditions, and the General Conditions, which are attached hereto. If any provision of the Special Conditions should present any inconsistency or contradiction with the General Conditions, the provisions of the Special Conditions shall prevail. In the case of inconsistencies or contradictions between the provisions of the Special Conditions, specific provisions shall prevail over general provisions.

(b) Procedural provisions relating to the application of the sections regarding amortization, interest, credit fee, inspection and supervision, conversions, and disbursement, as well as other conditions related to Program execution, are established in detail in the General Conditions. The General Conditions also include general definitions.

3. EXECUTING AGENCY

The parties agree that the execution of the Program and the utilization of the resources of the loan granted by the Bank shall be carried out by the Borrower, through its Ministry of Finance, Economic Affairs and Investment (MFEI), which for the purposes of this Contract shall be referred to, without distinction, as either the "Borrower" or the "Executing Agency".

CHAPTER I
The Loan

SECTION 1.01. **Amount and Approval Currency of the Loan.** In accordance with this Contract, the Bank agrees to lend to the Borrower, and the Borrower accepts, a loan of up to the amount of one hundred million Dollars (US$100,000,000) hereinafter the "Loan".

SECTION 1.02. **Disbursement requests and Disbursement currency.** (a) The Borrower may request disbursements of the Loan by submitting a disbursement request to the Bank pursuant to Article 4.03 of the General Conditions.

(b) All disbursements shall be denominated and made in Dollars, unless the Borrower requests that a disbursement be denominated in a currency other than the Dollar, pursuant to the provisions of Chapter V of the General Conditions.

SECTION 1.03. **Currency Availability.** If the Bank is unable to obtain access to the currency requested by the Borrower, the Bank may, in consultation with the Borrower, disburse the Loan in another currency of its choice.

SECTION 1.04. **Disbursement Period.** The Original Disbursement Period will be one (1) year from the effective date of this Contract. Any extension to the Original Disbursement Period shall be subject to the provisions of Article 3.02(f) of the General Conditions.

SECTION 1.05. **Amortization Schedule.** (a) The Final Amortization Date is the date twenty (20) years from the date of signature of this Contract. The Original WAL of the Loan is twelve point seventy-five (12.75) years.

(b) The Loan shall be repaid by the Borrower in semiannual, consecutive and as far as possible, equal installments. The first installment shall be due on the expiration date of the sixty-six (66) month period after the date of entry into effect of this Contract, and the last installment shall be paid no later than the Final Amortization Date. If the expiration date of the period for the payment of the first amortization installment does not fall on an interest payment date, the payment of the first amortization installment shall be made on that interest payment date that most immediately precedes the expiration date of such period (in the same month or the prior month, as the case may be.)

(c) The Parties may agree to modify the Loan Amortization Schedule as set forth in Article 3.02 of the General Conditions.

(d) The Borrower and the Bank agree on the activation of the Principal Payment Option applicable to this Loan in accordance with the terms and conditions established in Articles 3.03 to 3.06 of the General Conditions.

SECTION 1.06. **Interest.** (a) The Borrower shall pay interest on the daily Outstanding Loan Balances at a rate determined pursuant to the provisions of Article 3.07 of the General Conditions.

(b) Interest shall be payable to the Bank semiannually. The first interest payment shall be due on the expiration date of the six (6) month period following the date of entry into effect of this Contract. If the expiration date of the period for the payment of the first interest payment does not fall on the fifteenth (15th) day of the month, the first interest payment shall be made on that date which is the fifteenth (15th) day of the month, which date most immediately precedes the expiration date of such period (in the same month or the prior month, as the case may be).

SECTION 1.07. **Credit Fee**. The Borrower shall pay a credit fee as set forth in Articles 3.08, 3.09, and 3.11 of the General Conditions.

SECTION 1.08. **Resources for General Inspection and Supervision**. The Borrower shall not be required to cover the Bank's expenses for general inspection and supervision, unless the Bank establishes otherwise pursuant to Article 3.10 of the General Conditions.

SECTION 1.09. **Conversion**. The Borrower may request Currency Conversions, Interest Rate Conversions, Commodity Conversions, and/or Catastrophe Protection Conversion at any time during the term of this Contract, as set forth in Chapter V of the General Conditions.

(a) **Currency Conversion.** The Borrower may request that a disbursement or all or part of the Outstanding Loan Balance be converted to a Non-Borrowing Country Currency, or to a Local Currency, which the Bank can efficiently source, subject to the Bank's operational and risk management considerations. It is understood that any disbursement denominated in Local Currency shall constitute a Currency Conversion, even when the Approval Currency is the same Local Currency.

(b) **Interest Rate Conversion.** The Borrower may request that, with respect to all or part of the Outstanding Loan Balance, the SOFR-based Interest Rate be converted to a fixed interest rate or any other Interest Rate Conversion option requested by the Borrower and accepted by the Bank.

(c) **Commodity Conversion.** The Borrower may request the entering into Commodity Put Options and Commodity Call Options.

(d) **Catastrophe Protection Conversion.** The Borrower may request the entering into a Catastrophe Protection Conversion that will be agreed and structured on a case-by-case basis subject to the Bank's operational and risk management considerations and in accordance with the terms and conditions established in the corresponding Catastrophe Protection Engagement Letter.

CHAPTER II
Objective and Use of Funds

SECTION 2.01. **Objective**. (a) The Loan aims to support the execution of a policy-based reform program consisting of strengthening the efficiency and effectiveness of public policy and fiscal management in Barbados in response to the health and economic crisis caused by COVID-19, through the design and implementation of effective and fiscally responsible policy

measures. The specific development objectives are to: (i) promote the availability and timely execution of public resources to respond to the health crisis caused by COVID-19; (ii) strengthen the countercyclical effect of fiscal policy through the temporary introduction of measures to protect the income of vulnerable households and increase liquidity for businesses during the health and economic crisis; and (iii) promote economic and fiscal recovery during the post-pandemic period.

(b) The Borrower may not use resources of the Loan to finance expenditures described in Section 2.04 of these Special Conditions. The resources of the Loan may be used to finance the item referred to in Section 1.08 of these Special Conditions and Article 3.10 of the General Conditions.

(c) The Bank will make the disbursements in one (1) Disbursement Tranche. The disbursement of the Disbursement Tranche will be subject to the compliance by the Borrower of the conditions precedent set forth in this Contract.

SECTION 2.02. **Conditions precedent to the disbursement of first and only Disbursement Tranche.** The disbursements of the Loan will be subject to compliance, by the Borrower, to the Bank's satisfaction, with the following conditions in addition to those set forth in Articles 4.01 and 4.03 of the General Conditions:

(a) Maintains a macroeconomic framework conducive to the achievement of the Program's objectives and in accordance with the Policy Letter referred to in Section 3.01 of these Special Conditions.

(b) Fulfills the conditions established in these Special Conditions for the disbursement of the corresponding Disbursement Tranche.

(c) Maintains open throughout execution of the Program the special bank account(s) referred to in Article 4.01(c) of the General Conditions, to which the Bank will disburse the resources of the Loan; and

(d) Continues to fulfill the policy measures regarding the Disbursement Tranche.

SECTION 2.03. **Special conditions precedent to the disbursement of the first and only Disbursement Tranche.** The disbursement of the first and only Disbursement Tranche of the Loan is subject to compliance by the Borrower, to the Bank's satisfaction, with the following conditions in addition to those set forth in Articles 4.01 and 4.03 of the General Conditions, and those set forth in Section 2.03 of these Special Conditions:

Component 2. Strengthening public policy and fiscal management to respond to the health crisis caused by COVID-19

(a) The Government of Barbados allocates budgetary resources to the health sector to: (i) manage the health consequences of COVID-19; (ii) attain the required level of health services to manage and/or suppress future COVID-19 cases; and (iii) realise any potential increases in health personnel to support COVID-19 efforts.

Component 3. Strengthening public policy and fiscal management to respond to the economic crisis

(a) The Government of Barbados implements the following measures: (i) complete an evaluation report on the implementation of all the programmes listed in 3.1(i) to (iv) of the First Programmatic Operation (5168/OC-BA) to measure their performance and goals achieved; and (ii) approve a system of digital national identification cards.

(b) The Government of Barbados implements the following measures: (i) evaluate performance of the Business Interruption Benefit, (ii) support economic recovery in the post-pandemic period through: (A) a programme to support SMEs to help boost business continuity in an online environment; and (B) a Draft of the Sustainable Industrial Development Bill completed and approved by the Cabinet, (iii) develop a plan to address capitalisation and structural issues of the National Insurance Scheme (NIS); and (iv) review the need to extend or terminate the deferment of employer's contributions to the NIS in the post-pandemic period.

Component 4. Economic and fiscal strengthening for the post-pandemic period

(a) The Government of Barbados implements the following measures: (i) present a progress report of the measures prioritized by the Jobs and Investment Council; (ii) draft of Customs Bill approved; (iii) presentation of amendments to CAP67B of the Laws of Barbados[1] to take measures to: (A) strengthen tax revenue take; (B) reduce tax expenditures; and (C) update fiscal incentive regulations; (iv) simplify the tariff structure under the Customs Act by Order; (v) strengthen macro-fiscal management by developing a procedural fiscal rule; (vi) undertake comprehensive tax administration improvements to strengthen the Barbados Revenue Authority (BRA) and Customs enforcement capabilities; (vii) approval of an Excise and VAT holiday on electric vehicles for twenty-four (24) months commencing on April 1, 2022; and (viii) approval of a Draft Climate Change and Fiscal Work Plan.

SECTION 2.04. Expenditures excluded from the Loan. (a) Resources of the Loan may not be used to finance:

(i) expenditures in goods included in the groups or sub-groups of the United Nations Standard International Trade Classification (SITC) list, as indicated in Section 2.08 of these Special Conditions;

(ii) expenditures in goods acquired under contracts for an amount less than the equivalent of ten thousand dollars (US$10,000);

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1 DUTIES, TAXES AND OTHER PAYMENTS (EXEMPTION) of the Laws of Barbados - An Act to make certain provisions respecting the exemption from the payment of taxes and duties and other moneys by persons, businesses or undertakings (Chapter 67B).

(iii) expenditures in goods financed in foreign exchange, under medium or long terms;

(iv) expenditures in luxury goods;

(v) expenditures in weapons;

(vi) expenditures in goods for the use of the armed forces; and

(vii) expenditures in goods from countries that are not members of the Bank.

(b) If the Bank determines at any time that resources of the Loan have been used to pay for any expenditures referred to in subsection (a) of this Section, the Borrower will have to immediately reimburse to the Bank or to the special account referred to in subsection (c) of Article 4.01 of the General Conditions, as the Bank may determine, the total amount of the resources of the Loan used for the payment of expenditures excluded from the Loan.

SECTION 2.05. Negative list. The goods referred to in subparagraph (a)(i) of Section 2.04 hereinabove are included in the following groups and sub-groups of the United Nations Standard International Trade Classification (SITC)[1], including any amendment that may be made to these groups or sub-groups and of which the Bank shall notify the Borrower:

GROUPS	SUB-GROUPS	DESCRIPTION OF ITEM
112	-	Alcoholic beverages
121	-	Tobacco, unmanufactured tobacco refuse
122	-	Tobacco, manufactured (whether or not containing tobacco substitutes)
525	-	Radioactive and associated materials
667	-	Pearls, precious and semi-precious stones, worked or unworked
718	7187	Nuclear reactors, and parts thereof, fuel elements (cartridges), non-irradiated for nuclear reactors
897	8973	Gold, silver or platinum jewelry (except watches, and watch cases) and goldsmiths' or silversmiths' wares (including set gems)
971	-	Gold, non-monetary (excluding gold ores and concentrates)

[1] See the Standard International Trade Classification, Revision 3 (SITC, Rev. 3), published by the United Nations in Statistical Papers, Series M, No. 34/Rev. 3 (1986).

CHAPTER III
Execution of the Program

SECTION 3.01. **Policy Letter**. The Borrower and the Bank agree that the substantive contents of the Policy Letter dated November 18, 2022, from the Borrower to the Bank, that describes the objectives, policies and actions directed toward the achievement of the objectives of the Program and in which the Borrower declares its commitment to the execution of the Program, are an integral part of the Program for the purposes established in Section 3.04 of these Special Conditions.

SECTION 3.02. **Periodic meetings**. (a) The Borrower, through the Executing Agency and the Bank shall meet, at the request of either party and on the date and place agreed upon, to exchange views on: (i) the general progress achieved in the implementation of the Program, and the compliance with the obligations set forth in Sections 2.02 and 2.03 of these Special Conditions; and (ii) the consistency of the Borrower's macroeconomic framework with the Program. Prior to any such meeting, the Borrower shall submit to the Bank, for its review and comments, a report in such detail as the Bank shall reasonably request on the fulfillment of the obligations referred to in subparagraphs (a)(i) and (ii) of this Section.

(b) If from the review of the Borrower's reports, the Bank determines that the implementation of the Program is not satisfactory, the Borrower shall submit to the Bank within thirty (30) days from the date of the Bank's notification, the plans or reports necessary to correct the problems, along with a timetable for their implementation.

SECTION 3.03. **Ex-Post evaluation**. The Borrower agrees to cooperate, directly or through the Executing Agency, in the evaluation of the Program to be carried out by the Bank after the Program's execution, with the purpose of identifying to what extent objectives of the Program have been reached, and to provide to the Bank all the information, data and documentation that the Bank may request to carry out said evaluation.

SECTION 3.04. **Modification of legal provisions and basic regulations**. The parties agree that, if changes are made to the macroeconomic and sector policies indicated in the Policy Letter referred to in Section 3.01 of these Special Conditions, or in the legislation or basic regulations relating to the Executing Agency, that the Bank considers could substantially affect the Program, the Bank shall have the right to request of the Borrower all necessary and reasonable information, with the purpose of determining whether said changes may have a substantial adverse effect in the execution of the Program. The Bank, after receiving and analyzing the information provided by the Borrower, and after consultation with the Borrower, may take the measures it deems necessary in accordance with the provisions of this Contract.

CHAPTER IV
Records, Inspections, and Reports

SECTION 4.01. **Records, inspections, and reports**. The resources of the Loan will be deposited in the Special Account or in the Special Accounts exclusively designated for the Program. The Borrower agrees to maintain accounting records, and an adequate internal control system, in accordance with Article 7.01 of the General Conditions.

SECTION 4.02. **Audits**. In accordance with Article 7.01 of the General Conditions of this Contract, the Borrower shall submit to the Bank, upon request of the Bank, and within ninety (90) days following such request, an audited financial report of the use of the resources of the Loan. The report will be duly certified by a firm of public independent accountants acceptable to the Bank, and in accordance with terms of reference previously approved by the Bank.

CHAPTER V
Miscellaneous Provisions

SECTION 5.01. **Entry into Effect**. The parties agree that this Contract shall enter into effect on the date of its signature by the Borrower.

SECTION 5.02. **Termination**. The Loan and all the obligations that derive thereof shall be deemed terminated upon full payment of the Loan and all interest and fees, together with other expenses, premiums, costs and payments arising out this Contract.

SECTION 5.03. **Validity**. The rights and obligations set forth in this Contract are valid and enforceable in accordance with its terms, regardless of the laws of any given country.

SECTION 5.04. **Communications and Notices**. Any notice, request, or communication from one party to another by virtue of this Contract shall be made in writing and shall be considered to have been made when the relevant document is delivered to the addressee at the respective address given below, or by electronic means under such terms and conditions as the Bank establishes and communicates to the Borrower, unless the parties agree otherwise in writing:

For the Borrower:

Mailing address:

Permanent Secretary, Finance
Ministry of Finance, Economic Affairs and Investment
Government Headquarters
Bay Street
St. Michael
Barbados

Email address: barbadosloans@barbados.gov.bb

For the Bank:

Mailing address:

Inter-American Development Bank
1300 New York Avenue, N.W.
Washington, D.C. 20577
U.S.A.

Facsimile: (202) 623-3096

CHAPTER VI
Arbitration

SECTION 6.01. **Commitment to Arbitrate.** For the resolution of any controversy which may arise under this Contract and which is not resolved by agreement between the parties, the Borrower and the Bank agree to unconditionally and irrevocably submit themselves to the procedures and ruling of the Arbitration Tribunal referred to in Chapter IX of the General Conditions.

IN WITNESS WHEREOF, the Borrower and the Bank, each acting through its authorized representative, have signed this Contract in Bridgetown, Barbados, on the date specified below.

THE GOVERNMENT OF BARBADOS	INTER-AMERICAN DEVELOPMENT BANK
The Hon. Mia Amor Mottley, S.C., M.P. Prime Minister Minister of Finance, Economic Affairs and Investment	Viviana Alva Hart Representative of the Bank in Barbados
Date: February 28, 2023	Date: February 28, 2023

PART TWO

GENERAL CONDITIONS
January 2022

CHAPTER I
Application of the General Conditions

ARTICLE 1.01. **Application of the General Conditions**. These General Conditions apply to the Loan Contracts entered into by the Inter-American Development Bank with its Borrowers in order to support policy-based programs, and accordingly the provisions hereof form an integral part of this Contract.

CHAPTER II
Definitions

ARTICLE 2.01. **Definitions**. For the purposes of the obligations contracted between the parties, the following definitions are adopted:

1. "Amortization Schedule" means the original schedule set forth in the Special Conditions for the payment of amortization installments of the Loan or any modified schedule agreed upon between the Parties pursuant to the provisions of Article 3.02 and/or Article 3.06, as applicable, of these General Conditions.

2. "Amortization Schedule Modification Request Letter" means an irrevocable communication from the Borrower to the Bank requesting a modification to the Amortization Schedule.

3. "Amortization Schedule Modification Notification Letter" means a communication by means of which the Bank responds to an Amortization Schedule Modification Request Letter.

4. "Approval Currency" means the currency in which the Bank approves the Loan, which may be Dollars or any Local Currency which the Bank can efficiently source, taking into account the Bank's operational and risk management considerations.

5. "Bank" means the Inter-American Development Bank.

6. "Bank's Cost of Funding" means a cost margin relative to SOFR or other Base Interest Rate applicable to the Loan, to be determined periodically by the Bank based on the average cost of its funding corresponding to sovereign guaranteed loans, and expressed in terms of an annual percentage.

7. "Bank Group" means the Bank, the Inter-American Investment Corporation and the Multilateral Investment Fund.

8. "Base Interest Rate" means the rate determined by the Bank at the time of a Conversion execution, (other than a Commodity Conversion or a Catastrophe Protection Conversion), based on: (i) the currency requested by the Borrower; (ii) the type of interest rate requested by the Borrower; (iii) the Amortization Schedule; (iv) the existing market conditions; and (v) one of the following, among others: (1) SOFR or other base interest rate applicable to the Loan plus a margin reflecting the Bank's estimated cost of funding in Dollars at the time of disbursement or Conversion; or (2) the Bank's actual cost of funding used as a basis for the Conversion; (3) the relevant interest rate index plus a margin reflecting the Bank's estimated cost of funding in the requested currency at the time of disbursement or Conversion; or (4) with respect to Outstanding Loan Balances that have been subject to a previous Conversion (other than a Commodity Conversion or a Catastrophe Protection Conversion), the interest rate in effect for such Outstanding Loan Balances.

9. "Board" means the Board of Executive Directors of the Bank.

10. "Borrower" shall have the meaning assigned to it in the Special Conditions.

11. "Business Day" means a day on which commercial banks and foreign exchange markets settle payments and are open for general business (including dealings in foreign exchange and foreign currency deposits) in New York or, in case of a Conversion, in the cities listed in the Conversion Request Letter or the Conversion Notification Letter, as the case may be.

12. "Calculation Agent" means the Bank, unless otherwise specified in writing by the Bank. Any determination made by the Calculation Agent shall be final, conclusive and binding on the parties (except in the case of manifest error), and, if made by the Bank as Calculation Agent, shall be duly documented and made in good faith and in a commercially reasonable manner.

13. "Cash Settlement Amount", (i) with respect to Commodity Conversions, has the meaning assigned to it in Articles 5.12(b), (c), and (d) of these General Conditions; and (ii) with respect to Catastrophe Protection Conversions, means an amount in Dollars owed by the Bank to the Borrower upon the determination of the occurrence of a Cash Settlement Event, to be calculated by the Event Calculation Agent in accordance with the Cash Settlement Event Determination Instructions.

14. "Cash Settlement Event" means an Event that, upon occurrence, causes a Cash Settlement Amount to be due by the Bank to the Borrower under a Catastrophe Protection Conversion, as determined by the Event Calculation Agent in accordance with the Cash Settlement Event Determination Instructions.

15. "Cash Settlement Event Determination Instructions" means a detailed, reproducible, and transparent set of conditions and instructions included in a Catastrophe Conversion Notification Letter that: (i) specifies how the Event Calculation Agent will determine whether the occurrence of an Event constitutes a Cash Settlement Event and, in that case, how the Cash Settlement Amount will be calculated; (ii) provides the Bank with the necessary parameters to secure the protection in the market via a transaction in the financial markets (such as the probability of attachment, expected loss, and exhaustion probability); and (iii) specifies other information in relation to the procedures and roles of each of the parties in the determination of the occurrence of a Cash Settlement Event and the calculation of a Cash Settlement Amount, if any.

16. "Catastrophe" means a serious disruption of the functioning of a society, a community, or a project that occurs as a result of a hazard and causes widespread or serious human, material, economic or environmental losses.

17. "Catastrophe Conversion Notification Letter" means a communication by which the Bank informs the Borrower of the terms and conditions of the Catastrophe Protection Conversion including, among others, the identification of one or more Events protected against and the Cash Settlement Event Determination Instructions.

18. "Catastrophe Protection Conversion" means any agreement entered into between the Bank and the Borrower, formalized on the Catastrophe Protection Conversion Date by means of a Catastrophe Conversion Notification Letter, where the Bank undertakes to pay to the Borrower a Cash Settlement Amount upon the occurrence of a Cash Settlement Event, subject to the fulfillment of the conditions specified in the Catastrophe Conversion Notification Letter and the Cash Settlement Event Determination Instructions.

19. "Catastrophe Protection Conversion Date" means the effective date of a Catastrophe Protection Conversion set forth in the applicable Catastrophe Conversion Notification Letter.

20. "Catastrophe Protection Engagement Letter" means an agreement entered into between the Borrower and the Bank, with the consent of the Guarantor, if any, in the initial stages of the structuring of a Catastrophe Protection Conversion whereby, the parties agree, among others to: (i) the main terms and conditions of the structuring of a potential Catastrophe Protection Conversion; and (ii) the pass-through to the Borrower of all costs incurred by the Bank (including fees charged by any third party, such as the Modeling Agent, external legal counsel and distributors, among others) in relation to such potential Catastrophe Protection Conversion and its corresponding transaction in the financial markets.

21. "Commodity Call Option" means, with respect to all or part of a Required Outstanding Loan Balance, a cash-settled call option exercisable by the Borrower as contemplated in Article 5.12 of these General Conditions.

22. "Commodity Conversion" means, with respect to all or part of a Required Outstanding Loan Balance, the entry into a Commodity Put Option or a Commodity Call Option pursuant to Article 5.01 of these General Conditions.

23. "Commodity Conversion Date" means the date of entry into a Commodity Conversion. This date shall be set forth in the Conversion Notification Letter.

24. "Commodity Conversion Maturity Date" means the Business Day on which the Commodity Option matures. This date shall be set forth in the Conversion Notification Letter.

25. "Commodity Conversion Settlement Date" means, with respect to a Commodity Conversion, the date on which the Cash Settlement Amount thereof is required to be paid, which shall be that date occurring five (5) Business Days following a Commodity Conversion Maturity Date unless otherwise agreed to by the Parties and specified in the Conversion Notification Letter.

26. "Commodity Option" shall have the meaning assigned to it in Article 5.11(a) of these General Conditions.

27. "Commodity Put Option" means, with respect to all or part of a Required Outstanding Loan Balance, a cash-settled put option exercisable by the Borrower as contemplated in Article 5.12 of these General Conditions.

28. "Contingent Credit Facility" means the Contingent Credit Facility for Natural Disaster Emergencies or the Contingent Credit Facility for Natural Disaster and Public Health Emergencies, as the case may be, approved by the Bank, and as may be amended from time to time.

29. "Contract" means this loan contract.

30. "Conversion" means a modification of the terms of all or any portion of the Loan as requested by the Borrower and accepted by the Bank, under the terms of this Contract, which may be: (i) a Currency Conversion; (ii) an Interest Rate Conversion; (iii) a Commodity Conversion; or (iv) a Catastrophe Protection Conversion.

31. "Conversion Date" means the Currency Conversion Date, the Interest Rate Conversion Date, the Commodity Conversion Date, or the Catastrophe Protection Conversion Date, as the case may be.

32. "Conversion Notification Letter" means the communication by which the Bank informs the Borrower of the financial terms and conditions upon which a Conversion has been effected, in accordance with the Conversion Request Letter sent by the Borrower; provided that, for a Catastrophe Protection Conversion, "Conversion Notification Letter" means a Catastrophe Conversion Notification Letter.

33. "Conversion Period" means, (i) with respect to any Conversion (other than a Commodity Conversion or Catastrophe Protection Conversion), the period between the Conversion Date and the last day of the interest period in which the Conversion ends, pursuant to its terms. Notwithstanding the foregoing, for purposes of the last payment of principal and interest, the Conversion Period shall end on the day on which interest corresponding to such interest period is paid; and (ii) with respect to any Commodity Conversion or Catastrophe Protection Conversion, the period from the date on which a Conversion enters into effect through the date set forth in the applicable Conversion Notification Letter or the Catastrophe Conversion Notification Letter.

34. "Conversion Request Letter" means an irrevocable communication of the Borrower to the Bank requesting a Conversion, pursuant to Article 5.01 of these General Conditions.

35. "Converted Currency" means any Local Currency or Non-Borrowing Member Country Currency in which all or part of the Loan is denominated after a Currency Conversion has been effected.

36. "Currency Conversion" means with respect to a disbursement or with respect to all or part of an Outstanding Loan Balance, a change in the currency of denomination to a Local Currency or a Non-Borrowing Member Country Currency which the Bank can efficiently source, taking into account the Bank's operational and risk management considerations.

37. "Currency Conversion Date" means, in relation to Currency Conversions for new disbursements, the effective date on which the Bank makes the disbursement and, in the case of Currency Conversions of Outstanding Loan Balances, the date on which the debt is redenominated. These dates shall be set forth in the Conversion Notification Letter.

38. "Derivative Contract" means any contract entered into between the Bank and the Borrower or the Bank and the Guarantor, if any, to document and/or confirm one or more derivative transactions agreed between the Bank and the Borrower, or the Bank and the Guarantor, if any, and its subsequent amendments. All attachments and other supplemental agreements to a Derivative Contract shall form an integral part of such Derivative Contract.

39. "Disbursement Tranche" means, for loans to support policy reforms, the amount or the portion of the resources of the Loan eligible for disbursement once the Borrower has complied with the relevant contractual conditions.

40. "Dollar" means the legal tender of the United States of America.

41. "Eligible Natural Disaster" means (i) an earthquake; (ii) a tropical cyclone; and/or (iii) another natural disaster for which the Bank can offer the Principal Payment Option, subject to the Bank's operational and risk management considerations, in either of the three cases of catastrophic proportions, that meets the parametric and non-parametric conditions established by the Bank in the Principal Payment Option Parametric and Non-Parametric Terms and Conditions.

42. "Event" means a phenomenon or occurrence identified in the Catastrophe Conversion Notification Letter that has the potential to cause a Catastrophe, the risk of which the Borrower is requesting the protection against, and for which the Bank can execute a Catastrophe Protection Conversion subject to market availability and to the Bank's operational and risk management considerations.

43. "Event Calculation Agent" means a third party engaged by the Bank who, based on the Reporting Agent's data concerning an Event, and in accordance with the Cash Settlement Event Determination Instructions, determines whether the occurrence of an Event constitutes a Cash Settlement Event and, in that case, calculates the related Cash Settlement Amount.

44. "Event Calculation Notice" means a communication submitted by the Borrower to the Event Calculation Agent, with a copy to the Bank, requesting (i) the determination of whether a Cash Settlement Event has occurred; and (ii) if a Cash Settlement Event is determined to have occurred, the calculation of the corresponding Cash Settlement Amount.

45. "Event Report" means a report released by the Event Calculation Agent after receipt of an Event Calculation Notice, determining whether the occurrence of an Event constitutes a Cash Settlement Event and specifying the corresponding Cash Settlement Amount due, if any.

46. "Execution Period" means the period during which the Bank may effect a Conversion as determined by the Borrower in the Conversion Request Letter. The Execution Period starts from the day on which the Conversion Request Letter is received by the Bank.

47. "Executing Agency/Agencies" means the entity/entities responsible for executing all or part of the Program.

48. "Final Amortization Date" means the latest date on which the Loan may be fully repaid, in accordance with the Special Conditions.

49. "Flexible Financing Facility" means the financial platform the Bank uses to provide sovereign-guaranteed Loans chargeable to the resources of the Bank's ordinary capital.

50. "Full-Term Catastrophe Protection Conversion" means a Catastrophe Protection Conversion for which the Conversion Period ends on the Final Amortization Date.

51. "Full-Term Commodity Conversion" means a Commodity Conversion whose Commodity Conversion Maturity Date coincides with the Final Amortization Date.

52. "Full Term Currency Conversion" means a Currency Conversion for a Conversion Period equal to the period set forth in the Amortization Schedule requested for such Currency Conversion, pursuant to Article 5.03 of these General Conditions.

53. "Full Term Interest Rate Conversion" means an Interest Rate Conversion for a Conversion Period equal to the period set forth in the Amortization Schedule requested for such Interest Rate Conversion, pursuant to Article 5.04 of these General Conditions.

54. "General Conditions" means the entirety of articles which comprise the second part of this Contract and reflect the basic policies of the Bank uniformly applicable to its loan contracts.

55. "Guarantor" means the party which guarantees the fulfillment of the obligations contracted by the Borrower and which assumes other obligations for which it is liable under the Guarantee Contract.

56. "Interest Rate Calculation Convention" means the convention regarding the number of days used to calculate interest payments, as set forth in the Conversion Notification Letter.

57. "Interest Rate Cap" means the establishment of an upper limit for a variable interest rate.

58. "Interest Rate Collar" means the establishment of an upper and a lower limit for a variable interest rate.

59. "Interest Rate Conversion" means: (i) a change of interest rate type with respect to all or part of the Outstanding Loan Balance; or (ii) the establishment of an Interest Rate Cap or an Interest Rate Collar with respect to all or part of the Outstanding Loan Balance; or (iii) any other hedging option that affects the interest rate applicable to all or part of the Outstanding Loan Balance.

60. "Interest Rate Conversion Date" means the effective date of the Interest Rate Conversion upon which the new interest rate applies. This date shall be set forth in the Conversion Notification Letter.

61. "Loan" shall have the meaning assigned to it in the Special Conditions.

62. "Local Currency" means a currency that is legal tender in any of the Bank's borrowing members.

63. "Loan Tranche" means any of the tranches into which the Loan may be divided as a result of a Conversion or a modification of the Amortization Schedule.

64. "Modeling Agent" means an independent third party engaged by the Bank to calculate the relevant pricing metrics in a Catastrophe Protection Conversion, including but not limited to the probability of attachment, expected loss, and exhaustion probability as defined in the Cash Settlement Event Determination Instructions.

65. "Non-Borrowing Member Country Currency" means a currency that is legal tender in any of the Bank's non-borrowing member countries.

66. "Notional Quantity" means, with respect to a Commodity Conversion, the number of units of the underlying commodity.

67. "Option Type" means the type of Commodity Option for which the Bank could, subject to market availability and to the Bank's operational and risk management considerations, execute a Commodity Conversion, including but not limited to, European, fixed-strike arithmetic Asian and binary options.

68. "Original Disbursement Period" means the original period for disbursements of the Loan, which is set forth in the Special Conditions.

69. "Original WAL" means the WAL of the Loan in effect as of the date of signature of this Contract and set forth in the Special Conditions.

70. "Outstanding Loan Balance" means the amount that the Borrower owes the Bank for the portion of the Loan that has been disbursed.

71. "Partial-Term Catastrophe Protection Conversion" means a Catastrophe Protection Conversion for which the Conversion Period ends prior to the Final Amortization Date.

72. "Partial-Term Commodity Conversion" means a Commodity Conversion whose Commodity Conversion Maturity Date occurs prior to the Final Amortization Date.

73. "Partial-Term Currency Conversion" means a Currency Conversion for a shorter Conversion Period than the period set forth in the Amortization Schedule requested for such Currency Conversion, pursuant to Article 5.03 of these General Conditions.

74. "Partial-Term Interest Rate Conversion" means an Interest Rate Conversion for a shorter Conversion Period than the period set forth in the Amortization Schedule requested for such Interest Rate Conversion, pursuant to Article 5.04 of these General Conditions.

75. "Parties" means the Bank and the Borrower and each of them, indistinctively, a Party.

76. "Payment Valuation Date" means a date that is determined based on a number of Business Days prior to any amortization or interest payment, as specified in a Conversion Notification Letter.

77. "Principal Payment Option" means the one-time principal payment option with respect to the Amortization Schedule which may be offered to a Borrower which is a member country of the Bank pursuant to Articles 3.03 to 3.06 of these General Conditions.

78. "Principal Payment Option Activation Notification Letter" means the communication by which the Bank responds to a Principal Payment Option Activation Request Letter.

79. "Principal Payment Option Activation Request Letter" means the communication from the Borrower to the Bank requesting that the Loan be eligible for the Principal Payment Option subject to the terms and conditions set forth in this Contract.

80. "Principal Payment Option Exercise Notification Letter" means the communication by which the Bank responds to a Principal Payment Option Exercise Request Letter and informs the Borrower of the adjusted Amortization Schedule resulting from the exercise of the Principal Payment Option.

81. "Principal Payment Option Exercise Request Letter" means the communication from the Borrower to the Bank requesting a modification to the Amortization Schedule under the Principal Payment Option pursuant to Article 3.06 of these General Conditions.

82. "Principal Payment Option Parametric and Non-Parametric Terms and Conditions" means the terms and conditions of the parametric and non-parametric conditions established by the Bank and applicable for the verification of the occurrence of an Eligible Natural Disaster.

83. "Program" means the policy reform program supported by this Loan.

84. "Prohibited Practices" means the act(s) defined in Article 6.03 of these General Conditions.

85. "Protection Amount" means the maximum amount of the aggregate Cash Settlement Amounts under a Catastrophe Protection Conversion, in Dollars, that would be due by the Bank upon the determination of the occurrence of one or more Cash Settlement Events.

86. "Quarter" means each of the following three-month (3-month) periods of the calendar year: the period beginning on January 1st and ending on March 31st; the period beginning on April 1st and ending on June 30th; the period beginning on July 1st and ending on September 30th and the period beginning on October 1st and ending on December 31st.

87. "Reporting Agent" means an independent third-party that provides the relevant data and information for a Cash Settlement Event calculation under a Catastrophe Protection Conversion in accordance with the Cash Settlement Event Determination Instructions.

88. "Required Outstanding Loan Balance" has the meaning assigned to it in Article 5.02(f) of these General Conditions.

89. "Semester" means the first six (6) months or last six (6) months of the calendar year.

90. "Settlement Currency" means the currency used to settle principal and interest payments. For fully deliverable currencies, the Settlement Currency is the Converted Currency. For non-deliverable currencies, the Settlement Currency is the Dollar.

91. "SOFR" means with respect to any day the secured overnight financing rate published for such day by the SOFR Administrator on the SOFR Administrator's website, currently at http://www.newyorkfed.org, or any successor source.

92. "SOFR Administrator" means the Federal Reserve Bank of New York as administrator of SOFR, or any successor administrator of SOFR.

93. "SOFR-Based Interest Rate" means the sum of the SOFR Interest Rate and the Bank's Cost of Funding.

94. "SOFR Interest Rate" means, for any calculation period, the daily compounded SOFR determined by the Calculation Agent in accordance with the following formula):

$$\left[\left(\frac{\text{SOFR Index}_{End}}{\text{SOFR Index}_{Start}}\right) - 1\right] \times 360/d_c$$

Where:

i) "d_c" means the number of days in the relevant calculation period

ii) "SOFR $Index_{Start}$" means the SOFR Index value on the first date of the relevant calculation period.

iii) "SOFR $Index_{End}$" means the SOFR Index value on the day after the end of the relevant calculation period.

iv) "SOFR Index" means, with respect to (1) any U.S. Government Securities Business Day, the value published by the SOFR Administrator on its website on or about 3:00 p.m. (New York Time) on such U.S. Government Securities Business Day, or any corrected value published by the SOFR Administrator on its website on the same U.S Government Securities Business Day and (2) any non-U.S. Government Securities Business Day, the Projected SOFR Index.

If a SOFR Index value is not publicly available by 5:00 p.m. (New York Time) on such U.S. Government Securities Business Day, then the Calculation Agent will use the Projected SOFR Index or if such value is not publicly available for two or more consecutive U.S. Government Securities Business Days, such other value determined by the Bank in accordance with Article 3.07(e) of these General Conditions.

v) "Projected SOFR Index" means, with respect to any non-U.S. Government Securities Business Day, the SOFR Index calculated by the Bank using a methodology substantially similar to the SOFR Administrator based on the last published SOFR Index and the last published SOFR rate.

vi) "U.S. Government Securities Business Day" means any day except for a Saturday, a Sunday or a day on which the Securities Industry and Financial Markets Association recommends that the fixed income departments of its members be closed for the entire day of trading in U.S. government securities.

95. "Special Conditions" means the entirety of the provisions which comprise the first part of this Contract and contain the particular terms of the operation.

96. "Specified Price" means the price of the underlying commodity according to the Underlying Commodity Index on the Commodity Conversion Maturity Date except that, for certain Option Types, such price will be calculated on the basis of a formula to be determined in the Conversion Notification Letter.

97. "Strike Price" means, with respect to a Commodity Conversion, the fixed price at which (i) the owner of a Commodity Call Option is entitled to purchase; or (ii) the owner of a Commodity Put Option is entitled to sell, the underlying commodity (on a cash-settled basis).

98. "Underlying Commodity Index" means a published index that is a measure of the price of the underlying commodity that is the subject of a Commodity Option. The source and calculation of the Underlying Commodity Index will be set forth in the Conversion Notification Letter. If the Underlying Commodity Index relating to a commodity is (i) not calculated and announced by the sponsor thereof in effect on the Commodity Conversion Date but is calculated and announced by a successor sponsor acceptable to the Calculation Agent, or (ii) replaced by a successor index using, in the determination of the Calculation Agent, the same or a substantially similar formula for and method of calculation as used in the calculation of the Underlying Commodity Index, then in each case that index will be the Underlying Commodity Index.

99. "Valuation Exchange Rate" is equal to the number of units of the Converted Currency per Dollar, applicable on each Payment Valuation Date, pursuant to the source established in the Conversion Notification Letter.

100. "WAL" means the weighted average life, whether the Original WAL or the weighted average life resulting from a modification of the Amortization Schedule, as a result of a Conversion or otherwise. The WAL is calculated in years (to two decimal places) based on the Amortization Schedule of all Loan Tranches and is defined as the division of (i) by (ii) below, where:

(i) is the sum of the products of (A) and (B), defined as:

(A) the amount of each amortization payment;

(B) the difference in the number of days between the amortization payment date and the execution date of this Contract, divided by 365 days;

and

(ii) the sum of amortization payments.

The applicable formula is the following:

$$WAL = \frac{\sum_{j=1}^{m}\sum_{i=1}^{n} A_{i,j} \times \left(\frac{PD_{i,j} - ED}{365} \right)}{TA}$$

where:

WAL is the weighted average life of all amortizations, expressed in years.

m is the total number of Loan Tranches.

n is the total number of amortization payments for each Loan Tranche.

A_{ij} is the amortization amount referring to payment i of Loan Tranche j, calculated in Dollar equivalent at the exchange rate determined by the Calculation Agent, for the date of modification of the Amortization Schedule.

PD_{ij} is the payment date referring to payment i of Loan Tranche j.

ED is the execution date (date of signature) of this Contract.

TA is the sum of all A_{ij}, calculated in Dollar equivalent as of the date of the calculation at the exchange rate determined by the Calculation Agent.

CHAPTER III
Amortization, Interest, Credit Fee, Inspection and Supervision, and Prepayments

ARTICLE 3.01. Dates of Payment of Amortization and Interest. The Loan will be amortized in accordance with the Amortization Schedule. Interest and amortization installments will be paid on the fifteenth (15th) day of the respective month, as set forth in the Special Conditions of this Contract, in an Amortization Schedule Modification Notification Letter, in a Conversion Notification Letter, or in a Principal Payment Option Exercise Notification Letter, as the case may be. The amortization payment dates shall always coincide with an interest payment date.

ARTICLE 3.02. Modification of the Amortization Schedule. (a) The Borrower, with the prior consent of the Guarantor, if any, may request the modification of the Amortization Schedule at any time from the entry into effect of the Contract and up to sixty (60) days prior to the expiration of the Original Disbursement Period as set forth in this Article. The Borrower may also request the modification of the Amortization Schedule in the case of a Principal Payment Option, a Currency Conversion, or an Interest Rate Conversion, as set forth respectively in Articles 3.06, 5.03, and 5.04 of these General Conditions.

(b) For any modifications to the Amortization Schedule, except pursuant to the Principal Payment Option, a Currency Conversion, or an Interest Rate Conversion, the Borrower shall deliver to the Bank an Amortization Schedule Modification Request Letter, which shall: (i) state whether the proposed modification to the Amortization Schedule is applicable to all or part of the Loan; and (ii) indicate the new amortization schedule, including the first and last amortization dates, the frequency of payments, and the percentage that these payments represent of the total Loan or Loan Tranche thereof for which the modification is requested.

(c) The Bank may accept any requested modifications to the Amortization Schedule, subject to the Bank's operational and risk management considerations and the satisfaction of the following conditions:

(i) the last amortization date and the cumulative WAL of all the Amortization Schedules exceed neither the Final Amortization Date nor the Original WAL;

(ii) the Loan Tranche subject to a new Amortization Schedule shall not be less than the equivalent of three million Dollars (US$3,000,000); and

(iii) the Loan Tranche subject to the modification of the Amortization Schedule has not been subject to a prior modification, unless the new Amortization Schedule modification is the result of the exercise of the Principal Payment Option, a Currency Conversion, or an Interest Rate Conversion.

(d) The Bank will communicate to the Borrower its decision in an Amortization Schedule Modification Notification Letter. If the Bank accepts the Borrower's request, the Amortization Schedule Modification Notification Letter will include: (i) the new Amortization Schedule for the Loan or Loan Tranche; (ii) the cumulative WAL of the Loan; and (iii) the effective date of the new Amortization Schedule.

(e) The Loan may not have more than four Loan Tranches denominated in a Non-Borrowing Member Country Currency with different Amortization Schedules. The number of Loan Tranches in Local Currency may exceed this amount, subject to the Bank's operational and risk management considerations.

(f) To ensure that the cumulative WAL continues to be equal to or less than the Original WAL, in those cases in which an extension to the Original Disbursement Period is granted (i) resulting in an extension of such period beyond a date that is sixty (60) days prior to the due date for the first amortization installment of the Loan or the Loan Tranche, as the case may be; and (ii) when disbursements occur during such extension period, the Amortization Schedule shall be modified. Such modification will consist of moving forward the Final Amortization Date or, if the Loan has different Loan Tranches, moving forward the final amortization date of the Loan Tranche or Loan Tranches from which funds are disbursed during the extension period of the Original Disbursement Period, unless the Borrower expressly requests, in lieu of the foregoing, an increase in the amount of the amortization installment following each disbursement of the Loan or the Loan Tranche, as the case may be, that results in a longer WAL than the Original WAL. With respect to this second option, the Bank will determine the corresponding amount for such amortization installment.

ARTICLE 3.03. Principal Payment Option. (a) The Principal Payment Option may only be offered by the Bank to a borrower which is a member country of the Bank. For the purposes of the Principal Payment Option described in this Contract, the term "Borrower" should be understood as the member country of the Bank. The Borrower may request to the Bank, and the Bank may accept, that this Loan be eligible for the Principal Payment Option in accordance with the provisions set forth in this Contract. Upon acceptance by the Bank of the Borrower's request, the Borrower may be allowed to exercise the Principal Payment Option during the amortization period of the Loan by requesting the modification of the Amortization Schedule following the occurrence of an Eligible Natural Disaster in accordance with Article 3.06 of these General Conditions.

(b) **Principal Payment Option Activation Request after the entry into effect of this Contract.** The Borrower may request to the Bank, and the Bank may accept, that this Loan be eligible for the Principal Payment Option after it has entered into effect and up to sixty (60) days prior to the expiration of the Original Disbursement Period. To this end, the Borrower shall deliver to the Bank a Principal Payment Option Activation Request Letter in form and substance satisfactory to the Bank, signed by a duly authorized representative of the Borrower. Once the Bank has received a Principal Payment Option Activation Request Letter, the Bank may accept the request by delivering to the Borrower a Principal Payment Option Activation Notification Letter.

(c) **Condition to Request the Activation of the Principal Payment Option.** A request from the Borrower to activate the Principal Payment Option will be eligible provided that, at the time of the request, there is a Contingent Credit Facility entered into between the Borrower and the Bank with a corresponding active natural disaster coverage for at least one Eligible Natural Disaster.

(d) **Expansion of Contingent Credit Facility Natural Disaster Coverage.** If the Borrower expands the natural disaster coverage of its Contingent Credit Facility with the Bank to include one or more natural disasters that said Contingent Credit Facility did not provide coverage for at the time of activation of the Principal Payment Option as set forth in paragraph (c) above, the Borrower may request that the Bank update the Principal Payment Option Parametric and Non-Parametric Terms and Conditions accordingly. If the Bank approves said request, the parametric and non-parametric terms and conditions applicable for the verification of the respective natural disaster will be established by the Bank, at its own discretion, in the updated Principal Payment Option Parametric and Non-Parametric Terms and Conditions, which shall be communicated by the Bank to the Borrower. Once the Bank has communicated the updated Principal Payment Option Parametric and Non-Parametric Terms and Conditions as set forth in this paragraph, the natural disaster will be considered an Eligible Natural Disaster for the purposes of the Principal Payment Option.

(e) **Cancellation.** The Principal Payment Option may be cancelled upon written request by the Borrower to the Bank, in which case the Principal Payment Option transaction fee shall continue to accrue until thirty (30) days after the receipt by the Bank of the Borrower's request for cancellation. The Parties agree that any amount paid by the Borrower in connection with the transaction fee of the Principal Payment Option between the date of receipt of the notice of cancellation by the Bank and the effective date of the cancellation will not be reimbursed by the Bank to the Borrower.

(f) **Ineligibility.** This Loan will not be eligible for the Principal Payment Option if the Amortization Schedule of the Loan contemplates either a bullet payment or principal payments in the last five (5) years of the amortization period of the Loan.

ARTICLE 3.04. **Principal Payment Option Parametric and Non-Parametric Terms and Conditions.** (a) The parametric and non-parametric conditions applicable for the verification of the Eligible Natural Disaster will be established by the Bank, at its own discretion, in the Principal

Payment Option Parametric and Non-Parametric Terms and Conditions, which shall be communicated by the Bank to the Borrower following the activation of the Principal Payment Option as set forth in Article 3.03 of these General Conditions. The Principal Payment Option Parametric and Non-Parametric Terms and Conditions shall be binding on the Borrower and may be amended by the Bank by written notification to the Borrower.

(b) The fulfillment of the parametric conditions established for the verification of an Eligible Natural Disaster as set forth in the Principal Payment Option Parametric and Non-Parametric Terms and Conditions will be verified by the Bank using data provided by independent third-party entities determined by the Bank.

(c) The fulfillment of the non-parametric conditions established for the verification of an Eligible Natural Disaster as set forth in the Principal Payment Option Parametric and Non-Parametric Terms and Conditions will be verified by the Bank and, to that end, the Bank may, at its own discretion, consult with any third parties.

ARTICLE 3.05. **Transaction Fee Applicable to the Principal Payment Option.** (a) The Borrower shall pay the Bank a transaction fee applicable to the Principal Payment Option, which will be determined by the Bank periodically. The Bank will notify the Borrower of the transaction fee to be paid for the Principal Payment Option. Such fee shall remain in effect until it ceases to accrue as established in paragraph (c) of this Article.

(b) The transaction fee applicable to the Principal Payment Option: (i) shall be expressed in the form of basis points per annum; (ii) shall begin to accrue from the expiration date of the Original Disbursement Period on the Outstanding Loan Balance; and (iii) shall be paid on each interest payment date as provided for in Article 3.01 of these General Conditions.

(c) The transaction fee applicable to the Principal Payment Option shall cease to accrue: (i) on the date the Borrower exercises the Principal Payment Option pursuant to Article 3.06 of these General Conditions; or (ii) five (5) years prior to the last amortization date as provided in the Amortization Schedule as set forth in paragraph (g) of Article 3.06 of these General Conditions, whichever occurs first.

ARTICLE 3.06. **Exercise of the Principal Payment Option.** (a) Following the occurrence of an Eligible Natural Disaster during the amortization period of the Loan, the Borrower may request to exercise the Principal Payment Option by delivering to the Bank a Principal Payment Option Exercise Request Letter, in form and substance satisfactory to the Bank, by which the Borrower shall:

(i) notify the Bank of the occurrence of an Eligible Natural Disaster;

(ii) submit to the Bank the supporting documentation related to the fulfillment of the parametric and non-parametric conditions applicable to the Eligible Natural Disaster;

(iii) indicate the Loan number; and

(iv) include the new amortization schedule, which shall reflect the redistribution of Loan amortization payments that would be due during the two-year period following the occurrence of an Eligible Natural Disaster in accordance with the provisions of paragraphs (b) and (d) of this Article.

(b) The Bank may accept the request referred to in paragraph (a) of this Article subject to the Bank's operational and risk management considerations and to the satisfaction of the following requirements:

(i) the new amortization schedule of the Loan corresponds to an amortization schedule with semiannual principal payments;

(ii) the last amortization date and the cumulative WAL of the modified Amortization Schedule does not exceed the Final Amortization Date nor the Original WAL; and

(iii) there has been no delay in the payment of any sums owed by the Borrower to the Bank for principal, fees, interest, return of resources of the Loan used for ineligible expenditures, or for any other reason, under this Contract or any other contract entered into between the Bank and the Borrower, including any loan contract or Derivative Contract.

(c) The Bank will notify the Borrower of its decision in a Principal Payment Option Exercise Notification Letter. If the Bank accepts the Borrower's request, the Principal Payment Option Exercise Notification Letter will include: (i) the new Amortization Schedule for the Loan; and (ii) the effective date of the new Amortization Schedule.

(d) If the Principal Payment Option is exercised less than sixty (60) days in advance of the next principal payment due to the Bank as set forth in the Amortization Schedule, the modified Amortization Schedule shall not affect such next principal payment and, therefore, the two-year period of the Principal Payment Option would commence immediately after said principal payment.

(e) All interest, fees, premiums, and any other Loan charge, as well as any other payment for expenses or costs that may be imputed to this Contract, will continue to be due by the Borrower during the two-year period following the occurrence of an Eligible Natural Disaster in accordance with the provisions of this Contract.

(f) The Principal Payment Option may only be exercised by the Borrower regarding an Eligible Natural Disaster for which the Borrower had, at the time of activation of the Principal Payment Option, a corresponding active natural disaster coverage under a Contingent Credit Facility. If, following the activation of the Principal Payment Option, the Bank approves that the Borrower be eligible to exercise the Principal Payment Option for additional natural disasters pursuant to paragraph (d) of Article 3.03 of these General Conditions, the Borrower may also exercise the Principal Payment Option regarding said Eligible Natural Disaster.

(g) The Principal Payment Option may be exercised by the Borrower, subject to the Bank's operational and risk management considerations, up to five (5) years prior to the date of the last scheduled amortization payment to the Bank, as set forth in the Amortization Schedule. If the Principal Payment Option is not exercised within such period, it shall be deemed automatically cancelled, and the respective transaction fee shall cease to accrue upon the expiration of the said period.

(h) Once the Principal Payment Option has been exercised pursuant to this Article, the Borrower shall not be eligible to exercise such option again with respect to the Loan.

ARTICLE 3.07. Interest. (a) **Interest on Outstanding Loan Balances that have not been subject to Conversion.** To the extent that the Loan has not been subject to a Conversion, interest on the Loan shall accrue on daily Outstanding Loan Balances at the applicable SOFR-Based Interest Rate plus the applicable lending spread for the Bank's ordinary capital loans. For each interest period, the Borrower shall pay an estimated interest amount calculated based on a formula determined by the Bank, which formula, unless otherwise specified by the Bank, will incorporate the published SOFR Index for some portion of the relevant interest period and the last published SOFR rate as a proxy for the remainder of the relevant interest period. A corresponding adjustment to the interest amount payable by the Borrower shall be made for the subsequent interest period in a manner determined by the Bank, or in the case of the last interest period the corresponding adjustment shall be made immediately thereafter.

(b) **Interest on Outstanding Loan Balances that have been subject to Conversion.** If the Outstanding Loan Balances have been subject to a Conversion, the Borrower shall pay interest on the Outstanding Loan Balances converted under such Conversion at: (i) the Base Interest Rate determined by the Bank using the methodology and conventions determined by the Bank, including any necessary conforming changes in interest period, interest rate determination date or other technical, administrative or operational changes that the Bank decides are appropriate to effectuate such Conversion; plus (ii) the applicable lending spread for the Bank's ordinary capital loans.

(c) **Interest on Outstanding Loan Balances subject to an Interest Rate Cap.** If an Interest Rate Conversion has been effected to establish an Interest Rate Cap and the interest rate payable by the Borrower pursuant to this Article exceeds the Interest Rate Cap at any time during the Conversion Period, the maximum interest rate applicable during such Conversion Period shall be equal to the Interest Rate Cap.

(d) **Interest on Outstanding Loan Balances subject to an Interest Rate Collar.** If an Interest Rate Conversion has been effected to establish an Interest Rate Collar and the interest rate payable by the Borrower pursuant to this Article exceeds the upper limit or falls below the lower limit of the Interest Rate Collar at any time during the Conversion Period, the maximum interest rate applicable during such Conversion Period shall be equal to the upper limit of the Interest Rate Collar, and the minimum interest rate applicable during such Conversion Period shall be equal to the lower limit of the Interest Rate Collar.

(c) **Changes to the interest rate calculation basis**. The Parties agree that the Borrower's payments shall remain linked to the Bank's funding, notwithstanding any change in market practice that may, at any moment, affect the determination of the SOFR Interest Rate or any other applicable Base Interest Rate, and including if the Bank determines that it is no longer able, or it is no longer commercially acceptable for the Bank, to continue to use the SOFR Interest Rate or any other applicable Base Interest Rate, for purposes of its asset and liability management. For purposes of obtaining and maintaining such link under such circumstances, the Parties expressly agree that the Calculation Agent, seeking to reflect the Bank's corresponding funding, shall determine: (a) the occurrence of such changes; and (b) the alternate base rate applicable to determine the appropriate amount to be paid by the Borrower using the methodology and conventions determined by the Bank, including any applicable spread adjustments and any necessary conforming changes in interest period, interest rate determination date or other technical, administrative or operational changes that the Bank considers are appropriate. The Calculation Agent shall provide no less than sixty (60) days prior notice to the Borrower and the Guarantor, if any, of the applicable alternate base interest rate, with any necessary conforming changes. The alternate base rate and conforming changes shall become effective on the expiration of such notice period.

ARTICLE 3.08. Credit fee. (a) The Borrower shall pay a credit fee on the undisbursed balance of the Loan, at a percentage set by the Bank periodically during its review of financial charges on ordinary capital loans. The credit fee shall not exceed 0.75% per annum.

(b) The credit fee will begin to accrue sixty (60) days from the date of signature of the Contract.

(c) The credit fee shall cease to accrue: (i) when all disbursements have been made; and (ii) in full or in part, as the case may be, when the Loan has been totally or partially cancelled pursuant to Articles 4.02, 4.06, 4.07 or 6.02 of these General Conditions.

ARTICLE 3.09. Computation of Interest and Credit Fee. The interest and credit fee shall accrue daily for each interest Period from the first day to the last day of such interest period, calculated on the basis of the actual number of days elapsed in the respective interest period and a 360-day year, unless the Bank adopts another convention to follow for this purpose, in which case the Bank will inform the Borrower in writing.

ARTICLE 3.10. Resources for Inspection and Supervision. The Borrower shall not be required to cover the Bank's expenses for general inspection and supervision, unless the Bank establishes otherwise during the Original Disbursement Period as a consequence of its periodic review of financial charges for ordinary capital loans, and notifies the Borrower accordingly. In this case, the Borrower shall indicate whether it will pay the corresponding amount directly to the Bank or whether such amount should be withdrawn and withheld by the Bank from the resources of the Loan. In no case may the Bank charge for a specific semester more than the result of applying one percent (1%) of the Loan amount divided by the number of semesters comprising the Original Disbursement Period.

ARTICLE 3.11. Currency of payment for amortization, interest, credit fee, and inspection and supervision expenses. Interest and principal payments shall be made in Dollars, unless a Currency Conversion has been effected, in which case the provisions of Article 5.05 of these General Conditions shall apply. Credit and inspection and supervision fees shall always be paid in the Approval Currency.

ARTICLE 3.12. Prepayments. (a) **Prepayment of Outstanding Loan Balances denominated in Dollars with SOFR-Based Interest Rate**. The Borrower may prepay all or part of the Outstanding Loan Balances in Dollars subject to a SOFR-Based Interest Rate on any interest payment date, provided that it delivers to the Bank a written irrevocable request, with the consent of the Guarantor, if any, at least thirty (30) days in advance. Any such prepayment shall be applied as set forth in Article 3.13 of these General Conditions. In the event that the prepayment does not cover the entire Outstanding Loan Balance, the prepayment shall be applied proportionately to the remaining amortization installments. If the Loan has Loan Tranches with different Amortization Schedules, the Borrower shall prepay individual Tranches in their entirety, unless the Bank agrees otherwise.

(b) **Prepayments of amounts that have been subject to Conversion**. Except for the case of Catastrophe Protection Conversions as set forth in paragraph (c) of this Article, and provided that the Bank is able to unwind or reallocate its corresponding funding (or any related hedge), the Borrower, with the consent of the Guarantor, if any, may prepay on any interest payment date set forth in the Amortization Schedule attached to the Conversion Notification Letter: (i) all or part of the amount that has been subject to a Currency Conversion; (ii) all or part of the amount that has been subject to an Interest Rate Conversion; and/or (iii) all or part of an amount equivalent to the Required Outstanding Balance under a Commodity Conversion. For this purpose, the Borrower shall deliver an irrevocable written request to the Bank at least thirty (30) days in advance. Said request shall specify the amount the Borrower intends to prepay and the Conversion to which such prepayment relates. In the event that the prepayment does not cover the full amount of the Outstanding Loan Balance related to such Conversion, the prepayment shall be applied proportionately to the remaining amortization installments of such Conversion. The Borrower may not prepay converted amounts in an amount less than the equivalent of three million Dollars (US$3,000,000), unless the remaining Outstanding Loan Balance related to the respective Conversion is less than such amount and is paid in full.

(c) **Prepayments of Amounts that have been Subject to Catastrophe Protection Conversion**. The prepayment of any amount subject to a Catastrophe Protection Conversion will be evaluated on a case-by-case basis, subject to the Bank's operational and risk management considerations.

(d) For purposes of paragraphs (a), (b), and (c) above, the following payments shall be considered as prepayments: (i) the return of unjustified Advances of Funds; and (ii) payments resulting from all or a part of the Loan being declared immediately due and payable, pursuant to Article 6.02 of these General Conditions.

(c) Notwithstanding paragraph (b) above, in the event of a prepayment, the Borrower shall receive from the Bank, or alternatively, shall pay the Bank, as applicable, any gain or loss incurred by the Bank as a result of unwinding or reallocating its corresponding funding (or any related hedge), as determined by the Calculation Agent. In case of a gain, it will be credited first to any amounts due and payable by the Borrower. In case of a loss, the Borrower shall pay the corresponding amount concurrently on the prepayment date.

ARTICLE 3.13. **Application of Payments**. All payments shall be applied first to fees and interest due on the payment date, and if a balance exists, to the amortization of installments of principal due.

ARTICLE 3.14. **Transactions Falling Due on Non-Business Days**. Any payment or other transaction which, pursuant to this Contract, should be effected on a day other than a Business Day, shall be considered validly effected if made on the first Business Day immediately thereafter, and in such case no penalty whatsoever shall apply, unless the Bank adopts another convention to follow for this purpose, in which case the Bank will inform the Borrower in writing.

ARTICLE 3.15. **Place of Payments**. All payments shall be made at the principal office of the Bank in Washington, District of Columbia, United States of America, unless the Bank designates another place or places for this purpose by written notification to the Borrower.

ARTICLE 3.16. **Participations**. (a) The Bank may assign to other public or private institutions, in the form of participations, the rights corresponding to the Borrower's pecuniary obligations under this Contract. The Bank shall promptly notify the Borrower of each such assignment.

(b) Participations may be granted in respect of either Outstanding Loan Balances or amounts of the Loan which are still undisbursed at the time of entering into the participation agreement.

(c) With the prior consent of the Borrower, and of the Guarantor, if any, the Bank may assign all or part of the undisbursed amount of the Loan to other public or private institutions. To that end, the portion subject to assignment shall be denominated in terms of a fixed number of units of either the Approval Currency or Dollars. Likewise, with the prior consent of the Borrower and of the Guarantor, if any, the Bank may set, for the portion subject to assignment, an interest rate other than that established in this Contract.

CHAPTER IV
Conditions Relating to Disbursements

ARTICLE 4.01. **Conditions Precedent to First Disbursement**. The first disbursement of the Loan shall be subject to the fulfillment of the following requirements to the satisfaction of the Bank:

(a) The Bank shall have received one or more well-founded legal opinions which establish, with citations of the pertinent constitutional, legal, and regulatory provisions, that the obligations undertaken by the Borrower in this Contract, and those of the Guarantor, if any, in the Guarantee Contract, are valid and enforceable. Such opinions shall also refer to any other legal question that the Bank may reasonably deem relevant.

(b) The Borrower, directly or through the Executing Agency, if any, shall have designated one or more officials to represent it in all acts relating to the implementation of this Contract and shall have furnished the Bank with authentic copies of the signatures of said representatives. Should two or more officials be designated, the designation shall indicate whether such officials may act separately or must act jointly.

(c) The Borrower, either directly or through the Executing Agency, as the case may be, shall have presented to the Bank information regarding the special bank account in which the Bank shall deposit the disbursements of the Loan; and

(d) The Borrower, either directly or through the Executing Agency, as the case may be, shall have submitted in writing a disbursement request in accordance with the terms and conditions established in Article 4.03 hereof.

ARTICLE 4.02. **Period for Fulfilling the Conditions Precedent to First Disbursement.** If within sixty (60) days from the effective date of this Contract, or within such longer period as the parties may agree in writing, the conditions precedent to the first disbursement established in Article 4.01 of these General Conditions and in the Special Conditions have not been fulfilled, the Bank may terminate this Contract by giving notice to the Borrower.

ARTICLE 4.03. **Requisites for All Disbursements.** For the Bank to make any disbursement of the resources of the Loan, it shall be necessary that: (a) the Borrower or the Executing Agency, as the case may be, shall have submitted in writing, or by electronic means in such form and conditions as may be specified by the Bank, a disbursement request and, in support thereof, shall have supplied to the Bank such pertinent documents and other background materials as the Bank may have required; (b) the Borrower or the Executing Agency, as the case may be, maintains open the special bank account referred to in Article 4.01(c) of these General Conditions; (c) unless the Bank otherwise agrees, disbursement requests must be presented no later than thirty (30) days in advance of the date of expiration of the Original Disbursement Period or any extension thereof; (d) none of the circumstances described in Article 6.01 of these General Conditions shall have occurred; and (e) the Guarantor, if any, shall not be in non-compliance for more than one hundred twenty (120) days with any obligation to make payments to the Bank on any loan or Guarantee.

ARTICLE 4.04. **Disbursement Procedures.** The Bank may make disbursements of the resources of the Loan against the Loan, as follows: (a) by transferring to the Borrower the sums to which it is entitled under this Contract to be deposited in the special bank account referred to in Articles 4.01(c) and 4.03(b) of these General Conditions; (b) by making payments on behalf of and in agreement with the Borrower to other bank entities; and (c) any other method agreed to in writing by the parties. Any banking expenses that may be charged by a third party in connection with disbursements shall be borne by the Borrower. Unless the parties agree otherwise,

disbursements shall be made each time only in amounts of not less than five percent (5%) of the total amount of the Loan.

ARTICLE 4.05 **Receipts**. At the request of the Bank, the Borrower shall sign and deliver to the Bank, upon the completion of disbursements of the resources of the Loan, a receipt or receipts for the amounts disbursed.

ARTICLE 4.06. **Renunciation of Part of the Loan**. The Borrower, with the concurrence of the Guarantor, if any, may renounce, by written notice to the Bank, its right to utilize any part of the Loan which has not been disbursed before the receipt of the notice.

ARTICLE 4.07 **Automatic Cancellation of Part of the Loan**. Unless the Bank and the Borrower and the Guarantor, if any, expressly agree in writing to extend the term of the Original Disbursement Period, that portion of the Loan not committed or disbursed, as the case may be at the expiration of said period or extensions thereof, shall automatically be canceled.

CHAPTER V
Conversions

ARTICLE 5.01. **Exercise of Conversion Options**. (a) The Borrower may request a Currency Conversion, an Interest Rate Conversion, a Commodity Conversion or a Catastrophe Protection Conversion by delivering to the Bank an irrevocable "Conversion Request Letter" in form and substance satisfactory to the Bank, indicating the financial terms and conditions requested by the Borrower for the respective Conversion. The Bank may provide the Borrower with a form of Conversion Request Letter. For Catastrophe Protection Conversion, the Borrower will be able to submit the Conversion Request Letter to the Bank at any time after (i) entering into a Catastrophe Protection Engagement Letter; and (ii) signing-off on the final form of the transaction documents of the transaction in the financial markets that, in the determination of the Bank, are relevant to the Catastrophe Protection Conversion.

(b) The Conversion Request Letter shall be signed by a duly authorized representative of the Borrower, with the consent of the Guarantor, if any, and shall contain at least the following information:

(i) **For all Conversions:** (A) Loan number; (B) amount subject to Conversion; (C) Conversion type (Currency Conversion, Interest Rate Conversion, Commodity Conversion, or Catastrophe Protection Conversion); (D) Execution Period; (E) account number where funds shall be deposited, if applicable; and (F) Interest Rate Calculation Convention.

(ii) **For Currency Conversions:** (A) currency into which the Borrower requests to convert the Loan; (B) Amortization Schedule associated with such Currency Conversion, which may have an amortization period equal to or less than the Final Amortization Date; (C) the portion of the disbursement or Outstanding Loan Balance to which the Conversion shall

apply; (D) the type of interest rate applicable to the amounts subject to the Currency Conversion; (E) whether the Currency Conversion is a Partial Term Conversion or a Full Term Conversion; (F) Settlement Currency; and (G) any other instructions regarding the Currency Conversion request. If the Conversion Request Letter relates to a disbursement, the request shall indicate the amount of the disbursement in units of the Approval Currency, in Dollar units, or in units of the desired currency for the Conversion, except in the case of the last disbursement, in which case the request shall be made in units of the Approval Currency. In such cases, if the Bank effects the Conversion, the disbursements shall be denominated in the Converted Currency and the disbursements shall be made in (i) the Converted Currency or (ii) Dollars at an amount equal to the exchange rate set forth in the Conversion Notification Letter, to be determined by the Bank when sourcing its financing. If the Conversion Request Letter relates to Outstanding Loan Balances, the request shall indicate the amount in units of the currency of denomination of the Outstanding Loan Balance.

(iii) **For Interest Rate Conversions:** (A) type and tenor of interest rate requested; (B) the portion of the Outstanding Loan Balance to which the Interest Rate Conversion shall apply; (C) whether the Interest Rate Conversion is a Partial Term Interest Rate Conversion or a Full Term Interest Rate Conversion; (D) the Amortization Schedule associated with the Interest Rate Conversion, which may have an amortization period equal to or less than the Final Amortization Date; (E) for Interest Rate Conversions establishing an Interest Rate Cap or an Interest Rate Collar, the applicable upper and/or lower limits, as the case may be; and (F) any other instructions regarding the Interest Rate Conversion request.

(iv) **For Commodity Conversions:** (A) whether a Commodity Put Option or Commodity Call Option is requested; (B) the Option Type; (C) the identity of the commodity that is the subject of such Commodity Conversion (including the physical properties thereof); (D) the Notional Quantity; (E) the Underlying Commodity Index; (F) the Strike Price; (G) the Commodity Conversion Maturity Date; (H) whether the Conversion is a Full-Term Commodity Conversion or a Partial-Term Commodity Conversion; (I) the formula for the determination of the Cash Settlement Amount, if applicable; (J) the Required Outstanding Loan Balance; (K) a specification of the bank account information where the Cash Settlement Amount, if any, will be paid by the Bank to the Borrower on the Commodity Conversion Settlement Date; (L) at the option of the Borrower, the maximum amount of premium it is willing to pay to enter into a Commodity Conversion given a certain Notional Quantity and Strike Price, as contemplated in paragraph (e) below; and (M) any other instructions regarding the Commodity Conversion request.

(v) **For Catastrophe Protection Conversions**, (A) the Catastrophe type for which the Borrower is requesting protection; (B) the Cash Settlement Event Determination Instructions; (C) the Protection Amount being sought; (D) the term of the Catastrophe Protection Conversion; (E) whether the Conversion is a Full-Term Catastrophe Protection Conversion or a Partial-Term Catastrophe Protection Conversion; (F) the Outstanding Loan Balance; (G) the Catastrophe Protection Engagement Letter; (H) a specification of the bank account information where the Bank would transfer the Cash Settlement Amount, if any; (I) at the option of the Borrower, the maximum amount of premium it is willing to pay to enter into a Catastrophe Protection Conversion given a certain Protection Amount, as contemplated in paragraph (f) below; (J) the Borrower's sign-off to the final form of the transaction documents of the transaction in the financial markets that are relevant to the Catastrophe Protection Conversion, which must be attached to the Conversion Request Letter; and (K) other terms, conditions, or special instructions, if any, regarding the Catastrophe Protection Conversion request.

(c) Any principal amount payable during the period of fifteen (15) days prior to the beginning of the Execution Period until and including the Conversion Date may not be subject to a Conversion and shall be paid pursuant to the terms applicable prior to the execution of the Conversion.

(d) Once the Bank has received a Conversion Request Letter, it will proceed to review it. If it finds it acceptable, it will effect the Conversion during the Execution Period pursuant to the terms of this Chapter V. Once the Conversion has been effected, the Bank will deliver a Conversion Notification Letter or Catastrophe Conversion Notification Letter, as applicable, to the Borrower indicating the financial terms and conditions of the Conversion.

(e) With respect to Commodity Conversions, the Borrower may indicate in the Conversion Request Letter the maximum amount of premium it is willing to pay to enter into a Commodity Conversion given a certain Notional Quantity and Strike Price. If no limit is specified, the Bank may execute the related commodity hedge at the prevailing premium market price. Alternatively, at a given Dollar premium amount and a defined Strike Price, the Borrower may instruct the Bank to execute the related commodity hedge. The resulting Notional Quantity will reflect market conditions at the time of execution.

(f) With respect to Catastrophe Protection Conversions, the Borrower may indicate in the Conversion Request Letter the maximum amount of premium it is willing to pay to enter into a Catastrophe Protection Conversion given a certain Protection Amount and risk metrics (such as the probability of attachment, expected loss, and exhaustion probability). If no limit is specified, the Bank may execute the related transaction in the financial markets at the prevailing premium market price. Alternatively, at a given Dollar premium amount and defined risk metrics (such as the probability of attachment, expected loss and exhaustion probability), the Borrower may instruct the Bank to execute the related transaction in the financial markets. The resulting Protection Amount will reflect market conditions at the time of execution.

(g) If the Bank determines that the Conversion Request Letter does not comply with the requirements provided in this Loan Contract, it shall so notify the Borrower during the Execution Period. The Borrower may deliver a new Conversion Request Letter, in which case the Execution Period for this Conversion will start from the time the Bank receives the new Conversion Request Letter.

(h) If the Bank cannot effect the Conversion pursuant to the terms requested by the Borrower in the Conversion Request Letter within the Execution Period, such Conversion Request Letter shall be considered null and void, without prejudice to the Borrower's right to deliver a new Conversion Request Letter.

(i) If a national or international catastrophe, a financial or economic crisis, a change in the capital markets or any other extraordinary circumstance occurs during the Execution Period that, in the opinion of the Bank, may have a material negative impact on its ability to effect a Conversion or enter into a related funding or hedge, the Bank shall so inform the Borrower and agree on the actions to be taken regarding the Conversion Request Letter.

(j) Considering that the Execution Period of a Catastrophe Protection Conversion is longer than those for other Conversions, the Bank reserves the right to seek the Borrower's written confirmation of the terms of the transaction in the financial markets regarding such Catastrophe Protection Conversion prior to its execution.

ARTICLE 5.02. Conversion Requirements. Any Conversion shall be subject to the following requirements, as applicable:

(a) The feasibility of the Bank to execute any Conversion will depend on the ability of the Bank to source its funding or, if applicable, on the ability of the Bank to enter into any hedge on terms and conditions acceptable to the Bank in its sole discretion, in accordance with its policies, and will be subject to legal, operational and risk management considerations and prevailing market conditions.

(b) The Bank will not execute Conversions on amounts that are less than the equivalent of three million Dollars (US$3,000,000), unless (i) in the case of the last disbursement, the undisbursed amount is less, or (ii) in the case of a fully disbursed Loan, the Outstanding Loan Balance under any Loan Tranche is less.

(c) The number of Currency Conversions to Non-Borrowing Member Country Currencies may not exceed four (4) during the term of this Contract. This limit shall not apply to Currency Conversions to Local Currency.

(d) The number of Interest Rate Conversions may not exceed four (4) during the term of this Contract.

(e) There will be no limit to the number of Commodity Conversions or Catastrophe Protection Conversions that can be executed during the term of this Contract.

(f) Each Commodity Conversion will only be executed by the Bank in relation to Outstanding Loan Balances in accordance with the following formula (hereinafter, the "Required Outstanding Loan Balance"):

(i) For Commodity Call Options, the Required Outstanding Loan Balance will be the Notional Quantity * (Z – Strike Price), where Z is the highest expected forward commodity price at the Commodity Conversion Maturity Date, for the relevant Option Type, as calculated by the Bank; and

(ii) For Commodity Put Options, the Required Outstanding Loan Balance will be the Notional Quantity * (Strike Price – Y), where Y is the lowest expected forward commodity price at the Commodity Conversion Maturity Date, for the relevant Option Type, as calculated by the Bank.

(g) Any modification to the Amortization Schedule requested by the Borrower at the time of requesting a Currency Conversion shall be subject to the provisions of Articles 3.02(c) and 5.03(b) of these General Conditions. Any modification to the Amortization Schedule requested by the Borrower at the time of requesting an Interest Rate Conversion shall be subject to the provisions of Articles 3.02(c) and 5.04(b) of these General Conditions.

(h) The Amortization Schedule defined in the Conversion Notification Letter, resulting from a Currency Conversion or Interest Rate Conversion, may not be subsequently modified during the Conversion Period, unless the Bank agrees otherwise.

(i) Unless the Bank agrees otherwise, an Interest Rate Conversion with respect to amounts that have been subject to a previous Currency Conversion may only be effected: (i) on the entire Outstanding Loan Balance associated with such Currency Conversion, and (ii) for a term equal to the remaining term of such Currency Conversion.

ARTICLE 5.03. **Partial or Full-Term Currency Conversion.** (a) The Borrower may request a Full-Term Currency Conversion or a Partial Term Currency Conversion.

(b) A Full-Term Currency Conversion and a Partial Term Currency Conversion may be requested and executed at any time until the Final Amortization Date. Notwithstanding the foregoing, if the Borrower makes a request within less than sixty (60) days prior to the expiration of the Original Disbursement Period, such Currency Conversion will have the limitation that the Outstanding Loan Balance under the new Amortization Schedule requested for the Conversion shall at no time exceed the Outstanding Loan Balance under the original Amortization Schedule, taking into account the exchange rates set forth in the Conversion Notification Letter.

(c) In the case of a Partial Term Currency Conversion, the Borrower shall include in the Conversion Request Letter: (i) the Amortization Schedule for the period up to expiration of the Conversion Period; and (ii) the Amortization Schedule for the Outstanding Loan Balance payable

from the expiration of the Conversion Period to the Final Amortization Date, which shall correspond to the terms and conditions applicable prior to effecting the Currency Conversion.

(d) Prior to the expiration of a Partial Term Currency Conversion, the Borrower, with the consent of the Guarantor, if any, may request from the Bank one of the following options:

(i) Effecting a new Currency Conversion, upon delivery of a new Conversion Request Letter not less than fifteen (15) Business Days prior to the expiration date of the Partial Term Currency Conversion. Such new Currency Conversion will have the additional limitation that the Outstanding Loan Balance under the new Amortization Schedule shall at no time exceed the Outstanding Loan Balance under the Amortization Schedule requested in the original Partial Term Currency Conversion. If subject to market conditions, it is feasible to effect a new Conversion, the Outstanding Loan Balance of the amount originally converted will continue to be denominated in the Converted Currency, applying the new Base Interest Rate that reflects prevailing market conditions at the time of effecting the new Conversion.

(ii) The prepayment of the Outstanding Loan Balance of the converted amount, by providing the Bank written notice at least thirty (30) days prior to the expiration date of the Partial Term Currency Conversion. This prepayment shall be made on the expiration date of the Partial Term Currency Conversion in the Settlement Currency pursuant to Article 5.05 of these General Conditions.

(e) For purposes of paragraph (d) of this Article 5.03, the Outstanding Loan Balance originally subject to a Currency Conversion will be automatically converted to Dollars on the expiration of the respective Partial Term Conversion, and shall be subject to the Interest Rate set forth in Article 3.07(a) of these General Conditions if: (i) the Bank is unable to effect a new Conversion; or (ii) fifteen (15) days before the expiration date of the Partial Term Currency Conversion, the Bank has not received a request from the Borrower pursuant to paragraph (d) of this Article 5.03; or (iii) on the expiration date of the Partial Term Currency Conversion, the Borrower fails to make the requested prepayment.

(f) If the Outstanding Loan Balance originally subject to a Currency Conversion is converted to Dollars as provided in paragraph (e) above, the Bank, at the expiration of the Partial Term Currency Conversion, shall inform the Borrower, and the Guarantor, if any, of the amounts converted to Dollars and the applicable exchange rate determined by the Calculation Agent, based on prevailing market conditions.

(g) The Outstanding Loan Balance converted to Dollars may be subject to a new Currency Conversion, subject to the provisions of this Chapter V.

(h) At the expiration of a Full-Term Currency Conversion, the Borrower shall pay in full the Outstanding Loan Balance of the converted amount in the Settlement Currency, pursuant to Article 5.05 of these General Conditions, and cannot request a new Currency Conversion.

(i) Within thirty (30) days from the date of cancellation or modification of a Currency Conversion, the Borrower shall receive from the Bank, or alternatively, shall pay to the Bank, as applicable, the amounts corresponding to any gain or loss incurred by the Bank as a result of unwinding or reallocating its corresponding funding (or any related hedge) associated with the cancelation or modification of such Currency Conversion. In case of a gain, the amount will be credited first to any amounts due and payable by the Borrower to the Bank.

ARTICLE 5.04. **Partial or Full-Term Interest Rate Conversion.** (a) The Borrower may request a Full-Term Interest Rate Conversion or a Partial Term Interest Rate Conversion.

(b) A Full-Term Interest Rate Conversion and a Partial Term Interest Rate Conversion may be effected at any time until the Final Amortization Date. Notwithstanding the foregoing, if the Borrower makes a request within less than sixty (60) days prior to the expiration of the Original Disbursement Period, any such Interest Rate Conversion will be subject to the limitation that the Outstanding Loan Balance under the new Amortization Schedule requested for the Conversion shall at no time exceed the Outstanding Loan Balance under the original Amortization Schedule.

(c) In the case of Partial-Term Interest Rate Conversion of amounts denominated in Dollars, the Borrower shall include in the Conversion Request Letter: (i) the Amortization Schedule for the period up to expiration of the Conversion Period; and (ii) the Amortization Schedule for the Outstanding Loan Balance payable from the expiration of the Conversion Period to the Final Amortization Date, which shall correspond to the terms and conditions applicable prior to effecting the Interest Rate Conversion.

(d) In the case of a Partial-Term Interest Rate Conversion on amounts denominated in Dollars, the interest rate applicable to the Outstanding Loan Balances upon the expiration of the Partial-Term Interest Rate Conversion shall be the interest rate set forth in Article 3.07(a) of these General Conditions. Partial-Term Interest Rate Conversions of Outstanding Loan Balances denominated in currencies other than the Dollar shall be subject to the requirements of Article 5.02(g) and shall therefore be subject to the same treatment relative to the expiration of the Conversion Period of the Partial-Term Currency Conversion, as set forth in Article 5.03(d) of these General Conditions.

(e) Within thirty (30) days from the date of cancellation or modification of an Interest Rate Conversion, the Borrower shall receive from the Bank, or alternatively, shall pay to the Bank, as applicable, the amounts corresponding to any gain or loss incurred by the Bank as a result of unwinding or reallocating its corresponding funding (or any related hedge) associated with such Interest Rate Conversion. In case of a gain, the amount will be credited first to any amounts due and payable by the Borrower to the Bank.

ARTICLE 5.05. **Payment of Interest and Amortization Installments in the event of a Currency Conversion.** Pursuant to Article 3.11 of these General Conditions, following a Currency Conversion, interest and amortization installments of converted amounts shall be paid in the Settlement Currency. If the Settlement Currency is the Dollar, the Valuation Exchange Rate in effect on the Payment Valuation Date for the respective expiration date shall be applied, as set forth in the Conversion Notification Letter.

ARTICLE 5.06. **Early Termination of a Conversion**. (a) The Borrower can request in writing an early termination of a Conversion which will be subject to the Bank's ability to terminate its corresponding funding, related hedge, or related transaction in the financial markets, as applicable.

(b) In the case of early termination of Conversions other than Catastrophe Protection Conversions, the Borrower shall receive from the Bank, or alternatively, shall pay to the Bank, as applicable, any gain (including any payoff resulting from the early termination of a commodity hedge) or cost incurred by the Bank as a result of unwinding or reallocating its corresponding funding (or any related hedge), as determined by the Calculation Agent. In case of a cost, the Borrower shall promptly pay the corresponding amount to the Bank. In case of a gain it will be credited first to any amount due and payable by the Borrower to the Bank, such as any fees or premium payments.

(c) In the case of early termination of a Catastrophe Protection Conversion, the Borrower shall pay to the Bank any costs incurred by the Bank as a result of such termination, as determined by the Bank. The Borrower shall pay these early termination costs to the Bank in Dollars, as a lump-sum amount, promptly upon termination.

ARTICLE 5.07. **Transaction fees applicable to Conversions**. (a) The transaction fees applicable to Conversions, as well as other fees, as the case may be, shall be determined by the Bank from time to time. Each Conversion Notification Letter shall indicate, if applicable, the fee the Borrower shall be required to pay for the execution of the respective Conversion, which fee shall remain in effect throughout the Conversion Period of such Conversion.

(b) The transaction fee applicable to a Currency Conversion: (i) shall be expressed in the form of basis points per annum; (ii) shall accrue in the Converted Currency, from and including the Conversion Date, and on the Outstanding Loan Balance of such Currency Conversion; and (iii) shall be paid together with the interest payments as set forth in Article 5.05 of these General Conditions.

(c) The transaction fee applicable to an Interest Rate Conversion: (i) shall be expressed in the form of basis points per annum; (ii) shall accrue in the currency of denomination of the Outstanding Loan Balance subject to such Interest Rate Conversion; (iii) shall accrue, from and including the Conversion Date, on the Outstanding Loan Balance subject to the Interest Rate Conversion; and (iv) shall be paid together with the interest payments, as set forth in Article 3.07 of these General Conditions.

(d) Notwithstanding the transaction fees provided for in paragraphs (b) and (c) above, in the case of Currency Conversions or Interest Rate Conversions involving an Interest Rate Cap or an Interest Rate Collar, a transaction fee associated with such Interest Rate Cap or Interest Collar shall apply. Such transaction fee: (i) shall be denominated in the same currency as the Outstanding Loan Balance subject to the Interest Rate Cap or Interest Rate Collar; and (ii) shall be paid upfront in a lump-sum amount, in the Settlement Currency, on the first interest payment date, as set forth in Article 5.05 of these General Conditions.

(e) The transaction fee applicable to a Commodity Conversion: (i) shall be expressed in the form of basis points; (ii) shall be calculated on the basis of the Notional Quantity times the commodity closing price on the Commodity Conversion Date according to the Underlying Commodity Index; and (iii) shall be paid in Dollars, in a lump-sum upfront or in installments, as agreed upon between the Bank and the Borrower and specified in the Conversion Notification Letter. In no event shall the Borrower pay such fee to the Bank later than the Commodity Conversion Maturity Date, or, if the case may be, the date in which a Commodity Conversion is terminated early pursuant to Article 5.06 of these General Conditions.

(f) In case of an early termination of a Commodity Conversion, an additional fee will apply, which: (i) shall be expressed in the form of basis points; (ii) shall be calculated on the basis of the Notional Quantity times the commodity closing price on the date of the early termination according to the Underlying Commodity Index; and (iii) shall be paid in Dollars, as a lump-sum amount, promptly upon termination.

(g) For Catastrophe Protection Conversion, the Bank will charge the Borrower the applicable transaction fees and, as the case may be, other fees that may be due in connection with a Cash Settlement Event. These fees: (i) shall be expressed in the form of basis points; (ii) shall be calculated on the basis of the Catastrophe and Protection Amount; (iii) shall be paid in Dollars, in a lump-sum upfront or in installments, as agreed upon between the Bank and the Borrower and specified in the Conversion Notification Letter; and (iii) may be deducted from the Cash Settlement Amount as provided in Article 5.13 of these General Conditions. In no event shall the Borrower pay such fees to the Bank later than the last day of the Conversion Period for a Catastrophe Protection Conversion or, if the case may be, the date on which a Catastrophe Protection Conversion is terminated early pursuant to Article 5.06 of these General Conditions.

(h) In case of early termination of a Catastrophe Protection Conversion, an additional fee will apply, which: (i) shall be expressed in the form of basis points; (ii) shall be calculated on the basis of the Catastrophe and Protection Amount; and (iii) shall be paid in Dollars, as a lump-sum amount, promptly upon termination.

ARTICLE 5.08. <u>Funding Expenses, Premiums or Discounts Associated, and Other Costs with a Conversion</u>. (a) In the event that the Bank uses its actual cost of funding to determine the Base Interest Rate, the Borrower shall pay all fees and expenses incurred by the Bank in sourcing its funding. In addition, any premiums or discounts related to the Bank's funding shall be paid by or credited to the Borrower, as the case may be. These expenses and premiums or discounts will be specified in the Conversion Notification Letter.

(b) Accordingly, when a Conversion (other than Catastrophe Protection Conversion) is effected in connection with a disbursement, the amount to be disbursed to the Borrower shall be adjusted to deduct or to add any amounts owed by or due to the Borrower as described in paragraph (a) above.

(c) Alternatively, when a Conversion (other than Catastrophe Protection Conversion) is effected on Outstanding Loan Balances, the amounts owed by or due to the Borrower as described in paragraph (a) above, shall be paid by the Borrower or the Bank, as the case may be, within thirty (30) days from the Conversion Date.

(d) In the case of a Catastrophe Protection Conversion, the Borrower shall pay to the Bank all costs that the Bank may incur associated with the structuring of a Catastrophe Protection Conversion and the corresponding market transaction and costs related to the occurrence of a Cash Settlement Event and the Cash Settlement Event calculation. Such costs: (i) shall be paid in Dollars, (ii) shall be paid in a lump-sum amount upfront or in installments, as agreed upon between the Bank and the Borrower and specified in the Catastrophe Conversion Notification Letter; and (iii) may be deducted from the Cash Settlement Amount as provided in Article 5.13 of these General Conditions. These costs include administration cost and the costs of all third parties the Bank may need to retain. The Bank may agree to alternative payment mechanisms, such as expressing these costs in the form of basis points per annum, in which case they will be paid together with interest on each interest payment date, as long as it is operationally possible for the Bank. In no event shall the Borrower pay such costs to the Bank later than the last day of the Conversion Period for a Catastrophe Protection Conversion or, if the case may be, the date on which a Catastrophe Protection Conversion is terminated early pursuant to Article 5.06 of these General Conditions.

(e) In the case of a Catastrophe Protection Conversion, the provisions of Article 5.13 may apply to any deduction of any premium, cost, or fees associated with a Catastrophe Protection Conversion.

ARTICLE 5.09. **Premiums payable in connection with Interest Rate Caps or Interest Rate Collars**. (a) In addition to the transaction fees payable pursuant to Article 5.07 of these General Conditions, the Borrower shall pay the Bank a premium on the Outstanding Loan Balance subject to the Interest Rate Cap or Interest Rate Collar requested by the Borrower, equal to the premium paid by the Bank to a counterparty, if any, as a result of the purchase of the Interest Rate Cap or Interest Rate Collar. Such premium shall be paid: (i) in the currency of denomination of the Outstanding Loan Balance subject to the Interest Rate Cap or Interest Rate Collar, or its equivalent in Dollars, at the exchange rate set forth in the Conversion Notification Letter, which shall be the exchange rate determined at the time the Bank sourced the funding or entered into the related hedge; and (ii) in a lump-sum amount, on a date agreed by the Parties, but in no event later than thirty (30) days after the Conversion Date; provided however that if operationally feasible for the Bank, the Bank may agree to a different payment mechanism.

(b) If the Borrower requests an Interest Rate Collar, it may request the Bank to establish the lower limit of the Interest Rate Collar to ensure that the premium corresponding to the lower limit be equal to the premium corresponding to the upper limit, thereby establishing an Interest Rate Collar at no cost (zero-cost collar). If the Borrower selects the upper and lower limits, the premium payable to the Bank by the Borrower with respect to the upper limit of the Interest Rate Collar will be offset by the premium payable by the Bank with respect to the lower limit of the Interest Rate Collar. Nevertheless, the premium payable to the Borrower by the Bank in respect of the lower limit of the Interest Rate Collar shall in no case exceed the premium payable by the

Borrower to the Bank with respect to the upper limit of the Interest Rate Collar. Accordingly, during the Execution Period, the Bank may reduce the lower limit of the Interest Rate Collar such that the corresponding premium does not exceed the premium on the upper limit of the Interest Rate Collar.

ARTICLE 5.10. Premiums Payable in Connection with a Commodity Conversion. In addition to the transaction fees payable pursuant to Article 5.07 of these General Conditions, but subject to Article 5.01(e) of these General Conditions, the Borrower shall pay to the Bank a premium equivalent to the premium paid by the Bank to a counterparty for entering into a related commodity hedge. Such premium shall be paid in Dollars, in a lump-sum amount upfront or in installments, as agreed upon between the Bank and the Borrower and specified in the Conversion Notification Letter. The Bank may agree to alternative payment mechanisms, such as expressing the premium in the form of basis points per annum, in which case it will be paid together with interest on each interest payment date. In no event shall the Borrower pay such premium to the Bank later than the Commodity Conversion Maturity Date, or, if the case may be, the date in which a Commodity Conversion is terminated early pursuant to Article 5.06.

ARTICLE 5.11. Premiums Payable in Connection with a Catastrophe Protection Conversion. In addition to the fees payable pursuant to Article 5.07 of these General Conditions, but subject to Article 5.01(f) of these General Conditions, the Borrower shall pay to the Bank a premium equivalent to the premium paid by the Bank in the financial markets for entering into a related Catastrophe Protection Conversion hedge. Such premium: (i) shall be paid in Dollars, (ii) shall be paid in a lump-sum amount upfront or in installments, as agreed upon between the Bank and the Borrower and specified in the Catastrophe Conversion Notification Letter; and (iii) may be deducted from the Cash Settlement Amount as provided in Article 5.13 of these General Conditions. The Bank may agree to alternative payment mechanisms, such as expressing the premium in the form of basis points per annum, over a timeline agreed between the Bank and the Borrower, in which case it will be paid together with interest on each interest payment date, as long as it is operationally possible for the Bank. The Borrower shall pay the premium to the Bank over a timeline agreed between the Bank and the Borrower or, as the case may be, no later than the date on which a Catastrophe Protection Conversion is terminated early pursuant to Article 5.06 of these General Conditions.

ARTICLE 5.12. Commodity Conversions. Each Commodity Conversion shall be entered into on the following terms and conditions:

(a) Each Commodity Conversion shall relate to either a Commodity Put Option or a Commodity Call Option (each, a "Commodity Option"). A Commodity Option shall constitute the grant by the Bank to the Borrower of the right (exercisable as provided in this Article) to cause the Bank to pay the Cash Settlement Amount, if any, on the Commodity Conversion Settlement Date.

(b) If, at the Commodity Conversion Maturity Date under a Commodity Call Option, the Specified Price exceeds the Strike Price, the "Cash Settlement Amount" shall equal the product of (i) the excess of the Specified Price over the Strike Price multiplied by (ii) the Notional Quantity of such Commodity Option. Otherwise, the "Cash Settlement Amount" for such Commodity Call Option shall be zero.

(c) If, at the Commodity Conversion Maturity Date under a Commodity Put Option, the Strike Price exceeds the Specified Price, the "Cash Settlement Amount" shall equal the product of (i) the excess of the Strike Price over the Specified Price multiplied by (ii) the Notional Quantity of such Commodity Option. Otherwise, the "Cash Settlement Amount" for such Commodity Put Option shall be zero.

(d) In case the Commodity Conversion refers to a binary Option Type, the "Cash Settlement Amount" will be determined on the basis of a formula to be specified in the Conversion Notification Letter (Article 5.01(b)(iv)(I) of these General Conditions).

(e) On the Commodity Conversion Maturity Date, the Bank will determine and give notice to the Borrower of the Cash Settlement Amount. If the Cash Settlement Amount is greater than zero, the Bank will pay such amount to the Borrower on the Commodity Conversion Settlement Date. If a loan made to the Borrower, or guaranteed by the Borrower, is in arrears for over thirty (30) days, then the Bank may deduct from the Cash Settlement Amount due to the Borrower in connection with a Commodity Conversion all amounts due and payable by the Borrower to the Bank under any loan made to or guaranteed by the Borrower that is in arrears for any length of time (either for more, or for less, than thirty (30) days).

(f) If the Borrower shall fail to make a payment when due of any premium payable under the Commodity Conversion, and such failure is not cured within a reasonable time, the Bank may by written notice to the Borrower terminate the related Commodity Option, whereupon the Borrower shall pay to the Bank an amount determined by the Bank to be the amount that would be incurred by the Bank as a result of its unwinding or reallocating any related commodity hedge. Alternatively, the Bank may choose not to terminate the Commodity Option, in which case any Cash Settlement Amount resulting upon a Commodity Conversion Maturity Date will be applied as provided for in Article 5.06 of these General Conditions.

ARTICLE 5.13. <u>Catastrophe Protection Conversions</u>. Each Catastrophe Protection Conversion shall be entered into on the following terms and conditions:

(a) If at the time of occurrence of a Cash Settlement Event, as determined in an Event Report by the Event Calculation Agent, there is a Cash Settlement Amount to be paid to the Borrower by the Bank, the Bank will pay such Cash Settlement Amount to the Borrower within five (5) Business Days, unless otherwise agreed between the Bank and the Borrower.

(b) If a loan made to the Borrower, or guaranteed by the Borrower, is in arrears for over thirty (30) days, then the Bank may deduct from the Cash Settlement Amount due to the Borrower in connection with a Catastrophe Protection Conversion all amounts due and payable by the Borrower to the Bank under any loan made to or guaranteed by the Borrower that is in arrears for any length of time (either for more or for less than thirty (30) days).

(c) In addition to the deductions set forth in paragraph (b) above, the Bank, at its own discretion, may deduct from the Cash Settlement Amount due to the Borrower in connection with a Catastrophe Protection Conversion all amounts due and payable by the Borrower to the Bank related to fees, premiums and costs as set forth, respectively, in Articles 5.07(g), 5.11, and 5.08(d) of these General Conditions, in accordance with the following:

(i) **Costs.** The Bank may deduct from the corresponding Cash Settlement Amount any outstanding unpaid costs associated with the Catastrophe Protection Conversion.

(ii) **Outstanding Installments.** If the Bank and the Borrower have agreed that the fees, premium, and/or costs will be paid by the Borrower in installments or annualized, then:

(A) **Fees.** The Bank may deduct from any Cash Settlement Amount the entirety of the outstanding fees, including amounts owed but not yet due under the relevant installments schedule agreed to between the Borrower and the Bank.

(B) **Costs.** The Bank may deduct from any Cash Settlement Amount the entirety of the outstanding costs, including amounts owed but not yet due under the relevant installments schedule agreed to between the Borrower and the Bank.

(C) **Premiums – Protection Amount Not Exhausted.** The Bank may deduct from any Cash Settlement Amount the outstanding premium, including amounts owed but not yet due under the relevant installments schedule agreed to between the Borrower and the Bank, up to a maximum of fifty percent (50%) of the Cash Settlement Amount, if the Cash Settlement Amount does not exhaust the Protection Amount under the Catastrophe Protection Conversion.

(D) **Premiums – Protection Amount Exhausted.** The Bank may deduct from the Cash Settlement Amount the entirety of the outstanding premium, including amounts owed but not yet due under the relevant installments schedule agreed to between the Borrower and the Bank, if the Cash Settlement Amount is such that it exhausts the Protection Amount under the Catastrophe Protection Conversion.

(iii) **Remaining Balance.** If the Cash Settlement Event exhausts the Protection Amount and, after deducting from the Cash Settlement Amount the applicable fees, costs and premium described above, the Borrower still owes the Bank any of amounts for fees, costs, or premiums; then the Borrower shall promptly make those payments to the Bank in accordance with the terms and in the manner indicated by the Bank.

(d) All determinations and calculations made by the Event Calculation Agent in an Event Report shall be final and binding on the Borrower.

ARTICLE 5.14. **Market Quotes Disruption Events**. The parties acknowledge that the amortization and interest payments made by the Borrower in connection with amounts subject to a Conversion, shall at all times be linked to the corresponding funding of the Bank in relation to payments under such Conversion. Therefore, the Parties agree that, notwithstanding the occurrence of any disruption event that may materially affect the currency exchange rates, interest rates and inflation adjustment index used in this Contract, if any, or in any Conversion Notification Letter, the Borrower's payments shall remain linked to the Bank's funding. For purposes of obtaining and maintaining such link under such circumstances, the parties expressly agree that the Calculation Agent, acting in good faith and in a commercially reasonable manner, seeking to reflect the Bank's corresponding funding, shall determine the applicability of: (a) such disruption events; and (b) the replacement rate or index applicable to determine the appropriate amount to be paid by the Borrower using the methodology and conventions determined by the Calculation Agent, including any necessary conforming changes to interest period, interest rate determination date or other technical, administrative or operational changes that the Calculation Agent decides are appropriate.

ARTICLE 5.15. **Cancellation and Reversal of the Currency Conversion**. If, after the execution of this Contract, a change in a law, decree, or other applicable rule or regulation is enacted or issued, or if there is a change in the interpretation of a law, decree or other applicable rule or regulation in force at the time of execution of this Contract that, as reasonably determined by the Bank, prevents the Bank from continuing to maintain, in whole or in part, its funding in the Converted Currency, for the remainder of the period and under the same terms as the corresponding Currency Conversion, the Borrower, upon being notified by the Bank, shall have the option to redenominate the Outstanding Loan Balances subject to the Currency Conversion to Dollars at the exchange rate applicable at that time, as determined by the Calculation Agent. Such Outstanding Loan Balances shall remain subject to the Amortization Schedule agreed for such Currency Conversion and the Interest Rate set forth in Article 3.07(a) of these General Conditions. Alternatively, the Borrower may prepay all amounts that it owes in the Converted Currency, pursuant to the provisions of Article 3.12 of these General Conditions.

ARTICLE 5.16. **Gains or Losses associated with the Redenomination into Dollars**. If the Borrower, with the consent of the Guarantor, if any, decides to redenominate the Outstanding Loan Balances subject to a Currency Conversion into Dollars pursuant to Article 5.15 above, within thirty (30) days after the redenomination date, the Borrower shall receive from the Bank, or alternatively, shall pay to the Bank, as applicable, the amounts corresponding to any gain or loss incurred by the Bank as determined by the Calculation Agent, up until the Dollar redenomination date, in connection with variations in the interest rates. In case of a gain, the amount will be credited first to any amounts due and payable by the Borrower to the Bank.

ARTICLE 5.17. **Delay in payment in case of Currency Conversion**. In the event of any payment delay in respect of amounts of principal or financial charges that the Borrower owes the Bank as a result of a Conversion and any premiums payable to the Bank pursuant to Article 5.09

in a currency other than the Dollar, the Bank may charge interest at a floating rate in the Converted Currency determined by the Calculation Agent, plus a spread of 100 basis points (1%) over the total amount in arrears, irrespective of the applicability of additional charges to ensure a full transfer of costs in the event such spread is not sufficient to cover for the Bank the costs incurred as a result of such delay.

ARTICLE 5.18. **Costs, expenses or losses in case of Conversions.** If an action or omission by the Borrower, or the Guarantor, if any, including: (a) nonpayment of principal, interest and fees relating to a Conversion on the due dates; (b) revoking or changing the terms set forth in the Conversion Request Letter; (c) nonfulfillment of a partial or full prepayment of the Outstanding Loan Balances in the Converted Currency, if such prepayment had been previously requested by the Borrower in writing; (d) a change in laws or regulations that have an impact on the maintenance of all or part of the Bank's Loan on the agreed Conversion terms; or (e) other actions not described above, results in the Bank incurring additional costs to those described in this Contract, the Borrower shall pay the Bank such amounts, as determined by the Calculation Agent, to ensure a full transfer of the costs incurred by the Bank. In the case of Catastrophe Protection Conversion, the Borrower shall pay the Bank such additional costs according to Article 5.08(d) of these General Conditions.

CHAPTER VI
Suspension of Disbursements and Accelerated Maturity

ARTICLE 6.01. **Suspension of Disbursements.** The Bank, by written notice to the Borrower, may suspend disbursements if any of the following circumstances occurs and so long as it continues:

(a) Delay in the payment of any sums owed by the Borrower to the Bank for principal, fees, interest, return of Advances of Funds or for any other reason, under this Contract or any other contract entered into between the Bank and the Borrower, including another Loan Contract or Derivatives Contract.

(b) Nonfulfillment by the Borrower of the Program agreed to by the Bank or of any other obligation set forth in this Contract or in any other contract entered into with the Bank for the financing of the Project or in any Derivative Contract signed with the Bank.

(c) Withdrawal or suspension from membership in the Bank of the country in which the Program is to be executed.

(d) The Program or the purposes of the Loan may be affected by any restriction, of the legal capacity or modification or alteration of the functions or assets of the Borrower or the Executing Agency. In such cases, the Bank will have the right to require the Borrower for purposes of weighing whether the change or changes, have or may have, a negative impact on the execution of the Program to provide reasoned and detailed information. Only after hearing the Borrower and weighing the

information or clarification received, or if the Borrower fails to respond, prior to the date of the following disbursement, may the Bank suspend disbursements if it considers that the modifications made affect the Program materially and unfavorably or render its execution impossible.

(e) The non-compliance on the part of the Guarantor, if any, of any obligation set forth in the Guarantee Contract or in any Derivatives Contract signed with the Bank.

(f) When the Borrower is not a member country, any extraordinary circumstance which, in the opinion of the Bank, makes it unlikely that the Borrower will be able to comply with the obligations established in this Contract or to fulfill the purposes for which it was entered into.

(g) If it is determined by the Bank, that an employee, agent, or representative of the Borrower or the Executing Agency, has engaged in a Prohibited Practice in connection with the Program.

ARTICLE 6.02. **Termination, Accelerated Maturity, or Partial Cancellation of Undisbursed Balances and other Measures.** The Bank may terminate this Contract with respect to the part of the Loan not yet disbursed or may declare the entire Loan or a portion thereof immediately due and payable, together with interest and fees accrued up to the date of payment if:

(a) Any of the circumstances set forth in paragraphs (a), (b), (c) and (e) of the preceding Article continues for more than sixty (60) days;

(b) If it is determined by the Bank that the Borrower, Executing Agency or an employee, agent or representative of these, has committed a Prohibited Practice in connection with the Program, provided that the Borrower or the Executing Agency, as the case may be, has not taken adequate remedial measures (including providing adequate notice to the Bank upon learning of the Prohibited Practice) within a period of time the Bank considers reasonable; or

(c) The information referred to in paragraph (d) of the preceding Article, or the clarifications or additional information presented by the Borrower or the Executing Agency, if any, are not satisfactory to the Bank.

ARTICLE 6.03. **Prohibited Practices.** (a) For the purposes of this Contract, "Prohibited Practice" shall be understood as the practice prohibited by the Bank in connection with the activities it finances, as defined by the Board or that are defined in the future and communicated to the Borrower, including among others: corrupt practice, fraudulent practice, coercive practice, collusive practice, obstructive practice, and misappropriation.

(b) If, under the provisions of Articles 6.01(g) and 6.02(b) of these General Conditions if the Bank determines that the Borrower, Executing Agency or an employee, agent or representative of these, has engaged in a Prohibited Practice in connection with the execution of the Program, the Bank may take the following actions, including:

(i) Issue a reprimand against the firm, entity or individual determined to be responsible for the Prohibited Practice in the form of a formal letter of censure for its behavior.

(ii) Declare any firm, entity or individual determined to be responsible for the Prohibited Practice ineligible, either permanently or temporarily, to participate in Bank-financed activities, whether directly as a contractor or supplier, or indirectly as a subconsultant, subcontractor, or a supplier of goods, consulting services, or non-consulting services.

(iii) Refer the matter to appropriate law enforcement authorities.

(iv) Impose fines representing reimbursement to the Bank for costs associated with investigations and proceedings.

(c) The imposition of any action to be taken by the Bank pursuant to the provisions referred to above may be made public.

(d) The Borrower, Executing Agency or an employee, agent or representative of these, may be sanctioned by the Bank pursuant to agreements the Bank may have with other international financial institutions regarding the mutual enforcement of debarment decisions. For purposes of this paragraph (d) the term "sanction" shall mean any permanent debarment, conditions on future contracting or any publicly-disclosed action taken in response to a violation of an international financial institution's applicable framework for addressing allegations of Prohibited Practices.

ARTICLE 6.04. **Non-waiver of Rights**. Any delay by the Bank in the exercise of its rights pursuant to this Contract, or failure to exercise them, shall not be construed as a waiver by the Bank of any such rights nor as acquiescence in events or circumstances which, had they occurred, would have empowered it to exercise them.

ARTICLE 6.05. **Provisions not Affected**. The application of any of the measures provided for by this Chapter shall not affect the obligations of the Borrower established in this Contract, which shall remain in full force and effect, except that in case the entire Loan has been declared due and payable, only the pecuniary obligations of the Borrower shall continue in force.

CHAPTER VII
Records, Inspections and Reports

ARTICLE 7.01. **Internal Control and Records**. The Borrower or the Executing Agency, as the case may be, shall maintain an appropriate system of internal accounting and administrative controls. The accounting system shall be organized so as to provide the necessary documentation to permit the verification of transactions and facilitate the timely preparation of financial and account statements and reports. The records of the Program shall be maintained for a minimum of three (3) years after the date of final disbursement of the Loan, in such a way that: (a) make it possible to identify the sums received from the Bank; and (b) allow the identification of the information related with the execution of the Program or the use of the resources of the Loan.

ARTICLE 7.02. **Inspections**. (a) The Bank may establish such inspection procedures as it deems necessary to ensure the satisfactory development of the Program.

(b) The Borrower and the Executing Agency, if any, shall permit the Bank to inspect at any time the records and documents the Bank may deem pertinent, providing all documents, including on costs incurred under the Loan, which the Bank may reasonably request. The Borrower or the Executing Agency, as the case may be, shall produce the documents in a timely manner or shall submit an affidavit to the Bank setting forth the reasons why the requested material is unavailable or is being withheld. In addition, the Borrower and the Executing Agency shall make their personnel available, upon reasonable notice, to respond to questions from Bank personnel, which arise during the review or audit of such documents.

(c) In relation to the investigation of allegations of Prohibited Practices, the Borrower and the Executing Agency, if any, shall provide full assistance to the Bank in the investigation, will deliver all documents deemed necessary for the investigation and will ensure that those employees or agents who are aware of the Bank-financed activities be available to respond to inquiries within the context of an investigation, be it from Bank personnel or from any investigator, agent, auditor or consultant duly assigned to the investigation.

(d) The personnel that the Bank shall send or designate as investigators, agents, auditors or experts for this purpose shall receive the complete cooperation of the respective authorities. All the costs relating to transportation, salaries, and other expenses of such personnel shall be borne by the Bank.

(e) If the Borrower or the Executing Agency, as the case may be, refuses to comply with the Bank's request, or otherwise obstructs the Bank's review of the matter, the Bank in its sole discretion, may take appropriate action against the Borrower or the Executing Agency.

CHAPTER VIII
Provision on Encumbrances and Exemptions

ARTICLE 8.01. Commitment on Encumbrances. If the Borrower should agree to create any specific encumbrance on all or part of its assets or revenues to secure an external debt, it shall at the same time create an encumbrance guaranteeing to the Bank, equally and proportionally, the fulfillment of the pecuniary obligations arising from this Contract. However, the foregoing shall not apply: (a) to encumbrances on goods used as security for payment of the unpaid balance of the purchase price; and (b) to encumbrances created in banking operations to secure payment of debts with maturities of not more than one year. In the event that the Borrower is a member country, the term "assets or revenues" shall mean all types of assets or revenues which belong to the Borrower or any of its dependent agencies which are not autonomous entities with their own separate capital.

ARTICLE 8.02. Tax Exemption. The Borrower undertakes to ensure that both the principal and the interest and other charges of the Loan shall be paid without any deduction or restriction whatsoever, exempt from any tax, fee, duty or charge established or that may be established by the laws of its country, and to pay any tax, fee, or duty applicable to the signing, negotiation, and execution of this Contract.

CHAPTER IX
Arbitration Procedure

ARTICLE 9.01. Composition of the Tribunal. (a) The Arbitration Tribunal shall be composed of three members to be appointed in the following manner: one by the Bank, another by the Borrower, and a third, hereinafter called the "Referee", by direct agreement between the parties or through their respective arbitrators. If the parties or the arbitrators fail to agree on who the Referee shall be, or if one of the parties should not designate an arbitrator, the Referee shall be appointed, at the request of either party, by the Secretary General of the Organization of American States. If either of the parties fails to appoint an arbitrator, one shall be appointed by the Referee. If either of the appointed arbitrators or the Referee is unwilling or unable to act or to continue to act, his successor shall be appointed in the same manner as for the original appointment. The successor shall have the same functions and faculties as his predecessor.

(b) If the controversy affects not only the Borrower but also the Guarantor, if any, both shall be considered a single party and consequently shall act jointly in the designation of the arbitrator and for the other purposes of the arbitration proceedings.

ARTICLE 9.02. Initiation of the Procedure. In order to submit the controversy to arbitration, the claimant shall address to the other party a written communication setting forth the nature of the claim, the satisfaction or compensation which it seeks, and the name of the arbitrator it appoints. The party receiving such communication shall, within forty-five (45) days, notify the adverse party of the name of the person it appoints as arbitrator. If, within thirty (30) days after delivery of such notification to the claimant, the parties have not agreed upon the person who is to act as Referee, either party may request the Secretary General of the Organization of American States to make the appointment.

ARTICLE 9.03. **Convening of the Tribunal**. The Arbitration Tribunal shall be convened in Washington, District of Columbia, United States of America, on the date designated by the Referee, and, once convened, shall meet on the dates which the Tribunal itself shall establish.

ARTICLE 9.04. **Procedure**. (a) The Tribunal shall be competent to hear only the matters in controversy. It shall adopt its own procedures and may on its own initiative designate whatever experts it considers necessary. In any case, it shall give the parties the opportunity to make oral presentations.

(b) The Tribunal shall proceed ex aequo et bono, basing itself on the terms of this Contract, and shall issue an award even if either party should fail to appear or present its case.

(c) The award shall be in writing and shall be adopted with the concurrent vote of at least two members of the Tribunal. It shall be handed down within approximately sixty (60) days from the date on which the Referee is appointed, unless the Tribunal determines that, due to special and unforeseen circumstances, such period should be extended. The award shall be notified to the parties by means of a communication signed by at least two members of the Tribunal, and shall be complied with within thirty (30) days from the date of notification. The award shall be final and will not be subject to any appeal.

ARTICLE 9.05. **Costs**. The fees of each arbitrator shall be paid by the party which appointed him and the fees of the Referee shall be paid by both parties in equal proportion. Prior to the convening of the Tribunal, the parties shall agree on the remuneration of the other persons who, by mutual agreement, they deem should take part in the arbitration proceedings. If such agreement is not reached in a timely manner, the Tribunal itself shall determine the compensation which may be reasonable for such persons under the circumstances. Each party shall defray its own expenses in the arbitration proceedings, but the expenses of the Tribunal shall be borne equally by the parties. Any doubt regarding the division of costs or the manner in which they are to be paid shall be determined, without appeal, by the Tribunal.

ARTICLE 9.06. **Notification**. All notifications relative to the arbitration or to the award shall be made in the manner provided in this Contract. The parties waive any other form of notification.

Annex 496

"Climate Resilient Debt Clauses", *Government of the United Kingdom*, 22 June 2023

CLIMATE RESILIENT DEBT CLAUSES - NEW CLAUSES 6.3 AND 6.4 FOR INCLUSION IN UKEF'S DIRECT LENDING PRECEDENT

N.B. HYBRID OPTIONS ARE COVERED WITHIN THE FOOTNOTES

6.3 Request for Debt Deferral

(a) [The provisions of this Clause 6.3 and Clause 6.4 (*Deferred Payment Provisions*) apply only to Direct Loans. Any Deferred Request Loan arising under paragraph (a) of Clause 6.4 (*Deferred Payment Provisions*) shall be a Direct Loan.][1]

(b) Following the occurrence of any Deferral Event and subject to the Eligibility Conditions being satisfied, the Borrower may, at its own cost, in a single document substantially in the form set out in Part A of Schedule [7][2] [9][3] (*Deferral Provisions*) submit a request to the Lender to have certain payments deferred (a "**Deferral Request**") which:

(i) gives notice to the Lender of the occurrence of that Deferral Event setting out details thereof;

(ii) confirms the need for payment deferral in order to respond effectively to the Deferral Event;

(iii) provides the Lender with a request for the Deferred Payment Provisions to apply to one or more specified payments under this Agreement ("**Applicable Payments**"); and

(iv) confirms that, following deferral, the funds which would otherwise have been paid will instead be used for response to, and recovery from, the Deferral Event.

(c) Applicable Payments may include payments which would otherwise become due and payable under this Agreement pursuant to either or both of Clause 6.1 (*Repayment of Loans*) and Clause 8.2 (*Payment of Interest*) in the 12 month period following the Relevant Date.

(d) The Lender shall:

(i) confirm receipt of the Deferral Request within five (5) Business Days of receipt thereof; and

(ii) shall notify the Borrower and the Agent within a further twenty (20) Business Days whether or not the Deferral Request and the applicable Deferred Payment Provisions are accepted.

(e) The Lender may request further information in connection with any aspect of the Deferral Request (or in respect of any matter in any way related thereto) from the Borrower at any stage.

(f) The Direct Lender and the Borrower will (at the cost of the Borrower) promptly implement the terms of a Deferral Request which is agreed in accordance with paragraph 6.3(d) above [by executing the Notice of Deferred Payment Dates as described in paragraph (c) of Clause 6.4 (*Deferred Payment Provisions*) which shall be effective as from the date on which the Agent has confirmed that the conditions precedent set out therein have been satisfied].

[1] Clause to be inserted in hybrid transaction only

[2] Reference to be used in Direct Lending

[3] Reference to be used in Hybrid

(g) For the avoidance of doubt the Finance Parties confirm that none of the following, namely:

(i) the submission, acceptance, rejection and implementation of a Deferral Request; and

(ii) in circumstances where a Deferred Request Loan is accepted by the Lender pursuant to paragraph (c) of Clause 6.3 (Request for Debt Deferral), the deferral of the date on which any associated Applicable Payment would otherwise be due and payable under this Agreement,

constitute a Default or Event of Default.

(h) For the purposes of paragraph (c) of this Clause 6.3, "**Relevant Date**" means (x) the date on which the Deferral Request is submitted to the Lender, or (y) with the consent of the Lender, an earlier date which is on or after the date on which the applicable Deferral Event occurred, however, in those circumstances Applicable Payments may not include any payment overdue prior to the Deferral Event Date. Where a Deferral Request includes an Applicable Payment which is either overdue or may become overdue before the Borrower receives a response from the Lender in accordance with paragraph (d) of this Clause 6.3 above then the Borrower may also include a request for a waiver of any associated Default or Event of Default in respect thereof.

(i) The Borrower may only request one (1) Deferral Request in any twelve (12) month period and a maximum of two (2) Deferral Requests over the term of the Facility Agreement.

6.4 Deferred Payment Provisions

If a Deferral Request and the associated Deferred Payment Provisions in respect of the associated Applicable Payments are accepted by the Lender then the payment obligations of the Borrower in respect of each such Applicable Payment under Clause 6.1 (*Repayment of Loans*) in relation to a principal amount and under Clause 8.2 (*Payment of Interest*) in relation to an amount of interest shall be a deferred on the following basis:

(a) on the Consolidation Date, all Applicable Payments and all Interim Interest thereon shall be automatically capitalised and converted into a new loan (the "**Deferred Request Loan**") owed by the Borrower to the Lender under this Agreement;

(b) where the Original Due Date of an Applicable Payment is earlier than the Consolidation Date, interest shall accrue on such Applicable Payment as from its Original Due Date to the Consolidation Date at the rate per annum which is the appropriate [EUR/USD/GBP] CIRR in place at its Original Due Date, as published by the OECD and shall be calculated in accordance with Clause 25.3 (*Day Count Convention*);

(c) the Borrower shall repay each Deferred Request Loan in instalments over a five year period commencing on the date which falls 12 months after the Consolidation Date as specified by the Lender in a notice to the Borrower and the Finance Parties substantially in the form set out in Part B of Schedule [7][4] [9][5] (*Deferral Provisions*) (the "**Notice of Deferred Payment Dates**") delivered as part of [(or subsequent to)] the Lender's acceptance of the applicable Deferral Request pursuant to paragraph 6.3(d) of Clause 6.3 (*Request for Debt Deferral*);

(d) the Notice of Deferred Payment Dates shall set out each instalment and the date on which that instalment is required to be paid by the Borrower and each such date shall be both a Repayment

[4] Reference to be used in Direct Lending

[5] Reference to be used in Hybrid

Date and an Interest Payment Date under this Agreement in relation to the applicable Deferred Request Loan;

(e) the Borrower shall repay each instalment of a Deferred Request Loan on the respective Repayment Date specified in relation thereto in the associated Notice of Deferred Payment Dates;

(f) interest shall accrue on the outstanding amount for the time being of the Deferred Request Loan on and from its Consolidation Date at the rate per annum which is the appropriate [EUR/USD/GBP] CIRR in place at the Consolidation Date, as published by the OECD and shall be calculated in accordance with Clause 25.3 (*Day Count Convention*);

(g) the Borrower shall pay interest on the outstanding amount for the time being of the Deferred Request Loan on each Interest Payment Date falling after the Consolidation Date;

(h) Clause [8.8][6] [8.8(b)][7] (*Amalgamation of Loans*) shall not apply to Deferred Request Loans;

(i) where one or more Applicable Payments are overdue on the date on which the Lender sends the associated Notice of Deferred Payment Dates, all or any amounts otherwise payable under Clause 8.4 (*Default Interest*) shall be treated in such manner as the Lender shall specify in that notice; and

(j) save in respect of matters referred to in this Clause 6.4 and in Clause 6.3 (*Request for Debt Deferral*), each Deferred Request Loan shall be treated as a Loan for all purposes of this Agreement.

For these purposes:

"**Consolidation Date**" means, in relation to an accepted Deferral Request and the Applicable Payments associated therewith, the date which is the latest Original Due Date in respect of those Applicable Payments.

"**Deferral Even**t" means any climate incident, natural disaster, pandemic or epidemic which in the opinion of the Lender has, or could reasonably be expected to have, an adverse impact on the Borrower's ability to repay the Loan.

"Deferral Event Date" means, in relation to a Deferral Event, the date on which that Deferral Event occurred.

"**Deferred Payment Provisions**" means the provisions set out in this Clause 6.4.

"**Eligibility Conditions**" means [the Borrower is an eligible member country of the IMF (on the associated Deferral Event Date)], and the Borrower meets any one or more of the following conditions, namely:

(a) the Borrower is eligible for finance under the IMF's Poverty Reduction and Growth Trust;

(b) the Borrower is eligible for finance under the World Bank International Development Association window;

(c) the Borrower is classified as a Least Developed Country by the UN;

(d) the Borrower is classified as a Small Island Developing State by the UN; and

[6] Reference to be used in Direct Lending

[7] Reference to be used in Hybrid

(e) the Borrower and the Direct Lender have agreed in writing prior to the date of the Facility Agreement that the Deferred Payment Provisions may apply.

"**Interim Interest**" means the aggregate of all interest accrued in accordance with paragraph (b) of this Clause 6.4.

"**Original Due Date**" means, in relation to an Applicable Payment, the date on which that Applicable Payment would have become due and payable in accordance with Clause 6.1 (*Repayment of Loans*) or Clause 8.2 (*Payment of Interest*), as the case may be, if that Applicable Payment had not been the subject of a Deferral Request which was accepted by the Lender.

SCHEDULE [7][8] [9][9]

DEFERRAL PROVISIONS

PART A

DEFERRAL REQUEST

From: [Borrower]

To: [Lender]

CC: [Agent and Arranger]

Dated: [●]

Deferral Request No. [●]

1. We refer to the facility agreement dated [●] made between, inter alia, [Borrower] (the "Borrower"), the financial institutions listed therein as original lenders and [Agent] (the "Agent") as amended from time to time (the "Facility Agreement").

2. This is a "Deferral Request" as defined in the Facility Agreement.

3. Terms defined in the Facility Agreement have the same meaning in this Deferral Request unless given a different meaning in this Deferral Request.

4. We notify you of the occurrence of the following Deferral Event: [(insert relevant details thereof)].

5. We request that the following payments are deferred:

   (a) The principal amount of [ ] falling due for payment on [ ]

   (b) The amount of interest [being [ ]] falling due for payment on [ ]

…….[*include all amounts in respect of which deferral is requested - where any such amount cannot be precisely determined, e.g. because the interest rate may vary, please include as full a description as possible*]

These payments are [together] the "Applicable Payments" for the purposes of this Deferral Request.

6. Where any Applicable Amount is (or may become) overdue prior to your decision as to whether or not to accept this Deferral Request, we request a waiver of any associated Default or Event of Default in respect thereof.

7. This Deferral Request is irrevocable.

8. We represent and warrant that:

   (a) the Eligibility Conditions are satisfied because [(explain which of the conditions (a) to (e) in the definition of Eligibility Conditions is applicable)];

   (b) the need for the requested payment deferral is in order to respond effectively to this Deferral Event; and

[8] Reference to be used for Direct Lending

[9] Reference to be used for Hybrid

(c) following deferral, the funds which would otherwise have been paid under the Facility Agreement will instead be used for response to, and recovery from, this Deferral Event.

9. We undertake to provide any other further information requested by the Lender from time to time in connection with any aspect of this Deferral Request (or in any way related thereto) at any stage.

Yours faithfully

For and on behalf of [*Borrower*]

Signature:* .....

Name: .....

Position: .....

Date: .....

*Signature of Borrower's Signatory

PART B

NOTICE OF DEFERRED PAYMENT DATES

From: [Lender]

To: [Borrower]

CC: [Agent and Arranger]

Dated: [●]

1. We refer to the facility agreement dated [●] made between, inter alia, [Borrower] (the "Borrower"), the financial institutions listed therein as original lenders and [Agent] (the "Agent") as amended from time to time (the "Facility Agreement").

2. We also refer to Deferral Request No. [●] dated [●], which has been accepted.

3. Terms defined in the Facility Agreement have the same meaning herein unless given a different meaning in this notice.

4. The Applicable Payments referenced in Deferral Request No. [●] dated [●] and all Interim Interest thereon shall form a Deferred Request Loan on and from [●]. That date shall be the "Consolidation Date" for the purposes of Deferral Request No. [●] dated [●].

5. This Deferred Request Loan shall be repaid in the following instalments and, in relation to each such instalment, the date for repayment is specified alongside that instalment below:

	AMOUNT OF INSTALMENT	REPAYMENT DATE
(a)	[specify amount of applicable instalment]	[insert date which is 12 months after the Consolidation Date]
(b)	[specify amount of applicable instalment]	[insert date]
(c)	[specify amount of applicable instalment]	[insert date]
(d)	[specify amount of applicable instalment]	[insert date]
(e)	[specify amount of applicable instalment]	[insert date]

Each such Repayment Date is also an Interest Payment Date in respect of this Deferred Request Loan.

6. [with reference to numbered paragraph 6 of your Deferral Request No. [●] dated [●], as one or more Applicable Payments were (or became) overdue prior to our decision to accept your Deferral Request No. [●] dated [●], we confirm that we will instruct the Agent to waive any associated Default or Event of Default in respect thereof and that no amounts will be payable under Clause 8.4 (Default Interest) in respect of any such overdue Applicable Payment. This waiver is given only in this specific instance and does not extend to any other rights or remedies we may have under the Facility Agreement.]

7. This notice is a Notice of Deferred Payment Dates and will become effective on the date on which we confirm in writing to you [and the Agent] that we have received a legal opinion (in form and substance satisfactory to us) from [local counsel] confirming that this Deferred Request Loan is a legal, valid, binding and enforceable obligation of [the Borrower].

Yours faithfully

For and on behalf of the [Lender]

Signature: .....

Name: .....

Position: .....

Date: .....

Annex 497

"PM's National Statement at COP28: December 01 2023", *GOV.UK*, 1 December 2023

Register to vote (/register-to-vote) Register by 18 June to vote in the General Election on 4 July.

Speech

PM's National Statement at COP28: December 01 2023

Prime Minister Rishi Sunak's National Statement at COP28.

From: **Prime Minister's Office, 10 Downing Street (/government/organisations/prime-ministers-office-10-downing-street)** and **The Rt Hon Rishi Sunak (/government/people/rishi-sunak)**

Published 1 December 2023

Location: **Dubai**
Delivered on: **1 December 2023 (Transcript of the speech, exactly as it was delivered)**

As we conclude the first Global Stocktake, we must be brutally honest.

Although we've made great progress together…

…the world is just not moving fast enough.

Climate science shows we're off track.

And climate politics is close to breaking point…

…because the gap between pledges and delivery is undermining credibility.

While we make new commitments here, major emitters must dramatically accelerate delivery of what they've already promised.

We all need to do more.

And we must address the disconnect between lofty rhetoric on stages like this and the reality of people's lives around the world.

The way to do that is by delivering a truly just transition.

Let me be clear, the UK is totally committed to Net Zero, the Paris Agreement, and to keeping 1.5 alive.

That's why we've decarbonised faster than any other major economy.

Our 2030 target means the deepest cuts of any major emitter, and we're determined to deliver.

But instead of putting more pressure on working people, we're choosing a pragmatic new approach.

We're ramping up renewables and embracing the opportunities of technology and green industry…

…because we've shown you can cut emissions while growing the economy and creating jobs.

Those facing the worst impacts of climate change are desperate for the world to do more.

So we're also working to deliver a just transition globally.

And that means more support for those in need.

The UK is already one of the largest global climate donors – and we're tripling our adaptation finance.

I've announced a further £1.6 billion for the Green Climate Fund – the UK's biggest single international climate commitment.

And today, I'm going further with an additional £1.6 billion of support…

…for clean energy and innovation…

…and to deliver on the historic Glasgow forests deal, because we can't get to Net Zero without nature.

This also includes up to £60 million for Loss and Damage… £40 million of which is for the new fund.

To succeed, the fund must be open to all sources of support.

And because the UK is the world-leading green finance centre…

…we're also helping unlock trillions in private finance to meet this need – and keep 1.5 degrees within reach.

I believe we can deliver here in Dubai – but we've got to work together.

The debate is too divided…

…developed versus developing… ambition on mitigation versus finance for transition and adaptation.

The truth is simple – we need both.

In place of division, we need ambitious, collective action – like we promised in Paris and Glasgow.

That's how we'll get back on track…

By bringing everyone with us…

…because a truly just transition leaves no one behind.

Thank you.

Published 1 December 2023

Explore the topic

[Climate change and energy (/environment/climate-change-energy)](/environment/climate-change-energy)

[International (/international)](/international)

World locations

[United Arab Emirates (/world/united-arab-emirates/news)](/world/united-arab-emirates/news)

OGL

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Annex 498

Deed of Guarantee between the Government of Barbados, acting through the Ministry of Finance, Economic Affairs and Investment and African Export-Import Bank, 13 April 2024

Dated APRIL 13, **2024**

The Government of Barbados, acting through the Ministry of Finance, Economic Affairs and Investment

as Guarantor

and

African Export-Import Bank

as Lender

DEED OF GUARANTEE

relating to obligations under a USD 25,000,000 term loan facility agreement between Kensington Oval Management Inc and the African Export-Import Bank

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Clause **Page**

THIS DEED OF GUARANTEE is made on APRIL 13, 2024.

PARTIES

(1) **THE GOVERNMENT OF BARBADOS, ACTING THROUGH THE MINISTRY OF FINANCE, ECONOMIC AFFAIRS AND INVESTMENT** as guarantor (the "**Guarantor**"); and

(2) **AFRICAN EXPORT-IMPORT BANK**, a multilateral financial institution created pursuant to the Agreement for the Establishment of the African Export-Import Bank, whose headquarters is at 72 (B) El-Maahad El-Eshteraky Street, Heliopolis, Cairo 11341, Egypt, as the lender under the Facility Agreement (as defined below) (the "**Lender**").

BACKGROUND

(A) By the Facility Agreement (as defined below), the Lender has agreed to make available to the Borrower (as defined below) a loan of up to USD 25,000,000.

(B) The execution and delivery to the Lender of this Guarantee is one of the conditions subsequent to the Facility Agreement.

(C) It is intended by the Parties that this document will take effect as a deed despite the fact that a Party may only execute this document under hand.

OPERATIVE PROVISIONS

1 DEFINITIONS AND INTERPRETATION

1.1 Definitions

In this Guarantee:

"**Annual Budget**" means the annual budget of Barbados which is approved by the Parliament of Barbados each year.

"**Authorisation**" means an authorisation, consent, approval, resolution, licence, exemption, filing, notarisation or registration.

"**Borrower**" means Kensington Oval Management Inc., a company registered and incorporated under the Companies Act, Cap. 308 of the Laws of Barbados as company number 25359, having its registered office at Barbados Tourism Investment Inc., Old Town Hall Building, Cheapside, Bridgetown, Barbados.

"**Business Day**" means a day (other than a Saturday or Sunday) on which banks are open for general business in:

(a) London, Cairo and Bridgetown (Barbados); and

(b) in relation to any date for the payment or purchase of Dollars, New York.

"**Facility Agreement**" means the USD 25,000,000 term loan facility agreement dated on or around the date of this Guarantee and entered into between the Borrower and the Lender.

"**Finance Documents**" has the meaning given to that term in the Facility Agreement.

"**Foreign Currency**" means any currency other than the lawful currency of Barbados.

"**IMF**" means the International Monetary Fund.

"**Partnership Agreement**" means the Agreement for the Establishment of a Partnership between Member States of the Caribbean Community and the African Export-Import Bank signed in Bridgetown, Barbados, on the 1 September 2022.

"**Party**" means a party to this Guarantee.

"**Restricted Party**" means a person that is:

(a) listed on, or owned or controlled by a person listed on, or acting on behalf of a person listed on, any Sanctions List;

(b) located in, incorporated under the laws of, or owned or (directly or indirectly) controlled by, or acting on behalf of, a person located in or organised under the laws of a country or territory that is the target of country-wide or territory-wide Sanctions; or

(c) otherwise a target of Sanctions ("target of Sanctions" signifying a person with whom a US person or other national of a Sanctions Authority would be prohibited or restricted by law from engaging in trade, business or other activities).

"**Sanctions**" means any economic sanctions laws, regulations, embargoes or restrictive measures administered, enacted or enforced by:

(a) the United States government;

(b) the United Nations;

(c) the United Kingdom; or

(d) the respective governmental institutions and agencies of any of the foregoing, including without limitation, the Office of Foreign Assets Control of the US Department of Treasury ("**OFAC**"), the United States Department of State and His Majesty's Treasury, (together, the "**Sanctions Authorities**").

"**Sanctions List**" means the "Specially Designated Nationals and Blocked Persons" list issued by OFAC, the "Consolidated List of Financial Sanctions Targets" and the "Investment Ban List" maintained by His Majesty's Treasury, or any similar list maintained by, or public announcement of Sanctions designation made by, any of the Sanctions Authorities.

"**Security**" means a mortgage, charge, pledge, lien or other security interest securing any obligation of any person or any other agreement or arrangement having a similar effect.

"**Tax**" means any tax, levy, impost, duty or other charge or withholding of a similar nature (including any penalty or interest payable in connection with any failure to pay or any delay in paying any of the same).

"**Treaty Obligations**" mean any obligation of the Guarantor under the articles of Agreement with the IMF and/ or the World Bank.

1.2 Construction

(a) Unless a contrary indication appears any reference in this Guarantee to:

(i) the "**Lender**", the "**Guarantor**", any "**Party**", or any other person shall be construed so as to include its successors in title, permitted assigns and permitted transferees to, or of, its rights and/or obligations under the Finance Documents;

(ii) an "**agency**" (or "**agencies**") of a state shall be construed as a reference to any ministry, department, agency or authority of central or local government (whether autonomous or not);

(iii) "**assets**" includes present and future properties, revenues and rights of every description;

(iv) "**this Guarantee**" or any "**Finance Document**" is a reference to this Guarantee or other "**Finance Document**" as it may have been amended, supplemented, replaced or novated from time to time and includes a reference to any document which amends, supplements, replaces, novates or is entered into, made or given pursuant to or in accordance with any terms of this Guarantee or, as the case may be, the relevant deed, agreement or instrument;

(v) "**include**" or "**including**" are to be construed without limitation;

(vi) "**guarantee**" means any guarantee, letter of credit, bond, indemnity or similar assurance against loss, or any obligation, direct or indirect, actual or contingent, to purchase or assume any indebtedness of any person or to make an investment in or loan to any person or to purchase assets of any person where, in each case, such obligation is assumed in order to maintain or assist the ability of such person to meet its indebtedness;

(vii) "**indebtedness**" includes any obligation (whether incurred as principal or as surety) for the payment or repayment of money, whether present or future, actual or contingent;

(viii) a "**person**" includes any individual, firm, company, corporation, government, state or agency of a state or any association, trust, joint venture, consortium, partnership or other entity (whether or not having separate legal personality);

(ix) a "**regulation**" includes any regulation, rule, official directive, request or guideline (whether or not having the force of law) of any governmental, intergovernmental or supranational body, agency, department or of any regulatory, self-regulatory or other authority or organisation;

(x) a provision of law is a reference to that provision as amended or re-enacted from time to time;

(xi) references to any Clause or Schedule shall be to a Clause or Schedule contained in this Guarantee; and

(xii) a time of day is a reference to London time.

(b) Clause and Schedule headings are for ease of reference only.

(c) Words importing the singular shall include the plural and vice versa.

1.3 Relationship with the Facility Agreement

The Guarantor acknowledges the terms of the Facility Agreement.

1.4 Third party rights

(a) Unless expressly provided to the contrary in a Finance Document, a person who is not a Party has no right under the United Kingdom Contracts (Rights of Third Parties) Act 1999 to enforce or to enjoy the benefit of any term of this Guarantee.

(b) Notwithstanding any term of any Finance Document, the consent of any person who is not a Party is not required to rescind or vary this Guarantee at any time.

2 GUARANTEE

2.1 Guarantee and indemnity

The Guarantor irrevocably and unconditionally:

(a) guarantees to the Lender punctual performance by the Borrower of all the Borrower's payment obligations to the Lender under or in connection with the Finance Documents;

(b) undertakes with the Lender that whenever the Borrower does not pay any amount to the Lender when due under or in connection with any Finance Document, it shall immediately on demand pay that amount as if it were the principal obligor and such payment obligation shall become a sovereign debt; and

(c) agrees with the Lender that if any obligation guaranteed by it is or becomes unenforceable, invalid or illegal, it will, as an independent and primary obligation, indemnify the Lender immediately on demand against any cost, loss or liability it incurs as a result of the Borrower not paying any amount which would, but for such unenforceability, invalidity or illegality, have been payable by it under any Finance Document on the date when it would have been due. The amount payable by the Guarantor under this indemnity will not exceed the amount it would have had to pay under this Guarantee if the amount claimed had been recoverable on the basis of a guarantee.

2.2 Continuing guarantee

This guarantee is a continuing guarantee and will extend to the ultimate balance of all sums payable by the Borrower under the Finance Documents, regardless of any intermediate payment or discharge in whole or in part.

3 PROTECTIONS FOR THE LENDER

3.1 Reinstatement

If any discharge, release or arrangement (whether in respect of the obligations of the Borrower or any security for those obligations or otherwise) is made by the Lender in whole or in part on the basis of any payment, security or other disposition which is avoided or must be restored in insolvency, liquidation, administration or otherwise, without limitation, then the liability of the

Guarantor under this Guarantee will continue or be reinstated as if the discharge, release or arrangement had not occurred.

3.2 Waiver of defences

The obligations of the Guarantor under this Guarantee will not be affected by any act, omission, matter or thing which, but for this Clause 3.2 (*Waiver of defences*), would reduce, release or prejudice any of its obligations under this Guarantee (without limitation) including:

(a) any time, waiver or consent granted to, or composition with, the Borrower, the Guarantor or any other person;

(b) the release of the Borrower, the Guarantor or any other person under the terms of any composition or arrangement with any creditor of any person;

(c) the taking, variation, compromise, exchange, renewal or release of, or refusal or neglect to perfect, take up or enforce, any rights against, or security over assets of, the Borrower, the Guarantor or any other person or any non-presentation or non-observance of any formality or other requirement in respect of any instrument or any failure to realise the full value of any security;

(d) any incapacity or lack of power, authority or legal personality of or dissolution or change in the members or status of the Borrower, the Guarantor or any other person;

(e) any amendment, novation, supplement, extension, restatement (however fundamental and whether or not more onerous) or replacement of any Finance Document or any other document or security including, without limitation, any change in the purpose of, any extension of or any increase in any facility or the addition of any new facility under any Finance Document or other document or security;

(f) any unenforceability, illegality or invalidity of any obligation of any person under any Finance Document or any other document or security; or

(g) any insolvency or similar proceedings.

3.3 Immediate recourse

The Guarantor waives any right it may have of first requiring the Lender (or any trustee or agent on its behalf) to proceed against or enforce any other rights or security or claim payment from any person before claiming from it under this Guarantee. This waiver applies irrespective of any law or any provision of a Finance Document to the contrary.

3.4 Appropriations

Until all amounts which may be or become payable by the Borrower under or in connection with the Finance Documents have been irrevocably paid in full, the Lender (or any trustee or agent on its behalf) may:

(a) refrain from applying or enforcing any other moneys, security or rights held or received by the Lender (or any trustee or agent on its behalf) in respect of those amounts, or apply and enforce the same in such manner and order as it sees fit (whether against those amounts or otherwise) and the Guarantor shall not be entitled to the benefit of the same; and

(b) hold in an interest-bearing suspense account any moneys received from the Guarantor or on account of the Guarantor's liability under this Guarantee.

3.5 Deferral of rights

(a) Until all amounts which may be or become payable by the Borrower under or in connection with the Finance Documents have been irrevocably paid in full and unless the Lender otherwise directs, the Guarantor will not exercise any rights which it may have by reason of performance by it of its obligations under this Guarantee or by reason of any amount being payable, or liability arising, under this Guarantee:

(i) to be indemnified or reimbursed by the Borrower;

(ii) to claim any contribution from any other guarantor of the Borrower's or the Guarantor's obligations under the Finance Documents;

(iii) to take the benefit (in whole or in part and whether by way of subrogation or otherwise) of any rights of the Lender under the Finance Documents or of any other guarantee or security taken pursuant to, or in connection with, the Finance Documents by the Lender;

(iv) to bring legal or other proceedings for an order requiring the Borrower to make any payment, or perform any obligation, in respect of which that Guarantor has given a guarantee, undertaking or indemnity under this Guarantee;

(v) to exercise any right of set-off against the Borrower; and/or

(vi) to claim or prove as a creditor of the Borrower in competition with the Lender.

(b) If the Guarantor receives any benefit, payment or distribution in relation to such rights it shall hold that benefit, payment or distribution to the extent necessary to enable all amounts which may be or become payable to the Lender by the Borrower or the Guarantor under or in connection with the Finance Documents to be repaid in full on trust for the Lender and shall promptly pay or transfer the same to the Lender or as the Lender may direct, for application in accordance with the terms of the Facility Agreement.

3.6 Additional security

This Guarantee is in addition to and is not in substitution for or in any way prejudiced by any other guarantee or security now or subsequently held by the Lender.

4 ENFORCEMENT AND PRESERVATION COSTS

The Guarantor shall, on demand, pay to the Lender the amount of all reasonable costs and expenses (including reasonable legal fees) incurred by the Lender in connection with the enforcement of, or the preservation of any rights under, this Guarantee and with any proceedings instituted by or against the Lender as a result of enforcing those rights.

5 PAYMENTS

5.1 Payments free of deduction

All payments to be made to the Lender under this Guarantee shall be made free and clear of and without deduction for or on account of Tax unless the Guarantor is required to make such payment subject to the deduction or withholding of Tax, in which case the sum payable by the relevant Guarantor shall be increased to the extent necessary to ensure that, after the making of such deduction or withholding, the person on account of whose liability to Tax such deduction or withholding has been made, receives and retains (free from any liability in respect of any such deduction or withholding) a net sum equal to the sum which it would have received and so retained had no such deduction or withholding been made or required to be made.

5.2 No set-off by Guarantor

All payments to be made by the Guarantor under this Guarantee shall be calculated and be made in full without (and free and clear of any deduction for) set-off or counterclaim.

5.3 Business Days

Any payment under this Guarantee which is due to be made on a day that is not a Business Day shall be made on the next Business Day in the same calendar month (if there is one) or the preceding Business Day (if there is not).

5.4 Currency of payments

(a) Subject to paragraphs (b) and (c) below, any amount payable under this Guarantee is payable in United States Dollars.

(b) Each payment in respect of costs, expenses or Taxes shall be made in the currency in which the costs, expenses or Taxes are incurred.

(c) Any amount expressed to be payable in a currency other than United States Dollars shall be paid in that other currency.

(d) If, on conversion into that currency, the amount of the payment falls short of the amount of the obligation concerned, the Lender will have a separate cause of action against the Guarantor for the shortfall.

6 INTEREST

If the Guarantor fails to pay any sum payable by it pursuant to this Guarantee on its due date, interest shall accrue on the overdue amount from the due date until the date of actual payment (both before and after judgment) calculated on a daily basis at the rate determined in accordance with clause 9.3 (*Default interest*) of the Facility Agreement; provided that under no circumstances will the Guarantor be liable to pay interest under both this Clause 6 and clause 9.3 (*Default interest*) of the Facility Agreement in respect of the same amount.

7 REPRESENTATIONS

7.1 General

(a) The Guarantor makes the representations and warranties set out in this Clause 7 (*Representations*) to the Lender on the date of this Guarantee.

(b) Each of the representations and warranties set out in this Clause 7 will be correct and complied with in all respects at all times while any obligations remain outstanding under this Guarantee as if repeated then by reference to the then existing circumstances.

7.2 Status

(a) It is a sovereign entity validly existing under the laws of Barbados and is not subject to any insolvency procedure. The Ministry of Finance, Economic Affairs and Investment is legally competent to enter into this Guarantee on behalf of the Government of Barbados.

(b) It has the power to sue and be sued in its own name, including before any court and/or arbitration tribunal which may be competent pursuant to the Finance Documents.

(c) It has the power to own its own assets and to enter into and to perform its obligations under the Finance Documents in its own name and on behalf of the Borrower.

7.3 Binding obligations

(a) The obligations expressed to be assumed by it under this Guarantee are, subject to any general principles of law limiting its obligations which are specifically referred to in any legal opinion delivered in relation to this Guarantee, legal, valid, binding and enforceable obligations.

(b) Each Finance Document is, in proper legal form under the laws of Barbados.

7.4 Non-conflict with other obligations

The entry into and performance by it of, and the transactions contemplated by, this Guarantee do not and will not conflict with:

(a) any limit or restriction applicable to it (whether contained in the constitution of Barbados or the relevant Annual Budget or otherwise);

(b) any law or regulation applicable to it; or

(c) agreement, mortgage, bond, judgment, arbitral award or other instrument, international agreement or treaty obligation, including with the IMF or the World Bank, binding upon it or any agency of it or constitute a default or termination event (however described) under any such agreement, mortgage, bond, judgment, arbitral award or other instrument, international agreement or treaty obligation.

7.5 Power and authority

It has the power to enter into, perform and deliver, and has taken all necessary action to authorise its entry into, performance and delivery of, this Guarantee and the obligations and liabilities created under this Guarantee.

7.6 Validity and admissibility in evidence

(a) All Authorisations required or desirable:

(i) to enable it lawfully to enter into, exercise its rights and comply with its obligations in this Guarantee;

(ii) to ensure that the obligations expressed to be assumed by the Guarantor under this Guarantee are legal valid, binding and enforceable; and

(iii) to make this Guarantee admissible in evidence in Barbados, have been obtained or effected and are in full force and effect.

(b) All Authorisations which are required or which are otherwise necessary for the conduct of its business, trade and ordinary activities have been obtained or effected and are in full force and effect and are not likely to be revoked or materially adversely amended and no notice of an intention to terminate any such Authorisation has been received by it.

7.7 Governing law and enforcement

(a) The choice of English law to govern this Guarantee will be recognised and enforced in Barbados.

(b) Any judgment obtained in relation to this Guarantee in England and Wales will be recognised and enforced in Barbados.

7.8 No filing or stamp taxes

Under the law of Barbados, it is not necessary that this Guarantee be filed, recorded or enrolled with any court or other authority in that jurisdiction or that any stamp, registration or similar tax be paid on or in relation to this Guarantee or the transactions contemplated by this Guarantee.

7.9 Deduction of Tax

It is not required to make any deduction for or on account of Tax from any payment it may make under this Guarantee.

7.10 Foreign currency

(a) It is legally and beneficially entitled to all Foreign Currency owed to or held by it.

(b) It is legally entitled to make payments in Foreign Currency under the terms of this Guarantee.

7.11 Commercial acts

Its execution of this Guarantee constitutes, and its exercise of its rights and performance of its obligations under this Guarantee will constitute, commercial acts done and performed for commercial purposes.

7.12 Membership of organisations

It is a member and eligible to use the resources of the IMF and the World Bank and is able to draw or make use of funds available to it under any IMF funding program and no such program has been cancelled or suspended.

7.13 Public Procurement

No public procurement rules in Barbados apply to its entry into and performance by it of its obligations under the Finance Documents or otherwise in relation to the Facility.

7.14 Treaty Obligations

(a) The Treaty Obligations of the Guarantor do not contain any provisions which, expressly or implicitly, limit the ability of the Guarantor to enter into, deliver or perform any of its obligations under this Guarantee.

(b) No negative sanctions are or could be made against the Guarantor under the Treaty Obligations as a result of the Guarantor entering into, delivering or performing any of its obligations under this Guarantee.

7.15 Sanctions

Neither the Guarantor nor any of its agencies, nor any of their respective directors, officers or employees nor, to the knowledge of the Guarantor, any persons acting on any of their behalf:

(i) is a Restricted Party; or

(ii) has received notice of, or is aware of, any claim, action, suit, proceeding or investigation against it with respect to Sanctions by any Sanctions Authority.

7.16 Anti-corruption law

The Guarantor has: (i) conducted its operations in compliance with applicable anti-bribery, anti-corruption and anti-money laundering laws, regulations and rules in all applicable jurisdictions; and (ii) maintained policies and procedures designed to promote and achieve compliance with such laws.

7.17 No adverse consequences

(a) It is not necessary under the laws of Barbados:

(i) in order to enable the Lender to enforce its rights under this Guarantee; or

(ii) by reason of the execution of this Guarantee or the performance by it of its obligations under this Guarantee, that the Lender should be licensed, qualified or otherwise entitled to carry on business in Barbados or that it should appoint an agent, representative or attorney in Barbados for any purpose whatsoever.

(b) The Lender is not nor will be deemed to be resident, domiciled or carrying on business in Barbados by reason only of the execution, performance and/or enforcement of this Guarantee.

(c) It is not necessary for the Lender to obtain the consent or approval of any authority or agency in Barbados in order to enter into or effect the transactions contemplated by this Guarantee.

(d) It is not necessary for the Lender to establish a place of business or be licensed, qualified or otherwise entitled to carry on business in Barbados or to meet any other criteria applicable under the laws of Barbados to enter into or effect the transactions contemplated by this Guarantee.

7.18 CBB Payment Instruction

(a) The CBB Payment Instruction and each Promissory Note is in full force and effect and has not been rescinded, rejected, cancelled or terminated.

(b) The Guarantor is not aware (having made due and careful enquiry) of any circumstances which are likely to lead to the CBB Payment Instruction or any Promissory Note not remaining in full force and effect.

7.19 Repetition

Each of the representations set out in this clause 7 are deemed to be made by the Guarantor by reference to the facts and circumstances then existing on each day on which the representations set out in clause 17.23 (*Repetition*) of the Facility Agreement are deemed to be made.

8 GENERAL UNDERTAKINGS

The undertakings in this Clause 8 shall remain in force from the date of this Guarantee for so long as any amount is outstanding under the Finance Documents.

8.1 Authorisations

The Guarantor shall promptly:

(a) obtain, comply with and do all that is necessary to maintain in full force and effect; and

(b) if requested to do so, supply certified copies to the Lender of,

any Authorisation required under any law or regulation of Barbados to:

(i) enable it to perform its obligations under this Guarantee; and

(ii) ensure the legality, validity, enforceability or admissibility in evidence in Barbados of this Guarantee.

8.2 Compliance with laws

The Guarantor shall comply in all respects with all laws to which it may be subject.

8.3 Anti-corruption law

The Borrower shall:

(i) conduct its operations in compliance with applicable anti-corruption laws; and

(ii) maintain policies and procedures designed to promote and achieve compliance with such laws.

8.4 Pari passu ranking

The Guarantor shall ensure that at all times any unsecured and unsubordinated claims of the Lender against it under this Guarantee rank at least *pari passu* with the claims of all its other unsecured and unsubordinated creditors except those creditors whose claims are mandatorily preferred by law applying to public bodies in Barbados.

8.5 CBB Payment Instruction and Promissory Notes

(a) The Guarantor shall deliver to the Lender Promissory Notes at the times, in the amounts in otherwise in the manner set out in clause 4 (*Promissory Notes*) of the Facility Agreement.

(b) The Guarantor shall promptly do all that is necessary to maintain in full force and effect the CBB Payment Instruction and each Promissory Note.

(c) The Guarantor shall not, without the prior written consent of the Lender:

(i) agree to or acquiesce in any assignment, variation, amendment of the CBB Payment Instruction or any Promissory Note; nor

(ii) terminate, repudiate, cancel or rescind the whole or any part of the CBB Payment Instruction or any Promissory Note.

8.6 Partnership Agreement

The Guarantor recognises the Facility as a multilateral development bank facility, which shall not be subject to any moratorium, controls or other restrictions in line with the Partnership Agreement. The Guarantor shall, at all times, comply with the provisions of the Partnership Agreement.

9 NOT USED

10 SET OFF

The Lender may set off any matured obligation due from the Guarantor under this Guarantee (to the extent beneficially owed to the Lender) against any matured obligation owed by the Lender to that Guarantor, regardless of the place of payment, booking branch or currency of either obligation. If the obligations are in different currencies, the Lender concerned may convert either obligation at a market rate of exchange in its usual course of business for the purpose of the set-off.

11 NO LENDER LIABILITY

Neither the Lender nor any of its officers shall be liable or responsible in any way to the Guarantor for any loss or liability of any kind arising from any act or omission by it of any kind in relation to this Guarantee, except to the extent caused by its gross negligence or wilful misconduct.

12 SUPPLEMENTAL

12.1 Accounts

In any litigation or arbitration proceedings arising out of or in connection with this Guarantee, the entries made in the accounts maintained by the Lender are *prima facie* evidence of the matters to which they relate.

12.2 Certificates and determinations

Any certification or determination by the Lender of a rate or amount under this Guarantee is, in the absence of manifest error, conclusive evidence of the matters to which it relates.

12.3 Partial invalidity

If, at any time, any provision of this Guarantee is or becomes illegal, invalid or unenforceable in any respect under any law of any jurisdiction, neither the legality, validity or enforceability of the remaining provisions of this Guarantee or any other Finance Document under the law of that jurisdiction nor the legality, validity or enforceability of such provision under the law of any other jurisdiction will in any way be affected or impaired.

12.4 Remedies and waivers

No failure to exercise, nor any delay in exercising, on the part of the Lender, any right or remedy under this Guarantee shall operate as a waiver of any such right or remedy or constitute an election to affirm this Guarantee. No election to affirm this Guarantee on the part of the Lender shall be effective unless it is in writing. No single or partial exercise of any right or remedy shall prevent any further or other exercise or the exercise of any other right or remedy. The rights and remedies provided in this Guarantee are cumulative and not exclusive of any rights or remedies provided by law.

12.5 Guarantor acknowledgement of the Facility Agreement

The Guarantor is fully familiar with, and acknowledges all of the provisions of, the Facility Agreement and the other Finance Documents to which it is not a party.

13 CHANGES TO THE PARTIES

13.1 Guarantor

The Guarantor may not assign any of its rights or transfer any of its rights or obligations under this Guarantee.

13.2 Lender

The Lender may:

(a) assign any of its rights; or

(b) transfer any of its rights or obligations to a successor lender,

under this Guarantee in accordance with and subject to the provisions of the Facility Agreement.

14 NATURAL DISASTER CLAUSE

14.1 This clause applies following the occurrence of any Earthquake Event, Tropical Cyclone Event or Covered Area Rainfall Event which is eligible for the coverage provided for under the CCRIF Policies and in respect of which a Policy Payment has been made to the Guarantor under a CCRIF Policy whereupon, subject to Clause 14.2 below, the Guarantor may, by written notice to the Lender, elect to defer payment of any Deferred Payment Amount on a Deferral Date for a period of two years commencing on that Deferral Date (such period being a "**Deferral Period**"). Any such Deferred Payment Amount shall remain outstanding and shall become due and payable at the end of the Deferral Period.

14.2 The Guarantor shall only be entitled to defer a Deferred Payment Amount following the occurrence of an Event pursuant to Clause 14.1 above if all of the following conditions are satisfied to the Lender's satisfaction on the relevant Deferral Date:

(a) each CCRIF Policy is in full force and effect and CCRIF has issued a written report confirming that the relevant Event is an Insured Event in respect of which a Policy Payment has been made to the Guarantor pursuant to the relevant CCRIF Policy;

(b) since the 22nd day of April, 2021, neither of the Coverage Limit or the Exhaustion Point applicable to earthquakes, tropical cyclone or excess rainfall has been reduced under the relevant CCRIF Policy, unless it has been reduced by CCRIF and CCRIF has declined a request submitted by the Guarantor to CCRIF to maintain such Coverage Limit or Exhaustion Point under the relevant CCRIF Policy, as the case may be;

(c) the Modelled Loss, in the case of an Earthquake Event or a Tropical Cyclone Event, or the Rainfall Index Loss, in the case of a Covered Area Rainfall Event, to Barbados from the Event is greater than US$5,000,000;

(d) the Grace Period has expired; and

(e) no Default or Event of Default has occurred and is continuing.

14.3 Upon electing to defer the Deferred Payment Amount, the Guarantor shall, at its own expense, provide notice thereof (a "**Deferral Request**") to the Lender, describing in reasonable detail the particulars of the Event giving rise to the right to make such Deferral Request.

14.4 For purposes of this clause:

Each of the terms "**Earthquake Event**", "**Tropical Cyclone Event**", "**Covered Area Rainfall Event**", "**Coverage Limit**", "**Exhaustion Point**", "**Insured Event**", "**Policy Payment**" and "**Rainfall Index Loss**" shall have the meanings given to those terms in the relevant CCRIF Policy;

"**CCRIF**" means CCRIF SPC (formerly, the Caribbean Catastrophe Risk Insurance Facility), or any successor thereof, with whom the Government of Barbados has entered into the CCRIF Policies;

"**CCRIF Policies**" means:

(a) the Parametric Insurance Contract dated 1st June, 2023 which the Government of Barbados has entered into with CCRIF to insure against risks of earthquake and tropical cyclone, including any documents incorporated by reference therein and any attachments, annexes, appendices or supplements thereto (including but not limited to the applicable coverage summary and

associated loss curve data spreadsheet), as such CCRIF Policy may be amended or supplemented from time to time; and

(b) the Parametric Insurance Contract dated 1st June, 2023 which the Government of Barbados has entered into with CCRIF to insure against risks of excess rainfall, including any documents incorporated by reference therein and any attachments, annexes, appendices or supplements thereto (including but not limited to the applicable coverage summary and associated loss curve data spreadsheet), as such CCRIF Policy may be amended or supplemented from time to time;

"**Deferral Request**" has the meaning given to that term in Clause 14.3 above;

"**Deferral Date**" means, in relation to any Deferral Request, the next Repayment Date to occur under the Facility Agreement immediately following the date of submission of that Deferral Request;

"**Deferred Payment Amount**" means, on any Deferral Request, any amount which is then due and payable, or becomes due and payable during the Deferral Period relating to that Deferral Request, by the Guarantor to the Lender under the terms of the Guarantee;

"**Event**" means an Earthquake Event, a Tropical Cyclone Event or a Covered Area Rainfall Event;

"**Modelled Loss**" has the meaning given to that term in each CCRIF Policy, in each case calculated as provided for under the relevant CCRIF Policy as in effect on the Closing Date, and using the relevant Return Period (years) applicable to the Event. When calculating the Reference Modelled Loss, the Return Period (years) applicable to the Event, if not divisible by 5, shall be rounded down to the nearest number that is divisible by 5; that if the Modelled Loss from an Event is more than 10.0% higher than the Reference Modelled Loss, "Modelled Loss" for purposes of paragraph (c) of Clause 14.2 above and the definition of "Deferral Date" in this clause will be the Reference Modelled Loss;

"**Reference Modelled Loss**" means the Modelled Loss in respect of an Event; and

"**Return Period**" in relation to years, means the return period applicable to the Event as that term is used in the model and formulae detailed in each CCRIF Policy.

15 NOTICES

15.1 Communications in writing

Any communication to be made under or in connection with this Guarantee shall be made in writing and, unless otherwise stated, may be made email or letter.

15.2 Addresses

The address (and the department or officer, if any, for whose attention the communication is to be made) of each Party for any communication or document to be made or delivered under or in connection with this Guarantee is:

(a) Lender

Address: 72 (B) El-Maahad El-Eshteraky Street, Heliopolis, Cairo 11341, Egypt

Attention: Director (Banking Operations)

Email: FrancoandNorth@afreximbank.com

(b) Guarantor

Address: Government Headquarters, Bay Street. St. Michael, Barbados.

Attention: Permanent Secretary, Finance

Email: barbadosloans@barbados.gov.bb

or any substitute address or email or department or officer as a Party may notify to the Lender (or the Lender may notify to the other Parties, if a change is made by the Lender) by not less than five (5) Business Days' notice.

15.3 Delivery

(a) Any communication or document made or delivered by one person to another under or in connection with this Guarantee will only be effective:

(i) if by way of email, when received in legible form; or

(ii) if by way of letter, when it has been delivered by hand left at the relevant address or five (5) Business Days after being deposited with an express international courier service in the post postage prepaid in an envelope addressed to the Party at the relevant address,

and, if a particular department or officer is specified as part of its address details provided under Clause 15.2 (*Addresses*), if addressed to that department or officer.

(b) Any communication or document to be made or delivered to the Lender will be effective only when actually received by the Lender and then only if it is expressly marked for the attention of the department or officer identified in Clause 15.2 (*Addresses*).

(c) Any communication or document which becomes effective, in accordance with paragraphs (a) and (b) above, on a day which is not a Business Day, or after 5:00 p.m. on a Business Day, in each case in the place of receipt shall be deemed only to become effective on the following Business Day.

15.4 English language

(a) Any notice given under or in connection with this Guarantee must be in English.

(b) All other documents provided under or in connection with this Guarantee must be:

(i) in English; or

(ii) if not in English, and if so required by the Lender, accompanied by a certified English translation and, in this case, the English translation will prevail unless the document is a constitutional, statutory or other official document.

16 COUNTERPARTS

This Guarantee may be executed in any number of counterparts, and this has the same effect as if the signatures on the counterparts were on a single copy of this Guarantee.

17 GOVERNING LAW

This Guarantee and any non-contractual obligations arising out of or in connection with it are governed by English law.

18 ENFORCEMENT

18.1 Jurisdiction

(a) The courts of England have exclusive jurisdiction to settle any dispute arising out of or in connection with this Guarantee (including a dispute regarding the existence, validity or termination of this Guarantee or any non-contractual obligation arising out of or in connection with this Guarantee) (a "**Dispute**").

(b) Each of the Parties agrees that the courts of England are the most appropriate and convenient courts to settle Disputes and accordingly it will not argue to the contrary.

18.2 Service of process

Without prejudice to any other mode of service allowed under any relevant law, the Guarantor:

(a) irrevocably appoints the High Commissioner for Barbados in London, 1 Great Russell St, London WC1B 3ND as its agent for service of process in relation to any proceedings before the English courts in connection with this Guarantee (the "**Process Agent**");

(b) agrees that failure by the Process Agent to notify the Guarantor of the process will not invalidate the proceedings concerned or any judgment based on them; and

(c) agrees that if for any reason the Process Agent is unable to act as such or its appointment ceases to be effective, that the Guarantor will promptly notify the Lender and within thirty (30) days will appoint a substitute process agent in England acceptable to the Lender (but if it fails to make such appointment within such period the Lender shall be entitled to appoint such substitute process agent by notice to the Guarantor).

18.3 Waiver of immunity

(a) The Guarantor hereby irrevocably waives, to the extent permitted by applicable law and international conventions:

(i) any immunity from jurisdiction it may have in any Dispute in the courts of England or in any other jurisdiction; and

(ii) except as provided below, any immunity from attachment or execution to which its assets or property might otherwise be entitled in any Dispute in the courts of England, and agrees that it will not claim any such immunity in any such Dispute.

(b) Notwithstanding the foregoing, the above waiver shall not constitute a waiver of immunity from attachment or execution with respect to:

(i) any property of the Central Bank of Barbados;

(ii) any property located in or outside the territory of Barbados that provides an essential public service;

(iii) any property entitled to the privileges and immunities of the Vienna Convention on Diplomatic Relations of 1961 and the Vienna Convention on Consular Relations of 1963, including, but not limited to, property, premises and bank accounts used by the missions of Barbados;

(iv) any property of a diplomatic, governmental or consular mission of Barbados;

(v) taxes, duties, levies, assessments, royalties or any other governmental charges imposed by Barbados, including the right of Barbados to collect any such charges;

(vi) any property of a military character or under the control of a military authority or defence agency of Barbados;

(vii) property forming part of the cultural heritage of Barbados; or

(viii) property of Barbados outside Barbados not used for a commercial purpose.

For the purposes of this Clause 18.3 "property" includes, without limitation, assets, accounts, bank deposits, cash, revenues, securities and rights, including rights against third parties.

This Guarantee is executed and delivered as a deed on the date stated at the beginning of this Guarantee.

EXECUTION PAGE

GUARANTOR

EXECUTED as a **DEED** by)
THE GOVERNMENT OF BARBADOS ACTING)
THROUGH ITS MINISTRY OF FINANCE,)
ECONOMIC AFFAIRS AND INVESTMENT)
acting by THE HON. MIA AMOR MOTTLEY, S.C., M.P.)
in the presence of:)

Signature of witness:

Name (in BLOCK CAPITALS): SHARON DEANE

Address: SUPREME COURT COMPLEX
WHITEPARK ROAD

Occupation: REGISTRAR SUPREME COURT (ag)

LENDER

EXECUTED as a **DEED** by)
AFRICAN EXPORT-IMPORT BANK)
acting by)

.....
Authorised Signatory

PROF. BENEDICT OKECHUKWU ORAMAH
Name

PRESIDENT AND CHAIRMAN OF THE BOARD OF DIRECTORS
Title

.....
Authorised Signatory

.....
Name

.....
Title

in the presence of:

.....
Notary Public

REGISTRAR AND AS SUCH A NOTARY PUBLIC IN AND FOR BARBADOS. (ag)

Annex 499

"Bridgetown Initiative 3.0, Consultation Draft (27th May 2024)",
Bridgetown Initiative, 28 May 2024

BRIDGETOWN INITIATIVE 3.0, CONSULTATION DRAFT (28th May 2024)

"We are living in the season of superlatives on a scorched Earth. To have any chance of reversing this trajectory, we must build a more responsive, fairer and more inclusive global financial system to fight inequalities, finance the climate transition, and accelerate the achievement of the Sustainable Development Goals."

~ H.E. Mia Amor Mottley, Prime Minister of Barbados

The global economic and financial system continues to fail us.

At a time when only 15% of the Sustainable Development Goals (SDGs) are on track, governments in the world's poorest countries are devoting more resources to debt service than to health, education, and infrastructure combined. **In the last four years, 165 million people have fallen into poverty.**

In 2023, the global average near-surface temperature was 1.45C above the preindustrial baseline and average temperatures temporarily breached the critical 1.5C threshold. The impact is especially devastating in climate vulnerable countries, which are home to 4.5bn people, half of whom live in poverty. **This can no longer be ignored. The voices of the people can no longer be left behind.**

Tinkering at the margins of a broken system is akin to rearranging deck chairs on the Titanic**. It is time to act in solidarity for people and planet.**

* * *

Unveiled in 2022, **the Bridgetown Initiative has led a paradigm shift in the global discourse on scaling capital flows and reshaping the financing system** to achieve the SDGs and spur climate action.

Some progress has been made. The International Monetary Fund (IMF) has created the Resilience and Sustainability Trust (RST). The G20 has committed to re-channeling $100 billion in Special Drawing Rights (SDRs). A Loss and Damage Fund was launched at COP28 with an initial $700 million in commitments. The Inter-American Development Bank (IADB), World Bank and other official sector lenders are including natural disaster clauses across a broad range of new and existing loan agreements. The Asian Development Bank has unlocked $100 billion of additional lending through reforms to its Capital Adequacy Framework. The African Development Bank (AfDB) is increasing lending by raising hybrid capital from private investors. The Multi-lateral Investment Guarantee Agency has committed to tripling its capacity. Currency hedging solutions and early-stage project pipeline facilities are being announced in several markets.

Still, this falls woefully short of what is required.

DRAFT - FOR DISCUSSION

There is much unfinished business from Bridgetown 2.0. Global efforts to facilitate the restructuring of unsustainable debts have proven slow, passive, and insufficient. While Multi-lateral Development Bank (MDB) reforms have momentum, we are a far cry from the $500bn a year in additional official lending that the world requires. Efforts to align private capital to sustainable development are too small scale. A more equitable governance of the International Financial Institutions remains elusive. Despite progress in expanding liquidity support, high interest rates have combined with maturing debt to create a wall of debt service over the next three years. Rather than supporting a green and just transition, our trading system is at risk of being subverted by geopolitical tensions over control of the market for green energy and transport.

We need a different way of measuring progress other than Gross National Income (GNI). **We need to rethink production and consumption patterns and trade systems**, eschewing extractive and exploitative practices in favor of those that are regenerative and equitable. **We need financing to flow to where it is required and at a sufficient scale** to meet the ambition of the SDGs, climate mitigation and adaptation without compromising debt sustainability. **We need that financing to be provided on affordable terms**, and countries to be given the **headroom to borrow. We need country commitment to establish frameworks that preserve debt sustainability** while scaling up spending to reduce poverty, promote inclusive and equitable growth together with climate resilient development. We need **to invest in Global Public Goods (GPGs)**—including climate resilience, fragility and conflict, pandemic prevention, renewable energy access, food security, water security, digitalization, and protecting biodiversity and nature—recognizing that our societies and economies are deeply interlinked. **We need a system that is fundamentally just, including providing funds to cover losses and damages** from shocks not of their making. **We need a viable insurance market**, as a precondition for governments, businesses and individuals to invest in assets—be that infrastructure or homes.

Small island developing states, like other low and middle-income vulnerable countries, understand this acutely. We can neither afford to choose between tackling development or climate; these are two sides of the same coin. Many of us have graduated out of concessional finance yet have only superficial market access given the unsustainable cost of today's borrowing. Our greater exposure to weather disasters prices us out of insurance, leaving us prone to endless cycles of shocks, with inadequate financing for recovery or programmes that significantly strengthen institutions and national capacity.

DRAFT - FOR DISCUSSION

* * *

<u>Closing the financing gap for people and planet.</u>

An additional $1.8 trillion is needed to address the climate crisis in emerging markets and developing countries and $1.2 trillion annually to achieve the SDGs. Of this $3 trillion, the Independent High-level Expert Group on Climate Finance estimates that $2 trillion must come from domestic sources, and the remaining $1 trillion from external sources. And of the external sources, half would come from public and half from private sector mobilization.

I. The rules of the game must change:

1) **Developing countries must be given a stronger voice through better and greater representation in the governance structures of the international development finance institutions**.
2) **The IMF and World Bank must reform the Debt Sustainability Assessment (DSA) framework,** and their own financing programs, to be based on a country's plan for productive and climate adaptation investments and long-term growth potential (as reflected in an Integrated National Financing Framework).
3) **Alongside these reforms, Credit Rating Agencies must play their part and overhaul their methodologies** to end the current systemic rating biases against small, poor and vulnerable countries, and specifically to capture longer term financial health.
4) **World Bank and finance providers must expand and go beyond per capita GNI as the criterion for determining eligibility for concessional financing to include climate vulnerability, natural capital and biodiversity conservation**, addressing the inequity of countries being graduated on a GNI per capita basis while being among the most climate vulnerable countries globally.
5) **All governments must establish a carbon price taking into account the Paris principles and their level of development.** Governments should further support the development of a **Global Carbon Pricing Framework that is just and equitable** and task the International Institutions to deliver on this.

II. We must shock proof economies:

6) In a world of fragmented central bank currency swaps, **the IMF must act as a liquidity provider of last resort at the center of the Global Financial Safety Net, providing financing at below market rates**.
7) **Countries must have access to early intervention for liquidity support free from onerous conditionalities**:
    a. With the recent approval by the IMF Board that enables SDRs to be used as hybrid capital, **contributing countries must urgently deliver on their commitments to ensure the expansion of scope and scale of re-channeling SDRs through MDBs**, leading with the AfDB and IADB.
    b. **The IMF and its shareholders must achieve agreement on a new $500bn issuance of SDRs.**
8) **IMF must improve, and reduce the cost of, lending** by allowing countries to access the Resilience and Sustainability Facility (RSF) on a stand-alone basis, overhaul surcharges and tenors for middle-income countries, and extend the Extended Fund Facility repayment period, last reformed in 1979, to match the newly-agreed RSF.
9) **All debtors and public and private creditors must introduce natural disaster clauses and regular principal amortizations in all lending instruments by COP29** to make public debt stocks resilient to climatic shocks and reduce refinancing risk.

DRAFT - FOR DISCUSSION

III. We must commit to dramatically increase financing:

10) **Donor countries must replenish IDA21 by at least $120 billion**, with significant increases in contributions from new and existing donors to maintain current grant and concessional finance levels and a view to **tripling IDA by 2030 in line with the G20 Independent Expert Group recommendation.**
11) **MDBs must demonstrate a credible path to delivering at least $300bn annually in affordable, longer-term—** e.g. 30-50-year—**financing** for the SDGs, including climate action.
12) **MDBs must fully implement the G20 Capital Adequacy Framework (CAF) recommendations**, including on risk management, callable capital, portfolio guarantees and hybrid capital to significantly increase lending.
13) **At least $500bn annually of private capital must be mobilized and catalyzed—including in local currency—** into mitigation and adaption by **international and regional development banks** by working to remove barriers, including by scaling 10x project development support, 5x de-risking products, partnering with pioneer funding from philanthropy, and **innovating robust solutions to the growing challenge of uninsurable assets.**
14) **New sources of finance must be secured to fund solutions to key global challenges affecting people, planet and stability:**
    a. Countries must establish a levy on fossil fuel company windfall profits, financial transactions, and emissions on shipping and aviation to help finance GPGs, and define a governance framework for their use.
    b. Philanthropic organizations must agree to a Global Compact through which a defined portion of their financing would go to GPGs.
15) Fully capitalize and effectively operationalize the Loss and Damage Fund.

If this agenda is not showing real progress on the ground at country level by the end of 2025, then the world will have failed to address the most critical issues of our time, putting the SDGs in jeopardy. This will result in unthinkable costs to lives, livelihoods and our planet. We can and must do better.

* * *

We are launching Bridgetown 3.0 for consultation at the 4th International Conference on Small Island Developing States in Antigua on 28th May 2024. Comments are welcome by June 30th 2024 and should be sent to: bridgetown.initiative@barbados.gov.bb. The document will be finalized during July 2024, after which time we formally launch and engage with decision-makers to translate asks in to action. Progress will be shared at the Summit of the Future, United Nations General Assembly (UNGA), Annual Meetings of the IMF and World Bank, G20 and COP29 to deliver tangible outcomes at 4th International Conference on Financing for Development and COP30.

DRAFT - FOR DISCUSSION

Annex 500

Request for Advisory Opinion submitted by the Commission of Small Island States on Climate Change and International Law, Advisory Opinion, 21 May 2024

INTERNATIONAL TRIBUNAL FOR THE LAW OF THE SEA

YEAR 2024

21 May 2024

List of cases:
No. 31

REQUEST FOR AN ADVISORY OPINION SUBMITTED BY THE COMMISSION OF SMALL ISLAND STATES ON CLIMATE CHANGE AND INTERNATIONAL LAW

ADVISORY OPINION

TABLE OF CONTENTS

ADVISORY OPINION

Present: *President* HOFFMANN; *Vice-President* HEIDAR; *Judges* JESUS, PAWLAK, YANAI, KATEKA, BOUGUETAIA, PAIK, ATTARD, KULYK, GÓMEZ-ROBLEDO, CABELLO, CHADHA, KITTICHAISAREE, KOLODKIN, LIJNZAAD, INFANTE CAFFI, DUAN, BROWN, CARACCIOLO, KAMGA; *Registrar* HINRICHS OYARCE.

On the Request submitted to the Tribunal by the Commission of Small Island States on Climate Change and International Law,

THE TRIBUNAL,

composed as above,

gives the following Advisory Opinion:

I. Introduction

A. Request

1. By letter dated 12 December 2022, received electronically by the Registry of the Tribunal on the same day, the Co-Chairs of the Commission of Small Island States on Climate Change and International Law (hereinafter "the Commission") transmitted to the Tribunal a request for an advisory opinion (hereinafter "the Request"), pursuant to a decision of the third meeting of the Commission held on 26 August 2022. The originals of that letter and of the decision of the Commission were filed with the Registry on 20 December 2022.

2. The Commission was created pursuant to the Agreement for the establishment of the Commission of Small Island States on Climate Change and International Law (hereinafter the "COSIS Agreement"), which was concluded on 31 October 2021 and entered into force on the same date. At the time of the filing of the Request, Antigua and Barbuda, Tuvalu, the Republic of Palau, Niue, the

Republic of Vanuatu and Saint Lucia were parties to the COSIS Agreement. Subsequently, Saint Vincent and the Grenadines, Saint Christopher (Saint Kitts) and Nevis, and the Commonwealth of the Bahamas also acceded to it. All parties to the COSIS Agreement are also States Parties to the United Nations Convention on the Law of the Sea (hereinafter "the Convention").

3. At its third meeting, the Commission adopted the following decisions:

DECISIONS OF THE THIRD MEETING OF THE COMMISSION OF SMALL ISLAND STATES ON CLIMATE CHANGE AND INTERNATIONAL LAW (*)

Virtual Meeting 26 August 2022

The Commission of Small Island States, pursuant to Article 3(5) of the Agreement of 31 October 2021, has decided as follows:

1. Further to the Co-Chairs' 24 November 2022 request for a recommendation regarding an Advisory Opinion from the International Tribunal for the Law of the Sea (ITLOS), the Commission notes with appreciation the work of the Sub-Committee on Protection and Preservation of the Marine Environment and approves the 18 June 2022 *Recommendation CLE. 1/2022/Rec* of the Committee of Legal Experts to request the following Advisory Opinion from ITLOS consistent with Article 2(2) of the Agreement:

   "What are the specific obligations of State Parties to the United Nations Convention on the Law of the Sea ('UNCLOS'), including under Part XII:

   (a) to prevent, reduce and control pollution of the marine environment in relation to the deleterious effects that result or are likely to result from climate change, including through ocean warming and sea level rise, and ocean acidification, which are caused by anthropogenic greenhouse gas emissions into the atmosphere?

   (b) to protect and preserve the marine environment in relation to climate change impacts, including ocean warming and sea level rise, and ocean acidification?"

2. The Commission expresses it support for the initiative of Vanuatu to request an Advisory Opinion on climate change from the International Court of Justice ("ICJ") and decides that the Committee of Legal Experts should assist members of the Commission in making submissions to the ICJ as appropriate.

3. The Commission requests the Sub-Committees on Sea-Level Rise, Human Rights, and Loss and Damages respectively, to propose further activities that the Commission may undertake to contribute

> to the definition, implementation, and progressive development of rules and principles of international law concerning climate change, consistent with its mandate under Article 1(3) of the Agreement.

(*) Adopted unanimously by COSIS Members meeting virtually: (1) Hon. Gaston Browne, Prime Minister of Antigua and Barbuda; (2) Hon. Kausea Natano, Prime Minister of Tuvalu; and (3) Hon. Surangel Whipps Jr., President of the Republic of Palau.

Vote recorded by Meeting Chair, Eselealofa Apinelu, High Commissioner of Tuvalu to Fiji

(Signed)	*(Signed)*	*(Signed)*
(Eselealofa Apinelu)	*(Gaston Browne)*	*(Surangel Whipps Jr.)*
	(Signed)	
	(Kausea Natano)	

4. In their letter dated 12 December 2022, the Co-Chairs of the Commission stated that they were "representing the Commission pursuant to Article 3(3) of the Agreement for the Establishment of the Commission" and were "hereby submit[ting] a request for an advisory opinion". The Co-Chairs of the Commission also referred to article 21 of the Statute of the Tribunal (hereinafter "the Statute") and article 138 of the Rules of the Tribunal (hereinafter "the Rules") and noted that,

> [i]n this respect, Article 2(2) of the Agreement provides (emphasis added):
>
> > Having regard to the fundamental importance of oceans as sinks and reservoirs of greenhouse gases and the direct relevance of the marine environment to the adverse effects of climate change on Small Island States, *the Commission shall be authorized* to request advisory opinions from the International Tribunal for the Law of the Sea ("ITLOS") on any legal question within the scope of the 1982 United Nations Convention on the Law of the Sea, consistent with Article 21 of the ITLOS Statute and Article 138 of its Rules.

5. In the same letter, the Co-Chairs informed the Tribunal of the appointment of Mr Payam Akhavan and Ms Catherine Amirfar as the Representative and Co-representative, respectively, of the Commission for the proceedings.

6. Together with the said letter, the Co-Chairs of the Commission transmitted to the Tribunal documents likely to throw light upon the questions contained in the request for an advisory opinion, pursuant to article 131 of the Rules. All these documents were posted on the website of the Tribunal.

7. On 12 December 2022, the Request was entered into the List of cases as Case No. 31, which was named “Request for an advisory opinion submitted by the Commission of Small Island States on Climate Change and International Law”. By letter of the same date, the Registrar of the Tribunal informed the Co-Chairs that the Request had been filed with the Registry on 12 December 2022 and entered into the List of cases as Case No. 31.

8. By a communication dated 19 December 2022, the Representative of the Commission corrected the date in paragraph 1, first line, of the decisions of 26 August 2022 adopted by the Commission to read 24 November 2021 instead of 24 November 2022.

B. Chronology of the procedure

9. By notes verbales dated 13 December 2022, in accordance with article 133, paragraph 1, of the Rules, the Registrar notified all States Parties to the United Nations Convention on the Law of the Sea (hereinafter “States Parties”) of the Request.

10. By letter of the same date, pursuant to the Agreement on Cooperation and Relationship between the United Nations and the International Tribunal for the Law of the Sea of 18 December 1997, the Registrar notified the Secretary-General of the United Nations of the Request.

11. By Order dated 16 December 2022, pursuant to article 133, paragraph 2, of the Rules, the President of the Tribunal decided “that the intergovernmental organizations listed in the annex to the … order are considered likely to be able to furnish information on the questions submitted to the Tribunal for an advisory opinion”. By the same Order, pursuant to article 133, paragraph 3, of the Rules, the President invited the States Parties, the Commission and the aforementioned intergovernmental organizations to present written statements on those questions and fixed 16 May 2023 as the time limit within which written statements could be presented to the Tribunal. By the same Order, the President decided that, in accordance with article 133, paragraph 4, of the Rules, oral proceedings would be

held. The Order was notified to the States Parties, the Commission and the intergovernmental organizations listed in its annex.

12. By letter dated 31 January 2023, the African Union requested that it be identified, pursuant to article 133, paragraph 2, of the Rules, “as an intergovernmental organization able to furnish information on the questions submitted to the Tribunal for an advisory opinion, thereby permitting [the African Union] to participate in the proceedings”. By letter dated 2 February 2023, the Registrar informed the African Union of the decision of the President to consider the African Union as such an intergovernmental organization and invited the African Union to furnish information within the time limit fixed by the Order of 16 December 2022.

13. By letter dated 3 February 2023, the European Commission requested the President “to extend the deadline to present written statements pursuant to Order 2022/4 by one month, until 16 June 2023.” By Order dated 15 February 2023, the President extended, pursuant to article 133, paragraph 3, of the Rules, to 16 June 2023 the time limit within which written statements could be presented to the Tribunal. The same Order recorded the President’s decision to consider the African Union as an intergovernmental organization likely to be able to furnish information on the questions submitted to the Tribunal for an advisory opinion. The Order was notified to the States Parties, the Commission, the intergovernmental organizations listed in the annex to the Order of 16 December 2022, and the African Union.

14. By letter dated 20 February 2023, the International Seabed Authority (hereinafter “the Authority”) requested the President “to consider the Authority as one of the intergovernmental organizations … likely to be able to furnish information on the questions submitted to the Tribunal and therefore to invite the Authority to present its written statement within the time limit as extended by the President of the Tribunal.” By letter dated 24 February 2023, the Registrar informed the Authority of the decision of the President to consider it as an intergovernmental organization likely to be able to furnish such information and invited the Authority to do so within the extended time limit fixed by the Order of 15 February 2023.

15. By letter dated 31 May 2023, received by the Registry on 8 June 2023, the Pacific Community requested, in accordance with article 133, paragraph 2, of the Rules, “the Tribunal’s authorisation to present observations on the questions submitted by the Commission … for an advisory opinion” and that the Tribunal include the Pacific Community “among those intergovernmental organisations invited to present observations in Case No. 31”. By letter dated 8 June 2023, the Registrar informed the Pacific Community of the decision of the President to consider the Pacific Community as an intergovernmental organization likely to be able to furnish information on the questions submitted to the Tribunal for an advisory opinion and invited it to do so within the extended time limit fixed by the Order of 15 February 2023.

16. By note verbale dated 5 June 2023, the Permanent Mission of India to the United Nations requested that “the deadline to submit written statement[s] to the Tribunal … further be extended for at least two months or as appropriate to enable member states to furnish written statements to the Tribunal.” By letter dated 6 June 2023, the Registrar informed the Permanent Mission of India, at the request of the President, that “at this stage of the written proceedings it is not contemplated to grant a further extension of the time limit prescribed” and invited India “to submit a written statement as soon as possible.”

17. Within the time limit fixed by the President in his Order dated 15 February 2023, written statements were submitted by the following 31 States Parties, which are listed in the order in which their statements were received: the Democratic Republic of the Congo, Poland, New Zealand, Japan, Norway, Germany, Italy, China, the European Union, Mozambique, Australia, Mauritius, Indonesia, Latvia, Singapore, the Republic of Korea, Egypt, Brazil, France, Chile, Bangladesh, Nauru, Belize, Portugal, Canada, Guatemala, the United Kingdom, the Netherlands, Sierra Leone, Micronesia (Federated States of) and Djibouti. Within the same time limit, written statements were also submitted by the Commission and the following seven intergovernmental organizations, which are listed in the order in which their statements were received: the United Nations; the International Union for Conservation of Nature (hereinafter “the IUCN”); the International Maritime

Organization (hereinafter “the IMO”); the Pacific Community; the United Nations Environment Programme; the African Union and the Authority.

18. By letter dated 20 June 2023, in accordance with article 133, paragraph 3, of the Rules, the Registrar notified the States Parties, the Commission and the intergovernmental organizations that had submitted written statements of the list of those participants. By the same letter, the Registrar also informed them that these statements were accessible in a dedicated section of the Tribunal’s website.

19. In addition, statements were submitted by the following entities: the United Nations Special Rapporteurs on Human Rights and Climate Change, Toxics and Human Rights and Human Rights and the Environment (on 31 May 2023); the High Seas Alliance (on 15 June 2023); ClientEarth (on 15 June 2023); Opportunity Green (on 15 June 2023); the Center for International Environmental Law and Greenpeace International (on 15 June 2023); the Advisory Committee on Protection of the Sea (on 16 June 2023); the World Wide Fund for Nature (on 16 June 2023); Our Children’s Trust and Oxfam International (on 16 June 2023); the Observatory for Marine and Coastal Governance (on 16 June 2023); and One Ocean Hub (on 17 June 2023).

20. The statements from the High Seas Alliance, Opportunity Green, the Center for International Environmental Law and Greenpeace International, and Our Children’s Trust and Oxfam International were accompanied by a petition to be granted permission to act as amici curiae in the proceedings. Furthermore, in a communication transmitting its statement, ClientEarth sought permission to “[i]ntervene in the Advisory Proceedings of Case No. 31”.

21. At the request of the President, the Registrar, by separate letters dated 5, 15, 16 and 19 June 2023, respectively, informed the entities mentioned in paragraph 20 above that their statements would not be included in the case file since they had not been transmitted under article 133 of the Rules; the statements would, however, be transmitted to the States Parties, the Commission and the intergovernmental organizations that had presented written statements, and also posted on the website of the Tribunal in a separate section of documents relating to the case. By letter

dated 20 June 2023, the aforementioned States Parties, the Commission and the intergovernmental organizations were informed thereof.

22. By note verbale dated 19 June 2023, after the expiry of the time limit for the submission of written statements, Rwanda submitted a written statement. By the said note verbale, Rwanda also transmitted a letter dated 17 June 2023 from the Minister of Justice/Attorney-General of Rwanda. Therein, the Minister of Justice/Attorney-General stated that "Rwanda recognises the slight delay in this submission, owing to the fact that the Convention did not enter into force for Rwanda until today." By note verbale of the Tribunal dated 20 June 2023, Rwanda was informed that, in light of the reasons provided in the letter dated 17 June 2023, the President had decided that the written statement of Rwanda should be admitted and included in the case file.

23. By communication dated 21 June 2023, after the expiry of the time limit for the submission of written statements, the Food and Agriculture Organization of the United Nations (hereinafter "the FAO") submitted a written statement. By letter of the same date, the Registrar informed the FAO that, although the statement had reached the Registry after the expiry of the time limit for the submission of statements, the President had decided that the statement should be admitted and included in the case file.

24. By communication dated 23 June 2023, the Registrar informed the States Parties, the Commission and the intergovernmental organizations that had presented written statements of the submission of the statements of Rwanda and of the FAO. These statements were posted on the Tribunal's website in a section entitled "Statements received after the expiry of the time limit fixed by Order 2023/1 of 15 February 2023".

25. On 26 June 2023, pursuant to article 134 of the Rules, all written statements submitted to the Tribunal were made accessible to the public on the Tribunal's website.

26. By Order dated 30 June 2023, in accordance with article 133, paragraph 4, of the Rules, the President fixed 11 September 2023 as the date for the opening of the hearing at which oral statements could be made by the States Parties, the Commission and the intergovernmental organizations listed in the annex to the Order of the President of 16 December 2022, as well as the African Union, the Authority and the Pacific Community. The same Order recorded the President's decisions to consider the Authority and the Pacific Community as intergovernmental organizations likely to be able to furnish information on the questions submitted to the Tribunal for an advisory opinion (see paras. 14 and 15 above). By the same Order, the States Parties, the Commission and the above-mentioned intergovernmental organizations were invited to indicate to the Registrar, no later than 4 August 2023, their intention to make oral statements at the hearing. The Order was notified to the States Parties, the Commission and the above-mentioned intergovernmental organizations.

27. By note verbale dated 30 June 2023, after the expiry of the time limit for the submission of written statements, Viet Nam submitted a written statement. By note verbale of the Tribunal dated 13 July 2023, Viet Nam was informed that, although the statement had reached the Registry after the expiry of the time limit for the submission of statements, the President had decided that the statement should be admitted and included in the case file. By communication dated 14 July 2023, the Registrar informed the States Parties, the Commission and the intergovernmental organizations that had presented written statements of the submission of the statement of Viet Nam. The statement was posted on the Tribunal's website in a section entitled "Statements received after the expiry of the time limit fixed by Order 2023/1 of 15 February 2023".

28. Within the time limit prescribed by the Order of the President of 30 June 2023, 34 States Parties, listed as follows in alphabetical order, expressed their intention to participate in the oral proceedings: Argentina, Australia, Bangladesh, Bolivia, Chile, China, Comoros, the Democratic Republic of Congo, Djibouti, the European Union, France, Germany, Guatemala, India, Indonesia, Italy, Latvia, Mauritius, Mexico, Micronesia (Federated States of), Mozambique, Nauru, the Netherlands, New Zealand, Norway, the Philippines, Portugal, the Republic of Korea, Saudi Arabia,

Sierra Leone, Singapore, Timor-Leste, the United Kingdom and Viet Nam. Within the same time limit, the Commission, the African Union, the IUCN and the Pacific Community also expressed their intention to participate in the oral proceedings.

29. By separate notes verbales dated 18 July 2023, the United Kingdom and the Netherlands, respectively, requested the Tribunal "to order a second round of written statements and to revise the date for the oral hearings accordingly". Both States Parties stated that "introducing a second round of written statements is necessary and appropriate in a case of this significance and complexity", that "[t]his would allow participating States and intergovernmental organizations to respond in writing to statements" already made, and that it would facilitate "narrowing of the issues before the Tribunal", leading to "a more efficient oral phase of the proceedings". In their respective notes verbales, the United Kingdom and the Netherlands further stated that, should the Tribunal decline to accede to that request, they invited it "to bear firmly in mind the lack of opportunity afforded to States Parties and participating intergovernmental organizations to respond in writing to the written statements when the Tribunal comes to consider the appropriate procedure for the hearing, including in particular a fair allocation of time", and that "all participants should be accorded an equal allocation of time at the hearing", which "includes the Commission of Small Island States on Climate Change and International Law (COSIS)". They added that "the status of COSIS as the international organization requesting the advisory opinion should give it no greater procedural rights, including in particular time allocation for oral submissions, than any of the participating States Parties to UNCLOS."

30. By letter dated 20 July 2023, France requested a postponement of the hearing by a few weeks to allow States more time to prepare the oral statements, taking account of the number of written statements made and the importance and complexity of the legal issues raised in the Request. By letter dated 21 July 2023, Italy suggested a postponement of the hearing "by a few weeks, in consideration of the significant number of statements filed and of the complexity of the issues raised by the Request of Advisory Opinion."

31. By separate notes verbales of the Tribunal dated 7 August 2023, the United Kingdom and the Netherlands were informed that the matter raised in their respective notes verbales had been brought to the attention of the Tribunal, that the Tribunal had concluded that a second round of written statements was not required, and that no further time limit would be fixed pursuant to article 133, paragraph 3, of the Rules within which States Parties and the intergovernmental organizations which had made written statements could present written statements on the statements made. The United Kingdom and the Netherlands were further informed that the Tribunal would allow delegations sufficient time at the hearing to make their oral submissions and also to respond to the written statements made by other participants.

32. By letters dated 7 and 8 August 2023 addressed to Italy and France, respectively, the Registrar, at the request of the President, informed the two States that the matter raised in their respective letters had been brought to the attention of the Tribunal and that, in the view of the Tribunal, a postponement of the date for the opening of the hearing was not required. The Registrar further indicated that the Tribunal however considered that the schedule of the hearing should be organized in such a manner so as to grant delegations sufficient time to make their oral statements and also to respond to the written statements made by other participants.

33. By letter dated 28 July 2023, the Commission “provide[d] notice of its intention to examine two expert witnesses, Dr. Sarah Cooley and Dr. Shobha Maharaj, each of whom ha[d] submitted a report annexed to the Commission’s written statement, and request[ed] permission to proceed as such at the hearing under Articles 73(2), 77(2), and 78(1) of the Rules of the Tribunal.” By letter dated 8 August 2023, the Registrar, at the request of the President, invited the Commission to include Dr Cooley and Dr Maharaj as members of its delegation in order to allow them to address the Tribunal.

34. By letter dated 21 August 2023, the Sub-Regional Fisheries Commission (hereinafter “the SRFC”) requested permission to make oral statements at the hearing. By letter dated 28 August 2023, the Registrar informed the SRFC, at the

request of the President, that since the SRFC was not included in the Order of 30 June 2023, its request to participate in the oral proceedings was not granted.

35. By note verbale dated 28 August 2023, after the expiry of the time limit for the submission of written statements, India submitted a written statement. By note verbale of the Tribunal dated 8 September 2023, India was informed that although the statement had reached the Registry after the expiry of the time limit for the submission of statements, the Tribunal had decided that the statement should be admitted and included in the case file. By communication of the same date, the States Parties, the Commission and the intergovernmental organizations that had presented written statements were informed of the submission of the statement of India. The statement was posted on the Tribunal's website in a section entitled "Statements received after the expiry of the time limit fixed by Order 2023/1 of 15 February 2023".

36. By note verbale dated 5 September 2023, Belize informed the Tribunal of its intention to participate in the hearing. By note verbale of the Tribunal dated 8 September 2023, Belize was informed that, "[w]hile noting that the note verbale dated 5 September 2023 was received after the date fixed in the Order of the President of 30 June 2023 for a State Party to indicate its intention to make an oral statement at the hearing, the Tribunal nevertheless decided to allow Belize to make an oral statement at the hearing."

37. Prior to the opening of the oral proceedings, the Tribunal held initial deliberations on 7 and 8 September 2023.

38. The Tribunal held 18 public sittings on 11, 12, 13, 14, 15, 18, 19, 20, 21 and 25 September 2023, at which it heard oral statements, in the following order, from:

For the Commission of Small Island States on Climate Change and International Law:	Mr Gaston Browne, Prime Minister of Antigua and Barbuda, Co-Chair of COSIS, Mr Kausea Natano, Prime Minister of Tuvalu, Co-Chair of COSIS,

Mr Arnold Kiel Loughman, Attorney General, Republic of Vanuatu,

Mr Payam Akhavan, SJD OOnt FRSC, Professor of International Law, Chair in Human Rights, and Senior Fellow, Massey College, University of Toronto; member, Permanent Court of Arbitration; associate member, Institut de droit international; member, Bar of New York; member, Law Society of Ontario,

Ms Naima Te Maile Fifita, Founder, Moana Tasi Project; 2023 Sue Taei Ocean Fellow,

Ms Phoebe Okowa, Professor of International Law, Queen Mary University, London; member, International Law Commission; advocate, High Court of Kenya,

Ms Sarah Cooley, Director of Climate Science, Ocean Conservancy,

Ms Shobha Maharaj, Science Director, Terraformation,

Ms Margaretha Wewerinke-Singh, Associate Professor of Sustainability Law, University of Amsterdam; Adjunct Professor of Law, University of Fiji; member, Bar of Vanuatu; Blue Ocean Law,

Mr Makane Moïse Mbengue, Professor of International Law, University of Geneva; member, Curatorium of the Hague Academy of International Law; associate member, Institut de droit international,

Mr Brian McGarry, Assistant Professor of Public International Law, Grotius Centre for International Legal Studies, Leiden University; member, Bar of New York,

Ms Jutta Brunnée, Dean, Faculty of Law, University of Toronto; University Professor; associate member, Institut de droit international,

Mr Jean-Marc Thouvenin, Professor, University Paris Nanterre; Secretary-General, The Hague Academy of International Law; associate member, Institut de droit international; member, Paris Bar; Sygna Partners,

Ms Catherine Amirfar, Debevoise & Plimpton LLP; member, Bars of New York and of the Supreme Court of the United States; Immediate Past President, American Society of International Law,

Ms Philippa Webb, Professor of Public International Law, King's College, London; Barrister, Twenty Essex; member, Bar of England and Wales; member, Bar of New York; member, Bar of Belize,

Ms Nilüfer Oral, Director, Centre for International Law, National University of Singapore; member, International Law Commission; associate member, Institut de droit international,

Mr Conway Blake, Debevoise & Plimpton LLP; solicitor advocate of the senior courts of England and Wales; member, Bar of the Eastern Caribbean Supreme Court,

Mr Eden Charles, Special Representative of the Secretary-General, International Seabed Authority; Lecturer of Law, University of the West Indies; Chair, Advisory Board, One Ocean Hub, UK Research and Innovation,

Mr Zachary Phillips, Crown Counsel, Attorney General's Chambers, Ministry of Legal Affairs, Antigua and Barbuda; member, Bar of Antigua and Barbuda,

and

Mr Vaughan Lowe KC, Emeritus Chichele Professor of International Law, University of Oxford; barrister, Essex Court Chambers; member, Institut de droit international; member, Bar of England and Wales;

For Australia:

Mr Jesse Clarke, General Counsel (International Law), Office of International Law, Attorney-General's Department,

Mr Stephen Donaghue KC, Solicitor-General of Australia,

and

Ms Kate Parlett, member of the Bar of England and Wales, Twenty Essex;

For Germany:	Ms Tania Freiin von Uslar-Gleichen, Legal Adviser, Federal Foreign Office;
For Saudi Arabia:	Ms Noorah Mohammed S. Algethami, Legal Consultant;
For Argentina:	Mr Gabriel Herrera, Minister, Legal Adviser, Ministry of Foreign Affairs, International Trade and Worship;
For Bangladesh:	Mr Md. Khurshed Alam, Rear Admiral (Retd.), BN, Secretary, Maritime Affairs Unit, Ministry of Foreign Affairs, Ms Catherine Amirfar, Debevoise & Plimpton LLP; member, Bars of New York and of the Supreme Court of the United States; Immediate Past President, American Society of International Law, and Mr Payam Akhavan, SJD OOnt FRSC, Professor of International Law, Chair in Human Rights, and Senior Fellow, Massey College, University of Toronto; member, Permanent Court of Arbitration; associate member, Institut de droit international; member, Bar of New York; member, Law Society of Ontario;
For Chile:	Ms Ximena Fuentes Torrijo, Representative;
For Portugal:	Ms Patrícia Galvão Teles, Director-General for Legal Affairs, Ministry of Foreign Affairs;
For Djibouti:	Mr Yacin Houssein Doualé, Ambassador of the Republic of Djibouti, Germany, and Mr Guled Yusuf, Partner, Allen & Overy LLP;
For Guatemala:	Mr Lesther Antonio Ortega Lemus, Minister Counsellor and Chargé d'Affaires, Embassy of the Republic of Guatemala in the Kingdom of the Netherlands, and

Mr Alfredo Crosato Neumann, PhD, Geneva Graduate Institute; Member, Bar of Lima;

For India: Mr Luther M. Rangreji, Joint Secretary (L&T), Ministry of External Affairs;

For Nauru: Ms Anastasia Francilia Adire, Legal Advisor, Permanent Mission of the Republic of Nauru to the United Nations, New York,

and

Mr Eirik Bjorge, Professor of International Law, University of Bristol, United Kingdom;

For Indonesia: Mr L. Amrih Jinangkung, Director General for Legal Affairs and International Treaties, Ministry of Foreign Affairs;

For Latvia: Ms Kristīne Līce, Legislation and International Law Adviser to the President of Latvia,

and

Mr Mārtiņš Paparinskis, Professor of Public International Law, University College London; member, International Law Commission; member, Permanent Court of Arbitration;

For Mauritius: Mr Jagdish Dharamchand Koonjul, G.C.S.K., G.O.S.K., Ambassador and Permanent Representative of the Republic of Mauritius to the United Nations, New York,

Mr Philippe Joseph Sands KC, G.C.S.K., Professor of International Law, University College London; Barrister, 11 King’s Bench Walk, London,

and

Ms Kate Cook, Barrister, Matrix Chambers, London;

For Micronesia: Mr Clement Yow Mulalap, Adviser (Legal), Permanent Mission of the Federated States of Micronesia to the United Nations, New York;

For New Zealand:	Ms Victoria Hallum, Deputy Secretary, Multilateral and Legal Affairs Group, Ministry of Foreign Affairs and Trade, and Ms Charlotte Skerten, Lead Adviser, Legal Division, Ministry of Foreign Affairs and Trade;
For the Republic of Korea:	Mr Hwang Jun-shik, Director-General for International Legal Affairs, Ministry of Foreign Affairs;
For China:	Mr Ma Xinmin, Director-General, Department of Treaty and Law, Ministry of Foreign Affairs;
For Mozambique:	Ms Paula da Conceição Machatine Honwana, Representative, Mr Charles C. Jalloh, Professor, Florida International University; Member, Special Rapporteur and Second-Vice Chairperson, International Law Commission, Ms Phoebe Okowa, Professor, Queen Mary University, London; Member, International Law Commission, and Mr Andrew Loewenstein, Partner, Foley Hoag LLP;
For Norway:	Mr Andreas Motzfeldt Kravik, State Secretary, Ministry of Foreign Affairs;
For Belize:	Mr Lennox Gladden, Chief Climate Change Officer, National Climate Change Office, Ministry of Sustainable Development, Climate Change and Disaster Risk Management, Mr Sean Aughey, Barrister, Essex Court Chambers, member of the Bar of England and Wales, and Mr Sam Wordsworth KC, Barrister, Essex Court Chambers, member of the Bar of England and Wales, member of the Paris Bar;

For the Philippines:	Mr Carlos D. Sorreta, Permanent Representative, Permanent Mission to the United Nations, Geneva, Mr Gilbert U. Medrano, Assistant Solicitor General, Office of Solicitor General, and Ms Maria Angela A. Ponce, Assistant Secretary, Maritime and Ocean Affairs Office, Department of Foreign Affairs;
For Sierra Leone:	Mr Alpha Sesay, Deputy Minister of Justice, Mr Dire D. Tladi, Professor, University of Pretoria; former Member, Special Rapporteur and Chair, International Law Commission, Mr Charles C. Jalloh, Professor, Florida International University; Member, Special Rapporteur and Second-Vice Chairperson (74th session), International Law Commission, and Ms Christina Hioureas, Partner, Foley Hoag LLP;
For Singapore:	Mr Lionel Yee, Deputy Attorney-General, Attorney-General's Chambers;
For Timor-Leste:	Ms Elizabeth Exposto, Chief of Staff to the Prime Minister; Chief Executive Officer, Land and Maritime Boundary Office, Mr John Middleton AM KC, Senior Advisor, DLA Piper; Former Judge, Federal Court of Australia, and Mr Eran Sthoeger, Legal Counsel;
For the European Union:	Mr André Bouquet, Legal Adviser, Legal Service, European Commission, and

Ms Margherita Bruti Liberati, Member, Legal Service, European Commission;

For Viet Nam: Ms Le Duc Hanh, Director-General, Department of International Law and Treaties, Ministry of Foreign Affairs;

For the Pacific Community: Ms Rhonda Robinson, Director, SPC Geoscience, Energy and Maritime Division,

and

Ms Kathy Jetñil-Kijiner, Climate Envoy;

For Comoros: Mr Youssouf Mondoha Assoumani, Ambassador of the Union of Comoros to the Federal Democratic Republic of Ethiopia; Permanent Representative to the African Union,

Mr Iain Sandford, Partner, Sidley Austin LLP, Geneva; Barrister and Solicitor, High Court of Australia, Supreme Court of the Australian Capital Territory and High Court of New Zealand,

Mr Dominic Coppens, Senior Managing Associate, Sidley Austin LLP, Brussels; Professor, Department of International and European Law, Maastricht University; Member, Brussels Bar – A list,

and

Ms Katherine Connolly, Senior Managing Associate, Sidley Austin LLP, Geneva; Barrister and Solicitor, Supreme Court of New South Wales;

For the Democratic Republic of the Congo: Mr Ivon Mingashang, Professor of International Law, Law Faculty, University of Kinshasa; member of the International Law Commission; member, Kinshasa/Gombe Bar,

Mr Sylvain Lumu Mbaya, Professor of International Law, Law Faculty, University of Kinshasa; Judge at the Constitutional Court of the DRC,

Mr Jean-Paul Segihobe Bigira, Professor of International Law, Department of Public International Law and International Relations, Law Faculty, University of Kinshasa; Member of Parliament; member, Kinshasa/Gombe Bar,

and

Mr Nicolas Angelet, Professor of International Law, Université libre de Bruxelles; member, Brussels Bar;

For the International Union for Conservation of Nature:

Ms Christina Voigt, Chair, IUCN World Commission on Environmental Law (WCEL); Co-Chair, Paris Agreement Implementation and Compliance Committee; Professor, Department of Public and International Law, University of Oslo,

Ms Cymie R. Payne, Chair, IUCN-WCEL Ocean Law Specialist Group; Associate Professor, Rutgers University, New Jersey,

and

Ms Tara Davenport, Assistant Professor, Faculty of Law, National University of Singapore (NUS); Co-Head, Oceans Law and Policy Programme, Centre for International Law, Singapore;

For the African Union:

Mr Tordeta Ratebaye, Ambassador, Deputy Chief of Staff, Cabinet of the Chairperson, African Union Commission,

Mr Mohamed Salem Boukhari Khalil, Acting Legal Counsel, Director of Legal Affairs, African Union Commission,

Mr Nicolas J.S. Lockhart, Partner, Sidley Austin LLP, Geneva; Solicitor (Scotland),

Mr Deepak Raju, Senior Managing Associate, Sidley Austin LLP, Geneva; Solicitor (England and Wales); Advocate (Maharashtra and Goa, India),

and

Mr Mamadou Hébié, Associate Professor of International Law, Grotius Centre for International Legal Studies, Leiden University; Member, Bar of the State of New York;

For France:

Ms Sandrine Barbier, Deputy Director of Legal Affairs, Ministry for Europe and Foreign Affairs,

and

	Mr Mathias Forteau, Professor, University of Paris Nanterre;
For Italy:	Mr Stefano Zanini, Head, Service for Legal Affairs, Diplomatic Disputes and International Agreements, Ministry of Foreign Affairs and International Cooperation,
	and
	Mr Roberto Virzo, Professor of International Law, University of Messina;
For the Netherlands:	Mr René J.M. Lefeber, Legal Adviser, Ministry of Foreign Affairs;
For the United Kingdom:	Mr Ben Juratowitch KC, Barrister, Essex Court Chambers,
	and
	Ms Amy Sander, Barrister, Essex Court Chambers.

39. The hearing was broadcast on the Internet as a webcast.

40. On 11 September 2023, the Registrar communicated questions posed by Judge Kittichaisaree pursuant to article 76 of the Rules to the Commission and to the IUCN. The question posed to the Commission was as follows:

> In light of Chapters 6, 7 and 8 of your Written Statement, could you please clarify further which specific obligations mentioned by you insofar as they are relevant to the Request for an Advisory Opinion are, in your view, obligations of conduct and which ones are obligations of result, and why?

The question posed to the IUCN was as follows:

> In light of paragraph 74 *et seq.* of your Written Statement, could you please clarify further which specific obligations mentioned by you insofar as they are relevant to the Request for an Advisory Opinion are, in your view, obligations of conduct and which ones are obligations of result, and why?

The Commission and the IUCN were requested to respond to the respective questions orally during the oral arguments and/or in writing by the end of the hearing.

41. By letter dated 24 September 2023, the Commission transmitted a written response to the question put to it. During the sitting held on 21 September 2023, the IUCN provided a response to the question put to it. The written response of the Commission and a transcript of the oral response of the IUCN were posted on the Tribunal's website.

42. By communication dated 25 September 2023, the Registrar invited the States Parties, the Commission and the intergovernmental organizations that had participated in the oral proceedings to submit comments on the responses of the Commission and the IUCN by 2 October 2023. Comments were received from Australia, France, Latvia, the Netherlands and the United Kingdom by separate communications dated 2 October 2023 and from Timor-Leste by letter dated 4 October 2023. By communication dated 16 October 2023, the Registrar informed the States Parties, the Commission and the intergovernmental organizations that had participated in the hearing of the comments received. These comments were posted on the Tribunal's website.

43. By communications dated 18 and 20 September 2023, the IMO transmitted two documents to the Tribunal and requested that those documents be considered documents in support of the written statement submitted by the IMO on 16 June 2023. By letter dated 13 October 2023, the Registrar informed the IMO that the Tribunal had decided, on 12 October 2023, to admit the two documents in support of the IMO's written statement and therefore considered them as part of the case file.

44. In accordance with article 17 of the Rules, President Hoffmann and Judges Pawlak, Yanai, Kateka, Paik and Gómez-Robledo, whose term of office expired on 30 September 2023, having participated in the meeting mentioned in article 68 of the Rules, continued to sit in the case until its completion. President Hoffmann continued to preside over the Tribunal in the present case until completion, pursuant to article 16, paragraph 2, of the Rules.

II. Background

45. The Tribunal notes that the Request submitted by the Commission has scientific aspects. It further notes that various international instruments have been adopted to address climate change. The Tribunal thus finds it appropriate to provide at the outset an overview of the science and legal regime relating to climate change as a background to the Request.

A. Scientific aspects

46. The phenomenon of climate change is central to the Request and the questions contained therein necessarily have scientific aspects. In their written and oral submissions, the participants in the present proceedings addressed at length scientific aspects related to climate change and the ocean, and submitted or referred to abundant materials on scientific issues.

47. In relation to the phenomenon of climate change, the Tribunal notes that, in its resolution 43/53 of 6 December 1988, the United Nations General Assembly (hereinafter "the General Assembly") recognized, for the first time, that "climate change is a common concern of mankind". In the same resolution, the General Assembly stated that "the emerging evidence indicates that continued growth in atmospheric concentrations of 'greenhouse' gases could produce global warming with an eventual rise in sea levels, the effects of which could be disastrous for mankind if timely steps are not taken at all levels". In this resolution, the General Assembly also endorsed the action of the World Meteorological Organization and the United Nations Environment Programme in jointly establishing an Intergovernmental Panel on Climate Change (hereinafter "the IPCC") to provide "internationally coordinated scientific assessments of the magnitude, timing and potential environmental and socio-economic impact of climate change and realistic response strategies". At present, there are 195 member countries of the IPCC. In its resolution 67/210 of 21 December 2012, the General Assembly declared that "climate change is one of the greatest challenges of our time". This statement has been subsequently reaffirmed by the General Assembly in several resolutions. The Tribunal further notes that, in its resolution 76/296 of 25 July 2022, the General

Assembly endorsed the declaration adopted by the 2022 United Nations Ocean Conference that it was “deeply alarmed by the adverse effects of climate change on the ocean and marine life”.

48. Since its establishment in 1988, the IPCC has produced several assessment reports on climate change, the latest within the sixth assessment cycle concluded in 2023. This cycle produced several special reports, such as the 2018 Special Report on Global Warming of 1.5°C (hereinafter “the 2018 Report”) and the 2019 Special Report on the Ocean and Cryosphere in a Changing Climate (hereinafter “the 2019 Report”). The sixth assessment cycle also produced three separate working group reports – the Working Group I report entitled “Climate Change 2021: The Physical Science Basis” finalized on 6 August 2021 (hereinafter “the WGI 2021 Report”), the Working Group II report entitled “Climate Change 2022: Impacts, Adaptation and Vulnerability” finalized on 27 February 2022 (hereinafter “the WGII 2022 Report”), and the Working Group III report entitled “Climate Change 2022: Mitigation of Climate Change” finalized on 4 April 2022 – and a Synthesis Report published in March 2023 (hereinafter “the 2023 Synthesis Report”).

49. The Tribunal notes that the IPCC reports are subject to review and endorsement by the IPCC member countries. According to the IPCC, such endorsement “acknowledges that the report is a definitive assessment that has been developed following the IPCC’s defined procedures, underpinning the report’s authority” (IPCC Factsheet, “How does the IPCC approve reports?”, first paragraph). Different levels of formal endorsement apply to the different types of materials prepared by the IPCC. The summary for policymakers, which is prepared for each IPCC report, including for synthesis reports, is submitted for “approval”, where approval means that the summary has been subject to detailed, line-by-line discussion and agreement during an IPCC plenary session. The body of the underlying reports is subject to “acceptance” by the plenary. “Acceptance” means that, while “the material has not been subject to line by line discussion and agreement, it nevertheless presents a comprehensive, objective and balanced view of the subject matter” (Principles Governing IPCC Work, Appendix A, p. 2). The synthesis report of an IPCC cycle summarizes the key findings of the working group reports and any special reports of that cycle. While its summary for policymakers is

again approved line by line, the body of the synthesis report is subject to “adoption”, section by section and not line by line.

50. With regard to the confidence levels used in IPCC reports, the IPCC explains the following:

> A level of confidence is expressed using five qualifiers: very low, low, medium, high and very high, and typeset in italics, for example, *medium confidence*. The following terms have been used to indicate the assessed likelihood of an outcome or result: virtually certain 99–100% probability; very likely 90–100%; likely 66–100%; about as likely as not 33–66%; unlikely 0–33%; very unlikely 0–10%; and exceptionally unlikely 0–1%. Additional terms (extremely likely 95–100%; more likely than not >50–100%; and extremely unlikely 0–5%) are also used when appropriate. Assessed likelihood is typeset in italics, for example, *very likely*.
> (WGI 2021 Report, p. 4, fn. 4)

51. The Tribunal observes that most of the participants in the proceedings referred to reports of the IPCC, recognizing them as authoritative assessments of the scientific knowledge on climate change, and that none of the participants challenged the authoritative value of these reports.

52. The Tribunal notes that the IPCC defines climate change as:

> A change in the state of the *climate* that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. *Climate change* may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent *anthropogenic* changes in the composition of the *atmosphere* or in *land use*.
> (WGII 2022 Report, p. 2902)

53. Successive IPCC reports provide important findings in relation to the changes of the Earth’s climate that have occurred over time and their causes. The 2023 Synthesis Report states that “[w]idespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred”, and that “[h]uman-caused climate change is already affecting many weather and climate extremes in every region across the globe” (2023 Synthesis Report, p. 46). The same report further states that “[i]t is unequivocal that human influence has warmed the atmosphere, ocean and land” and that “[t]he scale of recent changes across the climate system as a whole

and the present state of many aspects of the climate system are unprecedented over many centuries to many thousands of years" (2023 Synthesis Report, p. 46).

54. The IPCC affirms in its 2023 Synthesis Report that human activities, principally through greenhouse gases (hereinafter "GHGs"), "have unequivocally caused global warming" (2023 Synthesis Report, p. 42). Greenhouse gases are "[g]aseous constituents of the *atmosphere*, both natural and *anthropogenic*, that absorb and emit radiation at specific wavelengths within the spectrum of radiation emitted by the Earth's *ocean* and *land* surface, by the *atmosphere* itself and by clouds" (WGII 2022 Report, p. 2911). The most common GHGs in the Earth's atmosphere include carbon dioxide, methane and nitrous oxide. The IPCC explains that GHGs "absorb infrared radiation, emitted by the Earth's surface, the atmosphere and clouds", and "[t]hey emit in turn infrared radiation in all directions including downward to the Earth's surface" (Climate Change 2001, The Scientific Basis, pp. 89-90). According to the IPCC, GHGs thus "trap heat within the atmosphere" (Climate Change 2001, The Scientific Basis, p. 90). Anthropogenic GHG emissions, according to the Climate Change 2014 Synthesis Report of the IPCC (hereinafter "the 2014 Synthesis Report"), "have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever", and this "has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years" (2014 Synthesis Report, p. 4). In this regard, the Tribunal notes that the IPCC defines the term "anthropogenic" as "[r]esulting from or produced by human activities" which "include the burning of *fossil fuels, deforestation, land use* and land use changes …, livestock production, fertilisation, waste management, and industrial processes," and the term "anthropogenic emissions" as "[e]missions of *greenhouse gases (GHGs), precursors* of GHGs, and *aerosols*, caused by human activities" (2019 Report, p. 679).

55. The IPCC has also assessed the role of the ocean in the climate system. The 2019 Report observes that the ocean is "a fundamental climate regulator on seasonal to millennial time scales" (2019 Report, p. 78). This role is twofold: the ocean "stores heat trapped in the atmosphere caused by increasing concentrations of greenhouse gases" and thus "masks and slows surface warming"; at the same time, it also stores excess carbon dioxide (*ibid*., p. 456), and such carbon storage

represents a major control on atmospheric carbon dioxide. According to the IPCC, “[a]bout a quarter of carbon dioxide (CO_2) released by human activities is taken up by the ocean” (*ibid*., p. 218) and “[a]bsorption by the ocean and uptake by plants and soils are the primary natural CO_2 sinks on decadal to centennial time scales” (WGI 2021 Report, p. 179).

56. The IPCC observes that “[c]oastal blue carbon ecosystems, such as mangroves, salt marshes and seagrasses, can help reduce the risks and impacts of climate change, with multiple co-benefits” (WGII 2022 Report, p. 2692). These coastal habitats “are characterised by high, yet variable, organic carbon storage in their soils and sediments” (2019 Report, p. 522) and “have sequestered carbon dioxide from the atmosphere continuously over thousands of years, building stocks of carbon in biomass and organic rich soils” (WGII 2022 Report, p. 1480). The IPCC further observes that “the protection and enhancement of coastal blue carbon can be an important contribution to both mitigation and adaptation at the national scale” (2019 Report, p. 454), while noting that “[t]he potential climatic benefits of blue carbon ecosystems can only be a very modest addition to, and not a replacement for, the very rapid reduction of greenhouse gas emissions” (*ibid.*, p. 454).

57. The reports of the IPCC indicate that the accumulation of anthropogenic GHGs in the atmosphere has had numerous effects on the ocean. The 2023 Synthesis Report states that climate change has caused “substantial damages and increasingly irreversible losses”, including in “cryospheric and coastal and open ocean ecosystems (*high confidence*)” (2023 Synthesis Report, p. 46). According to the 2019 Report, “[c]limate change-related effects in the ocean include sea level rise, increasing ocean heat content and marine heat waves, ocean deoxygenation, and ocean acidification” (2019 Report, p. 79).

58. With respect to ocean warming, the WGI 2021 Report observes that “the dominant effect of human activities is apparent not only in the warming of global surface temperature, but also in … the warming of the ocean” (WGI 2021 Report, p. 515). The 2019 Report states that “[i]t is virtually certain that the global ocean has warmed unabated since 1970 and has taken up more than 90% of the excess heat in the climate system (*high confidence*)” (2019 Report, p. 9). The report further states

that “[s]ince 1993, the rate of ocean warming has more than doubled (*likely*). Marine heatwaves have very likely doubled in frequency since 1982 and are increasing in intensity (*very high confidence*)” (*ibid*., p. 9). The report states that “[w]arming of the ocean reduces not only the amount of oxygen it can hold, but also tend[s] to stratify it” and that, “[a]s a result, less oxygen is transported to depth, where it is needed to support ocean life” (2019 Report, p. 113). It further states that “[i]n response to ocean warming and increased stratification, open ocean nutrient cycles are being perturbed” (*ibid*., p. 450) and that “[w]arming-induced changes in spatial distribution and abundance of fish stocks have already challenged the management of some important fisheries and their economic benefits (*high confidence*)” (*ibid*., p. 451).

59. Regarding sea level rise, the WGI 2021 Report indicates that “[h]eating of the climate system has caused global mean sea level rise through ice loss on land and thermal expansion from ocean warming” (WGI 2021 Report, p. 11). According to the 2023 Synthesis Report, “[g]lobal mean sea level increased by 0.20 [0.15 to 0.25] m between 1901 and 2018” and “[h]uman influence was *very likely* the main driver of these increases since at least 1971” (2023 Synthesis Report, p. 46). Among other effects, the 2019 Report indicates that “[g]lobal mean sea level rise will cause the frequency of extreme sea level events at most locations to increase”, that “[c]oastal tidal amplitudes and patterns are projected to change”, that “[r]ising mean sea levels will contribute to higher extreme sea levels associated with tropical cyclones”, and that “[c]oastal hazards will be exacerbated by an increase in the average intensity, magnitude of storm surge and precipitation rates of tropical cyclones” (2019 Report, pp. 20-21). The 2019 Report also states that “[c]oastal ecosystems are observed to be under stress from ocean warming and SLR [sea level rise] that are exacerbated by non-climatic pressures from human activities on ocean and land (*high confidence*)” (*ibid*., p. 451). The WGII 2022 Report notes that “[s]ea level rise poses an existential threat for some Small Islands and some low-lying coasts (*medium confidence*)” (WGII 2022 Report, p. 15).

60. The IPCC defines ocean acidification as follows:

> A reduction in the *pH* of the *ocean*, accompanied by other chemical changes (primarily in the levels of carbonate and bicarbonate ions), over an extended period, typically decades or longer, which is caused primarily

> by *uptake* of *carbon dioxide (CO_2)* from the *atmosphere*, but can also be caused by other chemical additions or subtractions from the ocean. *Anthropogenic* OA [ocean acidification] refers to the component of pH reduction that is caused by human activity.
> (2019 Report, p. 693)

A 2001 IPCC report notes that, "[b]ecause of its solubility and chemical reactivity, CO_2 is taken up by the ocean much more effectively than other anthropogenic gases" (Climate Change 2001, The Scientific Basis, p. 197). The IPCC, in its WGI 2021 Report, explains that, "[o]nce dissolved in seawater, CO_2 reacts with water and forms carbonic acid" (WGI 2021 Report, p. 714) and that, as it explains in a 2007 report, as carbon dioxide increases, the pH decreases and therefore the ocean becomes more acidic. According to the 2014 Synthesis Report, "[s]ince the beginning of the industrial era, oceanic uptake of CO_2 has resulted in acidification of the ocean; the pH of ocean surface water has decreased by 0.1 (*high confidence*), corresponding to a 26% increase in acidity" (2014 Synthesis Report, p. 41).

61. Regarding the effects of ocean acidification, the same report indicates that "[m]arine ecosystems, especially coral reefs and polar ecosystems, are at risk" from this process, which "has impacts on the physiology, behaviour and population dynamics of organisms" and "acts together with other global changes (e.g., warming, progressively lower oxygen levels) and with local changes (e.g., pollution, eutrophication) (*high confidence*), leading to interactive, complex and amplified impacts for species and ecosystems" (*ibid*., p. 67). With regard to the effects on species, a 2014 IPCC report states that "the absorption of rising atmospheric CO_2 by … organisms changes carbonate system variables … in organism internal fluids" and that "[a]ccumulation of CO_2 and the resulting acidification can also affect a wide range of organismal functions" (Climate Change 2014, Impacts, Adaptation, and Vulnerability, p. 436). As to species producing calcified exoskeletons, the 2019 Report states that dissolved carbon dioxide taken up by the ocean "makes the water more corrosive for marine organisms that build their shells and structures out of mineral carbonates, such as corals, shellfish and plankton" (2019 Report, p. 113). According to the same report, "[b]iogenic shallow reefs with calcified organisms (e.g., corals, mussels, calcified algae) are particularly sensitive to ocean acidification" (*ibid*., p. 502). The 2019 Report further states that "[p]rojected ocean acidification

and oxygen loss will also affect deep ocean biodiversity and habitats that are linked to provisioning services in the deep ocean" (*ibid*., p. 509). Furthermore, as stated in the 2018 Report, "[l]arge-scale changes to foodweb structure are occurring in all oceans" (2018 Report, p. 227).

62. With regard to climate-related risks, the IPCC, in its 2023 Synthesis Report, concludes that "[r]isks and projected adverse impacts and related losses and damages from climate change escalate with every increment of global warming (*very high confidence*)" (2023 Synthesis Report, p. 14), and, in the 2018 Report, states that they "are higher for global warming of 1.5°C than at present, but lower than at 2°C (*high confidence*)" (2018 Report, p. 5). The WGI 2021 Report also indicates that "[m]any changes due to past and future greenhouse gas emissions are irreversible for centuries to millennia, especially changes in the ocean, ice sheets and global sea level" (WGI 2021 Report, p. 21). In addition, the 2019 Report anticipates that, "[o]ver the 21st century, the ocean is projected to transition to unprecedented conditions with increased temperatures (*virtually certain*), greater upper ocean stratification (*very likely*) [and] further acidification (*virtually certain*)" (2019 Report, p. 18). According to the 2023 Synthesis Report, the "[i]ncreasing frequency of marine heatwaves will increase risks of biodiversity loss in the oceans, including from mass mortality events (*high confidence*)" (2023 Synthesis Report, p. 98). In particular, "[w]arm-water corals are at high risk already and are projected to transition to very high risk even if global warming is limited to 1.5°C (*very high confidence*)" (2019 Report, p. 24).

63. In the 2018 Report, the IPCC states that "[l]imiting warming to 1.5°C implies reaching net zero CO_2 emissions globally around 2050 and concurrent deep reductions in emissions of non-CO_2 forcers, particularly methane (*high confidence*)" (2018 Report, p. 95). As to what is required to reach this goal, in the same report, the IPCC further states:

> Such mitigation pathways are characterized by energy-demand reductions, decarbonization of electricity and other fuels, electrification of energy end use, deep reductions in agricultural emissions, and some form of CDR [carbon dioxide removal] with carbon storage on land or sequestration in geological reservoirs. Low energy demand and low demand for land- and GHG-intensive

> consumption goods facilitate limiting warming to as close as possible to 1.5°C. (*Ibid*., p. 95)

64. Furthermore, the 2018 Report observes that "1.5°C implies very ambitious, internationally cooperative policy environments that transform both supply and demand (*high confidence*)" (2018 Report, p. 95) and that, "[i]n comparison to a 2°C limit, the transformations required to limit warming to 1.5°C are qualitatively similar but more pronounced and rapid over the next decades (*high confidence*)" (*ibid*., p. 95).

65. The IPCC concludes, in its 2023 Synthesis Report, that "[g]lobal warming will continue to increase in the near term in nearly all considered scenarios and modelled pathways" (2023 Synthesis Report, p. 68). With regard to climate change mitigation, i.e., "human intervention to reduce emissions or enhance the sinks of greenhouse gases" (2023 Synthesis Report, Annex I, p. 126), the IPCC finds in the same report that "[d]eep, rapid, and sustained GHG emissions reductions, reaching net zero CO_2 emissions and including strong emissions reductions of other GHGs, in particular CH_4, are necessary to limit warming to 1.5°C … or less than 2°C … by the end of century *(high confidence*)" (2023 Synthesis Report, p. 68).

66. The Tribunal notes that the IPCC, in its 2023 Synthesis Report, states that "climate change is a threat to human well-being and planetary health" (2023 Synthesis Report, p. 89), and that "[v]ulnerable communities who have historically contributed the least to current climate change are disproportionately affected (*high confidence*)" (2023 Synthesis Report, p. 5). The 2019 Report observes that "[h]uman communities in close connection with coastal environments … are particularly exposed to ocean and cryosphere change" (2019 Report, p. 5). For instance, the same report identifies future shifts in fish distribution and decreases in fisheries which would affect "income, livelihoods, and food security of marine resource-dependent communities", as well as impacts on marine ecosystems which would put "key cultural dimensions of lives and livelihoods at risk" (*ibid*., p. 26). In addition, the WGII 2022 Report indicates that "[c]limate hazards are a growing driver of involuntary migration and displacement" and that "[c]limate-related illnesses … and threats to mental health and well-being are increasing" (WGII 2022 Report, p. 1044).

In this respect, the Tribunal notes that climate change represents an existential threat and raises human rights concerns.

B. International instruments on climate change

67. The Tribunal notes that various international agreements and other instruments have been negotiated and adopted to address the issue of climate change. At the core of these agreements is the United Nations Framework Convention on Climate Change (hereinafter "UNFCCC"), which opened for signature in June 1992 at the United Nations Conference on Environment and Development in Rio de Janeiro and entered into force on 21 March 1994. To date, there are 198 Parties to the UNFCCC, including all States Parties to the Convention.

68. The objective of the UNFCCC, as set out in its Article 2, is to achieve "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." This provision further specifies that such a level should be achieved "within a timeframe sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner." The UNFCCC defines climate change in Article 1, paragraph 2, as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." In Article 1, paragraph 4, the term "[e]missions" is defined as "the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time." In Article 1, paragraph 5, the term "[g]reenhouse gases" is defined as "those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation." The use by the UNFCCC of the plural ("emissions") and of the qualifier "over a period of time" suggests that these are multiple and, to a certain extent, lasting releases of GHGs, which, *inter alia*, indicates their eventual accumulation or concentration.

69. With a view to achieving the objective of the UNFCCC and the implementation of its provisions, the Parties to the UNFCCC are guided by the provisions of Article 3.

These provisions refer, *inter alia*, to common but differentiated responsibilities and respective capabilities, specific needs and special circumstances of developing country Parties, precautionary measures, sustainable development and cooperation. Article 4, paragraph 1, contains general commitments for all Parties to the UNFCCC, while paragraph 2 of the same article formulates specific commitments applicable only to Parties listed in Annex I to the UNFCCC (hereinafter “Annex I Parties”), which includes developed country Parties and country Parties that are undergoing the process of transition to a market economy. These commitments relate to all GHGs not controlled by the Montreal Protocol on Substances that Deplete the Ozone Layer (hereinafter “the Montreal Protocol”). The UNFCCC also establishes the Conference of the Parties (hereinafter “COP”), which, in accordance with Article 7, is entrusted to “keep under regular review the implementation of the [UNFCCC] and any related legal instruments that the [COP] may adopt, and shall make, within its mandate, the decisions necessary to promote the effective implementation of the [UNFCCC].” In the implementation of commitments, “full consideration” is to be given to the specific needs and concerns of developing country Parties arising from the adverse effects of climate change or the impact of the implementation of response measures (see Article 4, para. 8). Low-lying and other small island countries, countries with low-lying coastal, arid and semi-arid areas or areas liable to floods, drought and desertification, and developing countries with fragile mountainous ecosystems are identified as those particularly vulnerable to the adverse effects of climate change (see nineteenth preambular paragraph).

70. On 11 December 1997, the third COP adopted the Kyoto Protocol to the UNFCCC, which entered into force on 16 February 2005. To date, there are 192 Parties to it, including 167 States Parties to the Convention. The Kyoto Protocol operationalizes the UNFCCC by setting quantified emission reduction targets for Annex I Parties. It establishes commitments for these Parties to limit and reduce their GHG emissions in accordance with agreed individual targets over a first commitment period from 2008 to 2012 (see Article 3, para. 1). Moreover, the Kyoto Protocol introduces flexible market-based mechanisms that rely on the trade of emissions permits (see Articles 6, 12 and 17) and establishes an extensive monitoring, review and verification system for ensuring compliance with commitments (see Articles 5, 7, 8 and 18). The Doha Amendment, which was

adopted on 8 December 2012, *inter alia*, established a second commitment period for Annex I Parties from 2013 until 2020.

71. Under the Kyoto Protocol, Annex I Parties are also required to limit or reduce GHG emissions from aviation and marine bunker fuels. This commitment is to be achieved by "working through" the International Civil Aviation Organization (hereinafter "ICAO") and the IMO, respectively (see Article 2, para. 2, of the Kyoto Protocol).

72. On 12 December 2015, the twenty-first COP adopted the Paris Agreement, which entered into force on 4 November 2016. To date, there are 195 Parties to it, including 168 States Parties to the Convention. The Paris Agreement aims to strengthen the global response to the threat of climate change, including by setting a temperature goal which is defined in Article 2, paragraph 1(a), as follows:

> Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change.

73. In order to achieve the temperature goal set out in Article 2 of the Paris Agreement, Article 4, paragraph 1, thereof provides that

> Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.

74. In accordance with Article 4, paragraph 2, of the Paris Agreement, the temperature and emissions goals of this treaty are to be attained, *inter alia*, through the preparation, communication and maintenance of successive nationally determined contributions that each Party intends to achieve and the pursuance of domestic mitigation measures. In accordance with Article 4, paragraph 3,

> [e]ach Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition, reflecting its common

> but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

Article 4, paragraph 6, provides that the least developed countries and Small Island Developing States "may" prepare and communicate strategies, plans and actions for low GHG emissions development reflecting their special circumstances.

75. A further aim of the Paris Agreement is to increase the ability to adapt to the adverse impacts of climate change and foster climate resilience and low GHG emissions development in a manner that does not threaten food production (see Article 2, para. 1(b)). Accordingly, each Party is required, as appropriate, to engage in adaptation planning processes and the implementation of actions, including the development or enhancement of relevant plans, policies and/or contributions (see Article 7, para. 9).

76. Making finance flows consistent with a pathway towards low GHG emissions and climate-resilient development is another aim of the Paris Agreement (see Article 2, para. 1(c)). In this regard, Article 9, paragraph 1, of the Paris Agreement requires developed country Parties to provide financial resources to assist developing country Parties with respect to both mitigation and adaptation in continuation of their existing obligations under the UNFCCC.

77. The Tribunal also notes that the COP has adopted numerous decisions in relation to the UNFCCC, the Kyoto Protocol and the Paris Agreement. Thus, on 20 November 2022, the twenty-seventh COP adopted the Sharm el-Sheikh Implementation Plan, in which it "[*r*]*ecognizes* that limiting global warming to 1.5°C requires rapid, deep and sustained reductions in global greenhouse gas emissions of 43 per cent by 2030", "[*a*]*lso recognizes* that this requires accelerated action" and "*requests* Parties that have not yet done so to revisit and strengthen the 2030 targets in their nationally determined contributions as necessary to align with the Paris Agreement temperature goal by the end of 2023, taking into account different national circumstances" (Decision 1/CMA.4 of 20 November 2022, paras. 15, 16 and 23). In its decision 1/CP.27 of 20 November 2022, the COP "[*r*]*eiterates* that the impacts of climate change will be much lower at the temperature increase of 1.5°C

compared with 2 °C and *resolves* to pursue further efforts to limit the temperature increase to 1.5 °C". On 13 December 2023, the twenty-eighth COP adopted the First Global Stocktake, where it, *inter alia*, in paragraph 28, recognized "the need for deep, rapid and sustained reductions in greenhouse gas emissions in line with 1.5°C pathways" and called on Parties to contribute to certain global efforts enumerated therein (Decision FCCC/PA/CMA/2023/L.17 of 13 December 2023). Several COP decisions address matters relating to climate change and the ocean (Decision 1/CP.25 of 15 December 2019, para. 31; Decision 1/CP.26 of 12 November 2021, paras. 60-61; Decision 1/CP.27 of 20 November 2022, paras. 49-50; Decision 1/CMA.4 of 20 November 2022, para. 79).

78. The Tribunal further notes that international instruments adopted within the framework of the IMO, ICAO and the Montreal Protocol also address matters related to climate change.

79. On 15 July 2011, the IMO adopted amendments to Annex VI to the International Convention for the Prevention of Pollution from Ships of 2 November 1973, as modified by the Protocol of 1978 (hereinafter "MARPOL"). Annex VI deals with the prevention of air pollution from ships. The 2011 amendments were made with a view to reducing GHG emissions from ships through the inclusion of regulations concerning energy efficiency (Resolution MEPC.203(62), Annex). Pursuant to the regulations, new ships engaged in international voyages are required to meet gradually increasing levels of energy efficiency. In 2018, the IMO introduced the Initial IMO Strategy on reduction of GHG emissions from ships. In 2021, the IMO adopted amendments to Annex VI (Resolution MEPC.328(76), Annex), which entered into force in November 2022. Regulation 20 of Annex VI, as amended, states that the goal of the relevant regulations "is to reduce the carbon intensity of international shipping, working towards the levels of ambition set out in the *Initial IMO Strategy on reduction of GHG emissions from ships* [adopted in 2018]."

80. On 7 July 2023, the IMO adopted the 2023 IMO Strategy on Reduction of GHG Emissions from Ships (hereinafter "the 2023 IMO GHG Strategy"). It seeks to enhance IMO's contribution to global efforts by addressing GHG emissions from international shipping. The 2023 IMO GHG Strategy identifies a set of levels of

ambition for the sector, notably “to peak GHG emissions from international shipping as soon as possible and to reach net-zero GHG emissions by or around, i.e. close to, 2050, taking into account different national circumstances” (see paras. 1.10.1, 3.1 and 3.3.4 of the 2023 IMO GHG Strategy).

81. In 2017 and 2018, the ICAO adopted Volumes III and IV, respectively, of Annex 16 to the Convention on International Civil Aviation (hereinafter “the Chicago Convention”). Annex 16 to the Chicago Convention contains international standards and recommended practices that govern the environmental impacts of international aviation. Volumes III and IV of Annex 16 relate to climate change mitigation. Volume III concerns the certification of aeroplane carbon dioxide emissions, while Volume IV establishes a carbon offsetting and reduction scheme for international aviation.

82. On 16 September 1987, the Montreal Protocol was adopted as a protocol to the Vienna Convention for the Protection of the Ozone Layer and entered into force on 1 January 1989. To date, there are 197 Parties to it, including all States Parties to the Convention. The Montreal Protocol deals with the phase-out of the production and consumption of chemicals that deplete the ozone layer, including chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), which are GHGs. An amendment to the Montreal Protocol adopted on 15 October 2016 (hereinafter “the Kigali Amendment”) provides for the phase-down of hydrofluorocarbons (HFCs), used to replace HCFCs, and which are substances that are not ozone depleting but are potent GHGs. The Kigali Amendment entered into force on 1 January 2019 (with the exception of the amendment to article 4 of the Montreal Protocol (control of trade with non-parties) which will enter into force on 1 January 2033). To date, there are 159 Parties to the Kigali Amendment.

III. Jurisdiction and discretion

83. The Tribunal will now proceed to the issue of jurisdiction and discretion. It will first consider whether it has jurisdiction to give the advisory opinion requested by the

Commission and, if so, whether there is any reason the Tribunal should, in the exercise of its discretion, decline to answer the Request.

A. Jurisdiction

84. The Tribunal's jurisdiction to render an advisory opinion is based on article 21 of its Statute. This provision reads: "The jurisdiction of the Tribunal comprises all disputes and all applications submitted to it in accordance with this Convention and all matters specifically provided for in any other agreement which confers jurisdiction on the Tribunal."

85. In *Request for an Advisory Opinion submitted by the Sub-Regional Fisheries Commission (SRFC)* (hereinafter "the *SRFC Advisory Opinion*"), the Tribunal stated that its jurisdiction comprises three elements:

> (i) all "disputes" submitted to the Tribunal in accordance with the Convention; (ii) all "applications" submitted to the Tribunal in accordance with the Convention; and (iii) all "matters" ("toutes les fois que cela" in French) specifically provided for in any other agreement which confers jurisdiction on the Tribunal
> (*Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015, ITLOS Reports 2015,* p. 4, at p. 21, para. 54).

86. The Tribunal further stated that the term "all matters" ("*toutes les fois que cela*" in French) includes advisory opinions, if specifically provided for in "any other agreement which confers jurisdiction on the Tribunal" (*Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015*, *ITLOS Reports 2015*, p. 4, at p. 21, para. 56).

87. The Tribunal also clarified that the expression "all matters specifically provided for in any other agreement which confers jurisdiction on the Tribunal" does not by itself establish the advisory jurisdiction of the Tribunal. In terms of article 21 of the Statute, it is the "other agreement" which confers such jurisdiction on the Tribunal. When the "other agreement" confers advisory jurisdiction on the Tribunal, the Tribunal is then rendered competent to exercise such jurisdiction with regard to "all matters" specifically provided for in the "other agreement". Article 21 and the

"other agreement" conferring jurisdiction on the Tribunal are interconnected and constitute the substantive legal basis of the advisory jurisdiction of the Tribunal (*Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015*, *ITLOS Reports 2015*, p. 4, at p. 22, para. 58).

88. Article 2, paragraph 2, of the COSIS Agreement states:

> Having regard to the fundamental importance of oceans as sinks and reservoirs of greenhouse gases and the direct relevance of the marine environment to the adverse effects of climate change on Small Island States, the Commission shall be authorized to request advisory opinions from the International Tribunal for the Law of the Sea ("ITLOS") on any legal question within the scope of the 1982 United Nations Convention on the Law of the Sea, consistent with Article 21 of the ITLOS Statute and Article 138 of its Rules.

The Tribunal considers that by providing for authorization enabling the Commission to request advisory opinions from the Tribunal, the COSIS Agreement "confers jurisdiction on the Tribunal" within the meaning of article 21 of the Statute.

89. Thus, article 21 of the Statute and the COSIS Agreement conferring jurisdiction on the Tribunal constitute the substantive legal basis of the advisory jurisdiction of the Tribunal in this case.

90. The Tribunal notes that its finding in the *SRFC Advisory Opinion* regarding the legal basis of its advisory jurisdiction has been supported by most States Parties to the Convention.

91. The Tribunal further notes that most participants in the current proceedings expressed the view that the Tribunal has jurisdiction to render the advisory opinion requested by the Commission.

92. The Tribunal also observes that the Agreement under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (hereinafter "the BBNJ Agreement"), the latest agreement adopted to ensure the effective

implementation of the Convention, specifically provides that the Conference of the Parties may request the Tribunal to give an advisory opinion. This Agreement was adopted by consensus on 19 June 2023 and has not yet entered into force.

93. The Tribunal now turns to the prerequisites to be satisfied in order for the Tribunal to exercise its jurisdiction. Article 138, paragraphs 1 and 2, of the Rules reads as follows:

> 1. The Tribunal may give an advisory opinion on a legal question if an international agreement related to the purposes of the Convention specifically provides for the submission to the Tribunal of a request for such an opinion.
>
> 2. A request for an advisory opinion shall be transmitted to the Tribunal by whatever body is authorized by or in accordance with the agreement to make the request to the Tribunal.

94. As the Tribunal clarified in the *SRFC Advisory Opinion*, article 138 of the Rules does not establish the jurisdiction of the Tribunal but only furnishes the prerequisites that must be met before the Tribunal can exercise its advisory jurisdiction (see *Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015*, *ITLOS Reports 2015*, p. 4, at p. 22, para. 59).

95. These prerequisites are as follows: (a) there is an international agreement related to the purposes of the Convention which specifically provides for the submission to the Tribunal of a request for an advisory opinion; (b) the request has been transmitted to the Tribunal by a body authorized by or in accordance with the agreement; and (c) the request submitted to the Tribunal concerns a legal question.

96. As regards the first prerequisite, the Tribunal notes that the COSIS Agreement is an international agreement which entered into force on 31 October 2021 and to which six States were Parties at the time the Request was filed.

97. As set out in its preamble, the basis for the COSIS Agreement is the need to address the adverse effects that GHG emissions have on the marine environment,

including marine living resources, and their devastating impact for small island States. Furthermore, the Commission's mandate, as stated in article 1, paragraph 3, of the COSIS Agreement, is "to promote and contribute to the definition, implementation, and progressive development of rules and principles of international law concerning climate change, including, but not limited to, the obligations of States relating to the protection and preservation of the marine environment and their responsibility for injuries arising from internationally wrongful acts in respect of the breach of such obligations."

98. Considering that one of the main objectives of the Convention is the protection and preservation of the marine environment, to which Part XII is dedicated, it is clear that the COSIS Agreement is an international agreement related to the purposes of the Convention.

99. In article 1, paragraph 1, the COSIS Agreement establishes the Commission of Small Island States on Climate Change and International Law as an intergovernmental organization with international legal personality. Pursuant to article 3, membership of the Commission is open to all members of the Alliance of Small Island States (AOSIS) that become parties to the COSIS Agreement.

100. The Tribunal further observes that article 2, paragraph 2, of the COSIS Agreement specifically states that "the Commission shall be authorized to request advisory opinions from the International Tribunal for the Law of the Sea ("ITLOS") on any legal question within the scope of the 1982 United Nations Convention on the Law of the Sea, consistent with Article 21 of the ITLOS Statute and Article 138 of its Rules."

101. As to the second prerequisite whereby the request must be transmitted to the Tribunal by a body authorized by or in accordance with the COSIS Agreement, the Tribunal notes that the Commission, during its Third Meeting, convened on 26 August 2022, unanimously decided to submit to the Tribunal a request for an advisory opinion pursuant to article 3, paragraph 5, of the Agreement. The Request was subsequently transmitted to the Tribunal by the Co-Chairs of the Commission (see paras. 1 and 3 above).

102. The Tribunal now turns to the third prerequisite whereby the request for an advisory opinion must concern a legal question. The questions read as follows:

> What are the specific obligations of State Parties to the United Nations Convention on the Law of the Sea ('UNCLOS'), including under Part XII:
>
> (a) to prevent, reduce and control pollution of the marine environment in relation to the deleterious effects that result or are likely to result from climate change, including through ocean warming and sea level rise, and ocean acidification, which are caused by anthropogenic greenhouse gas emissions into the atmosphere?
>
> (b) to protect and preserve the marine environment in relation to climate change impacts, including ocean warming and sea level rise, and ocean acidification?

103. The Tribunal considers that these questions have been framed in terms of law. To respond to these questions, the Tribunal is called upon to interpret the relevant provisions of the Convention and of the COSIS Agreement and to identify other relevant rules of international law (see *Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015*, *ITLOS Reports 2015*, p. 4, at pp. 23-24, para. 65).

104. The Tribunal therefore concludes that the questions raised by the Commission are of a legal nature.

105. In addition to the aforementioned prerequisites, article 21 of the Statute lays down that the jurisdiction of the Tribunal extends to "all matters specifically provided for in any other agreement which confers jurisdiction on the Tribunal." Accordingly, it is necessary for the Tribunal to assess whether the questions posed by the Commission constitute matters which fall within the framework of the COSIS Agreement (see *Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015*, *ITLOS Reports 2015*, p. 4, at p. 24, para. 67).

106. In this regard, the questions need not necessarily be limited to the interpretation or application of any specific provision of the COSIS Agreement. It is

enough if the questions have a “sufficient connection” with the purpose of the COSIS Agreement (see *Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015*, *ITLOS Reports 2015*, p. 4, at p. 24, para. 68).

107. The Tribunal notes that article 2, paragraph 1, of the COSIS Agreement provides that the purpose of the Commission is to, *inter alia*, “[assist] Small Island States to promote and contribute to the definition, implementation, and progressive development of rules and principles of international law concerning climate change, in particular the protection and preservation of the marine environment”.

108. The Tribunal is satisfied in the present case that the questions posed by the Commission (see para. 102 above) have a sufficient connection with the purpose of the COSIS Agreement. The questions are directly relevant to matters which fall within the framework of the Agreement.

109. For the aforementioned reasons, the Tribunal finds that it has jurisdiction to give the advisory opinion requested by the Commission.

B. Discretion

110. Having found that it has jurisdiction to entertain the Request, the Tribunal will now turn to the issue of its discretionary power to decline to render an advisory opinion in the present case.

111. The Tribunal stated in the *SRFC Advisory Opinion* that “[a]rticle 138 of the Rules, which provides that ‘the Tribunal may give an advisory opinion’, should be interpreted to mean that the Tribunal has a discretionary power to refuse to give an advisory opinion even if the conditions of jurisdiction are satisfied” (see *Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015*, *ITLOS Reports 2015*, p. 4, at p. 25, para. 71). The Tribunal further stated that “[i]t is well settled that a request for an advisory opinion should not in principle be refused except for ‘compelling reasons’” (see *ibid*.; see also *Legality of*

the Threat or Use of Nuclear Weapons, Advisory Opinion, I.C.J. Reports 1996, p. 226, at p. 235, para. 14).

112. Some participants in the present proceedings expressed the view that the lack of consent of States not party to the COSIS Agreement to any aspect of the Request might constitute a ground for the Tribunal to decline to give an advisory opinion.

113. Contrary to this view, it was contended that the fact that the advisory opinion has been requested by some States Parties to the Convention, and not by all, cannot be a reason for the Tribunal to refrain from giving the opinion. The lack of consent, it was stated, has no bearing on the discretionary power of the Tribunal to refuse to give an advisory opinion to an entity entitled to request it.

114. The Tribunal notes that an advisory opinion is given to the requesting entity, which considers it desirable in order to obtain enlightenment as to the course of action it should take. An advisory opinion as such has no binding force and the consent of States not members of the requesting entity is not relevant (see *Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015*, *ITLOS Reports 2015*, p. 4, at p. 26, para. 76).

115. The Tribunal observes that, in response to its invitation, a large number of participants in the written and oral proceedings furnished the Tribunal with information relevant to the Request. A vast majority of the participating States Parties expressed support for an advisory opinion to be rendered by the Tribunal and were of the view that the present proceedings did not give rise to any compelling reasons for the Tribunal to exercise its discretion to decline to give an advisory opinion. Some participants drew attention to the urgency of the threat of climate change to member States of the Commission and also to the collective interest of States Parties to the Convention in emphasizing that there were compelling reasons for the Tribunal to proceed expeditiously to answer the questions.

116. Another reason the Tribunal might decline to exercise its jurisdiction is the possibility that the questions raised in the Request may be closely related to questions which are the subject of a dispute affecting the rights and obligations of

third States that have not consented to the Request (see *Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015*, *ITLOS Reports 2015*, p. 4, at pp. 25-26, para. 75). The Tribunal is not aware of any legal dispute between the members of the Commission and any other States relating to the subject matter of the advisory opinion which would require the latter's consent.

117. Some participants expressed the view that the Commission, in this case, was not seeking guidance in respect of its own actions but rather clarification in respect of the obligations of States Parties to the Convention regarding the protection and preservation of the marine environment.

118. In this regard, the Tribunal is aware of the importance of the questions in the Request for the members of the Commission and that by answering the questions, the Tribunal would be assisting the Commission in the performance of its activities and contributing to the fulfilment of its mandate, including the implementation of the Convention.

119. It was further argued by some participants that the Request contains questions that are wide, abstract and of a general nature and that since the Request is framed in broad terms, the Tribunal should have careful regard to the parameters of its judicial function. On the other hand, it was contended that the questions in the Request are clear enough and that there is sufficient information and evidence to enable the Tribunal to give an advisory opinion.

120. The Tribunal is of the view that the questions raised by the Commission are clear and specific enough to enable it to give an advisory opinion. The Tribunal considers that sufficient information and evidence have been made available on which to base its findings. The Tribunal further finds that the Request is compatible with its judicial functions, as it is called upon to clarify and provide guidance concerning the specific obligations of States Parties to the Convention by interpreting and applying the provisions of the Convention, in particular the provisions of Part XII, and other relevant rules of international law. As the Tribunal made clear in the *SRFC Advisory Opinion*, it "does not take a position on issues beyond the scope of its

judicial functions" (see *Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015*, *ITLOS Reports 2015*, p. 4, at p. 25, para. 74).

121. In light of the foregoing, the Tribunal deems it appropriate to render the advisory opinion requested by the Commission.

122. The Tribunal is mindful of the fact that climate change is recognized internationally as a common concern of humankind. The Tribunal is also conscious of the deleterious effects climate change has on the marine environment and the devastating consequences it has and will continue to have on small island States, considered to be among the most vulnerable to such impacts. Bearing this in mind, the Tribunal will provide clarification on the issues raised by the Commission.

IV. Applicable law

123. The Tribunal will now address the applicable law in this case. Article 138, paragraph 3, of the Rules states that "[t]he Tribunal shall apply *mutatis mutandis* articles 130 to 137" of the Rules in the exercise of its functions relating to advisory opinions. These articles are those which lay down the rules applicable to the Seabed Disputes Chamber in the exercise of its functions relating to advisory opinions.

124. Article 130, paragraph 1, of the Rules states:

> In the exercise of its functions relating to advisory opinions, the Seabed Disputes Chamber shall apply this section and be guided, to the extent to which it recognizes them to be applicable, by the provisions of the Statute and of these Rules applicable in contentious cases.

125. The Tribunal refers in this regard to article 23 of the Statute, which provides that "[t]he Tribunal shall decide all disputes and applications in accordance with article 293."

126. Article 293, paragraph 1, of the Convention reads:

> A court or tribunal having jurisdiction under this section shall apply this Convention and other rules of international law not incompatible with this Convention.

127. Therefore, the Tribunal concludes that the Convention, the COSIS Agreement and other relevant rules of international law not incompatible with the Convention constitute the applicable law in this case.

V. Interpretation of the Convention and the relationship between the Convention and external rules

128. Having addressed the applicable law, the Tribunal will now proceed to the question of the interpretation of the Convention and the relationship between the Convention and other relevant rules of international law (external rules). The questions posed by the Commission to the Tribunal relate to the interpretation of the Convention. The rules governing treaty interpretation are codified in articles 31 to 33 of the Vienna Convention on the Law of Treaties (hereinafter "VCLT") and form part of the applicable law in this case.

129. The general rule of treaty interpretation is contained in article 31 of the VCLT and reads:

> *General rule of interpretation*
>
> 1. A treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose.
>
> 2. The context for the purpose of the interpretation of a treaty shall comprise, in addition to the text, including its preamble and annexes:
>
> (a) any agreement relating to the treaty which was made between all the parties in connection with the conclusion of the treaty;
>
> (b) any instrument which was made by one or more parties in connection with the conclusion of the treaty and accepted by the other parties as an instrument related to the treaty.

> 3. There shall be taken into account, together with the context:
>
> (a) any subsequent agreement between the parties regarding the interpretation of the treaty or the application of its provisions;
>
> (b) any subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation;
>
> (c) any relevant rules of international law applicable in the relations between the parties.
>
> 4. A special meaning shall be given to a term if it is established that the parties so intended.

130. The Tribunal notes that many participants in the present proceedings have emphasized the open character of the Convention and its constitutional and framework nature. In the Tribunal's view, coordination and harmonization between the Convention and external rules are important to clarify, and to inform the meaning of, the provisions of the Convention and to ensure that the Convention serves as a living instrument. The relationship between the provisions of Part XII of the Convention, entitled "Protection and Preservation of the Marine Environment", and external rules is of particular relevance in this case.

131. In this regard, the Tribunal points out the following mechanisms through which a relationship between the provisions of Part XII of the Convention and external rules is formed. First, the Convention contains certain provisions – also called rules of reference – that refer to external rules. These rules of reference employ different terms and have both a different scope and legal effect.

132. Second, article 237 of the Convention clarifies the relationship of Part XII of the Convention with other treaties relating to the protection and preservation of the marine environment. Article 237 reads:

> *Obligations under other conventions on the protection and preservation of the marine environment*
>
> 1. The provisions of this Part are without prejudice to the specific obligations assumed by States under special conventions and agreements concluded previously which relate to the protection and preservation of the marine environment and to agreements which may be concluded in furtherance of the general principles set forth in this Convention.

> 2. Specific obligations assumed by States under special conventions, with respect to the protection and preservation of the marine environment, should be carried out in a manner consistent with the general principles and objectives of this Convention.

133. Article 237 of the Convention reflects the need for consistency and mutual supportiveness between the applicable rules. On the one hand, Part XII of the Convention is without prejudice to the specific obligations of States under special conventions and agreements concluded previously in this field and to agreements which may be concluded in furtherance of the general principles of the Convention. On the other hand, such specific obligations should be carried out in a manner consistent with the general principles and objectives of the Convention.

134. The rules of reference contained in Part XII of the Convention and article 237 of the Convention demonstrate the openness of Part XII to other treaty regimes.

135. Third, article 31, paragraph 3(c), of the VCLT (see para. 129 above) requires that account be taken, together with the context, of any relevant rules of international law applicable in the relations between the parties. This method of interpretation ensures, as observed by the International Court of Justice (hereinafter “the ICJ”), that treaties do not operate in isolation but are “interpreted and applied within the framework of the entire legal system prevailing at the time of the interpretation” (*Legal Consequences for States of the Continued Presence of South Africa in Namibia (South West Africa) notwithstanding Security Council Resolution 276 (1970), Advisory Opinion, I.C.J. Reports 1971*, p. 16, at p. 31, para. 53). The term “any relevant rules of international law“ includes both relevant rules of treaty law and customary law.

136. The Tribunal is of the view that, subject to article 293 of the Convention, the provisions of the Convention and external rules should, to the extent possible, be interpreted consistently. In this context, the Tribunal notes that the Study Group of the International Law Commission (hereinafter “the ILC”), in its 2006 Report on the Fragmentation of International Law, concluded that “[i]t is a generally accepted principle that when several norms bear on a single issue they should, to the extent

possible, be interpreted so as to give rise to a single set of compatible obligations" (Fragmentation of International Law, Report of the Study Group of the ILC, 2006, p. 8; see also Guideline 9 of the 2021 ILC Guidelines on the protection of the atmosphere).

137. As reflected in paragraphs 67 to 82 above, there is an extensive treaty regime addressing climate change that includes the UNFCCC, the Kyoto Protocol, the Paris Agreement, Annex VI to MARPOL, Annex 16 to the Chicago Convention, and the Montreal Protocol, including the Kigali Amendment. The Tribunal considers that, in the present case, relevant external rules may be found, in particular, in those agreements.

VI. Scope of the Request and relationship between the questions

A. Scope of the Request

138. Before responding to the questions submitted to it, the Tribunal wishes to examine the scope of the Request.

139. There are two questions before the Tribunal:

> What are the specific obligations of State Parties to the United Nations Convention on the Law of the Sea ('UNCLOS'), including under Part XII:
>
> (a) to prevent, reduce and control pollution of the marine environment in relation to the deleterious effects that result or are likely to result from climate change, including through ocean warming and sea level rise, and ocean acidification, which are caused by anthropogenic greenhouse gas emissions into the atmosphere?
>
> (b) to protect and preserve the marine environment in relation to climate change impacts, including ocean warming and sea level rise, and ocean acidification?

The phrase: "What are the specific obligations of State Parties to the United Nations Convention on the Law of the Sea …, including under Part XII", applies both to Question (a) and Question (b). As the Tribunal has stated above, the questions raised by the Commission are clear enough to enable it to give an advisory opinion

(see para. 120 above). However, certain elements of that phrase have elicited divergent views in the present proceedings. Since the phrase is important to the scope of the Request, the Tribunal will now address these elements.

140. The questions posed to the Tribunal are concerned with the specific obligations "of State Parties to the United Nations Convention on the Law of the Sea". This wording suggests that the Commission seeks an opinion from the Tribunal on the specific obligations under the Convention. However, in the present proceedings, certain participants invited the Tribunal to provide guidance on States Parties' obligations under international law to curb anthropogenic GHG emissions into the atmosphere and the marine environment. In particular, it was suggested that the Tribunal could determine specific obligations assumed by States under the UNFCCC and the Paris Agreement.

141. Article 2, paragraph 2, of the COSIS Agreement authorizes the Commission to request advisory opinions from the Tribunal "on any legal question *within the scope of the 1982 United Nations Convention on the Law of the Sea*, consistent with Article 21 of the ITLOS Statute and Article 138 of its Rules" (emphasis added). The Commission itself has suggested that both questions concern States Parties' obligations under the Convention. Specifically, in its final oral statement in the present proceedings, the Commission asked the Tribunal "to state, clearly and objectively *what the current legal duties of States Parties are under UNCLOS* in relation to the impact of climate change on the marine environment" (emphasis added).

142. The Tribunal concludes that it is requested to render an advisory opinion on the specific obligations of States Parties under the Convention. In order to identify these obligations and clarify their content, the Tribunal will have to interpret the Convention and, in doing so, also take into account external rules, as appropriate.

143. The questions posed to the Tribunal refer to the specific obligations of States Parties to the Convention, "including under Part XII". Many participants focused their pleadings on the obligations contained in Part XII. However, other participants noted

that the questions are not limited to the obligations under Part XII of the Convention and addressed obligations under other parts of the Convention as well.

144. The Tribunal is of the view that, as a matter of ordinary interpretation, the word “including” in the above phrase indicates that the Tribunal is requested to provide guidance as to the specific obligations of the States Parties under Part XII as well as other relevant provisions of the Convention.

145. The Tribunal will now consider whether the issues of responsibility and liability fall within the scope of the Request. Some participants in the present proceedings have stated that issues of responsibility and liability are relevant, in particular because the Request refers to obligations without characterizing them as primary or secondary. In contrast, it has been argued that the Request concerns only primary obligations and does not involve issues of responsibility and liability, nor does it invite the Tribunal to consider legal consequences arising from the breach of obligations. The Commission, for instance, has explained that it is asking the Tribunal to state what the legal duties of States Parties are in relation to the impacts of climate change on the marine environment and not for which acts or omissions injunctive relief or compensation is available.

146. The Commission asks the Tribunal to identify specific “obligations” under the Convention; terms such as “responsibility” and “liability” do not appear in the Request. The Tribunal notes that article 1, paragraph 3, of the COSIS Agreement clearly distinguishes between the obligations, on the one hand, and responsibility for their breaches, on the other (see para. 97 above). Considering the Request against the backdrop of this provision, the Tribunal is of the view that if the Commission had intended for the Tribunal to address issues of responsibility and liability, it would have expressly formulated the Request accordingly.

147. In this regard, the Request is notably different from the requests for advisory opinion previously dealt with by the Seabed Disputes Chamber and the Tribunal. The request submitted to the Seabed Disputes Chamber explicitly asked not only about the responsibilities and obligations of States Parties with respect to the sponsorship of activities in the Area but also, *inter alia*, about the extent of liability of a State Party

for any failure to comply with the provisions of the Convention and the Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 by an entity it has sponsored (*Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011*, p. 10, at p. 15, para. 1). The request to the Tribunal for an advisory opinion submitted by the SRFC expressly asked not only about the obligations of the flag State but also, *inter alia,* about the extent to which a State should be held liable for illegal, unreported and unregulated fishing activities conducted by vessels under its flag (*Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission,* Advisory Opinion*, 2 April 2015, ITLOS Reports 2015*, p. 4, at p. 8, para. 2).

148. In both previous advisory opinions, a distinction has been made between primary and secondary obligations under international law (see *Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011*, p. 10, at pp. 30-31, paras. 64-71; *Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015, ITLOS Reports 2015*, p. 4, at p. 44, para. 145). In the present case, the Tribunal will confine itself to primary obligations. However, to the extent necessary to clarify the scope and nature of primary obligations, the Tribunal may have to refer to responsibility and liability.

149. The Tribunal wishes to address another issue concerning the Request's scope. Some participants, referring to the mention of sea level rise in the Request, invited the Tribunal to deal with the issue of the relationship between sea level rise and existing maritime claims or entitlements. On the other hand, other participants expressed the view that, while acknowledging the importance of this issue, the present proceedings should focus instead on environmental issues. The Commission, in particular, explained that questions relating to consequences of sea level rise upon maritime zones, entitlements and boundaries are not before the Tribunal in the present case.

150. The Request mentions sea level rise in both questions. The preamble of the COSIS Agreement states, *inter alia*, that the Parties to the Agreement affirm that

maritime zones, as established and notified to the Secretary-General of the United Nations in accordance with the Convention, and the rights and entitlements that flow from them, “shall continue to apply, without reduction, notwithstanding any physical changes connected to climate change-related sea-level rise”. However, neither the Request nor the decision that approved it refers to this provision or otherwise addresses the issue of base points, baselines, claims, rights or entitlements to maritime zones established under the Convention, or maritime boundaries, and the corresponding obligations in the context of “physical changes connected to climate change-related sea-level rise”. Instead, the Request employs sea level rise to form part of the context within which the Tribunal should consider the specific obligations concerning the protection and preservation of the marine environment, a matter on which the Request clearly concentrates. The Tribunal is of the view that if the Commission had intended to solicit an opinion on the consequences of sea level rise for base points, baselines, claims, rights or entitlements to the maritime zones established under the Convention, or maritime boundaries, and the corresponding obligations, it would have expressly formulated the Request accordingly.

B. Relationship between the questions

151. Before examining the two questions in the Request, the Tribunal wishes to address the relationship between them. Several participants in the proceedings expressed the view that the obligation to protect and preserve the marine environment reflected in the second question is more comprehensive than the obligation to prevent, reduce and control pollution of the marine environment reflected in the first question; therefore, the second question is broader than the first question. In this regard, some participants proposed that the Tribunal address Question (b) prior to Question (a).

152. The Tribunal considers that the obligation addressed in the second question is broader in scope than the obligation addressed in the first question. The obligation to protect and preserve the marine environment encompasses the obligation to prevent, reduce and control marine pollution. In addition, it extends to the protection of the marine environment from any negative impacts. As the arbitral tribunal in the *Chagos Marine Protected Area* case stated, “[w]hile the control of pollution is

certainly an important aspect of environmental protection, it is by no means the only one" (*Arbitration regarding the Chagos Marine Protected Area between Mauritius and the United Kingdom of Great Britain and Northern Ireland, Award of 18 March 2015, RIAA, Vol. XXXI*, p. 359, at pp. 499-500, para. 320; see also *Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission*, *Advisory Opinion*, *2 April 2015, ITLOS Reports 2015*, p. 4, at p. 37, para. 120; *Southern Bluefin Tuna (New Zealand* v. *Japan; Australia* v. *Japan), Provisional Measures, Order of 27 August 1999, ITLOS Reports 1999,* p. 280, at p. 295, para. 70; *The South China Sea Arbitration between the Republic of the Philippines and the People's Republic of China, Award of 12 July 2016*, *RIAA, Vol. XXXIII*, p. 153, at pp. 521-522, para. 945). Thus, implementing the obligation to prevent, reduce and control pollution of the marine environment does not exhaust the implementation of the obligation to protect and preserve it. Given this relationship between the two obligations addressed in the questions before the Tribunal, it is plain that the second question is more comprehensive than the first question. The Tribunal will follow the order of the questions as they were posed in the Request and in its response to the second question will deal with the obligations not addressed in the first question.

VII. Question (a)

153. The Tribunal will now turn to the first question posed by the Commission. The question reads:

> What are the specific obligations of State Parties to the United Nations Convention on the Law of the Sea (the 'UNCLOS'), including under Part XII:
>
> (a) to prevent, reduce and control pollution of the marine environment in relation to the deleterious effects that result or are likely to result from climate change, including through ocean warming and sea level rise, and ocean acidification, which are caused by anthropogenic greenhouse gas emissions into the atmosphere?

A. Clarification of terms and expressions

154. The first question posed to the Tribunal by the Commission concerns the specific obligations of States Parties to the Convention to prevent, reduce and

control marine pollution in relation to the deleterious effects that result or are likely to result from climate change and ocean acidification, which are caused by anthropogenic GHG emissions into the atmosphere. Before responding to the question, the Tribunal wishes to clarify certain terms and expressions employed therein to determine the precise meaning of the question.

155. The Tribunal first notes that the question asks the Tribunal to identify specific obligations of “State Parties to UNCLOS”. The term “State Parties” refers to States and international organizations which have become Parties to the Convention in accordance with article 1, paragraph 2, subparagraphs 1 and 2, of the Convention. Currently, 168 States and one international organization are Parties to the Convention.

156. The next point the Tribunal wishes to clarify is the meaning of “specific obligations” to prevent, reduce and control pollution of the marine environment. The term “specific obligations” may denote concrete or particularized obligations, in contrast to general obligations. It may also mean obligations specific to pollution of the marine environment in relation to the deleterious effects arising from climate change and ocean acidification. In responding to the question, the Tribunal will bear in mind both aspects of the term “specific”.

157. The terms “climate change”, “greenhouse gas emissions”, and “ocean acidification” do not appear in the Convention. The Tribunal understands that those terms are used in Question (a) as they are defined in relevant legal instruments relating to climate change or in authoritative scientific works such as in the IPCC reports. For the purpose of responding to Question (a), the Tribunal accepts those definitions and usage, which have already been explained in paragraphs 52, 54, 60 and 68 above.

158. Question (a) points to the specific obligations under the Convention to prevent, reduce and control marine pollution “in relation to” the deleterious effects that result or are likely to result from climate change and ocean acidification, which are caused by anthropogenic GHG emissions. The Tribunal observes that the question is formulated on the premise that these obligations necessarily apply to

climate change and ocean acidification. However, in the Tribunal's view, the validity of this premise cannot be presumed and needs to be examined. Therefore, the Tribunal will first address whether the obligations under the Convention apply to climate change and ocean acidification. If they do, the Tribunal will then examine how those obligations should be interpreted and applied in relation to the deleterious effects caused by anthropogenic GHG emissions.

B. Whether anthropogenic GHG emissions fall within the definition of marine pollution under the Convention

159. In responding to Question (a), the first issue that should be addressed is whether anthropogenic GHG emissions into the atmosphere fall under the definition of "pollution of the marine environment" under article 1, paragraph 1, subparagraph 4, of the Convention.

160. A large majority of the participants in the proceedings recognized that anthropogenic GHG emissions meet the definition of "pollution of the marine environment" under article 1, paragraph 1, subparagraph 4, of the Convention. On the other hand, some participants argued that GHG emissions should not be considered "pollution of the marine environment" and that to include them within the ambit of "pollution of the marine environment" would be tantamount to the Tribunal exercising legislative functions.

161. Article 1, paragraph 1, subparagraph 4, of the Convention reads:

> For the purposes of this Convention … "pollution of the marine environment" means the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities.

This definition does not provide a list of pollutants or forms of pollution of the marine environment. Instead, it sets out three criteria to determine what constitutes such pollution: (1) there must be a substance or energy; (2) this substance or energy must be introduced by humans, directly or indirectly, into the marine environment; and

(3) such introduction must result or be likely to result in deleterious effects. These criteria are cumulative; all of them must be satisfied to meet the definition. The definition is general in that it encompasses whatever satisfies these criteria.

162. The Tribunal will now examine whether anthropogenic GHG emissions satisfy the criteria set out above.

163. The terms “substance” and “energy” have a broad meaning. The Tribunal is of the view that, in the context of the present case, the term “substance” refers to any particular kind of matter with uniform properties or a kind of matter of a definite chemical composition. As to the term “energy”, the Tribunal notes that one of the forms of energy is thermal energy or heat. It further notes that the ILC, in its commentary to the definition of “atmospheric pollution” – and specifically to the “introduction of energy” – in the 2021 Draft guidelines on the protection of the atmosphere, explains that this reference to energy is understood to include heat (ILC Draft guidelines on the protection of the atmosphere, Commentary to Guideline 1, subpara. (b)).

164. The term “gas”, in the context of the present case, refers to a substance in a form like air that is neither solid nor liquid. It is clear from the ordinary meaning of the word “gas” and from the UNFCCC and IPCC definitions of the term “greenhouse gases” (see paras. 54 and 68 above) that they are substances. Consequently, the first criterion of the Convention’s definition of “pollution of the marine environment” is satisfied.

165. The Tribunal will now address the second criterion. The first question concerns, in the context of pollution of the marine environment, not GHGs as such but “anthropogenic emissions” thereof. In view of the definitions of the term “emissions” in the UNFCCC (see para. 68 above) and of the terms “anthropogenic” and “anthropogenic emissions” by the IPCC (see para. 54 above), it is clear that anthropogenic GHG emissions are produced “by man”, within the meaning of article 1, paragraph 1, subparagraph 4, of the Convention.

166. The term “marine environment” appears in many provisions of the Convention. However, the Convention does not give a definition of it. The term “marine” means belonging to, existing or found in, or produced by, the sea; belonging to, or situated at, the sea-side, bounded by the sea. The term “environment” denotes the area surrounding a place or thing; the surroundings or physical context and conditions in which an organism lives, develops, or a thing exists; the external conditions in general affecting the life, existence, or properties of an organism or object. The ICJ has recognized that the environment “represents the living space, the quality of life and the very health of human beings, including generations unborn” (*Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, I.C.J. Reports 1996*, p. 226, at p. 241, para. 29). Thus, it may be assumed that the term “marine environment” in article 1, paragraph 1, subparagraph 4, of the Convention combines both spatial and material components. This is supported, in particular, by the context in which the term is used in the Convention, in light of its object and purpose, by the relevant subsequent practice of the States Parties to the Convention regarding its interpretation, and by the corresponding international jurisprudence.

167. According to its fourth preambular paragraph, one of the main goals of the Convention is to establish a legal order for the seas and oceans that will promote the protection and preservation of the marine environment. Here, the marine environment is referred to in a general sense. The Tribunal notes that most of the provisions of Part XII and, in particular, articles 192 and 194, use the term “marine environment” generally, without specifying to which maritime zone it relates.

168. Article 1, paragraph 1, subparagraph 4, of the Convention refers to “the marine environment, including estuaries”. Articles 145, paragraph (a), and 211, paragraph 1, refer to “the marine environment, including the coastline”. This indicates that the marine environment under the Convention encompasses certain spaces beyond maritime zones established thereunder.

169. Under article 194, paragraph 5, of the Convention, the measures taken in accordance with Part XII, i.e., protection and preservation of the marine environment, “shall include those necessary to protect and preserve rare or fragile ecosystems as

well as the habitat of depleted, threatened or endangered species and other forms of marine life." The term "ecosystem" is not defined in the Convention, but article 2 of the Convention on Biological Diversity (hereinafter "the CBD"), which was adopted on 5 June 1992 and entered into force on 29 December 1993, defines ecosystem to mean "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit." The IPCC defines "ecosystem" as a "functional unit consisting of living organisms, their non-living environment and the interactions within and between them" (2019 Report, Annex I, Glossary, p. 684). In this regard, the Tribunal recalls that in the *Southern Bluefin Tuna* cases and in the *SRFC Advisory Opinion*, it held that living resources of the sea and marine life are part of the marine environment (*Southern Bluefin Tuna (New Zealand* v. *Japan; Australia* v. *Japan), Provisional Measures, Order of 27 August 1999, ITLOS Reports 1999*, p. 280, at p. 295, para. 70; *Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015, ITLOS Reports 2015*, p. 4, at p. 61, para. 216; see also *Arbitration regarding the Chagos Marine Protected Area between Mauritius and the United Kingdom of Great Britain and Northern Ireland, Award of 18 March 2015, RIAA, Vol. XXXI*, p. 359, at p. 580, para. 538).

170. The Tribunal notes that the term "marine environment" is defined in the regulations relating to prospecting and exploration of mineral resources in the Area adopted by the Authority. These regulations all provide the same definition of the term "marine environment", stating that it

> includes the physical, chemical, geological and biological components, conditions and factors which interact and determine the productivity, state, condition and quality of the marine ecosystem, the waters of the seas and oceans and the airspace above those waters, as well as the seabed and ocean floor and subsoil thereof.
> (Regulations on prospecting and exploration for polymetallic sulphides in the Area, regulation 1, para. 3(c); Regulations on Prospecting and Exploration for Cobalt-rich Ferromanganese Crusts in the Area, regulation 1, paragraph 3(d); Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area, regulation 1, paragraph 3(c).)

This definition of the marine environment has spatial and material dimensions. In clarifying the term "marine environment", the Tribunal has taken these regulations

into account as representing the practice of the States Parties to the Convention and of the Authority in this respect.

171. The Tribunal also notes that the participants in the present proceedings who addressed the meaning of the term “marine environment” expressed the view that it should be understood broadly.

172. The ordinary meaning of the word “introduction” relevant in the present context is the action of introducing, bringing in or inserting. The ordinary relevant meaning of the word “directly” indicates the absence of an intervening medium or agent; that is to say, through a direct process or mode. The ordinary relevant meaning of the word “indirectly” suggests indirect action or through indirect means, connection, agency or instrumentality, or an intervening person or thing. Given these ordinary meanings of “direct” and “indirect”, the introduction of the anthropogenic GHGs into the marine environment may take place either immediately, through a direct mode or in stages. According to the science (see para. 60 above), because of its solubility and chemical reactivity, carbon dioxide from human activities, which has the largest share and growth in gross GHG emissions (2023 Synthesis Report, p. 4), is taken up by the ocean much more effectively than other emitted gases. Carbon dioxide then dissolves in sea water and mixes into the deep ocean (see, e.g., Climate Change 2001, The Scientific Basis, pp. 187, 197-199). Thus, GHGs, as substances, are directly introduced by humans into the marine environment. Furthermore, according to the science (see para. 54 above), GHGs trap heat within the atmosphere and the ocean then stores this heat. In this way, and considering that heat is a form of energy, humans indirectly introduce energy into the marine environment through anthropogenic GHG emissions.

173. In light of the above, the Tribunal concludes that anthropogenic GHG emissions satisfy the second criterion of the “pollution of the marine environment” definition.

174. To fall within the definition of marine pollution, the introduction of substances or energy must result or be likely to result “in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine

activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities". The Tribunal notes that the "deleterious effects" illustrated in article 1, paragraph 1, subparagraph 4, of the Convention are not exhaustive, as implied by the words "such ... as" and, in any case, are not limited to the marine environment. This is clear, considering, for instance, that effects on human health, marine activities or amenities are mentioned. The definition also points to actual ("results") or potential ("likely to result") deleterious effects. The Tribunal further notes that the definition neither qualifies the "likelihood" of the deleterious effects nor specifies the level of "harm" that can be considered a deleterious effect.

175. The introduction of excess heat (energy) into the marine environment due to the accumulation of GHGs in the atmosphere results in ocean warming. Being itself a component of climate change, ocean warming, according to the IPCC findings made with high confidence, "accounted for 91% of the heating in the climate system" (WGI 2021 Report, p. 11). Anthropogenic GHG emissions thereby cause climate change, which includes ocean warming and sea level rise. The introduction of anthropogenic GHGs into the marine environment also causes ocean acidification (see para. 60 above). In turn, climate change, including ocean warming and sea level rise, and ocean acidification, interacting with other climatic and non-climatic factors, produce multiple deleterious effects on the marine environment and beyond. These effects of climate change and ocean acidification are observed and explained by the science and are widely acknowledged by States (see paras. 51 to 61 above). In particular, adverse effects of climate change are recognized by international climate treaties.

176. The UNFCCC has already acknowledged that human activities have been substantially increasing the atmospheric concentrations of GHGs, that this will result on average in an additional warming of the Earth's surface and atmosphere and may adversely affect natural ecosystems and humankind, and that climate change has adverse effects (UNFCCC, first and second preambular paragraphs). This has been further recognized in the Kyoto Protocol and the Paris Agreement.

177. The UNFCCC defines the adverse effects of climate change as

> changes in the physical environment or biota resulting from climate change which have significant deleterious effects on the composition, resilience or productivity of natural and managed ecosystems or on the operation of socio-economic systems or on human health and welfare.
> (UNFCCC, Article 1, para. 1)

178. The adverse effects of climate change and ocean acidification satisfy the criterion relating to “deleterious effects” provided in article 1, paragraph 1, subparagraph 4, of the Convention. Thus, through the introduction of carbon dioxide and heat (energy) into the marine environment, anthropogenic GHG emissions cause climate change and ocean acidification, which results in the deleterious effects illustrated in the definition of pollution of the marine environment.

179. In light of the above, the Tribunal concludes that anthropogenic GHG emissions into the atmosphere constitute pollution of the marine environment within the meaning of article 1, paragraph 1, subparagraph 4, of the Convention.

C. Part XII of the Convention and marine pollution

180. Having found that anthropogenic GHG emissions into the atmosphere constitute “pollution of the marine environment” within the meaning of article 1, paragraph 1, subparagraph 4, of the Convention, the Tribunal will now turn to the specific obligations of States Parties to the Convention to prevent, reduce and control such pollution.

181. In this regard, the Tribunal will first identify the provisions of the Convention relevant to its response to Question (a). It will then interpret those provisions to the extent necessary to respond to the question and examine how they should be applied in relation to anthropogenic GHG emissions causing pollution of the marine environment. The Tribunal will conclude by setting out the specific obligations of States Parties to prevent, reduce and control pollution of the marine environment arising from climate change and ocean acidification.

182. The provisions of the Convention which are relevant to answering Question (a) are those dealing with the obligations to prevent, reduce and control pollution of the marine environment. These provisions are mostly found in Part XII of the Convention. Before identifying and analysing them, the Tribunal finds it appropriate to give an overview of the system for the protection and preservation of the marine environment set out in Part XII of the Convention, in particular the marine pollution regime.

183. As stated in the fourth preambular paragraph of the Convention, the protection and preservation of the marine environment is one of the goals to be achieved by the Convention. To that end, the Convention, in particular Part XII, sets out fundamental principles to provide direction and guidance to States in their endeavour to protect and preserve the marine environment, and imposes upon States various obligations in this regard.

184. Article 192 of the Convention, the first article of Part XII, provides that "States have the obligation to protect and preserve the marine environment." While article 192 imposes upon States a legal obligation, this provision is, at the same time, a statement of principle upon which the legal order for the protection and preservation of the marine environment under the Convention is based.

185. Article 193 of the Convention provides that

> States have the sovereign right to exploit their natural resources pursuant to their environmental policies and in accordance with their duty to protect and preserve the marine environment.

186. These two articles together reflect, in the context of the protection and preservation of the marine environment, a principle of international environmental law, which has its origin in the Stockholm Declaration on the Human Environment adopted on 16 June 1972 (hereinafter "the Stockholm Declaration"). Principle 21 of the Stockholm Declaration reads:

> States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do

> not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

This principle was further developed in Principle 2 of the Rio Declaration on Environment and Development adopted on 14 June 1992 (hereinafter "the Rio Declaration"), which refers to the sovereign right of States to exploit their own resources pursuant to their own environmental and "developmental" policies.

187. It should be noted that, while article 193 of the Convention recognizes the sovereign right of States to exploit their natural resources pursuant to their environmental policies, it further provides that States must exercise such right "in accordance with their duty to protect and preserve the marine environment." This article thus places a constraint upon States' exercise of their sovereign right. This shows the importance the Convention attaches to the protection and preservation of the marine environment.

188. The approach of the Convention to the protection and preservation of the marine environment is manifest in the subsequent provisions of Part XII. Those provisions impose upon States, among other obligations, those to prevent, reduce and control pollution of the marine environment. While the obligation to protect and preserve the marine environment is much broader in scope than the obligation to prevent, reduce and control marine pollution, the latter obligation constitutes the main component of the former obligation under the Convention.

189. Many provisions of Part XII of the Convention are directly or indirectly concerned with the prevention, reduction and control of pollution of the marine environment. They are structured in such a way as to provide for what may be called the regime for regulating marine pollution. The key provision in this regard is article 194 of the Convention, which requires States, *inter alia*, to take all necessary measures to prevent, reduce and control pollution of the marine environment from "any source". Thus, this article lays down an obligation common to all sources of pollution with which States must comply.

190. This obligation under article 194 of the Convention is complemented and elaborated upon by provisions in section 5 of Part XII (articles 207 to 212), which address the obligations of States with respect to specific sources of pollution. Those provisions are essentially concerned with the adoption of national legislation and the establishment of international rules and standards to regulate marine pollution. Section 6 of Part XII (articles 213 to 222), which corresponds to source-specific obligations under section 5, addresses the obligations of States to enforce national legislation and to implement international rules and standards.

191. In addition, there are other provisions in Part XII relevant to the prevention, reduction and control of pollution of the marine environment. They include provisions in section 2 on global and regional cooperation, section 3 on technical assistance and section 4 on monitoring and environmental assessment.

192. For the purpose of the present Advisory Opinion, the Tribunal will first consider the obligations of States under article 194 of the Convention and how they should be interpreted and applied in relation to marine pollution arising from anthropogenic GHG emissions. It will then proceed to examine the obligations of States with respect to the specific sources of pollution provided for in sections 5 and 6 of Part XII. The Tribunal will subsequently consider other relevant obligations under sections 2, 3 and 4 of Part XII.

D. Obligations applicable to any source of pollution under article 194 of the Convention

193. Article 194 of the Convention is the primary provision in the marine pollution regime set out in Part XII. This article provides for obligations to prevent, reduce and control marine pollution applicable to any source. Most of the participants in the proceedings took the view that article 194 of the Convention is a key provision in responding to Question (a).

194. Article 194 of the Convention reads:

Measures to prevent, reduce and control pollution of the marine environment

1. States shall take, individually or jointly as appropriate, all measures consistent with this Convention that are necessary to prevent, reduce and control pollution of the marine environment from any source, using for this purpose the best practicable means at their disposal and in accordance with their capabilities, and they shall endeavour to harmonize their policies in this connection.

2. States shall take all measures necessary to ensure that activities under their jurisdiction or control are so conducted as not to cause damage by pollution to other States and their environment, and that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights in accordance with this Convention.

3. The measures taken pursuant to this Part shall deal with all sources of pollution of the marine environment. These measures shall include, *inter alia*, those designed to minimize to the fullest possible extent:

(a) the release of toxic, harmful or noxious substances, especially those which are persistent, from land-based sources, from or through the atmosphere or by dumping;

(b) pollution from vessels, in particular measures for preventing accidents and dealing with emergencies, ensuring the safety of operations at sea, preventing intentional and unintentional discharges, and regulating the design, construction, equipment, operation and manning of vessels;

(c) pollution from installations and devices used in exploration or exploitation of the natural resources of the seabed and subsoil, in particular measures for preventing accidents and dealing with emergencies, ensuring the safety of operations at sea, and regulating the design, construction, equipment, operation and manning of such installations or devices;

(d) pollution from other installations and devices operating in the marine environment, in particular measures for preventing accidents and dealing with emergencies, ensuring the safety of operations at sea, and regulating the design, construction, equipment, operation and manning of such installations or devices.

4. In taking measures to prevent, reduce or control pollution of the marine environment, States shall refrain from unjustifiable interference with activities carried out by other States in the exercise of their rights and in pursuance of their duties in conformity with this Convention.

5. The measures taken in accordance with this Part shall include those necessary to protect and preserve rare or fragile ecosystems as well as the

> habitat of depleted, threatened or endangered species and other forms of marine life.

195. This article provides for three main obligations of States: first, the obligation under paragraph 1 to take necessary measures to prevent, reduce and control marine pollution; second, the obligation under paragraph 2 to take necessary measures to ensure that certain situations relating to pollution do not occur; and third, the obligation under paragraph 5 to take necessary measures to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life.

196. Although the third obligation is included in article 194 of the Convention addressing measures to prevent, reduce and control marine pollution, it is clear that the measures envisaged under paragraph 5 are not circumscribed to merely those concerning pollution. For that reason, this paragraph refers to the measures taken in accordance with “this Part” rather than “this article”. The Tribunal considers that the third obligation can be more adequately addressed in the context of its reply to Question (b) as to the specific obligations to protect and preserve the marine environment. In its response to Question (a), the Tribunal will accordingly confine itself to the two obligations under paragraphs 1 and 2.

1. Obligation under article 194, paragraph 1, of the Convention

197. Article 194, paragraph 1, of the Convention imposes upon States an obligation to take all necessary measures to prevent, reduce and control marine pollution from any source, regardless of the specific sources of such pollution. This obligation is applicable to any kind of pollution. As anthropogenic GHG emissions into the atmosphere constitute pollution of the marine environment, it follows that article 194, paragraph 1, applies to such pollution. Most of the participants in the present proceedings expressed the same view.

(a) Scope and content of the obligation

Objective

198. The aim of the obligation to take all necessary measures under article 194, paragraph 1, of the Convention is to "prevent, reduce and control" pollution of the marine environment from any source. As the objective of prevention refers to preventing pollution from occurring at all, it necessarily applies to pollution that has not yet occurred, namely, future or potential pollution. On the other hand, the objective of reducing and controlling pollution presupposes the existence of pollution. Thus, the objective of preventing, reducing and controlling pollution means preventing future or potential pollution and reducing and controlling existing pollution. The compound objective to prevent, reduce and control marine pollution should be understood in the context of the comprehensive nature of the obligation under article 194, paragraph 1, to prevent, reduce and control any kind of pollution from any source. It is also a reflection of the reality that prevention of pollution from all sources at all times is, in practice, not possible.

199. In relation to anthropogenic GHG emissions, the objective of preventing, reducing and controlling marine pollution should be appreciated on the basis of the scientific assessment that, even if anthropogenic GHG emissions were to cease, the deleterious effects on the marine environment would nevertheless continue owing to the extent of GHGs already accumulated in the atmosphere. The obligation under article 194, paragraph 1, of the Convention requires States to take all necessary measures with a view to reducing and controlling existing marine pollution from such emissions and eventually preventing such pollution from occurring at all. Therefore, this obligation does not entail the immediate cessation of marine pollution from anthropogenic GHG emissions.

200. The Tribunal notes in this regard Article 4, paragraph 1, of the Paris Agreement, which provides that

> [i]n order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country

> Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century.

The Tribunal considers that the aim set out in the above provision is consistent with the objective of the obligation under article 194, paragraph 1, of the Convention.

Modalities

201. All measures necessary to prevent, reduce and control marine pollution shall be taken individually or jointly as appropriate. The phrase “as appropriate” in this context implies that there is no priority between an individual action and a joint action. Either action can be taken if it is appropriate. The appropriateness of an individual or joint action depends on the particular circumstances in which measures are taken. The reference to the word “jointly” indicates the importance of cooperation in addressing pollution of the marine environment. This point is also underscored by requiring States to “endeavour to harmonize their policies” in taking necessary measures as set forth in the final part of article 194, paragraph 1, of the Convention.

202. In relation to marine pollution from anthropogenic GHG emissions, given the global and transboundary nature of such pollution, joint actions should be actively pursued. It was contended in this regard that it is only through joint action that global levels of GHG emissions in the atmosphere and the consequent pollution of the marine environment can be prevented, reduced and controlled. While the importance of joint actions in regulating marine pollution from anthropogenic GHG emissions is undisputed, it does not follow that the obligation under article 194, paragraph 1, of the Convention is discharged exclusively through participation in the global efforts to address the problems of climate change. States are required to take all necessary measures, including individual actions as appropriate.

Necessary measures

203. Article 194, paragraph 1, of the Convention requires States to take “all measures … that are necessary” to prevent, reduce and control pollution of the

marine environment. The word “necessary” ordinarily means “indispensable”, “requisite” or “essential”. In the context of this provision, “necessary” should be understood broadly. Such understanding is consistent with the expansive scope of the obligation under article 194, paragraph 1, implied by words such as “all” measures or “any” source. It is further supported by the inclusive definition of “pollution of the marine environment” set forth in article 1, paragraph 1, subparagraph 4, of the Convention. Accordingly, necessary measures include not only measures which are indispensable to prevent, reduce and control marine pollution but also other measures which make it possible to achieve that objective.

204. However, such measures must be “consistent with [the] Convention”, as stated in article 194, paragraph 1, of the Convention. It is clear that measures to prevent, reduce and control marine pollution must be consistent with the Convention, in which rights and duties of the coastal State or flag State in various maritime zones are set out. In addition, necessary measures must not deny or unjustifiably interfere with the rights of States recognized by the Convention, such as navigational rights. This point is underscored by article 194, paragraph 4, which provides that

> [i]n taking measures to prevent, reduce or control pollution of the marine environment, States shall refrain from unjustifiable interference with activities carried out by other States in the exercise of their rights and in pursuance of their duties in conformity with this Convention.

205. Article 194, paragraph 1, of the Convention does not provide for any specific criteria as to what constitutes necessary measures. However, paragraph 3 of this article gives some indication about the kinds of measures that States must take with respect to specific sources of pollution. Among such measures, there are those designed to minimize, to the fullest possible extent, the release of toxic, harmful or noxious substances, especially those which are persistent. In the context of climate change, those measures are commonly known as “mitigation measures”. Central to such measures is the reduction of anthropogenic GHG emissions into the atmosphere.

206. While article 194, paragraph 1, of the Convention leaves it to each State to determine what measures are necessary to prevent, reduce and control marine

pollution, this does not mean that such measures are whatever measures States deem necessary to that end. Rather, necessary measures should be determined objectively. Many participants in the proceedings emphasized the importance of objectively determining those measures.

207. In the Tribunal's view, there are various factors States should consider in their objective assessment of necessary measures to prevent, reduce and control marine pollution from anthropogenic GHG emissions. It is evident that the science is particularly relevant in this regard. International rules and standards relating to climate change are another relevant factor. There are other factors that may be considered, such as available means and capabilities of the State concerned.

208. With regard to climate change and ocean acidification, the best available science is found in the works of the IPCC which reflect the scientific consensus. As noted in paragraph 51 above, most of the participants expressed the view that the IPCC reports are authoritative assessments of the scientific knowledge on climate change and referred to them in their pleadings in the present proceedings. In this regard, the Tribunal considers that the assessments of the IPCC relating to climate-related risks and climate change mitigation deserve particular consideration.

209. In the 2018 Report, the IPCC concludes that there is a high risk of a much worse outcome if temperature increases exceed 1.5°C above pre-industrial levels (2018 Report, Summary for Policymakers, p. 10). It points out significant differences in impacts when global temperature increases are maintained within 1.5°C as compared to 2°C. It states with high confidence that limiting global warming to 1.5°C compared to 2°C

> is projected to reduce increases in ocean temperature as well as associated increases in ocean acidity and decreases in ocean oxygen levels … Consequently, limiting global warming to 1.5°C is projected to reduce risks to marine biodiversity, fisheries, and ecosystems, and their functions and services to humans.
> (*ibid*., p. 8)

As to ocean acidification, the IPCC states with high confidence that

> [t]he level of ocean acidification due to increasing CO_2 concentrations associated with global warming of 1.5°C is projected to amplify the adverse effects of warming, and even further at 2°C, impacting the growth, development, calcification, survival, and thus abundance of a broad range of species, for example, from algae to fish.
> (*ibid*., p. 9)

210. As to emission pathways, the IPCC states in the 2018 Report that "[l]imiting warming to 1.5°C implies reaching net zero CO_2 emissions globally around 2050 and concurrent deep reductions in emissions of non-CO_2 forcers, particularly methane (*high confidence*)" (2018 Report, p. 95). It also states in the 2023 Synthesis Report that

> [d]eep, rapid, and sustained GHG emissions reductions, reaching net zero CO_2 emissions and including strong emissions reductions of other GHGs, in particular CH_4, are necessary to limit warming to 1.5°C … or less than 2°C … by the end of century (*high confidence*).
> (2023 Synthesis Report, p. 68)

211. The Tribunal notes that while most of the participants in the proceedings agree that States should refer to the science in determining necessary measures, there is disagreement among them as to its exact role. In this regard, it was contended that best available scientific standards require States, at a minimum, to take all measures objectively necessary to limit average global temperature rise to no more than 1.5°C above pre-industrial levels, without overshoot, taking into account any current emission gaps. It was also contended that States are required to reach global peaking of GHG emissions as soon as possible and undertake rapid reduction thereafter in accordance with the best available science. However, other participants took the view that while the best available science is a relevant factor for States to consider in assessing necessary measures under article 194, paragraph 1, of the Convention, it is not the only relevant factor to be considered. It was argued in this regard that the view that necessary measures must be aimed at limiting average temperature rise to 1.5°C above pre-industrial levels would be to elevate scientific information to the status of a legal obligation under the Convention, without accounting for the other factors. According to this view, some of those factors may point in different directions from others, and a State must weigh them in any particular circumstance.

212. The Tribunal considers that in the determination of necessary measures to prevent, reduce and control marine pollution from anthropogenic GHG emissions, the science undoubtedly plays a crucial role, as it is key to understanding the causes, effects and dynamics of such pollution and thus to providing the effective response. However, this does not mean that the science alone should determine the content of necessary measures. In the Tribunal's view, as indicated above, there are other relevant factors that should be considered and weighed together with the best available science.

213. The Tribunal wishes to add at this juncture that in determining necessary measures, scientific certainty is not required. In the absence of such certainty, States must apply the precautionary approach in regulating marine pollution from anthropogenic GHGs. While the precautionary approach is not explicitly referred to in the Convention, such approach is implicit in the very notion of pollution of the marine environment, which encompasses potential deleterious effects. In this regard, the Tribunal recalls the observation of the Seabed Disputes Chamber in *Responsibilities and Obligations of States with Respect to Activities in the Area* (hereinafter "the *Area Advisory Opinion*") that

> the precautionary approach has been incorporated into a growing number of international treaties and other instruments, many of which reflect the formulation of Principle 15 of the Rio Declaration. In the view of the Chamber, this has initiated a trend towards making this approach part of customary international law.
> (*Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011*, p. 10, at p. 47, para. 135)

For marine pollution arising from anthropogenic GHG emissions, the precautionary approach is all the more necessary given the serious and irreversible damage that may be caused to the marine environment by such pollution, as is assessed by the best available science.

214. Relevant international rules and standards are another reference point for assessing necessary measures. In the context of climate change, such international rules and standards are found in various climate-related treaties and instruments.

The UNFCCC and the Paris Agreement stand out in this regard as primary treaties addressing climate change. Annex VI to MARPOL, which was amended in 2011 and 2021 with a view to reducing GHG emissions from ships, is also relevant. Volumes III and IV of Annex 16 to the Chicago Convention can be referred to in taking necessary measures to prevent, reduce and control GHG emissions from aircraft. The Montreal Protocol, including the Kigali Amendment, is also of relevance.

215. Most of the participants in the proceedings referred to the UNFCCC and the Paris Agreement as being relevant to the assessment of necessary measures. In this regard, the Tribunal considers the global temperature goal and the timeline for emission pathways set forth in the Paris Agreement particularly relevant. They are based upon the best available science stated above.

216. Article 2, paragraph 1, of the Paris Agreement, as stated above (see para. 72), provides that the Agreement aims to strengthen the global response to the threat of climate change, including by

> [h]olding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change.

The dual temperature goal stipulated in the Paris Agreement has been further strengthened by the successive decisions of the Parties to the Paris Agreement. In 2022, for example, the COP adopted the Sharm el-Sheikh Implementation Plan, in which it "[*r*]*eiterates* that the impacts of climate change will be much lower at the temperature increase of 1.5°C compared with 2 °C and *resolves* to pursue further efforts to limit the temperature increase to 1.5 °C" (Decision 1/CP.27 of 20 November 2022, para. 7; see also Decision FCCC/PA/CMA/2023/L.17 of 13 December 2023, para. 4).

217. Article 4, paragraph 1, of the Paris Agreement sets timelines for emission pathways to achieve the long-term temperature goal set out in Article 2. According to this provision,

> Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century.

218. Article 4, paragraph 2, of the Paris Agreement requires each Party to "prepare, communicate and maintain successive nationally determined contributions that it intends to achieve." Parties then "shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions." In addition, each Party's successive nationally determined contribution "will represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances."

219. Most of the participants in the proceedings took the view that the international rules and standards set out in the UNFCCC and the Paris Agreement are relevant in determining necessary measures under article 194, paragraph 1, of the Convention. The Tribunal notes, however, that there is a divergence of views among participants as to the relationship between the obligations under the Convention, on the one hand, and the obligations and commitments contained in the Paris Agreement, on the other. This dissent concerns, *inter alia*, the role to be accorded to international rules and standards under the Paris Agreement in the determination of necessary measures under article 194, paragraph 1, of the Convention.

220. It was contended in this regard that compliance with the UNFCCC and the Paris Agreement satisfies the specific obligation under article 194 of the Convention to take measures to prevent, reduce and control pollution of the marine environment arising from anthropogenic GHG emissions. It was also argued that Part XII of the Convention should not be interpreted as imposing obligations with respect to such emissions that are inconsistent with, or that go beyond, those agreed by the international community in the specific context of the UNFCCC and the Paris Agreement. According to this view, the UNFCCC and the Paris Agreement are *lex specialis* in respect of the obligations of States Parties under the more general provisions of the Convention. In the same vein, several participants took the view

that, as concerns obligations regarding the effect of climate change, the Convention does not by itself impose more stringent commitments than those laid down in the UNFCCC and the Paris Agreement.

221. Other participants disagreed with those views. It was contended that the question of what measures are necessary to prevent, reduce and control pollution of the marine environment is not to be interpreted solely or primarily by reference to the separate and independent commitments under the specialized treaties on climate change. It was also contended that the Paris Agreement should be considered as a minimum standard for compliance with Part XII of the Convention as concerns the deleterious effects of climate change. Similarly, many participants expressed the view that the Paris Agreement does not exhaust States' obligations to protect and preserve the marine environment from the adverse impacts of climate change. It was stated in this regard that while any true obligations under those specialized treaties are to be taken into account, this in no way precludes the Tribunal from going beyond the Paris Agreement. Many participants also took the view that it is not necessary to apply the principle of *lex specialis,* as no conflict exists between the rules concerned.

222. In the view of the Tribunal, the UNFCCC and the Paris Agreement, as the primary legal instruments addressing the global problem of climate change, are relevant in interpreting and applying the Convention with respect to marine pollution from anthropogenic GHG emissions. In particular, the temperature goal and the timeline for emission pathways set out in the Paris Agreement inform the content of necessary measures to be taken under article 194, paragraph 1, of the Convention. However, the Paris Agreement does not require the Parties to reduce GHG emissions to any specific level according to a mandatory timeline but leaves each Party to determine its own national contributions in this regard.

223. The Tribunal does not consider that the obligation under article 194, paragraph 1, of the Convention would be satisfied simply by complying with the obligations and commitments under the Paris Agreement. The Convention and the Paris Agreement are separate agreements, with separate sets of obligations. While the Paris Agreement complements the Convention in relation to the obligation to

regulate marine pollution from anthropogenic GHG emissions, the former does not supersede the latter. Article 194, paragraph 1, imposes upon States a legal obligation to take all necessary measures to prevent, reduce and control marine pollution from anthropogenic GHG emissions, including measures to reduce such emissions. If a State fails to comply with this obligation, international responsibility would be engaged for that State.

224. The Tribunal also does not consider that the Paris Agreement modifies or limits the obligation under the Convention. In the Tribunal's view, the Paris Agreement is not *lex specialis* to the Convention and thus, in the present context, *lex specialis derogat legi generali* has no place in the interpretation of the Convention. Furthermore, as stated above, the protection and preservation of the marine environment is one of the goals to be achieved by the Convention. Even if the Paris Agreement had an element of *lex specialis* to the Convention, it nonetheless should be applied in such a way as not to frustrate the very goal of the Convention.

Available means and capabilities

225. The Tribunal will now consider other factors relevant to the determination of necessary measures to prevent, reduce and control marine pollution. Article 194, paragraph 1, of the Convention provides that States shall take necessary measures, using for this purpose "the best practicable means at their disposal" and "in accordance with their capabilities". Thus, the scope and content of necessary measures may vary depending on the means available to States and their capabilities, such as their scientific, technical, economic and financial capabilities.

226. The reference to "the best practicable means at their disposal" and "in accordance with their capabilities" injects a certain degree of flexibility in implementing the obligation under article 194, paragraph 1, of the Convention. In particular, it seeks to accommodate the needs and interests of States with limited means and capabilities, and to lessen the excessive burden that the implementation of this obligation may entail for those States. However, the reference to available means and capabilities should not be used as an excuse to unduly postpone, or

even be exempt from, the implementation of the obligation to take all necessary measures under article 194, paragraph 1.

227. In the context of marine pollution from anthropogenic GHG emissions, States with greater means and capabilities must do more to reduce such emissions than States with less means and capabilities. The Tribunal notes in this regard that both the UNFCCC and the Paris Agreement recognize the principle of common but differentiated responsibilities and respective capabilities as a key principle in their implementation. Article 3 of the UNFCCC refers to this principle as one of the principles to guide the Parties in their actions to achieve the objective of that Convention and to implement its provisions. Article 2, paragraph 2, of the Paris Agreement also states that "[t]his Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances."

228. Article 4, paragraph 4, of the Paris Agreement, in particular, stipulates the differentiated responsibilities between developed country Parties and developing country Parties with respect to GHG mitigation efforts as follows:

> Developed country Parties should continue taking the lead by undertaking economy-wide absolute emission reduction targets. Developing country Parties should continue enhancing their mitigation efforts, and are encouraged to move over time towards economy-wide emission reduction or limitation targets in the light of different national circumstances.

229. The Tribunal considers that while the obligation under article 194, paragraph 1, of the Convention does not refer to the principle of common but differentiated responsibilities and respective capabilities as such, it contains some elements common to this principle. Thus, the scope of the measures under this provision, in particular those measures to reduce anthropogenic GHG emissions causing marine pollution, may differ between developed States and developing States. At the same time, it is not only for developed States to take action, even if they should "continue taking the lead". All States must make mitigation efforts.

Obligation to harmonize policies

230. Article 194, paragraph 1, of the Convention imposes an obligation upon States to endeavour to harmonize their policies in taking necessary measures to prevent, reduce and control marine pollution. The word “endeavour” indicates that States must make every effort to harmonize their policy but are not required to achieve such harmonization. Given the nature of marine pollution, it is not difficult to see the need for, and the benefit of, harmonization of policies. Lack of harmonization may make the anti-pollution policy of each State less effective. This is particularly true for marine pollution arising from anthropogenic GHG emissions, in light of its diffused causes and global effects.

Duty not to transfer or transform, and use of technologies

231. Article 195 of the Convention requires States, in taking measures to prevent, reduce and control pollution of the marine environment, not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another. In this context, some participants raised the issue of marine geoengineering. Marine geoengineering would be contrary to article 195 if it has the consequence of transforming one type of pollution into another. It may further be subject to article 196 of the Convention which requires States, *inter alia*, to take all measures necessary to prevent, reduce and control marine pollution resulting from the use of technologies under their jurisdiction or control. The Tribunal is aware that marine geoengineering has been the subject of discussions and regulations in various fora, including the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters 1972 and its 1996 Protocol, and the CBD.

(b) Nature of the obligation

232. The Tribunal will now turn to the question of the nature of the obligation under article 194, paragraph 1, of the Convention. This obligation requires States to take all measures that are necessary to prevent, reduce and control pollution of the marine environment. As stated above, the prevention, reduction and control of marine

pollution is the objective or result States must seek to achieve by taking necessary measures.

233. In the view of the Tribunal, what is required of States under this provision is not to guarantee the prevention, reduction and control of marine pollution at all times but to make their best efforts to achieve such result. In the words of the Seabed Disputes Chamber in the *Area Advisory Opinion*, this is "an obligation of conduct", and not "an obligation of result". As such, it is an obligation "to deploy adequate means, to exercise best possible efforts, to do the utmost" to obtain the intended result (see *Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011*, p. 10, at p. 41, para. 110). It is thus the conduct of a State, not the result which would be entailed by the conduct, that will determine whether the State has complied with its obligation under article 194, paragraph 1, of the Convention.

234. Since article 194, paragraph 1, of the Convention provides for an obligation of conduct, it requires States to act with "due diligence" in taking necessary measures to prevent, reduce and control marine pollution. As the Seabed Disputes Chamber has stated, "[t]he notions of obligations 'of due diligence' and obligations 'of conduct' are connected" (see *Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011*, p. 10, at p. 41, para. 111).

235. The obligation of due diligence requires a State to put in place a national system, including legislation, administrative procedures and an enforcement mechanism necessary to regulate the activities in question, and to exercise adequate vigilance to make such a system function efficiently, with a view to achieving the intended objective. The Tribunal notes in this regard that the ICJ, in *Pulp Mills on the River Uruguay,* described an obligation to act with due diligence as follows:

> It is an obligation which entails not only the adoption of appropriate rules and measures, but also a certain level of vigilance in their enforcement and the exercise of administrative control applicable to public and private operators, such as the monitoring of activities undertaken by such operators.

(*Pulp Mills on the River Uruguay (Argentina* v. *Uruguay), Judgment, I.C.J. Reports 2010 (I)*, p. 14, at p. 79, para. 197)

236. This obligation of due diligence is particularly relevant in a situation in which the activities in question are mostly carried out by private persons or entities. The obligation to regulate marine pollution from anthropogenic GHG emissions is a primary example in this respect. In that situation, it would not be reasonable to hold a State, which has acted with due diligence, responsible simply because such pollution has occurred.

237. Most of the participants in these proceedings expressed the view that the obligation under article 194, paragraph 1, of the Convention is an obligation of conduct and not an obligation of result. They also stated that it is an obligation of due diligence. However, it was contended that while the obligation under article 194, paragraph 1, is an obligation for States to adopt a certain conduct, it does also mean that States Parties have a positive obligation of result, which is to adopt and implement all measures necessary to prevent, reduce and control marine pollution. It was further contended that the provisions of Part XII of the Convention, and in particular articles 192 and 194, entail but also go beyond due diligence obligations. It was also suggested that the obligation under article 194, paragraph 1, is divided into the obligation of result with respect to governmental activities, such as taking all necessary measures, and the obligation of due diligence with respect to activities of non-State actors. In response, it was argued that while the wording of article 194 assumes that necessary measures must be taken, this in itself does not lead to the conclusion that this is an obligation of result.

238. The Tribunal observes that the obligation under article 194, paragraph 1, of the Convention, and, in fact, obligations under some other provisions of Part XII, including article 194, paragraph 2, are formulated in such a way as to prescribe not only the required conduct of States but also the intended objective or result of such conduct. Whether this obligation is that of conduct or of result depends on whether States are required to achieve the intended objective or result, i.e., prevention, reduction and control of marine pollution. This, in turn, depends essentially upon the text of the relevant provision and the overall circumstances envisaged by it. As

stated above (see paras. 232 to 236), the Tribunal considers that what is required under article 194, paragraph 1, is not to achieve the prevention, reduction and control of marine pollution but to take all necessary measures to that end.

239. In the words of the Seabed Disputes Chamber in the *Area Advisory Opinion*, due diligence is a "variable concept" (*Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011*, p. 10, at p. 43, para. 117). It is difficult to describe due diligence in general terms, as the standard of due diligence varies depending on the particular circumstances to which an obligation of due diligence applies. There are several factors to be considered in this regard. They include scientific and technological information, relevant international rules and standards, the risk of harm and the urgency involved. The standard of due diligence may change over time, given that those factors constantly evolve. In general, as the Seabed Disputes Chamber stated, "[t]he standard of due diligence has to be more severe for the riskier activities" (*ibid*.). The notion of risk in this regard should be appreciated in terms of both the probability or foreseeability of the occurrence of harm and its severity or magnitude.

240. In the context of marine pollution from anthropogenic GHG emissions, many participants in the proceedings expressed the view that the standard of due diligence should be set high. Some participants contended that due diligence cannot be interpreted as a simple best effort standard; a due diligence standard for marine pollution caused by GHG emissions should be substantially higher than best efforts, which has traditionally characterized pure conduct obligations; and the level of diligence must be set at its most severe in the case of climate change.

241. Best available science informs that anthropogenic GHG emissions pose a high risk in terms of foreseeability and severity of harm to the marine environment. As noted above (see para. 62), the IPCC, in its 2023 Synthesis Report, concludes that "[r]isks and projected adverse impacts and related losses and damages from climate change escalate with every increment of global warming (*very high confidence*)" (2023 Synthesis Report, p. 14). There is also broad agreement within the scientific community that if global temperature increases exceed 1.5°C, severe consequences for the marine environment would ensue. In light of such information,

the Tribunal considers that the standard of due diligence States must exercise in relation to marine pollution from anthropogenic GHG emissions needs to be stringent. However, its implementation may vary according to States' capabilities and available resources. Such implementation requires a State with greater capabilities and sufficient resources to do more than a State not so well placed. Nonetheless, implementing the obligation of due diligence requires even the latter State to do whatever it can in accordance with its capabilities and available resources to prevent, reduce and control marine pollution from anthropogenic GHG emissions.

242. The obligation of due diligence is also closely linked with the precautionary approach. As the Seabed Disputes Chamber stated in the *Area Advisory Opinion*, the precautionary approach is "an integral part of the general obligation of due diligence" (see *Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011*, p. 10, at p. 46, para. 131). Therefore, States would not meet their obligation of due diligence under article 194, paragraph 1, of the Convention if they disregarded or did not adequately account for the risks involved in the activities under their jurisdiction or control. This is so, even if scientific evidence as to the probability and severity of harm to the marine environment of such activities were insufficient. Accordingly, States must apply the precautionary approach in their exercise of due diligence to prevent, reduce and control marine pollution from anthropogenic GHG emissions.

(c) Conclusion

243. To conclude, under article 194, paragraph 1, of the Convention, States Parties to the Convention have the specific obligations to take all necessary measures to prevent, reduce and control marine pollution from anthropogenic GHG emissions and to endeavour to harmonize their policies in this connection. Such measures should be determined objectively, taking into account, *inter alia*, the best available science and relevant international rules and standards contained in climate change treaties such as the UNFCCC and the Paris Agreement, in particular the global temperature goal of limiting the temperature increase to 1.5°C above pre-industrial levels and the timeline for emission pathways to achieve that goal. The scope and content of necessary measures may vary in accordance with the means available to

States Parties and their capabilities. The necessary measures include, in particular, those to reduce GHG emissions. The obligation to take all necessary measures to prevent, reduce and control marine pollution from anthropogenic GHG emissions is one of due diligence. The standard of due diligence under article 194, paragraph 1, of the Convention is stringent, given the high risks of serious and irreversible harm to the marine environment from such emissions. However, the implementation of the obligation of due diligence may vary according to States' capabilities and available resources.

2. Obligation under article 194, paragraph 2, of the Convention

244. The Tribunal will now proceed to consider the obligation under article 194, paragraph 2, of the Convention in relation to anthropogenic GHG emissions. This provision sets out the obligation of States in the situation of transboundary pollution. It imposes upon States a particular obligation applicable to the transboundary setting in addition to the obligation to prevent, reduce and control marine pollution under article 194, paragraph 1.

245. Article 194, paragraph 2, of the Convention requires States to take all measures necessary to ensure that the following two situations do not occur: first, activities under their jurisdiction or control do not cause damage by pollution to other States and their environment; and second, pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights.

246. The obligation stipulated in article 194, paragraph 2, of the Convention bears a close resemblance to the well-established principle of harm prevention. First developed through arbitral and judicial decisions, this principle was incorporated in Principle 21 of the Stockholm Declaration, which states that "States have … the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction." This principle was reaffirmed in Principle 2 of the Rio Declaration. The Tribunal notes in this regard that the ICJ stated in the *Legality of the Threat or Use of Nuclear Weapons*:

> The existence of the general obligation of States to ensure that activities within their jurisdiction and control respect the environment of other States or of areas beyond national control is now part of the corpus of international law relating to the environment.
> (*Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, I.C.J. Reports 1996 (I)*, p. 226, at p. 242, para. 29; see also *Award in the Arbitration regarding the Iron Rhine ("Ijzeren Rijn") Railway between the Kingdom of Belgium and the Kingdom of the Netherlands, decision of 24 May 2005, RIAA, Vol. XXVII*, p. 35, at pp.66-67, para. 59)

(a) Scope and content of the obligation

247. The phrase "activities under their jurisdiction or control" refers to activities carried out by both public and private actors. In addition, there should be a link of jurisdiction or control between such activities and a State. The concept of "jurisdiction or control" of a State in this context is a broad one, encompassing not only its territory but also areas in which the State can, in accordance with international law, exercise its competence or authority. Such areas include, for example, a State's exclusive economic zone and continental shelf. Activities carried out on board ships or aircraft which are registered in a State may also be considered activities under the jurisdiction of that State.

248. The Tribunal notes that while "damage" is mentioned in the first situation of transboundary pollution involving two or more States, there is no such reference in the second situation. Given that the notion of pollution involves both actual and potential deleterious effects on the marine environment, the obligation in the former situation should be understood as requiring the prevention of actual damage by pollution, whereas the obligation in the latter situation extends not only to damage that actually occurred but also to damage that is likely to occur. In this sense, article 194, paragraph 2, of the Convention imposes a more stringent obligation by requiring States to prevent the "spread" of pollution than the principle laid down in the Stockholm Declaration and the Rio Declaration which refers to "damage" to the environment of other States and of areas beyond the limits of national jurisdiction.

249. Article 194, paragraph 2, of the Convention, unlike paragraph 1, does not refer to the means to be employed by States in taking necessary measures or to

capabilities. The absence of such reference could be understood to imply that the scope and content of necessary measures to be taken by States under article 194, paragraph 2, are not differentiated in accordance with the availability of means and capabilities. The transboundary context of the obligation under paragraph 2 could lend some support to such understanding. However, in the view of the Tribunal, despite the lack of the above reference, the scope and content of necessary measures under article 194, paragraph 2, may differ among States in accordance with the availability of means and capabilities. As will be seen below, this obligation is an obligation of due diligence, and its implementation may vary in relation to several factors, including the capabilities of each State.

250. In the context of anthropogenic GHG emissions causing marine pollution, article 194, paragraph 2, of the Convention requires States to take all necessary measures to ensure that GHG emissions under their jurisdiction or control do not cause damage to other States and their environment, and that pollution arising from such emissions under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights. Many participants in the proceedings took the view that article 194, paragraph 2, is relevant with respect to marine pollution caused by anthropogenic GHG emissions. It was submitted in this regard that, in order to fulfil the obligation under article 194, paragraph 2, States must be at least as diligent as necessary to limit average global temperature rise to no more than 1.5°C. The Tribunal has stated above that the temperature goal of 1.5°C is one of the relevant factors to consider in determining necessary measures under article 194, paragraph 1, but that it is not the only such factor. In the Tribunal’s view, this finding applies equally to the obligation under article 194, paragraph 2.

251. On the other hand, it was contended that GHG emissions are not activities of the kind to which article 194, paragraph 2, of the Convention is directed. According to this view, given that GHG emissions from the territory of one State will contribute to the volume of emissions in the atmosphere for decades to come, this provision cannot sensibly be interpreted as requiring States to ensure that such emissions do not spread to the territory of another State or on to the high seas. It was further contended that even if article 194, paragraph 2, covers GHG emissions, the measures necessary to ensure that such emissions do not cause damage to the

environment of other States, and that pollution does not spread beyond national jurisdiction, go no further than the measures necessary to prevent, reduce or control pollution pursuant to article 194, paragraph 1.

252. The Tribunal has concluded above that anthropogenic GHG emissions into the atmosphere fall under the definition of pollution of the marine environment within the meaning of article 1, paragraph 1, subparagraph 4, of the Convention. It follows that the obligations under article 194 thus apply to marine pollution from such emissions. In the Tribunal's view, there appears to be no convincing reason to exclude the application of article 194, paragraph 2, to such pollution. It is acknowledged that, given the diffused and cumulative causes and global effects of climate change, it would be difficult to specify how anthropogenic GHG emissions from activities under the jurisdiction or control of one State cause damage to other States. However, this difficulty has more to do with establishing the causation between such emissions of one State and damage caused to other States and their environment. This should be distinguished from the applicability of an obligation under article 194, paragraph 2, to marine pollution from anthropogenic GHG emissions.

253. The Tribunal is also not convinced by the argument that the obligation under article 194, paragraph 2, of the Convention can be satisfied by meeting the obligation under paragraph 1. Such a view would have the consequence of depriving the obligation under paragraph 2 of any effect with respect to marine pollution from anthropogenic GHG emissions. The Tribunal considers that article 194, paragraph 2, imposes upon States a particular obligation in the context of transboundary pollution.

(b) Nature of the obligation

254. The obligation under article 194, paragraph 2, of the Convention requires States to take all measures necessary to ensure that activities under their jurisdiction do not cause damage by pollution to other States and their environment and that pollution arising from their activities does not spread beyond the limits of their national jurisdiction. The Tribunal considers that this obligation is an obligation of due diligence for the same reason stated in the context of the obligation under

article 194, paragraph 1. The Tribunal recalls that the Seabed Disputes Chamber in the *Area Advisory Opinion* referred to article 194, paragraph 2, as an example of such obligation (see *Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011*, p. 10, at p. 42, para. 113).

255. It was argued that the obligation under article 194, paragraph 2, of the Convention is an explicit and broad obligation of States to adopt all measures necessary to ensure that certain events will not occur, whereas the obligation the Seabed Disputes Chamber considered in the *Area Advisory Opinion* was the responsibility to ensure compliance as set out in article 139 of the Convention. According to this argument, the obligation under article 194, paragraph 2, therefore, goes beyond acting merely with due diligence and encompasses an obligation of result. The Tribunal has already expressed its view on this argument in relation to the obligation under article 194, paragraph 1, of the Convention. That finding is equally valid for the obligation under article 194, paragraph 2.

256. As stated above, the standard of due diligence is variable, depending upon relevant factors, including risks of harm involved in activities. With respect to transboundary pollution affecting the environment of other States, the standard of due diligence can be even more stringent.

257. In this regard, the Tribunal wishes to emphasize that an obligation of due diligence should not be understood as an obligation which depends largely on the discretion of a State or necessarily requires a lesser degree of effort to achieve the intended result. The content of an obligation of due diligence should be determined objectively under the circumstances, taking into account relevant factors. In many instances, an obligation of due diligence can be highly demanding. Therefore, it would not be correct to assume that the obligation under article 194, paragraph 2, of the Convention, as an obligation of due diligence, would be less conducive to the prevention, reduction and control of marine pollution from anthropogenic GHG emissions.

(c) Conclusion

258. To conclude, article 194, paragraph 2, of the Convention imposes upon States Parties a particular obligation applicable to the transboundary setting in addition to the obligation to prevent, reduce and control marine pollution from anthropogenic GHG emissions. Under this provision, States Parties have the specific obligation to take all measures necessary to ensure that anthropogenic GHG emissions under their jurisdiction or control do not cause damage to other States and their environment, and that pollution from such emissions under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights. It is an obligation of due diligence. The standard of due diligence under article 194, paragraph 2, can be even more stringent than that under article 194, paragraph 1, because of the nature of transboundary pollution.

E. Obligations applicable to specific sources of pollution

259. Having addressed the obligations of States common to the prevention, reduction and control of pollution from any source, the Tribunal will now proceed to examining obligations relating to pollution from specific sources. The relevant provisions in this regard are found in sections 5 and 6 of Part XII of the Convention.

260. Section 5 of Part XII of the Convention addresses the obligations to adopt national laws and regulations and establish international rules and standards to prevent, reduce and control marine pollution from six different sources: pollution from land-based sources (article 207), pollution from seabed activities subject to national jurisdiction (article 208), pollution from activities in the Area (article 209), pollution by dumping (article 201), pollution from vessels (article 211), and pollution from or through the atmosphere (article 212). In particular, this section addresses the relationship between national legislation and international rules and standards, and how States should refer to international rules and standards in adopting their national laws and regulations. Depending on the specific sources of pollution, different formulations of reference to international rules and standards are introduced in section 5.

261. Section 6 of Part XII of the Convention addresses the obligation to enforce national laws and regulations and implement international rules and standards. This section follows the source-specific approach of the previous section. The provisions of section 6, as an enforcement sequel to national legislation and international rules and standards adopted in accordance with section 5, need to be read together with the corresponding provisions of that section.

262. The initial issue the Tribunal should consider is how to characterize pollution of the marine environment from anthropogenic GHG emissions in terms of specific sources of pollution. This is necessary because the scope and content of the obligations of States under section 5 of Part XII vary depending on the specific source of pollution. Most participants in the proceedings took the view that marine pollution from anthropogenic GHG emissions can be considered either pollution from land-based sources or pollution from or through the atmosphere. They also expressed the view that marine pollution from such emissions from vessels can be considered either pollution from vessels or pollution from or through the atmosphere. The Tribunal notes in this regard that Question (a) asks it to identify the specific obligations of States Parties to prevent, reduce and control marine pollution in relation to deleterious effects caused by “anthropogenic GHG emissions into the atmosphere”.

263. According to the information submitted to the Tribunal, most anthropogenic GHG emissions into the atmosphere causing marine pollution originate from land-based sources. In addition, such emissions originate from vessels or aircraft. There are also some GHG emissions from other sources, including from certain seabed activities such as venting and flaring.

264. While there are multiple sources of GHG emissions into the atmosphere, the Tribunal considers that the types of pollution most relevant to the present proceedings are confined to marine pollution caused by anthropogenic GHG emissions into the atmosphere from land-based sources, vessels and aircraft. The relevant provisions under the Convention addressing such pollution are found in articles 207 (pollution from land-based sources), 211 (pollution from vessels) and 212 (pollution from or through the atmosphere). The corresponding provisions for

enforcement are articles 213 (enforcement with respect to pollution from land-based sources), 217 (enforcement by flag States) and 222 (enforcement with respect to pollution from or through the atmosphere).

1. Obligations to adopt national legislation and establish international rules and standards

265. At the outset, the Tribunal wishes to reiterate that articles 207, 211 and 212 of the Convention complement and elaborate the obligations common to all sources of pollution set out in article 194. The interpretation of these articles, therefore, should be consistent with that of article 194. The Tribunal notes that the findings it made in interpreting and applying article 194 in relation to marine pollution from anthropogenic GHG emissions are equally applicable with respect to articles 207, 211 and 212.

(a) Obligations under article 207 of the Convention

266. The Tribunal will now consider the obligations under article 207 of the Convention, which reads:

> *Pollution from land-based sources*
>
> 1. States shall adopt laws and regulations to prevent, reduce and control pollution of the marine environment from land-based sources, including rivers, estuaries, pipelines and outfall structures, taking into account internationally agreed rules, standards and recommended practices and procedures.
>
> 2. States shall take other measures as may be necessary to prevent, reduce and control such pollution.
>
> 3. States shall endeavour to harmonize their policies in this connection at the appropriate regional level.
>
> 4. States, acting especially through competent international organizations or diplomatic conference, shall endeavour to establish global and regional rules, standards and recommended practices and procedures to prevent, reduce and control pollution of the marine environment from land-based sources, taking into account characteristic regional features, the economic capacity of developing States and their need for economic development. Such rules, standards and recommended practices and procedures shall be re-examined from time to time as necessary.

> 5. Laws, regulations, measures, rules, standards and recommended practices and procedures referred to in paragraphs 1, 2 and 4 shall include those designed to minimize, to the fullest extent possible, the release of toxic, harmful or noxious substances, especially those which are persistent, into the marine environment.

267. Article 207 of the Convention imposes upon States three main obligations: first, the obligation to adopt national legislation; second, the obligation to take other necessary measures; and third, the obligation to endeavour to establish international rules, standards and practices and procedures. Those obligations are mostly concerned with establishing the legal framework, both national and international, necessary to prevent, reduce and control marine pollution from land-based sources.

268. In addition to the above three obligations, article 207 of the Convention provides for obligations to endeavour to harmonize policies and to take certain specific measures. Article 207, paragraph 3, requires States to endeavour to harmonize their policies at the appropriate regional level. This obligation is consistent with the obligation to endeavour to harmonize policies under article 194, paragraph 1. Article 207, paragraph 5, which requires States to take measures to minimize the release of toxic, harmful or noxious substances, reiterates what is prescribed in article 194, paragraph 3, subparagraph (a).

269. Article 207, paragraph 1, of the Convention requires States to adopt laws and regulations to prevent, reduce and control marine pollution from land-based sources. Such laws and regulations are a formal means to give effect to necessary measures States must take under article 194 of the Convention. For marine pollution from anthropogenic GHG emissions, central to those laws and regulations is the reduction of such emissions.

270. In adopting laws and regulations, States are required to take into account “internationally agreed rules, standards and recommended practices and procedures”. There is no definition of this phrase in the Convention. Those rules, standards and practices and procedures encompass a broad range of norms, both binding and non-binding in nature. In the context of climate change, they include those contained in climate change treaties such as the UNFCCC and the Paris

Agreement. Accordingly, States Parties to the Convention have an obligation to take into account those norms in adopting their laws and regulations to prevent, reduce and control marine pollution from GHG emissions.

271. The phrase “taking into account” should be understood to mean that States are not required to adopt such rules, standards and practices and procedures in their national laws and regulations. However, States must, in good faith, give due consideration to them. In any case, States must comply with internationally agreed rules and standards, which are binding upon them.

272. Article 207, paragraph 2, of the Convention requires States to take other measures as may be necessary to prevent, reduce and control such pollution. Those measures can be wide-ranging, from the establishment of administrative procedures for the regulation of pollution to the monitoring of risks and effects of marine pollution and assessment of the potential effects of planned activities on the marine environment. In the context of marine pollution from anthropogenic GHG emissions, the Tribunal’s findings with respect to the obligation to take necessary measures under article 194 equally apply to the obligation under this paragraph.

273. Article 207, paragraph 4, of the Convention imposes upon States an obligation to endeavour to establish global and regional rules, standards and recommended practices and procedures to regulate pollution from land-based sources. Thus, States are required to make every effort in good faith to establish such rules, standards and practices and procedures, but are not required to succeed in establishing them. In this respect, States should act through competent international organizations or diplomatic conference. The efforts of States must be on a continuing basis. In the context of marine pollution from anthropogenic GHG emissions, this obligation means that States, which are parties to relevant international agreements such as the UNFCCC and the Paris Agreement, are required to participate in the process under those agreements with a view to “strengthen[ing] the global response to the threat of climate change”, as stated in Article 2, paragraph 1, of the Paris Agreement.

(b) Obligations under article 212 of the Convention

274. The Tribunal will now consider the obligations under article 212 of the Convention, which reads:

> *Pollution from or through the atmosphere*
>
> 1. States shall adopt laws and regulations to prevent, reduce and control pollution of the marine environment from or through the atmosphere, applicable to the air space under their sovereignty and to vessels flying their flag or vessels or aircraft of their registry, taking into account internationally agreed rules, standards and recommended practices and procedures and the safety of air navigation.
>
> 2. States shall take other measures as may be necessary to prevent, reduce and control such pollution.
>
> 3. States, acting especially through competent international organizations or diplomatic conference, shall endeavour to establish global and regional rules, standards and recommended practices and procedures to prevent, reduce and control such pollution.

275. Article 212 of the Convention imposes upon States three obligations: first, the obligation to adopt national legislation to prevent, reduce and control marine pollution from or through the atmosphere; second, the obligation to take other necessary measures; and third, the obligation to endeavour to establish international rules, standards and practices and procedures.

276. There is no substantial difference between the obligations under article 212 of the Convention and those under article 207 in terms of their scope. While article 212 does not explicitly provide for the obligations to endeavour to harmonize policies and to take measures to minimize the release of toxic, harmful or noxious substances into the marine environment, as article 207 does, such obligations apply with respect to pollution from or through the atmosphere under article 212. The obligation to endeavour to harmonize policies is an obligation common to all sources of pollution, including pollution from or through the atmosphere, under article 194, paragraph 1. The obligation to minimize the release of toxic, harmful or noxious substances applies to pollution from or through the atmosphere under article 194, paragraph 3, subparagraph (a).

277. The content of the obligations under article 212 of the Convention is similar to that of the obligations under article 207. Thus, the findings the Tribunal made above with respect to the obligations under article 207 apply *mutatis mutandis* to those under article 212. In this regard, “internationally agreed rules and standards and recommended practices and procedures” relevant to pollution from or through the atmosphere include not only those contained in climate change treaties but also those in instruments such as Volume IV of Annex 16 to the Chicago Convention establishing a carbon offsetting and reduction scheme for international aviation. The Tribunal also notes that the IMO adopted amendments to Annex VI to MARPOL in 2011 and 2021 with a view to reducing GHG emissions from ships. As stated above, the IMO also recently adopted the 2023 IMO GHG Strategy to enhance its contribution to global efforts in this regard (see para. 80 above).

(c) Obligations under article 211 of the Convention

278. The Tribunal will now consider the obligations relating to marine pollution from vessels. Those obligations are found in article 211 of the Convention. In the context of marine pollution from anthropogenic GHG emissions, the most relevant provision is article 211, paragraph 2. The Tribunal will confine itself to that provision, which reads:

> States shall adopt laws and regulations for the prevention, reduction and control of pollution of the marine environment from vessels flying their flag or of their registry. Such laws and regulations shall at least have the same effect as that of generally accepted international rules and standards established through the competent international organization or general diplomatic conference.

279. Article 211, paragraph 2, of the Convention imposes upon States the obligation to adopt laws and regulations to prevent, reduce and control marine pollution from vessels flying their flag or of their registry. Thus, the obligation under this provision is incumbent on the flag State. Such laws and regulations must at least have the same effect as that of generally accepted international rules and standards. This provision, therefore, provides for the minimum threshold national legislation must meet. States may adopt more stringent laws and regulations than generally accepted international rules and standards. This requirement stands in contrast with

the requirement to “take into account” internationally agreed rules and standards under articles 207 and 212.

280. The term “generally accepted international rules and standards” is not defined in the Convention. Such rules and standards may refer to those contained in international legal instruments that are accepted by a sufficiently large number of States. They must be established through the competent international organization or general diplomatic conference. The term “the competent international organization” in this context is understood to refer to the IMO. The reference to “the competent international organization or general diplomatic conference” is distinct from the reference to “competent international organizations or diplomatic conference” made in articles 207 and 212 of the Convention. Thus, only those rules and standards that satisfy the above requirements would qualify as “generally accepted international rules and standards”. In the context of marine pollution from GHG emissions from vessels, the Tribunal notes in this regard that the IMO adopted amendments to Annex VI to MARPOL in 2011 and 2021 with a view to reducing GHG emissions from ships.

2. Obligation of enforcement

281. The Tribunal now turns to the obligation of enforcement under articles 213, 217 and 222 of the Convention. The scope and content of the obligations with respect to land-based pollution under article 213 and with respect to pollution from or through the atmosphere under article 222 are similar. For the purpose of the present Advisory Opinion, the Tribunal will, therefore, address those obligations together. It will then deal with the obligation of enforcement with respect to pollution from vessels under article 217.

(a) Obligations under articles 213 and 222 of the Convention

282. Article 213 of the Convention reads:

> *Enforcement with respect to pollution from land-based sources*
>
> States shall enforce their laws and regulations adopted in accordance with article 207 and shall adopt laws and regulations and take other measures necessary to implement applicable international rules and standards established through competent international organizations or diplomatic conference to prevent, reduce and control pollution of the marine environment from land-based sources.

Article 222 of the Convention reads:

> *Enforcement with respect to pollution from or through the atmosphere*
>
> States shall enforce, within the air space under their sovereignty or with regard to vessels flying their flag or vessels or aircraft of their registry, their laws and regulations adopted in accordance with article 212, paragraph 1, and with other provisions of this Convention and shall adopt laws and regulations and take other measures necessary to implement applicable international rules and standards established through competent international organizations or diplomatic conference to prevent, reduce and control pollution of the marine environment from or through the atmosphere, in conformity with all relevant international rules and standards concerning the safety of air navigation.

283. The above two articles address, respectively, the enforcement of national legislation and the implementation of applicable international rules and standards with respect to pollution from land-based sources and pollution from or through the atmosphere. States have two obligations in this regard: first, the obligation to enforce their laws and regulations; and second, the obligation to adopt laws and regulations and take other measures necessary to implement applicable international rules and standards.

284. The first obligation requires States to enforce their laws and regulations to prevent, reduce and control pollution of the marine environment from land-based sources or from or through the atmosphere. The word “enforce” is a broad term, encompassing the variety of ways and means to ensure compliance with laws and regulations within the framework of the national legal system. Such ways and means

may include, for example, monitoring and inspection, administrative guidance, investigation and prosecution for breaches of laws, and judicial or quasi-judicial proceedings. The Tribunal notes in this regard that article 235, paragraph 2, of the Convention provides for the obligation of States to “ensure that recourse is available in accordance with their legal systems for prompt and adequate compensation or other relief in respect of damage caused by pollution of the marine environment by natural or juridical persons under their jurisdiction.” Section 7 of Part XII of the Convention provides for various safeguards relating to the institution of proceedings and the exercise of powers of enforcement.

285. The second obligation requires States to adopt laws and regulations and take other measures necessary to implement applicable international rules and standards. The term “applicable international rules and standards” should be understood to refer to those rules and standards which are binding upon the State concerned either as treaty or customary international law. Accordingly, they are to be distinguished from “internationally agreed rules, standards and recommended practices and procedures”, which States must “[take] into account” in adopting national laws and regulations under articles 207 or 212 of the Convention. Such rules, standards and practices and procedures do not have to be binding upon the States. Applicable international rules and standards must be established through competent international organizations or diplomatic conference. Such rules and standards must be implemented in accordance with the legal system of each State.

286. In the context of marine pollution from anthropogenic GHG emissions, articles 213 and 222 of the Convention should be interpreted as imposing an obligation to adopt laws and regulations and to take measures necessary to implement, among others, rules and standards set out in climate change treaties and other relevant instruments. If a State Party to the Convention, which is bound by those rules and standards, fails to take such measures, its international responsibility would be engaged for breach of the obligations under article 213 or 222 of the Convention.

(b) Obligations under article 217 of the Convention

287. Article 217 of the Convention provides for enforcement by States with respect to marine pollution from vessels flying their flag or of their registry. The Convention, in particular articles 218 and 220, also provides for enforcement by port States and coastal States. However, in the context of marine pollution from anthropogenic GHG emissions, the most relevant provision is article 217, paragraph 1, and the Tribunal will confine itself to this provision for the purpose of the present proceedings. Article 217, paragraph 1, reads:

> States shall ensure compliance by vessels flying their flag or of their registry with applicable international rules and standards, established through the competent international organization or general diplomatic conference, and with their laws and regulations adopted in accordance with this Convention for the prevention, reduction and control of pollution of the marine environment from vessels and shall accordingly adopt laws and regulations and take other measures necessary for their implementation. Flag States shall provide for the effective enforcement of such rules, standards, laws and regulations, irrespective of where a violation occurs.

288. Article 217, paragraph 1, of the Convention imposes upon States the obligation to ensure that vessels flying their flag or of their registry comply with applicable international rules and standards and their laws and regulations. To this end, it requires States to adopt laws and regulations and take other measures necessary to implement such international rules and standards as well as their national laws and regulations.

289. “[A]pplicable international rules and standards” refer to those rules and standards that are binding upon the States concerned. Such rules and standards must be established through the competent international organization or general diplomatic conference. The findings made by the Tribunal in this regard in relation to article 211 of the Convention equally apply to the present paragraph. The national “laws and regulations” to be implemented must be adopted in accordance with the Convention, in particular article 211, paragraph 2.

290. The means of implementation include laws and regulations, and other necessary measures. Such measures may be wide-ranging and include administrative and judicial measures.

291. In the context of marine pollution from anthropogenic GHG emissions from vessels, applicable international rules and standards may be found, *inter alia*, in Annex VI to MARPOL, as amended in 2011 and 2021.

F. Other obligations

292. The Tribunal will now proceed to examine other obligations relevant to its response to Question (a). Such obligations may be found in Part XII of the Convention, section 2 on global and regional cooperation, section 3 on technical assistance, and section 4 on monitoring and environmental assessment.

293. At the outset, the Tribunal points out that its findings in this regard apply not only in response to Question (a) but also in response to Question (b).

1. Global and regional cooperation

294. The Tribunal first wishes to turn to the specific obligations of cooperation under Part XII, section 2, of the Convention.

295. The Tribunal notes that almost all of the participants in the present proceedings shared the view that countering the effects of anthropogenic GHG emissions on the marine environment necessarily requires international cooperation. In this context, reference was made to the existence of a duty to cooperate under general international law, which informs Part XII of the Convention, and it was argued that this duty is central to the examination of the Request. It was also contended that pollution of the marine environment from such emissions calls for a regulatory response which must be supported by international coordination informed by internationally agreed standards. In this regard, references were made to cooperation efforts conducted under the auspices of the UNFCCC and the Paris Agreement. Almost all of the participants expressed the view that article 197 of the

Convention sets out the key obligation of cooperation and that this obligation is further elaborated upon in articles 198, 199, 200 and 201 of the Convention.

296. The Tribunal recalls its finding in the *MOX Plant Case* that "the duty to cooperate is a fundamental principle in the prevention of pollution of the marine environment under Part XII of the Convention and general international law" (*MOX Plant (Ireland* v. *United Kingdom)*, *Provisional Measures, Order of 3 December 2001, ITLOS Reports 2001*, p. 95, at p. 110, para. 82; see also *Land Reclamation by Singapore in and around the Straits of Johor (Malaysia* v. *Singapore), Provisional Measures, Order of 8 October 2003, ITLOS Reports 2003*, p. 10, at p. 25, para. 92; *Request for Advisory Opinion Submitted by the Sub-Regional Fisheries Commission*, *Advisory Opinion, 2 April 2005, ITLOS Reports 2015*, p. 4, at p. 43, para. 140; *Pulp Mills on the River Uruguay (Argentina* v. *Uruguay), Judgment*, *I.C.J. Reports 2010,* p. 14, at p. 49, para. 77).

297. In the Tribunal's view, the duty to cooperate is reflected in and permeates the entirety of Part XII of the Convention. This duty is given concrete form in a wide range of specific obligations of States Parties, which are central to countering marine pollution from anthropogenic GHG emissions at the global level. In this respect, the Tribunal notes the finding of the IPCC that

> [c]limate change has the characteristics of a collective action problem at the global scale, because most GHGs accumulate over time and mix globally, and emissions by any agent (e.g., individual, community, company, country) affect other agents. Effective mitigation will not be achieved if individual agents advance their own interests independently. Collective responses, including international cooperation, are therefore required to effectively mitigate GHG emissions and address other climate change issues.
> (2014 Synthesis Report, Summary for Policymakers, p. 17)

298. Most multilateral climate change treaties, including the UNFCCC and the Paris Agreement, contemplate and variously give substance to the duty to cooperate on the assumption, as indicated in the preamble of the UNFCCC, that "the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response".

299. In relation to marine pollution from anthropogenic GHG emissions, the Tribunal notes that the duty to cooperate is an integral part of the general obligations under articles 194 and 192 of the Convention given that the global effects of these emissions necessarily require States' collective action (see paras. 201 and 202 above). Furthermore, specific obligations to cooperate are provided for in Part XII, section 2, in particular in articles 197, 200 and 201. The Tribunal considers that these specific obligations complement the general obligations established in articles 194 and 192 by setting out the means for complying with the latter obligations.

(a) Obligation to cooperate under article 197 of the Convention

300. The core obligation of cooperation is enshrined in article 197 of the Convention, which reads as follows:

> *Cooperation on a global or regional basis*
>
> States shall cooperate on a global basis and, as appropriate, on a regional basis, directly or through competent international organizations, in formulating and elaborating international rules, standards and recommended practices and procedures consistent with this Convention, for the protection and preservation of the marine environment, taking into account characteristic regional features.

301. According to article 197 of the Convention, cooperation is expressly aimed at developing a common regulatory framework "for the protection and preservation of the marine environment". Article 197 must be read in conjunction with article 194, paragraph 1, which refers to "all measures" that States shall take, individually or *jointly* as appropriate, in order "to prevent, reduce and control pollution of the marine environment from any source". It follows that cooperation in the formulation and elaboration of international rules, standards and recommended practices and procedures under article 197 is among the joint measures contemplated in article 194, paragraph 1.

302. The obligation to cooperate under article 197 is aimed at the formulation and elaboration of rules, standards and practices and procedures for the protection and preservation of the marine environment, and is characterized by a large degree of

flexibility. Such rules, standards and practices and procedures may be binding or non-binding. States are free to choose whether to cooperate through competent international organizations or otherwise. The possibility of having recourse to various forms of cooperation is particularly useful in the prevention, reduction and control of marine pollution from anthropogenic GHG emissions.

303. The Tribunal observes that most of the participants in the proceedings emphasized the importance of global cooperation through international organizations. In addition, some of the participants referred to regional cooperation insofar as marine pollution from anthropogenic GHG emissions has a particular impact on certain regions.

304. The Tribunal considers that the expression “competent international organizations” used in article 197 of the Convention refers, in the context of the present case, to all international organizations with competence to address, directly or indirectly, the protection and preservation of the marine environment from anthropogenic GHG emissions.

305. Article 197 of the Convention provides for the possibility of having recourse to regional cooperation agreements and plans as a means to combat marine pollution “as appropriate” and “taking into account characteristic regional features”. Given the impacts of pollution from anthropogenic GHG emissions, cooperation on a global scale is typically the most appropriate means to that end. Nevertheless, some effects of marine pollution from such emissions may be particularly harmful for the marine environment of certain geographical areas because of their special characteristics. In such situations, the obligation to cooperate on a global scale may be supported by regional cooperation under article 197 and article 123 on cooperation of States bordering enclosed or semi-enclosed seas.

306. The Tribunal will now turn to the nature of the obligation under article 197 of the Convention. It notes that most of the participants in the present proceedings were of the view that the obligation of cooperation enshrined in article 197 is an obligation of conduct, and that compliance therewith should be assessed by reference to the efforts that States make to coordinate their actions. It was also

generally contended that such obligation is of an ongoing nature, that cooperation must be meaningful, and that States must participate in good faith in cooperative efforts.

307. In the view of the Tribunal, this provision does not oblige States to achieve a normative outcome but to participate meaningfully in the formulation and elaboration of rules, standards and recommended practices and procedures for the protection and preservation of the marine environment.

308. The Tribunal wishes to recall that, in the *SRFC Advisory Opinion*, it stated that

> the obligation to "seek to agree …" under article 63, paragraph 1, and the obligation to cooperate under article 64, paragraph 1, of the Convention are "due diligence" obligations which require the States concerned to consult with one another in good faith, pursuant to article 300 of the Convention. The consultations should be meaningful in the sense that substantial effort should be made by all States concerned, with a view to adopting effective measures necessary to coordinate and ensure the conservation and development of shared stocks.
> (*Request for Advisory Opinion Submitted by the Sub-Regional Fisheries Commission, Advisory Opinion of 2 April 2015, ITLOS Reports 2015*, p. 4, at pp. 59-60, para. 210; see also *Pulp Mills on the River Uruguay (Argentina* v. *Uruguay), Judgment*, *I.C.J. Reports 2010,* p. 14, at p. 49, para. 77)

The same reasoning applies to the obligation to cooperate under article 197 of the Convention.

309. Thus, the Tribunal considers that the obligation to cooperate under article 197 of the Convention, either on a global or regional basis, is an obligation of conduct which requires States to act with "due diligence". States are required to fulfil this obligation in good faith.

310. In the Tribunal's view, compliance with the obligation of cooperation is to be assessed by reference to the efforts made by States to formulate and elaborate international rules, standards and recommended practices and procedures. The results achieved by States through cooperation may, however, be relevant in assessing States' compliance with the obligation to cooperate.

311. The obligation of cooperation set out in article 197 of the Convention is of a continuing nature. It requires States to make an ongoing effort to formulate and elaborate rules, standards and recommended practices and procedures. The adoption of a particular treaty, such as the UNFCCC or the Paris Agreement, does not discharge a State from its obligation to cooperate, as the obligation requires an ongoing effort on the part of States in the development of new or revised regulatory instruments, in particular in light of the evolution of scientific knowledge.

(b) Obligation to cooperate under articles 200 and 201 of the Convention

312. The Tribunal notes that article 197 does not exhaust the obligation to cooperate under section 2 of Part XII of the Convention. States are also required to cooperate to promote studies, undertake research programmes, and encourage the exchange of information and data (article 200), and to establish appropriate scientific criteria for regulations (article 201).

313. Article 200 of the Convention reads:

> *Studies, research programmes and exchange of information and data*
>
> States shall cooperate, directly or through competent international organizations, for the purpose of promoting studies, undertaking programmes of scientific research and encouraging the exchange of information and data acquired about pollution of the marine environment. They shall endeavour to participate actively in regional and global programmes to acquire knowledge for the assessment of the nature and extent of pollution, exposure to it, and its pathways, risks and remedies.

Article 201 of the Convention reads:

> *Scientific criteria for regulations*
>
> In the light of the information and data acquired pursuant to article 200, States shall cooperate, directly or through competent international organizations, in establishing appropriate scientific criteria for the formulation and elaboration of rules, standards and recommended practices and procedures for the prevention, reduction and control of pollution of the marine environment.

The obligations under articles 200 and 201 provide the basis for the formulation and elaboration of international rules, standards and recommended practices and

procedures pursuant to article 197. The development of an effective common regulatory framework presupposes the existence of adequate information on the state of the marine environment based on updated scientific criteria and methods.

314. The Tribunal is of the view that articles 200 and 201 of the Convention apply in the context of marine pollution from anthropogenic GHG emissions.

315. Article 200 of the Convention is aimed at ensuring that pollution of the marine environment is properly acknowledged. In particular, this article is important for the development of an adequate common regulatory framework to protect and preserve the marine environment, as provided for under article 197. States are required to cooperate, directly or through competent international organizations, either globally or regionally, *inter alia*, in encouraging the exchange of information and data, primarily on the causes and effects of pollution. Cooperation also involves the search for possible and effective remedies in response to threats to the marine environment.

316. Article 201 of the Convention serves to link article 197 with article 200. Cooperation between States in the formulation and elaboration of rules, standards and recommended practices and procedures must be based on appropriate scientific criteria, developed through coordinated studies, research programmes and exchange of information and data. In particular, cooperation in the formulation and elaboration of a common regulatory framework would be ineffective if it did not rest on a solid scientific basis.

317. The Tribunal recalls that a close relationship between regulatory measures for the protection and preservation of the marine environment, on the one hand, and scientific findings and criteria, on the other, was previously highlighted by the Seabed Disputes Chamber in its *Area Advisory Opinion*. The Chamber held that measures adopted to prevent pollution of the marine environment may need to change over time to become stricter “in light ... of new scientific or technological knowledge” (*Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011*, p. 10, at p. 43, para. 117).

318. In the context of anthropogenic GHG emissions, the obligation under article 201 of the Convention requires States to participate in those fora for cooperation aimed at establishing appropriate scientific criteria for the formulation of rules and standards for the prevention, reduction and control of marine pollution from such emissions. An example of such cooperation is the Subsidiary Body for Scientific and Technological Advice (SBSTA) under the UNFCCC, which, *inter alia,* assists the COP and the Meeting of the Parties to the Paris Agreement by providing information and advice on scientific and technological matters.

319. The obligation under article 201 of the Convention requires States to make, in good faith, continuous efforts. Such efforts may be made directly or through competent international organizations, at the global or regional level. Cooperation can be pursued through various international organizations, including those without a specific law of the sea mandate, if the extent and nature of the effects of anthropogenic GHG emissions so require.

320. The participation of States in relevant international organizations and fora in undertaking scientific research programmes, encouraging the exchange of information and data as well as developing scientific criteria for regulating marine pollution from anthropogenic GHG emissions is particularly important in light of the global scale of such emissions.

(c) Conclusion

321. To conclude, the Tribunal finds that articles 197, 200 and 201, read together with articles 194 and 192 of the Convention, impose specific obligations on States Parties to cooperate, directly or through competent international organizations, continuously, meaningfully and in good faith in order to prevent, reduce and control marine pollution from anthropogenic GHG emissions. In this regard, first, States Parties are required to cooperate in formulating and elaborating rules, standards and recommended practices and procedures, consistent with the Convention and based on available scientific knowledge, to counter marine pollution from such emissions. Second, States Parties are required to cooperate to promote studies, undertake scientific research, and encourage the exchange of information and data on marine

pollution from anthropogenic GHG emissions, its pathways, risks and remedies, including mitigation and adaptation measures. Third, States Parties are required to establish appropriate scientific criteria on the basis of which rules, standards and recommended practices and procedures are to be formulated and elaborated to counter marine pollution from such emissions.

2. Technical assistance

322. The Tribunal now turns to the specific obligations contained in Part XII, section 3, of the Convention, namely, article 202 on scientific and technical assistance to developing States and article 203 on preferential treatment for developing States.

323. Article 202 reads:

> *Scientific and technical assistance to developing States*
>
> States shall, directly or through competent international organizations:
>
> (a) promote programmes of scientific, educational, technical and other assistance to developing States for the protection and preservation of the marine environment and the prevention, reduction and control of marine pollution. Such assistance shall include, *inter alia*:
>
> (i) training of their scientific and technical personnel;
> (ii) facilitating their participation in relevant international programmes;
> (iii) supplying them with necessary equipment and facilities;
> (iv) enhancing their capacity to manufacture such equipment;
> (v) advice on and developing facilities for research, monitoring, educational and other programmes;
>
> (b) provide appropriate assistance, especially to developing States, for the minimization of the effects of major incidents which may cause serious pollution of the marine environment;
>
> (c) provide appropriate assistance, especially to developing States, concerning the preparation of environmental assessments.

324. Article 203 of the Convention reads:

> *Preferential treatment for developing States*
>
> Developing States shall, for the purposes of prevention, reduction and control of pollution of the marine environment or minimization of its effects, be granted preference by international organizations in:
>
> (a) the allocation of appropriate funds and technical assistance; and
>
> (b) the utilization of their specialized services.

325. The Tribunal notes that most of the participants in the present proceedings were of the view that assistance to developing States is indispensable in combating pollution of the marine environment from anthropogenic GHG emissions. Such assistance seeks to alleviate the difficulties of developing States in addressing this issue and to enhance their capacity to do so. However, divergent views were expressed on the relationship between the obligation of assistance in the Convention and the principle of common but differentiated responsibilities and respective capabilities contemplated in the UNFCCC. It was contended that obligations of assistance under the Convention are a means of implementing the principle of common but differentiated responsibilities and respective capabilities in the context of the law of the sea. It was also argued that this principle, although not expressly mentioned in the Convention, must be considered, as the Convention and the climate change treaty regime are mutually supportive. It was further maintained that this principle should not be used as a pretext to escape the responsibility that weighs on all States, both individually and collectively, to counter marine pollution from anthropogenic GHG emissions. Other participants took the view that articles 202 and 203 should be interpreted only in the context of the Convention.

326. The Tribunal notes that articles 202 and 203 of the Convention do not refer to the principle of common but differentiated responsibilities and respective capabilities. However, the obligation of assistance to developing States under these articles has some elements underlying this principle in that States with lesser capabilities need assistance from States that are better placed in order to meet their environmental responsibilities.

327. In the view of the Tribunal, scientific, technical, educational and other assistance to developing States that are particularly vulnerable to the adverse effects of climate change is a means of addressing an inequitable situation. Although they contribute less to anthropogenic GHG emissions, such States suffer more severely from their effects on the marine environment. In this regard, the Tribunal notes the relevance of the UNFCCC and the Paris Agreement, which expressly recognize and take into account the specific needs and special circumstances of developing countries, "especially those that are particularly vulnerable to the adverse effects of climate change."

328. The Tribunal notes the fifth preambular paragraph of the Convention which states that the achievement of its goals "will contribute to the realization of a just and equitable international economic order which takes into account … the special interests and needs of developing countries". In the same vein, the General Assembly, in its annual resolution on oceans and the law of the sea, has recognized that

> the realization of the benefits of the Convention could be enhanced by international cooperation, technical assistance and advanced scientific knowledge, as well as by funding and capacity-building, and reiterating the essential need for cooperation, in accordance with States' capabilities, including through capacity-building and transfer and development of marine technology, inter alia, in relation to … the protection and preservation of the marine environment.
> (General Assembly Resolution 78/69, 5 December 2023, p. 4)

329. The Tribunal observes that articles 202 and 203 of the Convention identify a wide range of assistance mechanisms to permit developing States to appropriately address marine pollution from anthropogenic GHG emissions. These mechanisms coexist with those indicated by the UNFCCC (e.g., in Article 4, para. 3; Article 5, para. (b); Article 6, para. (a)(iv)) and the Paris Agreement (e.g., in Articles 9, 10 and 11) for supporting capacity-building, technical development and transfer, and the financial capabilities of developing States.

330. The main recipients of the assistance under article 202 of the Convention are developing States. In the context of marine pollution from anthropogenic GHG emissions, they should be those developing and least developed States that are

most directly and severely affected by the effects of such emissions on the marine environment. The above assistance is confined to that aimed at the protection and preservation of the marine environment and the prevention, reduction and control of marine pollution.

331. The obligation of assistance under article 202 of the Convention includes three categories of measures, the content of which is outlined broadly, allowing for an element of discretion on the part of States.

332. The first category of assistance measures, envisaged in article 202, subparagraph (a), of the Convention, includes the promotion of programmes of scientific, educational, technical and other assistance to developing States. The provision identifies some of the measures for promoting assistance. The purpose of this provision is, in the short and medium term, to provide the adequate scientific and technological knowledge to developing States by facilitating and supporting their participation in relevant international research and capacity-building programmes; and, in the long term, to develop capacities for research, production and management of scientific knowledge and technologies in these States to enable them to set up their own programmes to counter marine pollution from anthropogenic GHG emissions.

333. The Tribunal notes that the wide range of assistance measures provided for in article 202, subparagraph (a), of the Convention is not exhaustive. This is deduced from the expression “include, *inter alia*”, contained in the provision. It may also be noted that there are other provisions of the Convention which deal with assistance to developing States in the fields of science, technology and education (e.g., in Part XIII, section 2, and in Part XIV).

334. The second category of assistance measures, envisaged in article 202, subparagraph (b), of the Convention, concerns the provision of appropriate assistance, especially to developing States, in order to minimize the effects of major incidents which may cause serious marine pollution. This category appears to be of lesser relevance in the context of addressing marine pollution from anthropogenic GHG emissions.

335. The third category of measures, envisaged in article 202, subparagraph (c), of the Convention, is to provide appropriate assistance, especially to developing States, concerning the preparation of environmental assessments. The modalities of assistance are left to the discretion of States.

336. The Tribunal is of the view that “other assistance” referred to in article 202, subparagraph (a), of the Convention may include financial assistance aimed at providing developing States with assistance to promote the programmes and undertake the activities indicated in article 202 of the Convention. It is evident that scientific, educational and technical assistance entails financial implications. As indicated in paragraph 330 above, the financial assistance to developing States is confined to the protection and preservation of the marine environment and the prevention, reduction and control of marine pollution.

337. Article 203 of the Convention shifts the focus from the duty of assistance incumbent on States to the right to preferential treatment enjoyed by developing States within international organizations with respect to the allocation of appropriate funds and technical assistance and the use of their specialized services to prevent, reduce, control and minimize the effects of marine pollution.

338. The Tribunal notes that article 203 of the Convention implies the obligation of States to take, through the international organizations of which they are members, the measures necessary to put into effect preferential treatment for developing States as envisaged in this provision. In the context of marine pollution from anthropogenic GHG emissions, preferential treatment for developing States, in particular those vulnerable to the adverse effects of climate change (see para. 69 above), shall be granted for the purposes of prevention, reduction and control of marine pollution from such emissions or minimization of its effects.

339. To conclude, the Tribunal is of the view that articles 202 and 203 of the Convention set out specific obligations to assist developing States, in particular vulnerable developing States, in their efforts to address marine pollution from anthropogenic GHG emissions. Article 202 provides for the obligation of appropriate

assistance, directly or through competent international organizations, in terms of capacity-building, scientific expertise, technology transfer and other matters. Article 203 reinforces the support to developing States, in particular those vulnerable to the adverse effects of climate change, by granting them preferential treatment in funding, technical assistance and pertinent specialized services from international organizations.

3. Monitoring and environmental assessment

340. The Tribunal will now turn to the specific obligations of States stipulated in Part XII, section 4, of the Convention. Article 204 addresses the monitoring of the risks or effects of pollution; article 205, the publication of reports; and article 206, the assessment of potential effects of activities.

341. Article 204 reads:

> *Monitoring the risks or effects of pollution*
>
> 1. States shall, consistent with the rights of other States, endeavour, as far as practicable, directly or through the competent international organizations, to observe, measure, evaluate and analyse, by recognized scientific methods, the risks or effects of pollution of the marine environment.
>
> 2. In particular, States shall keep under surveillance the effects of any activities which they permit or in which they engage in order to determine whether these activities are likely to pollute the marine environment.

342. Article 205 reads:

> *Publication of reports*
>
> States shall publish reports of the results obtained pursuant to article 204 or provide such reports at appropriate intervals to the competent international organizations, which should make them available to all States.

343. Article 206 reads:

> *Assessment of potential effects of activities*
>
> When States have reasonable grounds for believing that planned activities under their jurisdiction or control may cause substantial pollution of or

> significant and harmful changes to the marine environment, they shall, as far as practicable, assess the potential effects of such activities on the marine environment and shall communicate reports of the results of such assessments in the manner provided in article 205.

344. The Tribunal notes that many participants in the present proceedings took the view that section 4 of Part XII of the Convention contains obligations which are highly relevant to the questions posed in the Request. It was contended that this section is concerned with obtaining and disseminating knowledge, and that it plays a critical role in ensuring the compliance of States with their obligations under article 192 and, in particular, article 194. It was further contended that monitoring and assessment conducted by a State pursuant to articles 204 and 206, and any reports made available to States pursuant to article 205, may be relevant in assessing what measures are necessary to prevent, reduce and control pollution of the marine environment from anthropogenic GHG emissions.

345. The Tribunal observes at the outset that the obligations envisaged in section 4 are procedural in nature. As held by the arbitral tribunal in the *Chagos Marine Protected Area Arbitration*, procedural obligations, such as the requirement to conduct an environmental impact assessment, "may, indeed, be of equal or even greater importance than the substantive standards existing in international law" (*Arbitration regarding the Chagos Marine Protected Area between Mauritius and the United Kingdom of Great Britain and Northern Ireland*, *Award of 18 March 2015, RIAA, Vol. XXXI*, p. 359, at p. 500, para. 322). Compliance with these procedural obligations is a relevant factor in meeting the general obligations under articles 194 and 192 of the Convention.

(a) Obligation under article 204 of the Convention

346. Under article 204 of the Convention, States shall endeavour to monitor the risks or effects of pollution of the marine environment (paragraph 1) and shall keep under surveillance the effects deriving from any activity in which they are involved, with a view to determining whether this activity is likely to pollute the marine environment (paragraph 2). Both obligations are continuing in nature, in that monitoring and surveillance must be ongoing. The extent of the monitoring obligation

is conditioned by the fact that States, consistent with the rights of other States, are obliged to make every effort, as far as practicable, taking into account their capabilities.

347. Article 204, paragraph 1, of the Convention aims to enhance knowledge of the harmful consequences of marine pollution as a whole. It provides for two phases of monitoring. First, the risks and effects of pollution of the marine environment are to be observed and measured. Second, the data collected are to be evaluated and analysed. In both phases, States are called upon to use “recognized scientific methods”. The standard of “recognized” scientific methods is exacting.

348. With respect to the means through which to fulfil the monitoring obligation, the provision gives discretion to the State concerned. States shall comply with this obligation by acting directly or through the competent international organizations, whether global or regional. In this respect, the Tribunal observes that the adverse effects caused to the marine environment by anthropogenic GHG emissions have been, for many years, the subject of monitoring by international scientific bodies and mechanisms.

349. Article 204, paragraph 2, of the Convention provides for the obligation to keep under surveillance the effects of activities that States have permitted, or in which they are engaged. This obligation is stricter than that under article 204, paragraph 1. The obligation applies irrespective of the place where the activities are conducted or the nationality of the individuals or entities carrying out the activities.

(b) Obligation under article 205 of the Convention

350. Under article 205 of the Convention, States are required to publish reports of the results of their monitoring activities or to provide such reports to the competent international organizations to make them available to all States.

351. The Tribunal notes that the obligation to publish such reports or to provide them to the competent international organizations complements the duty of monitoring set out in article 204 of the Convention. The obligation to circulate reports

is based on the assumption that one of the most effective means for the protection and preservation of the marine environment consists in sharing information and scientific results on risks to the marine environment. In the context of climate change, article 205 requires States to ensure transparency by disseminating the results of their monitoring activities with respect to the negative impacts caused to the marine environment by anthropogenic GHG emissions.

(c) Obligation under article 206 of the Convention

352. The obligation to conduct environmental impact assessments, contemplated in article 206 of the Convention, requires States to assess the potentially harmful effects of a planned activity prior to its execution and to disseminate the obtained results thereafter.

353. The Tribunal notes that most of the participants in the present proceedings were of the view that there is an obligation to conduct an environmental impact assessment under the Convention and customary international law. Most participants also shared the view that the due diligence standard is closely connected to this obligation. It was generally argued that the scope of article 206 of the Convention is wide and that the discretion of States in triggering the obligation therein is limited by various elements, including the precautionary approach. In this regard, it was contended that an environmental impact assessment may also concern the cumulative effects of a planned activity on the marine environment. Furthermore, it was argued that, although article 206 establishes the duty to carry out an environmental impact assessment, the means to assess the adverse effects of activities related to GHG emissions on the marine environment, and the implementation of such a duty, need further study. Finally, while the view was expressed that the form and content of impact assessments are a matter for domestic rather than international law, several participants referred to other international instruments for guidance on this issue.

354. The Tribunal is of the view that the obligation to conduct environmental impact assessments is crucial to ensure that activities do not harm the marine environment and is an essential part of a comprehensive environmental management system

(see *The South China Sea Arbitration between the Republic of the Philippines and the People's Republic of China, Award of 12 July 2016, RIAA, Vol. XXXIII*, p. 153, at p. 523, para. 948).

355. As the Seabed Disputes Chamber noted, this obligation also forms part of customary international law (*Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011*, p. 10, at pp. 50-51, paras. 145 and 147; see also *Pulp Mills on the River Uruguay (Argentina* v. *Uruguay), Judgment, I.C.J. Reports 2010*, p. 14, at p. 83, para. 204).

356. The obligation to conduct an environmental impact assessment pursuant to article 206 of the Convention encompasses the duty of vigilance and prevention. As noted by the ICJ, this duty would not be considered to have been fulfilled if an environmental impact assessment was not undertaken of activities at risk of affecting the environment (see *Pulp Mills on the River Uruguay (Argentina* v. *Uruguay), Judgment, I.C.J. Reports 2010*, p. 14, at p. 83, para. 204). Article 206 therefore constitutes a "particular application" of the obligation enunciated in article 194, paragraph 2 (*The South China Sea Arbitration*, *Award of 12 July 2016, RIAA, Vol. XXXIII*, p. 153, at p. 523, para. 948).

357. In the Tribunal's view, although article 206 of the Convention does not specify the scope and content of an environmental impact assessment, it indicates some of the components that are relevant in addressing the Request.

358. The obligation to conduct an environmental impact assessment concerns "planned activities". This broad term implies that such assessment is to be conducted prior to the implementation of a project (see *Pulp Mills on the River Uruguay (Argentina* v. *Uruguay), Judgment, I.C.J. Reports 2010*, p. 14, at pp. 83-84, para. 205; *Certain Activities Carried out by Nicaragua in the Border Area, (Costa Rica* v. *Nicaragua*), *Judgment, I.C.J. Reports 2015*, p. 665, at pp. 706-707, para. 104, p. 720, para. 153, and pp. 722-733, para. 161). The activities under assessment comprise both those planned by private entities and those planned by States.

359. Article 206 of the Convention establishes certain requirements to trigger the obligation to conduct an environmental impact assessment. These requirements are the “jurisdiction or control” of the State over the planned activities and the “reasonable grounds for believing” that these activities “may cause substantial pollution of or significant and harmful changes to the marine environment”.

360. As stated above, the concept of “jurisdiction or control” is a broad one. The duty under article 206 of the Convention applies to any planned activity under the jurisdiction or control of the State concerned (see para. 247 above). Land-based activities as well as those at sea are included.

361. Concerning the requirement of “reasonable grounds for believing”, the arbitral tribunal in the *South China Sea Arbitration* observed that the “terms ‘reasonable’ and ‘as far as practicable’ contain an element of discretion for the State concerned” (*The South China Sea Arbitration between the Republic of the Philippines and the People’s Republic of China, Award of 12 July 2016*, *RIAA, Vol. XXXIII*, p. 153, at p. 523, para. 948). However, the discretion of such a State is limited by the fact that it is required to determine whether an activity under its jurisdiction or control “may cause substantial pollution of or significant and harmful changes to the marine environment”. It is a matter of objective determination based on facts and scientific knowledge. Such pollution and changes need not be actual but can also be potential. Therefore, the Tribunal considers that the precautionary approach may restrict the margin of discretion on the part of the State concerned.

362. The expression “substantial pollution of or significant and harmful changes to the marine environment” is not further elaborated upon in article 206 of the Convention. In the Tribunal’s view, the use of the word “or” suggests that article 206 contemplates two alternative thresholds for subjecting a planned activity to an environmental impact assessment: one threshold for “substantial pollution” and another for “significant and harmful changes”. However, the issue of possible alternative thresholds to trigger the obligation to conduct an environmental impact assessment has little relevance in the case of anthropogenic GHG emissions in light of their impact on the marine environment.

363. Article 206 of the Convention does not specify the content of an environmental impact assessment or the procedure to be followed except for the reference to the communication of States' reports under article 205. Such content and procedure are to be determined by each State in its legislation. In this regard, it is worth recalling that the ICJ in *Pulp Mills on the River Uruguay* held that

> it is for each State to determine in its domestic legislation or in the authorization process for the project, the specific content of the environmental impact assessment required in each case, having regard to the nature and magnitude of the proposed development and its likely adverse impact on the environment as well as to the need to exercise due diligence in conducting such an assessment.
> (*Pulp Mills on the River Uruguay (Argentina* v. *Uruguay), Judgment, I.C.J. Reports 2010*, p. 14, at p. 83, para. 205)

364. In this context, a certain degree of flexibility is indicated by the expression "as far as practicable", which addresses, in particular, the different capabilities of States, especially developing States, in conducting environmental impact assessments.

365. Concerning the content of an environmental impact assessment, the Tribunal considers that the broad wording of article 206 of the Convention does not preclude such assessment from embracing not only the specific effects of the planned activities concerned but also the cumulative impacts of these and other activities on the environment. In the context of pollution of the marine environment from anthropogenic GHG emissions, planned activities may not be environmentally significant if taken in isolation, whereas they may produce significant effects if evaluated in interaction with other activities. Moreover, the broad wording of article 206 does not preclude the assessment from including the socio-economic impacts of the activities concerned.

366. The Tribunal notes that the BBNJ Agreement contains, *inter alia*, detailed provisions on environmental impact assessments relating to their thresholds and factors, the processes for conducting them and the reports of such assessments.

(d) Conclusion

367. In light of the foregoing, the Tribunal is of the view that articles 204, 205 and 206 of the Convention impose specific obligations on States Parties to monitor the risks or effects of pollution, to publish reports and to conduct environmental impact assessments as a means to address marine pollution from anthropogenic GHG emissions. Under article 204, paragraph 1, States Parties are required to endeavour to observe, measure, evaluate and analyse the risks or effects of pollution of the marine environment from anthropogenic GHG emissions. Under article 204, paragraph 2, States Parties have the specific obligation to keep under continuing surveillance the effects of activities they have permitted, or in which they are engaged, in order to determine whether such activities are likely to pollute the marine environment through anthropogenic GHG emissions. Article 205 requires States Parties to publish the results obtained from monitoring the risks or effects of pollution from anthropogenic GHG emissions or to communicate them to the competent international organizations for their dissemination. Article 206 sets out the obligation to conduct environmental impact assessments. Any planned activity, either public or private, which may cause substantial pollution to the marine environment or significant and harmful changes thereto through anthropogenic GHG emissions, including cumulative effects, shall be subjected to an environmental impact assessment. Such assessment shall be conducted by the State Party under whose jurisdiction or control the planned activity will be undertaken with a view to mitigating and adapting to the adverse effects of those emissions on the marine environment. The result of such assessment shall be reported in accordance with article 205 of the Convention.

VIII. Question (b)

368. The Tribunal will now turn to the second question posed by the Commission. The question reads:

> What are the specific obligations of State Parties to the United Nations Convention on the Law of the Sea (‘UNCLOS’), including under Part XII: …

> (b) to protect and preserve the marine environment in relation to climate change impacts, including ocean warming and sea level rise, and ocean acidification?

369. In its written submission, the Commission described Question (b) as "independent, but complementary to the first", encompassing the general obligation "to protect and preserve the marine environment in regulating the activities that cause climate change impacts, including ocean warming and sea level rise, and ocean acidification." In more precise terms, the Commission stated that "[t]his question concerns the meaning and scope of article 192". Other participants in the proceedings generally agreed with these observations.

370. The Tribunal has already drawn attention to the fact that Question (b) is broader in scope than Question (a) (see paras. 151 and 152 above). Question (b) is formulated in terms that invoke article 192 of the Convention, which provides that "States have the obligation to protect and preserve the marine environment." The obligation is comprehensive in nature and encompasses obligations contained in other provisions of the Convention, including article 194, which set out more specific obligations. The views of the Tribunal on Question (a) are fully applicable to Question (b).

371. The Tribunal notes that in addressing the definition of "pollution of the marine environment", it clarified the term "marine environment" (see paras. 166 to 171 above). This clarification applies to article 192 and other relevant provisions of the Convention that are considered below.

372. The Tribunal confines its observations herein to the specific obligations to protect and preserve the marine environment in relation to climate change impacts and ocean acidification that were not previously identified in its response to Question (a).

A. Clarification of terms and expressions

373. Certain terms employed in the Request are common to the first and second questions as formulated by the Commission. The Tribunal has already clarified some

terms in determining the precise meaning of Question (a), including the references made to “specific obligations”, “climate change” and “ocean acidification”.

374. As previously explained, the Tribunal accepts the definitions and usage of such terms as “climate change” and “ocean acidification” as they are defined in climate change treaties or widely used in authoritative scientific works such as the IPCC reports, which have already been explained in paragraphs 52, 60 and 68 above.

375. Question (b) concerns “climate change impacts”. The Tribunal observes that the word “impacts” is neutral. However, as formulated in the question submitted to the Tribunal, and in the arguments presented in the proceedings, the word is used in relation to circumstances in which drivers of climate change cause deleterious effects to the marine environment. The Tribunal is of the view that Question (b) concerns the negative impacts of climate change and ocean acidification on the marine environment.

376. As regards the term “specific obligations”, the Tribunal has already drawn attention to the fact that the term may denote concrete or particularized obligations in contrast to general obligations. It may also mean obligations specific to the protection and preservation of the marine environment in relation to climate change impacts and ocean acidification. In responding to Question (b), the Tribunal will bear in mind both aspects of the term “specific”.

B. Relevant provisions of the Convention

377. The Tribunal will now proceed to address the specific obligations of States Parties under the Convention to protect and preserve the marine environment in relation to climate change impacts and ocean acidification that go beyond the prevention, reduction and control of marine pollution as addressed in Question (a).

378. In this regard, the Tribunal will first identify the provisions of the Convention relevant to its response to Question (b). It will then interpret those provisions to the extent necessary to respond to the question, and examine how they should be

applied in protecting and preserving the marine environment in relation to climate change impacts and ocean acidification. Subsequently, the Tribunal will set out the specific obligations of States Parties under the Convention to protect and preserve the marine environment against climate change impacts and ocean acidification.

379. The provisions of the Convention which are relevant to answering Question (b) are found in Part XII, as well as other parts of the Convention. The Tribunal has already presented an overview of the system for the protection and preservation of the marine environment set out in Part XII (see paras. 182 to 191 above). The primary provision in this regard is article 192 of the Convention which provides for the general obligation.

380. The relationship between articles 192 and 193 of the Convention is also addressed in the overview of Part XII (see paras. 184 to 187 above). In the overview, it is noted that article 193 places a constraint upon States' exercise of their sovereign right to exploit their natural resources, which has to be exercised in accordance with their duty to protect and preserve the marine environment.

381. In addressing article 194 of the Convention on measures to regulate marine pollution in relation to the first question, the Tribunal observed that measures envisaged under paragraph 5 of that article cover more than those to regulate pollution, and for that reason, this paragraph refers to the measures taken in accordance with "this Part" rather than "this article". Paragraph 5 of article 194 is particularly relevant to the Tribunal's response to the second question concerning specific obligations to protect and preserve the marine environment.

382. The provisions of Part XII of the Convention that are not aimed exclusively at addressing marine pollution include article 196 on the use of technologies or introduction of alien or new species. Other provisions concerning the protection and preservation of the marine environment are found, in particular, in Part V, including articles 61, 63 and 64, and in Part VII, including articles 117, 118 and 119. These provisions are pertinent in addressing climate change impacts and ocean acidification.

383. The Tribunal's response to the first question addressed the provisions of Part XII of the Convention in section 2 on global and regional cooperation, section 3 on technical assistance, and section 4 on monitoring and environmental assessment. These provisions are also relevant to the Tribunal's consideration of the second question. The Tribunal will elaborate, as necessary, on the significance of these provisions in responding to the second question.

C. Obligations to protect and preserve the marine environment in relation to climate change impacts and ocean acidification

1. Obligation under article 192 of the Convention

(a) Scope of the obligation

384. A vast majority of participants argued that article 192 of the Convention must be interpreted so as to cover all contemporary threats to the marine environment, including those that have emerged following the adoption of the Convention. It was further contended that the mere fact that climate change and ocean acidification constitute a specific and considerable threat to the marine environment is already sufficient in and of itself to give rise to a specific obligation with regard to its protection and preservation in the context of article 192. Some participants, however, argued that Part XII of the Convention does not establish any specific obligations to protect and preserve the marine environment in relation to the impacts of climate change; rather, such obligations are found under specific international instruments, although the Convention may play a subsidiary role in protecting and preserving the marine environment from the adverse effects of climate change.

385. The Tribunal is of the view that the obligation contained in article 192 of the Convention has a broad scope, encompassing any type of harm or threat to the marine environment. The obligation under this provision has two distinct elements. The first element is the obligation to protect the marine environment. It is linked to the duty to prevent, or at least mitigate, environmental harm (see para. 246 above). The second element is the obligation to preserve the marine environment, which

entails maintaining ecosystem health and the natural balance of the marine environment.

386. Where the marine environment has been degraded, the Tribunal is of the view that the term “preservation” may include restoring marine habitats and ecosystems. The term “restoration” is not used in article 192 of the Convention but flows from the obligation to preserve the marine environment where the process of reversing degraded ecosystems is necessary in order to regain ecological balance.

387. The two distinct elements of article 192 of the Convention have been expressed in the following terms:

> This “general obligation” extends both to “protection” of the marine environment from future damage and “preservation” in the sense of maintaining or improving its present condition. Article 192 thus entails the positive obligation to take active measures to protect and preserve the marine environment, and by logical implication, entails the negative obligation not to degrade the marine environment.
> (*The South China Sea Arbitration between the Republic of the Philippines and the People’s Republic of China, Award of 12 July 2016*, *RIAA, Vol. XXXIII*, p. 153, at p. 519, para. 941)

388. Article 192 of the Convention does not specify the relevant harms and threats to which it applies. The open-ended nature of the obligation means that it can be invoked to combat any form of degradation of the marine environment, including climate change impacts, such as ocean warming and sea level rise, and ocean acidification. Article 192 does not specify how the marine environment must be protected and preserved against present and future harms. Other provisions of the Convention and external rules inform the content of article 192 and shape the types of measures that may be implemented to protect and preserve the marine environment. In this regard, the Tribunal has addressed the relevance of international instruments on climate change, including the UNFCCC and the Paris Agreement, to the questions before it (see paras. 67 to 82 above). Other agreements, such as the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (hereinafter “the Fish Stocks Agreement” or “FSA”), which was adopted

on 4 August 1995 and entered into force on 11 December 2001, and the CBD, may also provide relevant guidance, as indicated further below.

(b) Measures

389. Some participants argued that, in the context of climate change and ocean acidification, the specific obligations under article 192 of the Convention fall into three categories: to mitigate climate change; to implement resilience and adaptation measures; and to protect marine ecosystems that sequester carbon dioxide, thereby preventing further harm to the marine environment. In this regard, many participants noted the relevance of the UNFCCC and the Paris Agreement, and the subsequent relevant decisions taken by the governing bodies of these treaties, in interpreting the provisions of Part XII of the Convention.

390. The Tribunal has drawn attention to the role of the ocean in storing heat trapped in the atmosphere caused by increasing concentrations of GHGs and storage of excess carbon dioxide (see paras. 54 and 55 above). The ocean is the world's largest sink. Coastal "blue carbon" ecosystems, such as mangroves, tidal marshes, and seagrass meadows, are also important sinks and can contribute to ecosystem-based adaptation (see para. 56 above). The obligation to protect and preserve the marine environment is therefore of dual significance in that it promotes the conservation and resilience of living marine resources, while also mitigating anthropogenic GHG emissions by enhancing carbon sequestration through measures to restore the marine environment (see also Article 4, paragraph 1(d), of the UNFCCC and Article 5, paragraph 1, of the Paris Agreement).

391. The obligation to take mitigation measures to reduce anthropogenic GHG emissions has been addressed in the response to Question (a). Article 192 of the Convention also requires States to implement measures to protect and preserve the marine environment in relation to climate change impacts and ocean acidification that include resilience and adaptation actions as described in the climate change treaties.

392. The Convention does not use the term “adaptation measures”. As defined by the IPCC, adaptation is “the process of adjustment to actual or expected *climate* and its effects, in order to moderate harm or exploit beneficial opportunities. In *natural systems*, … human intervention may facilitate adjustment to expected *climate* and its effects” (WGII 2022 Report, Annex II, p. 2898). The ultimate objective of the UNFCCC, as stated in its Article 2, includes the “stabilization of greenhouse gas concentrations in the atmosphere … within a timeframe sufficient to allow ecosystems to adapt naturally to climate change”. Other provisions of the UNFCCC address measures to facilitate adequate adaptation to climate change. This is further developed in the Paris Agreement.

393. Article 2 of the Paris Agreement, in enhancing the implementation of the UNFCCC, including its objective, aims to strengthen the global response to the threat of climate change by, *inter alia*, “[i]ncreasing the ability to adapt to the adverse impacts of climate change and foster climate resilience”. The Paris Agreement establishes the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change in paragraph 1 of Article 7. Paragraphs 5 and 6 of Article 7 of the Paris Agreement address elements of adaptation strategies and read as follows:

> 5. Parties acknowledge that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems, with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate.
>
> 6. Parties recognize the importance of support for and international cooperation on adaptation efforts and the importance of taking into account the needs of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change.

394. The Tribunal is of the view that these provisions are compatible with the obligations of the Convention and exemplify how science and other relevant considerations are taken into account by States in implementing adaptation measures. The Tribunal notes that measures of adaptation and resilience-building frequently require significant resources. In this respect, the Tribunal has already

addressed the obligations under Part XII of the Convention on the provision of technical assistance to developing States (see paras. 322 to 339 above).

(c) Nature of the obligation

395. A vast majority of participants in the proceedings stated that article 192 of the Convention reflects an obligation to act with due diligence. Some noted that the principle of prevention is an integral part of the duty of due diligence, which is an obligation of conduct rather than of result. Other participants indicated that they deliberately avoided the binary characterization of obligations of conduct and of result because, in the context of the Convention and international law generally, these labels are largely unhelpful, as many obligations straddle both categories.

396. The Tribunal considers that the obligation to take measures necessary to protect and preserve the marine environment requires States to ensure that non-State actors under their jurisdiction or control comply with such measures. The obligation of the State, in this instance, is one of due diligence.

397. The Tribunal has already addressed the character of a due diligence obligation in responding to Question (a). The content of the due diligence obligation depends on the nature of the specific treaty obligation so qualified and may vary over time. The standard of this obligation is determined by, among other factors, an assessment of the risk and level of harm combined.

398. The impacts of climate change and ocean acidification on the marine environment are described in the IPCC reports as severe. The WGII 2022 Report states that “global sea level rise, as well as warming, ocean acidification and deoxygenation at depth, are irreversible for centuries or longer (*very high confidence*)” (WGII 2022 Report, p. 453). The 2023 Synthesis Report further states that “[t]he likelihood and impacts of abrupt and/or irreversible changes in the climate system, including changes triggered when tipping points are reached, increase with further global warming (*high confidence*)” (2023 Synthesis Report, p. 18). In its Judgment in *Gabčíkovo-Nagymaros Project (Hungary/Slovakia)*, the ICJ observed that “in the field of environmental protection, vigilance and prevention are required on

account of the often irreversible character of damage to the environment and of the limitations inherent in the very mechanism of reparation of this type of damage" (*Gabčíkovo-Nagymaros Project (Hungary/Slovakia), Judgment, I.C.J. Reports 1997*, p. 7, at p. 78, para. 140). In such circumstances, the standard of the due diligence obligation is stringent.

399. The Tribunal holds the view that, given the risks posed to the marine environment, States, in fulfilment of their obligations under article 192 of the Convention, are required to take measures as far-reaching and efficacious as possible to prevent or reduce the deleterious effects of climate change and ocean acidification on the marine environment. The standard of due diligence under article 192 is, as stated above, stringent given the high risks of serious and irreversible harm to the marine environment by climate change impacts and ocean acidification.

(d) Conclusion

400. To conclude, article 192 of the Convention imposes a general obligation on States Parties to protect and preserve the marine environment. It applies to all maritime areas and can be invoked to combat any form of degradation of the marine environment, including climate change impacts, such as ocean warming and sea level rise, and ocean acidification. Where the marine environment has been degraded, this may require restoring marine habitats and ecosystems. This obligation is one of due diligence. The standard of due diligence is stringent, given the high risks of serious and irreversible harm to the marine environment from climate change impacts and ocean acidification.

2. Obligation under article 194, paragraph 5, of the Convention

401. Many participants in the proceedings noted that article 194, paragraph 5, of the Convention gives a specific form to the general obligation enshrined in article 192 in the context of fragile ecosystems, which are particularly threatened by global warming and ocean acidification. Some participants drew attention to the fact that article 194, paragraph 5, refers to Part XII and invokes the phrase "protect and

preserve" contained in article 192. Some also suggested that article 194, paragraph 5, is reinforced by the call in the preamble of the Paris Agreement to protect the ecological integrity of the ocean.

402. The Tribunal observes that the obligation under article 192 of the Convention includes the specific obligation to take measures "necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life", as expressly provided for in article 194, paragraph 5. This paragraph does not provide specific criteria for determining what measures are "necessary". As stated above (see para. 203), the word "necessary" is to be interpreted in accordance with its ordinary meaning and should be understood broadly. The measures necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life are those which make it possible to achieve that objective.

403. The obligation stated in article 194, paragraph 5, of the Convention requires States to take both measures necessary to protect "rare or fragile ecosystems" and those necessary to protect the "habitat of depleted, threatened or endangered species and other forms of marine life." The Tribunal observes that the Convention does not define either expression. In clarifying the term "marine environment" in relation to article 1, paragraph 1, subparagraph 4, of the Convention, the Tribunal addressed the definition of the term "ecosystem" (see para. 169 above). The Tribunal notes that characteristics of an ecosystem, such as the uniqueness or rarity, and vulnerability, fragility, sensitivity, or slow recovery, may change over time. Consequently, the process of identifying "rare or fragile ecosystems" requires a case-by-case review. Article 234 of the Convention, concerning ice-covered areas, provides an example of fragile ecosystems where special measures may be required to protect and preserve the marine environment.

404. With regard to the phrase "the habitat of depleted, threatened or endangered species and other forms of marine life", the Tribunal notes that Article 2 of the CBD provides a generally accepted definition of the term "[h]abitat" as "the place or type of site where an organism or population naturally occurs." It is not necessary for such

place or site to form part of a rare or fragile ecosystem. The concern is with the conservation of depleted, threatened or endangered species and other forms of marine life and the preservation of their natural environment. The Convention does not identify a list of “depleted, threatened or endangered species”. The Tribunal notes that the Convention on International Trade in Endangered Species of Wild Fauna and Flora (hereinafter “CITES”), which was adopted on 3 March 1973 and entered into force on 1 July 1975, classifies species threatened with extinction and those likely to become endangered in the absence of trade regulations. CITES is an agreement to which there is near-universal adherence. The Tribunal considers that the classification of species in the appendices to CITES provides guidance in interpreting the term “depleted, threatened or endangered species” in article 194, paragraph 5 (see *The South China Sea Arbitration between the Republic of the Philippines and the People’s Republic of China, Award of 12 July 2016*, *RIAA, Vol. XXXIII*, p. 153, at p. 526, para. 956).

405. The Tribunal notes that the obligation imposed by article 194, paragraph 5, of the Convention may call for specific measures, such as the enactment and enforcement of laws and regulations or the undertaking of monitoring and assessment (see paras. 340 to 367 above). These measures are context-specific and call for objectively reasonable approaches to be taken on the basis of the best available science. Their implementation depends on the relevant domestic legal system and allows for the exercise of discretion. However, States do not have absolute discretion with respect to the action that is required. As stated by the Seabed Disputes Chamber in the *Area Advisory Opinion*, a “State must take into account, objectively, the relevant options in a manner that is reasonable, relevant and conducive to the benefit of mankind as a whole. It must act in good faith, especially when its action is likely to affect prejudicially the interests of mankind as a whole” (*Responsibilities and obligations of States with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011*, p. 10, at p. 71, para. 230). Although the Seabed Disputes Chamber addressed the specific obligations of sponsoring States under article 4, paragraph 4, of Annex III to the Convention, the Tribunal finds that the views it expressed are also applicable to measures taken to protect and preserve the marine environment in relation to the impacts of climate change and ocean acidification.

406. To conclude, article 194, paragraph 5, of the Convention, read together with article 192, imposes specific obligations on States Parties to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life from climate change impacts and ocean acidification.

3. Obligations under other provisions of the Convention

407. The Tribunal will now identify specific obligations under article 192, read with other provisions of the Convention, that require States to take conservation measures, including adaptation and resilience-building, to protect and preserve the marine environment in response to climate change impacts and ocean acidification.

408. Some participants in the proceedings argued that article 192 provides an umbrella obligation that encapsulates several more specific obligations found in different parts of the Convention as well as in the Fish Stocks Agreement. In addition to the Convention, the Fish Stocks Agreement was cited as providing a relevant framework for cooperation on the protection and preservation of the marine environment in relation to climate change impacts and ocean acidification.

409. The Tribunal notes that climate change and ocean acidification affect virtually all forms of marine life, including fish and corals that build structures providing the habitat for large numbers of species. As the Tribunal stated in the *Southern Bluefin Tuna* cases, “the conservation of the living resources of the sea is an element in the protection and preservation of the marine environment” (*Southern Bluefin Tuna (New Zealand* v. *Japan; Australia* v. *Japan), Provisional Measures, Order of 27 August 1999, ITLOS Reports 1999*, p. 280, at p. 295, para. 70). The Tribunal observes that the conservation of living resources and marine life, which falls within the general obligation to protect and preserve the marine environment, requires measures that may vary over time depending on the activities involved and the threats to the marine environment.

410. The impacts of climate change and ocean acidification include shifts in fish distribution and decreases in fisheries that affect the “income, livelihoods, and food security of marine resource-dependent communities”, as well as impacts on marine ecosystems which will put “key cultural dimensions of lives and livelihoods at risk” (see para. 66 above). For conservation measures to be effective, such impacts must be taken into account.

411. The specific obligations of the Convention on the conservation of living resources of the sea are stipulated, *inter alia*, in Parts V and VII, in particular article 61, on the conservation of living resources in the exclusive economic zone, and articles 117 and 119, on the conservation of living resources of the high seas.

(a) Obligations under articles 61, 117 and 119 of the Convention

412. Article 61 of the Convention provides for the obligations concerning the conservation of the living resources in the exclusive economic zone and general principles on what such conservation requires. Article 61, paragraphs 2, 3, and 4, reads as follows:

> 2. The coastal State, taking into account the best scientific evidence available to it, shall ensure through proper conservation and management measures that the maintenance of the living resources in the exclusive economic zone is not endangered by over-exploitation. As appropriate, the coastal State and competent international organizations, whether subregional, regional or global, shall cooperate to this end.
>
> 3. Such measures shall also be designed to maintain or restore populations of harvested species at levels which can produce the maximum sustainable yield, as qualified by relevant environmental and economic factors, including the economic needs of coastal fishing communities and the special requirements of developing States, and taking into account fishing patterns, the interdependence of stocks and any generally recommended international minimum standards, whether subregional, regional or global.
>
> 4. In taking such measures the coastal State shall take into consideration the effects on species associated with or dependent upon harvested species with a view to maintaining or restoring populations of such associated or dependent species above levels at which their reproduction may become seriously threatened.

413. Article 61 of the Convention identifies both the purpose of conservation and management measures and the factors to be taken into account in taking such measures. States retain discretion in determining the particular measures to achieve the stated objectives. As stated by the ICJ, in commenting on articles 61 and 62 of the Convention, in the *Fisheries Jurisdiction Case (Spain* v. *Canada*),

> [a]ccording to international law, in order for a measure to be characterized as a "conservation and management measure", it is sufficient that its purpose is to conserve and manage living resources and that, to this end, it satisfies various technical requirements.
> (*Fisheries Jurisdiction (Spain* v. *Canada), Jurisdiction of the Court, Judgment, I.C.J. Reports 1998*, p. 432, at p. 461, para. 70)

414. The purpose of conservation and management measures under article 61 of the Convention is to ensure that the maintenance of the living resources in the exclusive economic zone is not endangered by overexploitation. To that end, such measures must be informed by the best available science, including internationally coordinated scientific assessments of the magnitude, timing, and potential environmental and socio-economic impacts of climate change and ocean acidification, and realistic response strategies. States are required, in designing such measures, to take into account relevant environmental and economic factors, including the impact of climate change and ocean acidification on marine ecosystems, environmental stressors, stock migration, and the implications for vulnerable communities and specially affected developing States. Consideration should be given to fishing patterns and the effects on associated and dependent species, and the different rates at which different parts of the food web are responding to climate change and ocean acidification, leading to population-level changes, with a view to ensuring their populations are maintained or restored at levels above which their reproduction may become seriously threatened.

415. The general obligation expressed in article 192 of the Convention, to protect and preserve the marine environment, encompasses obligations stated in article 117. According to article 117, all States have the duty to take, or to cooperate with other States in taking, such measures for their respective nationals as may be necessary for the conservation of the living resources of the high seas. This

obligation is not limited to flag States but applies to all States with respect to their nationals engaged in activities on the high seas.

416. Article 119 of the Convention provides for the obligation to conserve the living resources in the high seas. This obligation substantially replicates that of article 61 of the Convention, as the conservation duty of all States in the high seas and of the coastal State in the exclusive economic zone is fundamentally the same. Paragraph 1 of article 119 reads:

> In determining the allowable catch and establishing other conservation measures for the living resources in the high seas, States shall:
>
> > (a) take measures which are designed, on the best scientific evidence available to the States concerned, to maintain or restore populations of harvested species at levels which can produce the maximum sustainable yield, as qualified by relevant environmental and economic factors, including the special requirements of developing States, and taking into account fishing patterns, the interdependence of stocks and any generally recommended international minimum standards, whether subregional, regional or global;
> >
> > (b) take into consideration the effects on species associated with or dependent upon harvested species with a view to maintaining or restoring populations of such associated or dependent species above levels at which their reproduction may become seriously threatened.

417. Articles 61 and 119 of the Convention establish a consistent framework that promotes the compatibility of measures established for the high seas and those adopted for areas under national jurisdiction in order to ensure the conservation of stocks in their entirety. In the *SRFC Advisory Opinion*, the Tribunal observed that "fisheries conservation and management measures, to be effective, should concern the whole stock unit over its entire area of distribution or migration routes" (*Request for Advisory Opinion Submitted by the Sub-Regional Fisheries Commission, Advisory Opinion of 2 April 2015, ITLOS Reports 2015*, p. 4, at p. 60, para. 214). To that end, the Tribunal emphasized that "States may, directly or through relevant subregional or regional organizations, seek the cooperation of non-Member States sharing the same stocks along their migrating routes with a view to ensuring conservation and sustainable management of these stocks in the whole of their geographical distribution or migrating area" (*ibid.*, at p. 61, para. 215). The views

expressed in the *SRFC Advisory Opinion* are relevant to the conservation and management measures relating to climate-driven shifts in the distribution of stocks.

418. To conclude, articles 61 and 119 of the Convention impose specific obligations on States Parties to take measures necessary to conserve living marine resources threatened by climate change impacts and ocean acidification. Under article 61, States Parties must ensure that the maintenance of the living resources in the exclusive economic zone is not endangered by overexploitation. Conservation and management measures must be informed by the best available science. States Parties are required to take into account relevant environmental and economic factors, including the impact of climate change and ocean acidification. This entails the application of the precautionary approach and an ecosystem approach. The obligation imposed on States Parties under article 119 of the Convention substantially replicates that of article 61, as the conservation duty of all States in the high seas and of the coastal State in the exclusive economic zone is fundamentally the same.

(b) Obligations under articles 63, 64 and 118 of the Convention

419. The importance of the obligation on cooperation in addressing climate change impacts and ocean acidification has already been dealt with by the Tribunal above (see paras. 294 to 321). The obligation to cooperate in conserving living marine resources is found not only in articles 61, 117 and 119 but also in other provisions of the Convention, in particular, articles 63, 64 and 118.

420. Article 63 of the Convention reads:

> *Stocks occurring within the exclusive economic zones of two or more coastal States or both within the exclusive economic zone and in an area beyond and adjacent to it*
>
> 1. Where the same stock or stocks of associated species occur within the exclusive economic zones of two or more coastal States, these States shall seek, either directly or through appropriate subregional or regional organizations, to agree upon the measures necessary to coordinate and ensure the conservation and development of such stocks without prejudice to the other provisions of this Part.

> 2. Where the same stock or stocks of associated species occur both within the exclusive economic zone and in an area beyond and adjacent to the zone, the coastal State and the States fishing for such stocks in the adjacent area shall seek, either directly or through appropriate subregional or regional organizations, to agree upon the measures necessary for the conservation of these stocks in the adjacent area.

421. In the case of highly migratory species, article 64, paragraph 1, of the Convention provides:

> The coastal State and other States whose nationals fish in the region for the highly migratory species listed in Annex I shall cooperate directly or through appropriate international organizations with a view to ensuring conservation and promoting the objective of optimum utilization of such species throughout the region, both within and beyond the exclusive economic zone. In regions for which no appropriate international organization exists, the coastal State and other States whose nationals harvest these species in the region shall cooperate to establish such an organization and participate in its work.

422. As noted above, in the *SRFC Advisory Opinion*, the Tribunal clarified the obligations imposed on States by articles 63 and 64 of the Convention in the following terms:

> The Tribunal observes that the obligation to "seek to agree ..." under article 63, paragraph 1, and the obligation to cooperate under article 64, paragraph 1, of the Convention are "due diligence" obligations which require the States concerned to consult with one another in good faith, pursuant to article 300 of the Convention. The consultations should be meaningful in the sense that substantial effort should be made by all States concerned, with a view to adopting effective measures necessary to coordinate and ensure the conservation and development of shared stocks.
> (*Request for Advisory Opinion submitted by the Sub-Regional Fisheries Commission, Advisory Opinion, 2 April 2015, ITLOS Reports 2015,* p. 4, at pp. 59-60, para. 210)

423. The Tribunal is of the view that the above clarifications provided in the *SRFC Advisory Opinion* are relevant in the context of climate change impacts and ocean acidification. The obligation to "seek to agree …" under article 63, paragraph 1, and the obligation to cooperate under article 64, paragraph 1, of the Convention require States, *inter alia*, to consult with one another in good faith with a view to adopting effective measures necessary to coordinate and ensure the conservation and development of shared stocks, taking into account the impacts of climate change and ocean acidification on living marine resources.

424. Article 118 of the Convention reads:

> *Cooperation of States in the conservation and management of living resources*
>
> States shall cooperate with each other in the conservation and management of living resources in the areas of the high seas. States whose nationals exploit identical living resources, or different living resources in the same area, shall enter into negotiations with a view to taking the measures necessary for the conservation of the living resources concerned. They shall, as appropriate, cooperate to establish subregional or regional fisheries organizations to this end.

According to this provision, States Parties have the specific obligation to cooperate in taking measures necessary for the conservation of living marine resources in the high seas that are threatened by climate change impacts and ocean acidification.

425. The Fish Stocks Agreement establishes an enhanced framework for the conservation and management of straddling and highly migratory fish stocks that is relevant to climate-driven shifts in the distribution of fish stocks. Article 5 of the Fish Stocks Agreement establishes general principles for the conservation and management of such stocks, including the precautionary approach (in accordance with article 6), an ecosystem approach and the protection of biodiversity. Article 7 of the Fish Stocks Agreement requires States, *inter alia*, to consult on necessary conservation measures, without prejudice to the sovereign rights of coastal States for the purpose of exploring and exploiting, conserving and managing the living marine resources within areas under national jurisdiction, and the right of all States for their nationals to engage in fishing on the high seas.

426. The Tribunal is of the view that articles 5 and 7 of the Fish Stocks Agreement may provide guidance in responding to distributional changes and range shifts of stocks due to climate change and ocean acidification, and inform the relevant provisions of Parts V and VII of the Convention.

427. According to the WGII 2022 Report, “[b]y altering physiological responses, projected changes in ocean warming … will modify growth, migration, distribution, competition, survival and reproduction (*very high confidence*)” of marine life (WGII

2022 Report, p. 400). The Report further states that the "[c]limate-driven movement of fish stocks is causing commercial, small-scale, artisanal and recreational fishing activities to shift poleward and diversify harvests (*high confidence*)" (WGII 2022 Report, pp. 381-382). The Tribunal observes that many uncertainties remain about the extent to which the impacts of climate change and ocean acidification may be manifested in particular regions. It notes that article 192 of the Convention requires States to anticipate risk, depending on the circumstances.

428. To conclude, articles 63, 64, and 118 of the Convention impose specific obligations on States Parties to cooperate, directly or through appropriate international organizations, in implementing conservation and management measures with regard to straddling and highly migratory species and other living resources of the high seas. This obligation requires States Parties, *inter alia*, to consult with one another in good faith with a view to adopting effective measures necessary to coordinate and ensure the conservation and development of shared stocks, taking into account the impacts of climate change and ocean acidification on living marine resources. Articles 5 and 7 of the Fish Stocks Agreement may provide guidance in responding to distributional changes and range shifts of stocks as a result of climate change and ocean acidification.

(c) Obligation under article 196 of the Convention

429. The possibility of significant and harmful changes to the marine environment, as a consequence of the introduction of alien species to a particular part of the marine environment due to climate change and ocean acidification, invokes article 196 of the Convention. Article 196, paragraph 1, reads:

> States shall take all measures necessary to prevent, reduce and control pollution of the marine environment resulting from the use of technologies under their jurisdiction or control, or the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto.

430. Some participants in the present proceedings expressed the view that in responding to Question (b), the Tribunal might have to determine whether other impacts of climate change which would not fall within the definition of pollution could

give rise to specific obligations to protect the marine environment from a future threat. It was suggested that this scenario might occur, for example, were certain invasive species to move in response to ocean warming or changes in ocean currents. Article 196, paragraph 1, of the Convention was identified as relevant in this regard.

431. The Tribunal notes that this provision contains two distinct obligations: the first, concerning the use of technologies, was addressed in the context of Question (a) (see para. 231 above); and the second, concerning the introduction of alien or new species, flows from the general obligation to protect and preserve the marine environment under article 192 of the Convention.

432. The second obligation under article 196, paragraph 1, of the Convention addresses a concern distinct from that of pollution of the marine environment *stricto sensu*, as defined in article 1, paragraph 1, subparagraph 4, of the Convention. The Tribunal notes that this provision is designed to address the disturbance of the ecological balance of the marine environment as a result of human activities which are not pollution, such as the introduction of alien or new living organisms. This is manifested in the proviso stated in paragraph 2 of article 196, which reads: “This article does not affect the application of this Convention regarding the prevention, reduction and control of pollution of the marine environment.” The obligation to take necessary measures concerning the introduction of alien or new species to a particular part of the marine environment, as provided for in article 196, paragraph 1, was not intended to be controlled by the definition of “pollution of the marine environment” as stated in article 1, paragraph 1, subparagraph 4, of the Convention.

433. Article 196 of the Convention may be invoked only where the introduction of alien or new species “may cause significant and harmful changes” to the marine environment. The Tribunal notes that this threshold is also applied in article 206, on the assessment of potential effects of activities, although it is not defined in the Convention. In this regard, the Tribunal observes that the ILC commentary on article 2, paragraph (a), of the Draft articles on Prevention of Transboundary Harm from Hazardous Activities, defining the “Risk of causing significant transboundary harm”, states:

> The term “significant” is not without ambiguity and a determination has to be made in each specific case. It involves more factual considerations than legal determination. It is to be understood that *“significant” is something more than “detectable” but need not be at the level of “serious” or “substantial”.* The harm must lead to a real detrimental effect [and] … [s]uch detrimental effects must be susceptible of being measured by factual and objective standards.
> (Draft articles on Prevention of Transboundary Harm from Hazardous Activities, with commentaries 2001, *Yearbook of the International Law Commission*, 2001, vol. II, Part Two, p. 148, at p. 152, para. (4))

434. The Tribunal notes that in establishing a threshold, article 196 of the Convention uses the word “may”, which implies the precautionary approach. It is sufficient that the introduction of non-indigenous species to a particular part of the marine environment due to climate change impacts and ocean acidification may have a real detrimental effect for article 196 to be engaged.

435. According to the WGII 2022 Report,

> [n]on-indigenous marine species are major agents of ocean and coastal biodiversity change, and climate and non-climate drivers interact to support their movement and success (*high confidence*) … . At times, non-indigenous species act invasively and outcompete indigenous species, causing regional biodiversity shifts and altering ecosystem function, as seen in the Mediterranean region (*high confidence*) … . Warming-related range expansions of non-indigenous species have directly or indirectly decreased commercially important fishery species and nursery habitat.
> (WGII 2022 Report, p. 456)

436. The Tribunal finds that the second clause of article 196, paragraph 1, of the Convention requires States to take appropriate adaptive measures to prevent, reduce and control pollution from the introduction of non-indigenous species as a result of climate change impacts and ocean acidification which may cause significant and harmful changes to the marine environment. This does not affect the application of the Convention regarding the prevention, reduction and control of pollution of the marine environment.

4. Area-based management tools

437. Some participants in the proceedings argued that rapidly implementing area-based management tools, including marine protected areas (hereinafter “MPAs”),

both within and beyond national jurisdiction, is one of the most effective ways to implement article 192 of the Convention in relation to climate change impacts and ocean acidification.

438. There is support in the WGII 2022 Report for the use of area-based management tools, including MPAs, as a realistic response strategy to climate change. It states:

> MPAs and other marine spatial-planning tools have great potential to address climate-change mitigation and adaptation in ocean and coastal ecosystems, if they are designed and implemented in a coordinated way that takes into account ecosystem vulnerability and responses to projected climate conditions, considers existing and future ecosystem uses and non-climate drivers, and supports effective governance (*high confidence*).
> (WGII 2022 Report, p. 483)

439. The Tribunal observes that the term “marine protected area” is not found in the Convention. It notes that Article 2 of the CBD defines “[p]rotected area” as a “geographically defined area which is designated or regulated and managed to achieve specific conservation objectives.” State practice in support of implementing MPAs in areas beyond national jurisdiction is based on regional treaties and collaborative arrangements, as evidenced, for example, in the practice of Contracting Parties to the Convention for the Protection of the Marine Environment of the North-East Atlantic (hereinafter “the OSPAR Convention”), which was adopted on 22 September 1992 and entered into force on 25 March 1998. The OSPAR Convention recognizes

> that it may be desirable to adopt, on the regional level, more stringent measures with respect to the prevention and elimination of pollution of the marine environment or with respect to the protection of the marine environment against the adverse effects of human activities than are provided for in international conventions or agreements with a global scope.
> (Preamble, eleventh paragraph)

440. The Tribunal notes that Part XII of the Convention does not preclude States from adopting more rigorous measures to protect and preserve the marine environment than provided for therein. However, such measures must be consistent with the Convention and other rules of international law. The Tribunal notes that the recently adopted BBNJ Agreement expresses the need for a global framework under

the Convention to better address the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction and provides for the use of area-based management tools, including MPAs.

IX. Operative clause

441. For these reasons,

THE TRIBUNAL,

(1) Unanimously

Decides **that it has jurisdiction to give the advisory opinion requested by the Commission.**

(2) Unanimously

Decides **to respond to the request for an advisory opinion submitted by the Commission**.

(3) Unanimously

Replies **to Question (a) as follows:**

(a) Anthropogenic GHG emissions into the atmosphere constitute pollution of the marine environment within the meaning of article 1, paragraph 1, subparagraph 4, of the Convention.

(b) Under article 194, paragraph 1, of the Convention, States Parties to the Convention have the specific obligations to take all necessary measures to prevent, reduce and control marine pollution from anthropogenic GHG emissions and to endeavour to harmonize their policies in this connection. Such measures should be determined objectively, taking into account, *inter alia*, the best available science and

relevant international rules and standards contained in climate change treaties such as the UNFCCC and the Paris Agreement, in particular the global temperature goal of limiting the temperature increase to 1.5°C above pre-industrial levels and the timeline for emission pathways to achieve that goal. The scope and content of necessary measures may vary in accordance with the means available to States Parties and their capabilities. The necessary measures include, in particular, those to reduce GHG emissions.

(c) The obligation under article 194, paragraph 1, of the Convention to take all necessary measures to prevent, reduce and control marine pollution from anthropogenic GHG emissions is one of due diligence. The standard of due diligence is stringent, given the high risks of serious and irreversible harm to the marine environment from such emissions. However, the implementation of the obligation of due diligence may vary according to States' capabilities and available resources.

(d) Under article 194, paragraph 2, of the Convention, States Parties have the specific obligation to take all measures necessary to ensure that anthropogenic GHG emissions under their jurisdiction or control do not cause damage by pollution to other States and their environment, and that pollution from such emissions under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights. This obligation applies to a transboundary setting and is a particular obligation in addition to the obligation under article 194, paragraph 1. It is also an obligation of due diligence. The standard of due diligence under article 194, paragraph 2, can be even more stringent than that under article 194, paragraph 1, because of the nature of transboundary pollution.

(e) In terms of specific sources of pollution, marine pollution from anthropogenic GHG emissions can be characterized as pollution from land-based sources, pollution from vessels, or pollution from or through the atmosphere.

(f) Under articles 207 and 212 of the Convention, States Parties have the specific obligation to adopt laws and regulations to prevent, reduce and control marine pollution from GHG emissions from land-based sources and from or through the atmosphere, respectively, taking into account internationally agreed rules,

standards and recommended practices and procedures contained, *inter alia*, in climate change treaties such as the UNFCCC and the Paris Agreement. To this effect, States Parties have the specific obligations to take other necessary measures and, acting especially through competent international organizations or diplomatic conference, to endeavour to establish global and regional rules, standards and recommended practices and procedures.

(g) Under article 211 of the Convention, States Parties have the specific obligation to adopt laws and regulations to prevent, reduce and control marine pollution from GHG emissions from vessels flying their flag or of their registry, which must at least have the same effect as that of generally accepted international rules and standards established through the competent international organization or general diplomatic conference.

(h) Under articles 213 and 222 of the Convention, States Parties have the specific obligation to enforce their national laws and regulations and to adopt laws and regulations and take other measures necessary to implement applicable international rules and standards established through competent international organizations or diplomatic conference to prevent, reduce and control pollution of the marine environment from anthropogenic GHG emissions from land-based sources and from or through the atmosphere, respectively.

(i) Under article 217 of the Convention, States Parties have the specific obligation to ensure compliance by vessels flying their flag or of their registry with applicable international rules and standards established through the competent international organization or general diplomatic conference and with their laws and regulations for the prevention, reduction and control of marine pollution from GHG emissions from vessels. To this end, they shall adopt laws and regulations and take other measures necessary for their implementation.

(j) Articles 197, 200 and 201, read together with articles 194 and 192 of the Convention, impose specific obligations on States Parties to cooperate, directly or through competent international organizations, continuously, meaningfully and in good faith, in order to prevent, reduce and control marine pollution from

anthropogenic GHG emissions. Under article 197, States Parties have the specific obligation to cooperate in formulating and elaborating rules, standards and recommended practices and procedures, consistent with the Convention and based on available scientific knowledge, to counter marine pollution from anthropogenic GHG emissions. Under article 200, States Parties have the specific obligations to cooperate to promote studies, undertake scientific research and encourage the exchange of information and data on marine pollution from anthropogenic GHG emissions, its pathways, risks and remedies, including mitigation and adaptation measures. Under article 201, States Parties have the specific obligation to establish appropriate scientific criteria on the basis of which rules, standards and recommended practices and procedures are to be formulated and elaborated to counter marine pollution from anthropogenic GHG emissions.

(k) Under article 202 of the Convention, States Parties have the specific obligation to assist developing States, in particular vulnerable developing States, in their efforts to address marine pollution from anthropogenic GHG emissions. This article provides for the obligation of appropriate assistance, directly or through competent international organizations, in terms of capacity-building, scientific expertise, technology transfer and other matters. Article 203 reinforces the support to developing States, in particular those vulnerable to the adverse effects of climate change, by granting them preferential treatment in funding, technical assistance and pertinent specialized services from international organizations.

(l) Articles 204, 205 and 206 of the Convention impose on States Parties specific obligations of monitoring, publishing the reports thereof and conducting environmental impact assessments as a means to address marine pollution from anthropogenic GHG emissions. Under article 204, paragraph 1, States Parties have the specific obligation to endeavour to observe, measure, evaluate and analyse the risks or effects of pollution of the marine environment from anthropogenic GHG emissions. Under article 204, paragraph 2, States Parties have the specific obligation to keep under continuing surveillance the effects of activities they have permitted, or in which they are engaged, in order to determine whether such activities are likely to pollute the marine environment through anthropogenic GHG emissions. Under article 205, States Parties have the specific obligation to publish

the results obtained from monitoring the risks or effects of pollution from such emissions or to communicate them to the competent international organizations for their dissemination. Under article 206, States Parties have the specific obligation to conduct environmental impact assessments. Any planned activity, either public or private, which may cause substantial pollution to the marine environment or significant and harmful changes thereto through anthropogenic GHG emissions, including cumulative effects, shall be subjected to an environmental impact assessment. Such assessment shall be conducted by the State Party under whose jurisdiction or control the planned activity will be undertaken with a view to mitigating and adapting to the adverse effects of such emissions on the marine environment. The result of such assessment shall be reported in accordance with article 205 of the Convention.

(4) Unanimously

***Replies* to Question (b) as follows:**

(a) The Tribunal's response to Question (a) is relevant to its response to Question (b). Subparagraphs (j), (k) and (l) of operative paragraph (3) are of particular relevance in this regard.

(b) The obligation under article 192 of the Convention to protect and preserve the marine environment has a broad scope, encompassing any type of harm or threat to the marine environment. Under this provision, States Parties have the specific obligation to protect and preserve the marine environment from climate change impacts and ocean acidification. Where the marine environment has been degraded, this obligation may call for measures to restore marine habitats and ecosystems. Article 192 of the Convention requires States Parties to anticipate risks relating to climate change impacts and ocean acidification, depending on the circumstances.

(c) This obligation is one of due diligence. The standard of due diligence is stringent, given the high risks of serious and irreversible harm to the marine environment from climate change impacts and ocean acidification.

(d) Under article 194, paragraph 5, of the Convention, States Parties have the specific obligation to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life from climate change impacts and ocean acidification.

(e) Under articles 61 and 119 of the Convention, States Parties have the specific obligations to take measures necessary to conserve the living marine resources threatened by climate change impacts and ocean acidification. In taking such measures, States Parties shall take into account, *inter alia*, the best available science and relevant environmental and economic factors. This obligation requires the application of the precautionary approach and an ecosystem approach.

(f) The obligation to seek to agree under article 63, paragraph 1, and the obligation to cooperate under article 64, paragraph 1, of the Convention, require States Parties, *inter alia*, to consult with one another in good faith with a view to adopting effective measures necessary to coordinate and ensure the conservation and development of shared stocks. The necessary measures on which consultations are required must take into account the impacts of climate change and ocean acidification on living marine resources. Under article 118 of the Convention, States Parties have the specific obligation to cooperate in taking measures necessary for the conservation of living marine resources in the high seas that are threatened by climate change impacts and ocean acidification.

(g) Under article 196 of the Convention, States Parties have the specific obligation to take appropriate measures to prevent, reduce and control pollution from the introduction of non-indigenous species due to the effects of climate change and ocean acidification which may cause significant and harmful changes to the marine environment. This obligation requires the application of the precautionary approach.

Done in English and French, both texts being equally authoritative, in the Free and Hanseatic City of Hamburg, this twenty-first day of May, two thousand and twenty-four, in three copies, one of which will be placed in the archives of the

Tribunal and the others transmitted to the Commission of Small Island States on Climate Change and International Law and to the United Nations.

(signed)
Albert J. HOFFMANN,
President

(signed)
Ximena HINRICHS OYARCE,
Registrar

Judge JESUS, availing himself of the right conferred on him by article 125, paragraph 2, of the Rules of the Tribunal, appends his declaration to the Advisory Opinion of the Tribunal.

(initialled) J.L.J.

Judge PAWLAK, availing himself of the right conferred on him by article 125, paragraph 2, of the Rules of the Tribunal, appends his declaration to the Advisory Opinion of the Tribunal.

(initialled) S.P.

Judge KULYK, availing himself of the right conferred on him by article 125, paragraph 2, of the Rules of the Tribunal, appends his declaration to the Advisory Opinion of the Tribunal.

(initialled) M.K.

Judge KITTICHAISAREE, availing himself of the right conferred on him by article 125, paragraph 2, of the Rules of the Tribunal, appends his declaration to the Advisory Opinion of the Tribunal.

(initialled) K.K.

Judge INFANTE CAFFI, availing herself of the right conferred on her by article 125, paragraph 2, of the Rules of the Tribunal, appends her declaration to the Advisory Opinion of the Tribunal.

(initialled) M.T.I.C.

Annex 501

"Macrofinancial Risks in Climate Vulnerable Developing Countries and the Role of the IMF: Towards a Joint V20-IMF Action Agenda", *The Vulnerable Twenty,* October 2020

Macrofinancial Risks in Climate Vulnerable Developing Countries and the Role of the IMF

TOWARDS A JOINT V20-IMF ACTION AGENDA

October 2020

Centre for Sustainable Finance
SOAS University of London

GLOBAL CENTER ON ADAPTATION

MCII

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Acronyms

CCF	*Convertible Concessional Finance*
CDRFI	*Climate and Disaster Risk Finance and Insurance*
CCL	*Contingent Credit Line*
CCRT	*Catastrophe Containment and Relief Trust*
CVF	*Climate Vulnerable Forum*
DC	*Development Committee*
DSSI	*Debt Service Suspension Initiative*
ECA	*Export Credit Agency*
ESG	*Environmental, Social and Governance*
GDP	*Gross Domestic Product*
G-20	*Group of Twenty Finance Ministers and Central Bank Governors*
G-24	*Intergovernmental Group of Twenty-Four on International Monetary Affairs*
HIPC	*Heavily Indebted Poor Countries*
IAIA	*International Association of Insurance Supervisors*
IMF	*International Monetary Fund*
IMFC	*International Monetary and Financial Committee*
IPP	*Independent Power Producers*
LIC	*Low Income Country*
MDRI	*Multilateral Debt Relief Initiative*
MSME	*Micro, Small, and Medium-sized enterprises*
NDC	*Nationally Determined Contribution*
ND-GAIN	*Notre Dame Global Adaptation Initiative*
NGFS	*Network for Greening the Financial System*
NPL	*Non-Performing Loan*
PRGT	*Poverty Reduction and Growth Trust*
RCF	*Rapid Credit Facility*

RFI	*Rapid Financing Instrument*
SDR	*Special Drawing Rights*
SIDS	*Small Island Development State*
SOE	*State-owned enterprises*
TCFD	*Task Force on Climate-related Financial Disclosures*
USD	*United States (of America) Dollars*
V20	*Vulnerable Group of Twenty Ministers of Finance of the Climate Vulnerable Forum*

Executive Summary

Climate vulnerable countries face considerable macrofinancial risks that threaten debt sustainability, worsen sovereign risk, and harm investment and development prospects. This paper reviews the macrofinancial implications and risks of climate change, in particular the impacts of climate vulnerability on sovereign risk and the cost of capital, with special consideration to challenges facing the V20, a group of 48 climate vulnerable countries that are home to 1.2 billion people. It also examines the International Monetary Fund (IMF)'s responsiveness to these challenges to date and recommends ten initial areas for a joint V20-IMF Action Agenda.

The IMF can play an important role in supporting climate vulnerable countries in mitigating and managing macrofinancial risks stemming from the physical and transition impacts of climate change, leveraging opportunities from climate policies to boost growth, investment and resilience. While the IMF's attention to climate issues has increased markedly, including through research produced by IMF staff, the Fund has been rather slow to address climate-related financial risks in its operational work, comprised of surveillance, technical assistance and training, and emergency lending and crisis support.

A non-representative survey among finance ministries and central banks of V20 countries indicates the desire for more support from the IMF in addressing climate risks and vulnerabilities. The views expressed by V20 members suggest that the IMF should integrate climate risk analysis in its surveillance activities, including Article IV consultations as well as Financial Sector Assessment Program assessments and Debt Sustainability Framework analysis conducted with the World Bank; scale up technical support; and explore options for developing its toolkit for climate emergency financing.

To address the needs of climate vulnerable economies and support them in building resilience through improved mitigation and management of climate-related macrofinancial risks and enhanced conditions for critical investments in adaptation and development, this paper suggests ten potential action areas for a joint V20-IMF Action Agenda:

i **Mainstreaming systematic and transparent assessments of climate-related financial risks in all IMF operations**

In order to better anchor and inform its policy work, the IMF can start integrating climate-related financial risks assessments across all of its operations, building on the increasing availability and sophistication of science-based climate financial risk metrics and methods such as climate stress-testing and climate-financial pricing models.

ii **Consistent, systematic, and universal appraisal and treatment of physical climate risks and transition risks for all countries in Article IV consultations and Financial Sector Assessment Programs**

To facilitate better management and mitigation of macrofinancial risks and enhance

the recognition of such risks in governments and the financial sector, the IMF can include a mandatory section on climate risks in its Article IV consultations with all member countries. The IMF could also introduce a mandatory section on climate-related financial risks to the Financial Sector Assessment Programs it conducts with the World Bank.

iii Advancing disclosure of climate-related financial risks and promoting sustainable finance and investment practices

To support the development of financial markets that facilitate climate-friendly private sector investment, the IMF can use its unique role in international finance to promote the disclosure of climate-related financial risks and the development of sustainable finance and investment practices.

iv Exploring synergies between fiscal and monetary policies

To support its membership, and particularly climate vulnerable countries, in building resilience while scaling up investments to achieve climate targets, the IMF could explore synergies between fiscal and monetary policies as well as macroprudential regulations to identify an optimal policy mix that would enhance finance for development oriented towards just transition outcomes while improving economic competitiveness and ensuring macrofinancial stability.

v Mainstreaming of climate risk analysis in public financial management and supporting the development of a climate disaster risk financing and insurance architecture

To support countries in climate-proofing public finances and strengthening their public debt management, the IMF can encourage and provide advice to finance ministries on how to analyse the potential impacts of climate change on the medium- to long-term quality and sustainability of public finances and mainstream climate risk analysis in public financial management. The IMF can also support the development of an international climate disaster risk financing and insurance architecture that addresses different layers of risks. It can also promote a discussion around adding natural disaster clauses to sovereign debt contracts and the use of instruments such as GDP-linked bonds.

vi Supporting climate vulnerable countries with debt sustainability problems

To address debt sustainability challenges, the IMF could explore options for the treatment of climate debt, i.e. public debt that has been incurred as a direct result of climate disasters or necessary adaptation measures. Moreover, the joint World Bank-IMF Debt Sustainability Framework for Low-Income Countries could be enhanced by a mandatory analysis of the impact of climate-related risks on debt sustainability. Such assessments could also be rolled out to climate vulnerable middle income countries.

vii Developing the IMF toolkit for climate emergency financing

To support vulnerable countries, the IMF could further develop the IMF's existing emergency financing facilities through raising access under the RCF/RFI, or converting these facilities into grants, particularly for PRGT-eligible countries. The IMF could also consider the establishment of an entirely new climate emergency facility.

viii Exploring options to use Special Drawing Rights (SDRs) to support climate vulnerable countries

To provide vulnerable countries with enhanced liquidity, the IMF could consider the possibility of allocating new SDRs or encourage advanced countries, whose historic carbon emissions are the main cause of anthropogenic climate change, to make their SDRs available to a new multilateral swap facility or donate their SDRs to a trust fund at the IMF. A further option would be to develop a mechanism where new SDRs are issued exclusively to climate vulnerable countries hit by climate disasters.

ix Supporting the design and implementation of carbon pricing mechanisms

To support V20 countries in re-directing investment towards climate resilient and low-emissions development while stimulating technological innovation and generating new revenue streams for governments, the IMF could support V20 countries in strengthening their fiscal framework and revenue outcomes through the design and implementation of appropriate carbon pricing mechanisms.

x Institutionalising collaboration between the Fund and the V20

To enhance vulnerable developing country voices and representation, and to provide a platform to articulate their views and interests, the IMF should recognise the V20 as an official stakeholder and hold regular consultations with the V20.

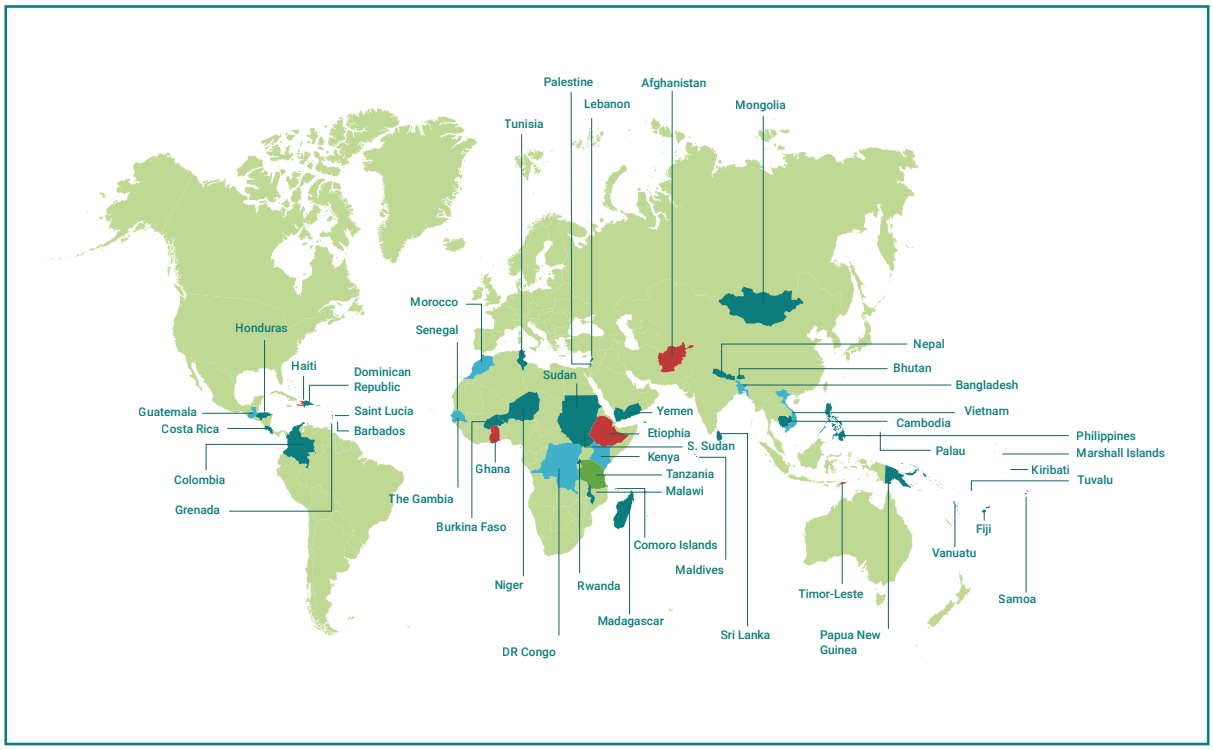
Contents

1. Introduction

Climate vulnerable countries are not only exposed to the physical effects of anthropogenic climate change. They also face transition risks stemming from the move away from fossil fuels to low-carbon sources of energy. Both transition and physical risks can generate considerable macrofinancial risks that can undermine debt sustainability and worsen sovereign risk. This has implications on the cost of capital of private and sovereign debt and the fiscal space governments have for crucial investments in climate adaptation and resilience and for sustainable development.

The Vulnerable Twenty (V20) Group of Ministers of Finance, representing 48 developing countries, was founded in 2015 by the Climate Vulnerable Forum. Its goal is to translate the political agenda for climate into real economy progress while mobilising international support for scaling up financial resources for climate action in V20 states. In November 2020, the first V20 Ministerial Dialogue with the International Monetary Fund (IMF) will explore the components of a "Joint Action Agenda". The IMF has increasingly recognised the macro-criticality of climate change and started to strengthen its analytical capacity in this area. The objective of this paper is to inform the formulation of the Joint Action Agenda by identifying actions through which the Fund could better address the needs of climate vulnerable economies and support them in building resilience through better mitigation and management of climate-related macrofinancial risks and improving conditions for critical investments in adaptation and development.

Figure 1: World map with V20 countries



This paper suggests ten potential action areas for a joint V20-IMF Action Agenda: (i) mainstreaming systematic and transparent assessments of climate-related financial risks in all IMF operations; (ii) consistent, systematic, and universal appraisal and treatment of physical climate risks and transition risks for all countries in Article IV consultations and Financial Sector Assessment Programs; (iii) advancing disclosure of climate-related financial risks and promoting sustainable finance and investment practices; (iv) exploring synergies between fiscal and monetary policies; (v) mainstreaming of climate risk analysis in public financial management and supporting the development of a climate disaster risk financing and insurance architecture; (vi) supporting climate vulnerable countries with debt sustainability problems; (vii) developing the IMF toolkit for climate emergency financing; (viii) exploring options to use Special Drawing Rights to support climate vulnerable countries; (ix) supporting the design and implementation of carbon pricing mechanisms; and (x) institutionalising collaboration between the Fund and the V20.

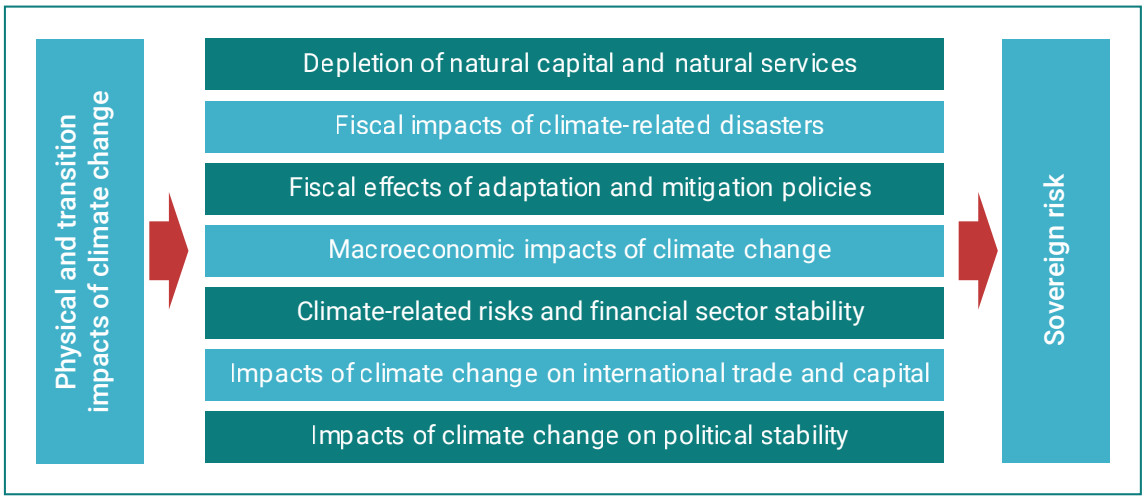
The paper is structured as follows: Section 2 reviews the macrofinancial implications and risks of climate change and highlights the implications of climate change for the cost of capital in climate vulnerable countries. Section 3 provides a brief overview of the macroeconomic conditions in and debt sustainability of V20 countries. Section 4 examines the IMF's current stance and the adequacy of policy frameworks relating to climate change. Section 5 presents insights from a survey of V20 finance ministries and central banks relating to the role of the IMF in addressing climate risks. Section 6 discusses options for a V20-IMF Action Agenda. Section 7 concludes.

2. The macrofinancial implications and risks of climate change

2.1 Impacts of climate change on sovereign risk[1]

Climate change can affect an economy and public finances – and thus debt sustainability – in multiple ways. Volz et al. (2020) identify seven different transmission channels through which climate change can distress public finances and amplify sovereign risk (Figure 2). Besides the impacts of climate change on natural capital and natural services, which will not be discussed here,[2] these transmission channels are: (i) fiscal impacts of climate-related disasters; (ii) fiscal effects of adaptation and mitigation policies, (iii) macroeconomic impacts of climate change, (iv) climate-related risks and financial sector stability, (v) impacts of climate change on international trade and capital flows, and (vi) impacts of climate change on political stability.

Figure 2: Transmission channels of risk



Source: Volz et al. (2020).

(i) Fiscal impacts of climate-related disasters

Climate-related disasters such as cyclones, floods, wildfire, storms and drought can have significant direct impacts on public finances. Government finances and a country's debt sustainability are exposed to different fiscal risks related to natural disasters or climate change-related shocks. The IMF classifies fiscal risk into two categories: macroeconomic risks and specific fiscal risks, which may "arise from the realization of contingent liabilities or other uncertain events, such as a natural disaster, the bailout of a troubled public corporation or subnational government by the central government, or the collapse of a bank" (IMF 2018: 95). Explicit contingent liabilities

1 This section draws on Volz et al. (2020).
2 All economic activity, and hence a country's economic and fiscal sustainability, is ultimately dependent on natural assets and eco-services. Climate change is expected to have dramatic and adverse effects on natural capital, even with the achievement of the mitigation goals of the Paris Agreement. Climate change will exacerbate the existing degradation of the natural environment and further diminish natural capital. For a detailed discussion, see Volz et al. (2020).

include public guarantees and other legal or contractual liabilities. Implicit contingent liabilities are not established by law or contract but may arise because of public expectations or a necessity for the government to intervene, for example in the context of public bailouts or spending on natural disaster relief, recovery and reconstruction, including increased social transfer payments (IMF 2011, 2018, Hochrainer-Stigler et al. 2018, Schuler et al. 2019). Disaster crisis response measures can have significant impact on public spending. Bova et al. (2019)'s analysis of contingent liability realisations in a sample of 80 advanced and emerging economies for the period 1990-2014 shows that natural disasters (including geophysical events) are one of the most important sources of contingent liabilities, the realisation of which can be a substantial source of fiscal distress. Moreover, a disruption of economic activity by climate-related disasters may cause supply or demand shocks and adversely affect tax income and other public revenues, or cause changes to commodity prices that could affect revenue or increase public spending via fossil fuel or food subsidies. Table 1 provides an illustration of the disruption caused by a single climate disaster, Typhoon Haiyan, which hit the Philippines in 2013.

Table 1: Typhoon Haiyan (Yolanda) in the Philippines: Losses and government

Number of affected municipalities	591
Confirmed deaths	6300
Missing persons	1602
Injured persons	28,688
People affected	14.1 million
Displaced persons	4.1 million
Houses damaged	1.1 million
Livelihoods affected	5.9 million
Structures totally or partially damaged	1.14 million
Economic damage	USD 12.9 billion
Needed budget for recovery	USD 8.2 billion

Impacts to MSMEs	According to DTI, there were about 50,000 MSMEs that were affected by the Super Typhoon. Around 90% of the disaster impact was borne by the private sector, especially the private households and the SMEs.
Recovery time	Minimum 2 years
Government intervention	The Philippines has various disaster risk financing windows: (1) the National DRRM Fund (NDRRMF) or the Calamity Fund in the General Appropriations Act (GAA); (2) the Local DRRM Fund (LDRRMF); (3) the Government Service Insurance System (GSIS); and (4) the People's Survival Fund (PSF). The Philippines' central bank implemented some policy decisions to facilitate credit flow in the wake of Typhoon Yolanda such as: • Extension of the depreciation period for writing off bad loans to ease banks' cash position and improved credit flow. • Allowed extension of the existing loans without classifying them as restructured loans and extending the period over the usual 30 days, both of which have reduced banks' risk assets and increased their lending capacity.

Sources: Compiled based on information from Athaves (2018), NDRRMC (2013), PSA (2014), and The Manila Times (2014).

(ii) Fiscal effects of adaptation and mitigation policies

Adaptation and mitigation policies are indispensable for responding to the challenges posed by climate change. Moreover, economies need to invest in adaptation and resilience to address vulnerabilities from extreme weather events and slow onset events, which are expected to increase in number and intensity with impacts happening sooner than forecasted due to global warming. The Global Commission on the Economy and Climate (2016) estimates that globally until 2030 around USD 90 trillion will have to be spent on infrastructure, including energy, all of which needs to be sustainable and climate resilient. While parts of these investments have to be financed by the private sector, governments will have to play an important role in setting the right incentives through policies such as carbon prices/taxes, border adjustments and prudential frameworks for financial institutions, as well as market structures and system design to include variable renewable energy and pricing of grid and non-grid

services. Moreover, a considerable share of adaptation and mitigation measures will have to be directly financed by the public sector.

Public adaptation to climate change affects public budgets directly on the expenditure side (e.g. Bachner et al. 2019). Adaptation costs comprise all expenses associated with policies and measures aimed at easing environmental, social, and economic impacts of climate change, both preventive and remedial (Forni et al. 2019). The 2016 Adaptation Finance Gap Report estimates the costs of adaptation at between USD 140 billion and USD 300 billion per year by 2030, and between USD 280 billion and USD 500 billion per year by 2050, with potentially higher costs for worse emission pathways (Puig et al 2016). However, Neufeldt et al. (2018) point to the existence of major information gaps and emphasise that particularly the omission of adaptation cost estimates for biodiversity and ecosystem services is likely to further increase the overall cost of adaptation. Despite the dividends generated by adaptation investment (Hallegatte et al. 2019, Tanner et al. 2015), including reduced future losses and positive economic benefits through reduced risks, adaptation finance in 2016 amounted to only USD 22 billion (Oliver et al. 2018).

Mitigation costs comprise all expenses associated with policies and efforts aimed at reducing or preventing greenhouse gas emissions to limit global warming (Forni et al. 2019). Climate change mitigation will require substantial investment in low-carbon sources of energy. The IPCC (2018) estimates that USD 1.6-3.8 trillion are annually needed for investment in energy systems alone to limit global warming to 1.5°C. While recent years have seen a rapid fall in the cost of low-carbon energy generation and storage that provide an opportunity to recalibrate towards cost-effective technology,[3] there is a risk that the necessary investments overstretch public finances and that opaque and complex financing practices lead to higher debt burdens than expected.

(iii) Macroeconomic impacts of climate change

The physical and transition impacts of climate change can cause aggregate supply and demand shocks. Supply shocks affect an economy's production or productive capacity and, accordingly, actual or potential output. Climate change may impact aggregate supply in various ways (e.g. Cœure 2018, Batten et al. 2020). Extreme weather events can interrupt production and service delivery, damage the capital stock and infrastructure, or diminish output in the agriculture, forestry, and fishing industry. They can also disrupt transport routes and value chains and cause input shortages. Natural disasters may divert resources from innovation to reconstruction and replacement or cause shocks to local labour markets.

Supply shocks can also be caused by gradual global warming. Climate change is predicted to have significant impact on land use through sea level rise, desertification, land degradation, among others (IPCC 2019a), as well as on marine ecosystems (IPCC 2019b). All these can affect productive assets and capacity in agriculture, forestry,

3 According to the International Renewable Energy Agency (IRENA), the price of solar has fallen 82% since 2010 and 13% between 2018 and 2019, while the price of concentrated solar power has fallen by 47%, onshore wind by 39% and offshore wind by 29%. Both onshore and offshore wind prices have fallen by 9% between 2018 and 2019. The deflationary trend in renewable energy means that replacing the costliest 500 gigawatts of coal capacity with solar and wind would cut annual system costs by up to USD 23 billion per year and yield a stimulus worth USD 940 billion, or around 1% of global GDP (IRENA 2020).

fishing and other industries directly relying on ecosystems. Further, the need for investment in adaptation may divert resources away from productive investment or spending on new technologies, although adaptation investment could also spur innovation. Climate change could also have substantial effects on the number of hours worked due to extreme heat and on labour productivity (e.g. Burke et al. 2015, Day et al. 2019).[4] For climate vulnerable countries, the economic cost of reduced productivity due to heat stress may be more than USD 2 trillion by 2030 (UNDP 2016). Furthermore, alterations in the physical environment could make living conditions in some regions unbearable and cause large-scale migration, which would affect labour supply.

Supply-side shocks can also be caused by transition impacts (McKibbin et al. 2017). The structural change of an economy away from high-carbon and towards low-carbon sectors can cause a stranding of assets and technology and render parts of the workforce unemployed if the sectors they were previously employed in cease and skills are not transferrable (Bos and Gupta 2019, Semieniuk et al. 2020). Moreover, climate policies may constrain the use of land or ecosystem services with impacts on an economy's output potential. Falling costs of renewable energy and storage interacting with climate policies could also lead to substantive changes in energy supply.

Climate change impacts can also cause demand-side shocks (Batten et al. 2020). Extreme weather events can reduce household income and wealth and therefore private consumption or affect international demand for goods and services. Furthermore, damages to corporate balance sheets can lead to a reduction of investment. However, after the initial stage of loss, natural disasters are typically followed by a period of recovery, in which the rebuilding of infrastructure and production sites and the replacement of stocks gives a temporary boost in investment and consumption (IMF 2016). A negative demand shock is more likely when a large share of losses is uninsured (Batten et al. 2016). Furthermore, slow-onset changes to global warming can lead to structural economic changes, which may impact on aggregate demand through effects on household income (e.g. income from farming or fishery), wealth effects (e.g., through changes in property prices), effects on corporate balance sheets, or effects on public finances. Global warming may also impact on investment through effects on household and corporate balance sheets.

(iv) Climate-related risks and financial sector stability

Extreme weather events and chronic physical risks such as worsening water stress or sea level rise can result in damage or loss of operating assets and reduce production output of borrowers. Such impacts can, in turn reduce borrowers' operating margins and cash flows and the value of collateral assets, leading to credit downgrades, a higher probability of default and a reduction in the secondary market value of loans held on bank balance sheets. In more severe situations, borrowers will not be able to meet their debt service obligations, resulting in a higher incidence of non-performing loans (NPLs) and a higher loss given default due to the reduced value of collateral assets.

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4 The International Labour Organization estimated that heat stress (i.e. temperatures above 35 degrees Centigrade) may cause productivity loss equivalent to 80 million full-time jobs by 2030 (ILO 2019).

Climate risks related to policy, technology and market changes may also have a negative impact on borrowers' credit profile by stranding production assets and/or reducing demand for their products and services (Box 1). These impacts can reduce the profitability and cash flows of businesses as well as the value of assets held as collateral by banks. These could result in credit downgrades, higher incidence of NPLs as well as higher losses given default.

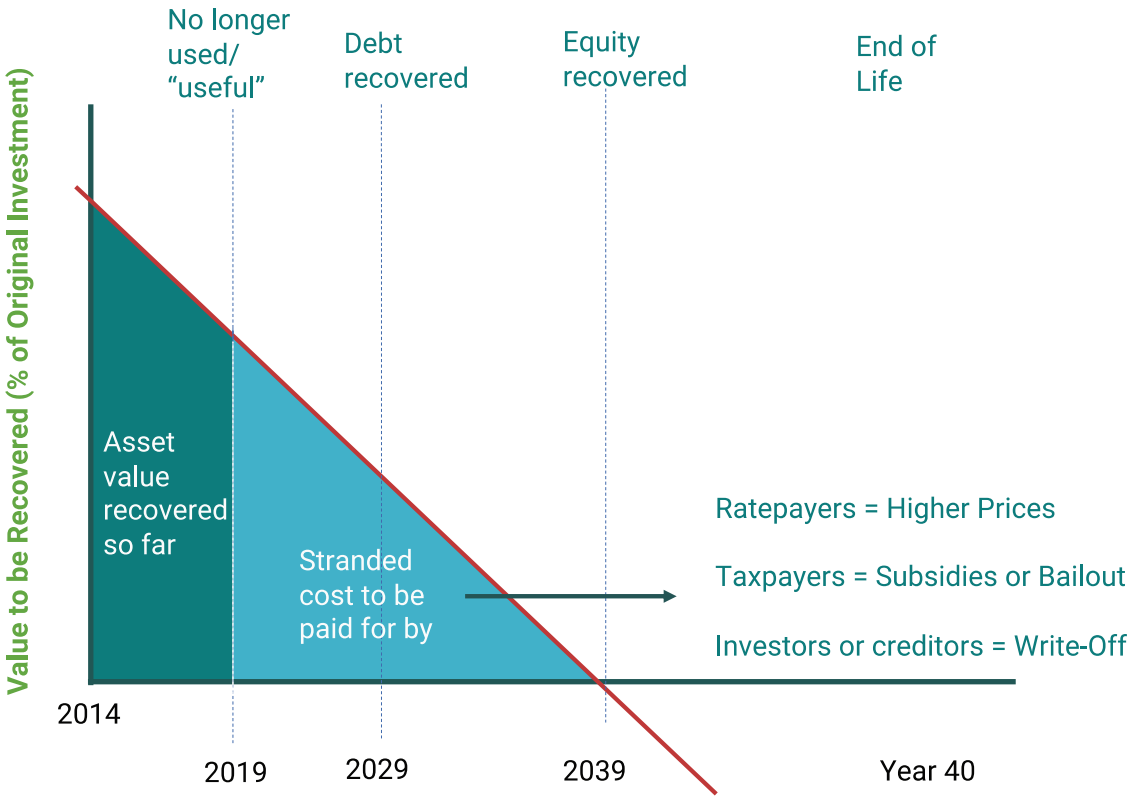
It is now widely recognised that climate change poses a material risk to financial stability. Financial instability can worsen sovereign risk. Governments may be forced to bail out the financial sector, which could weaken the sovereign balance sheet and trigger a negative feedback loop, which further weakens the credit profile of banks due to their exposure to sovereign debt (Farhi and Tirole 2018).

In several large V20 developing countries, public banks play a major role in the financial system. For example, in Ethiopia public banks account for about 60% of the country's banking system, while the share of public banks is 45% in Vietnam and 30% on Bangladesh (IMF, 2020g). Contingent liabilities from publicly owned banks could become a major problem for public finances if these banks suffer losses due to the materialisation of climate risks.

Box 1: Stranded Asset Risk

Fossil fuel lock-in has left many developing countries with high subsidies and/or prices due to progressive non-performing fossil fuel asset risk. This stranded-asset risk can be triggered by a number of causes, including (1) fuel and/or technology becoming uneconomical or obsolete due to competition from cheaper alternatives, (2) grid design problems that result in dispatch problems for poorly located power plants, (3) excess capacity due to inaccurate demand forecasts or a surplus of reserve power, (4) higher than anticipated construction costs, (5) operational inefficiency of the power plant often due to substandard maintenance, and (6) long-term contracted-fuel supply exceeding demand.

While the energy transition is assumed to trigger higher costs, it is important to realise that non-performing fossil fuel stranded assets today are already being paid for by end users, taxpayers, investors, creditors, or some combination of all four. The solution to this starts with solid policies to encourage energy transition that can change the generation mix and permit the deflationary nature of renewable energy and storage



technologies to insulate the system from future non-performance and stranding. So, when badly designed power market policies increase the plant life of underperforming fossil fuel assets with guaranteed contracts, it will translate to further costs in the form of higher electricity prices paid for by end users, write-offs by investors, non-performing loans for creditors, and/or subsidies/bailouts from government, which is ultimately paid for by taxpayers.

Due to the way that the project economics of fossil fuel IPPs deteriorate in the face of new cost-competitive technologies, the more that countries delay modernisation of their power sector, the greater the cost of displacement. This means an increase in the likelihood of fossil fuel asset stranding rises, resulting in higher non-performing loans, write-offs, and subsidies/bailouts. While the transition makes economic and financial sense, the key is to buy down the cost and the speed of this transition.

Source: Ahmed (2020).

(v) Impacts of climate change on international trade and capital flows

Climate change can have substantial impacts on an economy's trade in goods and services and capital flows with the rest of the world, and therefore their balance of payment. Historically, balance of payments problems were often at the root of country risk and led to external debt crises (Bouchet et al. 2018).

There are several ways through which climate change could affect the patterns and the volume of international trade flows, with potentially significant impacts on countries' balance of payments positions and, ultimately, sovereign risk. Impacts can be grouped in three categories: disruptions to trade from climate-related extreme events and disasters; long-term effects of global warming on endowments and production; and transition impacts on international trade.

First, climate-related extreme weather events could cause physical damages and disruptions to production facilities and critical transport infrastructure, and make industrial supply, transport and distribution chains more vulnerable. Climate change could lead to permanent changes to trade-production networks and transport routes and change country's access to and opportunities in international trade, with particularly detrimental effects for developing economies (WTO and UNEP 2009). Empirically, evidence suggests that natural disasters diminish exports, while the effects on imports are ambiguous (e.g. Gassebner et al. 2010).

Second, the physical effects of gradual global warming could affect domestic agricultural and manufacturing output in various ways through changes in endowments and production, with potential impacts on an economy's export capacity and import needs. Climate change could also have significant impact on international tourism, which often relies on natural assets and pleasant and safe climatic environments, and which for many developing countries constitutes an important services export in the balance of payments.

Third, climate policies adopted by trading partners, technological change and changes to consumption patterns could have significant impact on imports or exports. If major economies adopted forceful measures to curb carbon emissions, including a decarbonisation of their energy and transport systems, this would have significant repercussions on global demand for fossil fuels and their prices (e.g. Huxham et al. 2019). Countries that are currently dependent on fossil fuel imports may be able to substitute these with domestic renewable energy while fossil fuel exporters would stand to lose a source of revenue.

Gains and losses from physical and transition impacts of climate change on international trade volumes and patterns will be distributed unevenly across countries. Economies that are strongly dependent on carbon-intensive exports and little diversified export sectors are particularly at risk, as are climate vulnerable economies in geographies with relatively high average temperature. Commodity-dependent developing countries may be particularly at risk. UNCTAD Secretary-General Mukhisa Kituyi describes climate change as an "existential threat to commodity-dependent developing countries" (UN News 2019).[5]

5 According to UNCTAD (2019), all of the ten most climate vulnerable countries in 2017 were commodity-dependent developing countries, while only three of the 40 most climate vulnerable countries were not reliant on commodity exports.

(vi) Impacts of climate change on political stability

Economic and social effects of climate change may also accentuate social tensions within a society and fuel political instability (Islam and Winkel 2017). Moreover, climate shocks can trigger migration movements which could also lead to political tensions or even inter- or intrastate conflicts (Froese and Schilling 2019). Political instability can undermine the ability or willingness of a government to repay its debt. For instance, Clark (1997) emphasises the potential impact of political events on the probability of sovereign default. Countries that are politically unstable and more polarised often have higher default rates and are as a result charged a higher default risk premium in international credit markets (Cuadra and Sapriza 2008).

2.2 Climate change and the cost of capital

The first study to systematically analyse the impact of climate change on the cost of sovereign capital is Kling et al. (2018), the results of which feed into Buhr et al. (2018). Using annual data for a sample of 46 countries – including 25 V20 countries – over the period 1996 to 2016, their results indicate that climate vulnerable countries have to pay a risk premium on their sovereign debt because of their climate vulnerability. In particular, they estimate that vulnerability to climate change has already raised the cost of debt by 117 basis points on average for the sample of 25 V20 countries, translating to more than USD 40 billion in interest payments on government debt alone for 40 member countries of the V20. Incorporating higher sovereign borrowing rates into the cost of private external debt, the figure reaches USD 62 billion across both the public and private sectors.

In a related study, Kling et al. (2020) use firm-level data of 15,265 firms in 71 countries over the period 1999 to 2017 and find that climate vulnerability increases cost of debt directly and indirectly through its impact on restricting access to finance. Controlling for various firm-specific and macroeconomic factors, their results suggest that the direct effect of climate vulnerability on the average increase in cost of debt from 1991 to 2017 has been 0.63%, while the indirect effect through climate vulnerability's impact on financial leverage has contributed an additional 0.05% increase in the cost of financing.

Cevik and Tovar Jalles (2020) replicate the analysis by Kling et al. (2018), using the same measures for climate change vulnerability and resilience for 98 advanced and developing countries over the period 1995 to 2017. Like Kling et al., they find that the vulnerability and resilience to climate change have a significant impact on the cost government borrowing, after controlling for conventional determinants of sovereign risk. They also confirm that the magnitude and statistical significance of these effects are much greater in developing countries with weaker capacity to adapt to and mitigate the consequences of climate change.

Building on Kling et al. (2018), Beirne et al. (2020a) examine the relationship between the cost of sovereign borrowing and climate risk with quarterly data for 40 advanced and developing economies for the period 2002 to 2018, using more refined measures for climate vulnerability and resilience. Their results show that both vulnerability and resilience to climate risk are important factors driving the cost of sovereign borrowing

at the global level, supporting the original findings of Kling et al. (2018). With 275 basis points, the premium on sovereign bond yields from rising climate risk vulnerability is highest for a sub-sample of the "high risk group", which comprises 10 countries, compared to an increase of 113 basis points for other developing and emerging market economies. The effect of vulnerability on bond yields for advanced economies is not statistically significant.

Beirne et al. (2020b) empirically tests the link between climate risks and sovereign risk in Southeast Asia, one of the world's most heavily affected regions in terms of climate change. They conduct analysis both country-specific and panel estimations with monthly data for the period 2002 to 2018 for six Southeast Asian countries. Both the country-specific and the panel results show that greater climate vulnerability appears to have a sizable positive effect on sovereign bond yields, while greater resilience to climate change has an offsetting effect, although on a smaller magnitude. The effects tend to be the largest for countries that are more climate vulnerable.

Table 2 shows the comparatively high cost of capital of selected V20 member countries. There is a risk that the already high cost of capital currently impeding development in the majority of climate vulnerable economies will rise further due to the worsening impacts of climate change on their economies over the next decades.

Table 2: The V20's comparatively High Cost of Capital Economic Environment

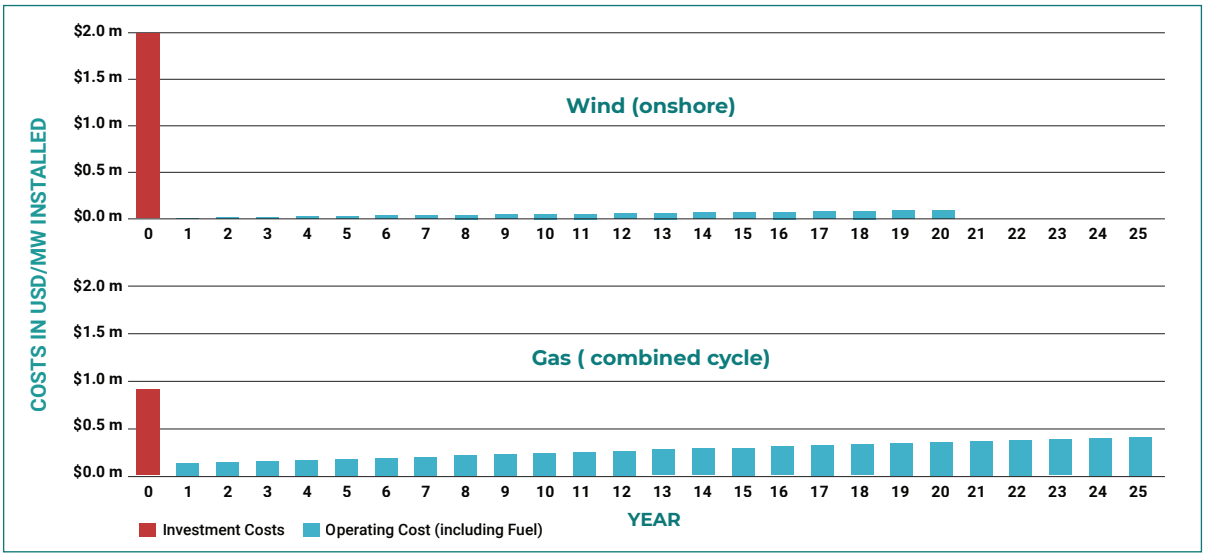
Average real interest rates, 2015-17		V20 real interest rate spikes, 2015-17	
V20	9.2%	Madagascar	48%
G20	5.7%	The Gambia	23%
G7	1.83%	Malawi	22%

Source: International Monetary Fund, International Financial Statistics and World Bank (GDP deflator)[6]

The cost of capital has far-reaching implications for the viability of investments and development prospects of countries. The financing of adaptation infrastructure projects, such as climate-resilient roads or coastal defences, requires a high proportion of capital in their first phase. Likewise, renewable energy projects, which have comparatively low operating cost since energy fuel is derived from naturally available sources, require high upfront investments, which makes financing much more sensitive to the cost of capital. In contrast, for fossil fuel energy projects operational costs are more significant than the capital investment needed to commence project operations (Figure 3). Fossil fuel projects like gas and coal are therefore relatively insensitive to the cost of capital compared to renewable energy projects, such as hydro, wind, solar, geothermal. For example, the investment cost required upfront is 80% of total cost of electricity generation from wind energy while the upfront investment cost for gas is only 15%.

6 Average real interest rates represent the lending interest rate adjusted for inflation as measured by the GDP deflator. Available data only used for averages with some country gaps in the data set.

Figure 3: Climate projects' relative capital intensity: power generation comparison of wind and gas energy projects

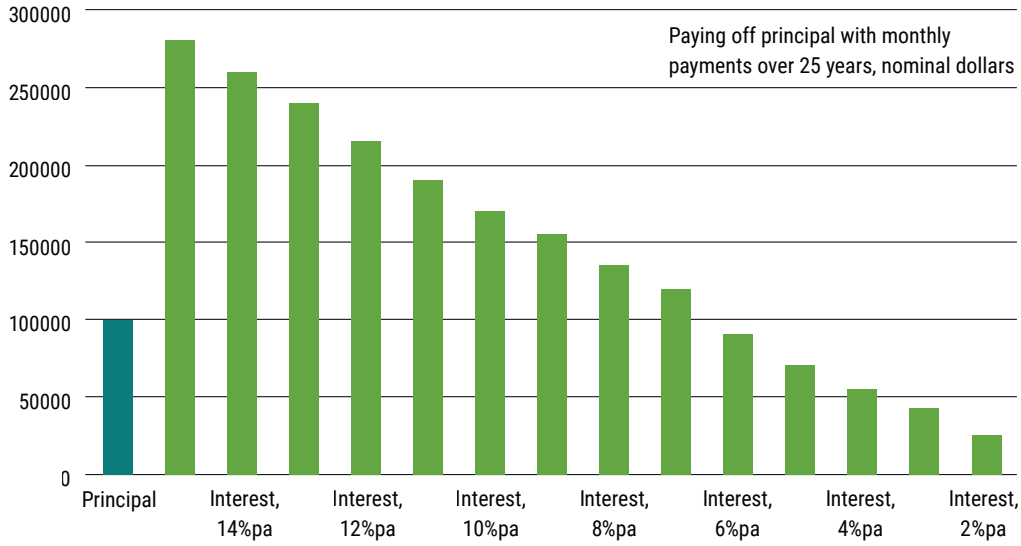


Source: Waissbein et al. (2013).

For adaptation infrastructure projects, a relative cost increment applies to already large up-front business-as-usual capital investments (such as in buildings, roads, bridges, coastal defences) that require an additional outlay to ensure those investments withstand current and future climate impacts, such as sea-level rise or changes in extreme weather. Amortisation of up-front capital investments is extremely sensitive to the cost of capital. According to UNDP, the total of capital expenditure plus cost of finance would be reduced by 50% for an effective interest rate of 6% versus 12% (Glemarec. 2011, Figure 4).

This means that when considering the effect of interest rates on the profitability of a climate-resilient or renewable energy infrastructure project, the most significant determining factor is not the cost of the technology or of achieving resilience, but the cost of capital (Ward, 2010).

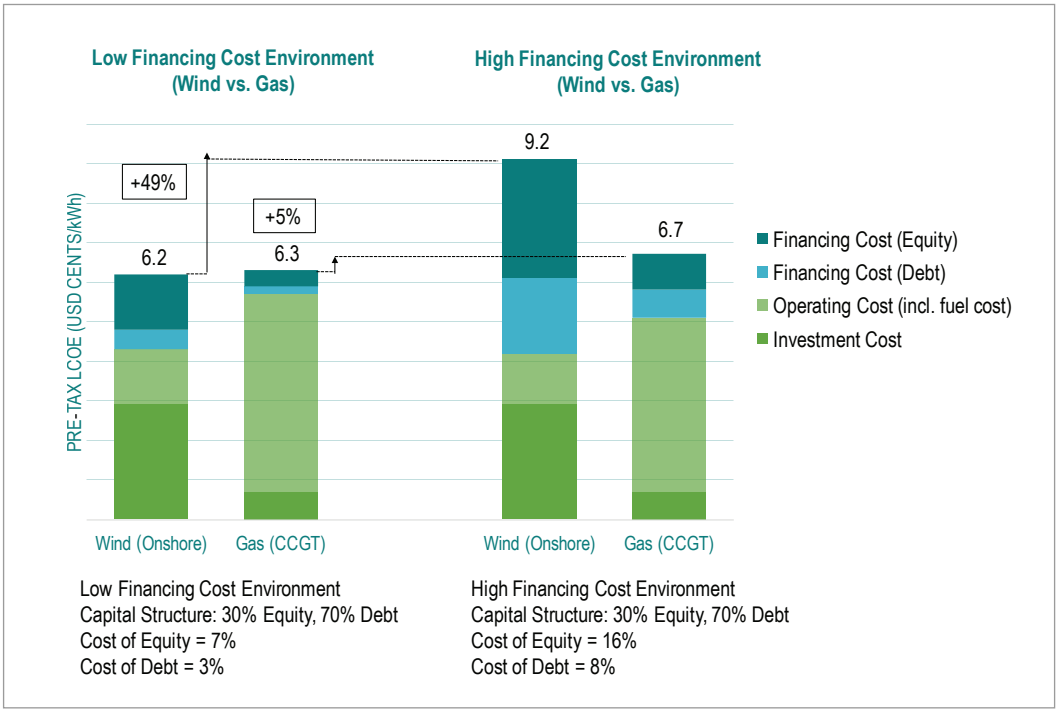
Figure 4: Effect of the Interest Rate on Profitability of the Green Investment



Source: Glemarec (2011).

Figure 5 illustrates how a high cost of capital financing environment can decrease the viability of a climate infrastructure project versus a conventional alternative.

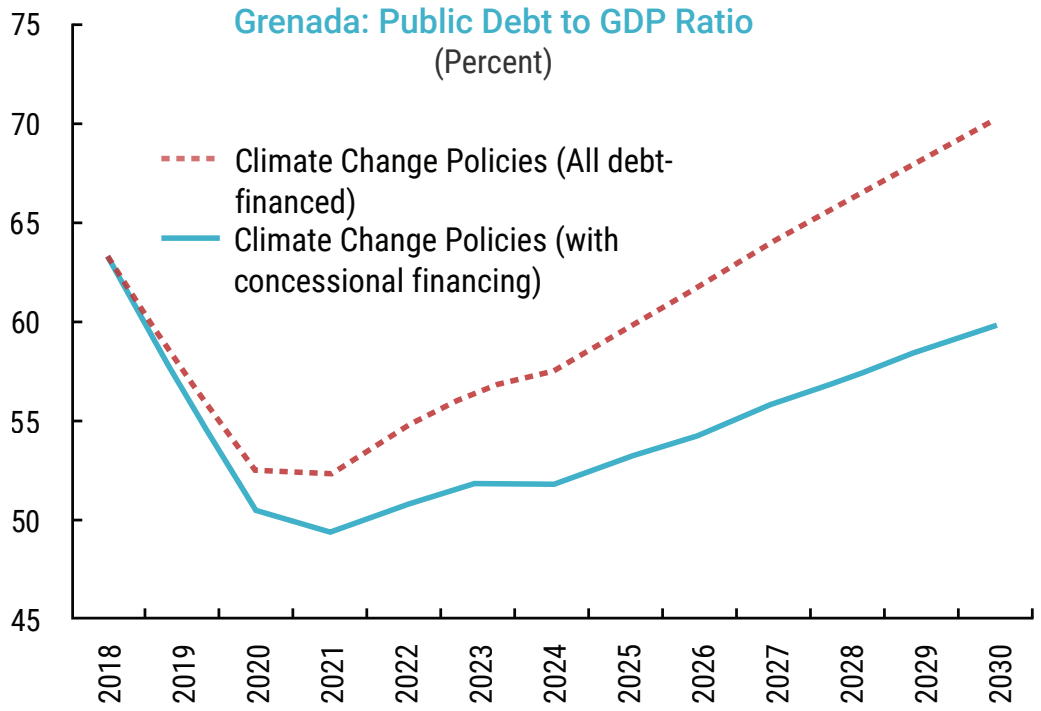
Figure 5: Impact of Financing Costs in Renewable Energy and Fossil Generation



Source: UNDP (2017).

Figure 6 illustrates the case of Grenada, which needs to make large-scale infrastructure investments to reduce its vulnerability to climate change. Given the cost of capital and the upfront cost, Grenada will require USD 15 million in grants financing annually until 2030 in order to stay within a debt to GDP ratio of 60%. If Grenada is unable to reduce the cost of capital or access grants, public debt is projected to rise to 70% by 2030 (IMF, 2019e).

Figure 6: Public Debt to GDP Ratio in Grenada



Source: IMF (2019e).

3. Brief overview of macroeconomic conditions, debt sustainability and climate vulnerability of V20 countries

Table 3 provides an overview of selected macroeconomic and climate vulnerability indicators for V20 countries. According to the World Bank's country classification, the V20 membership comprises low-income economies, lower- and upper-middle income economies, as well as two high-income economies (cf. Column 3).

More than half of the V20 countries face debt sustainability challenges, as indicated in columns 4, 5, 6, 7 and 8. Currently, 12 V20 countries are considered by the IMF to be at high risk of defaulting on their public debt, while three V20 countries are already in debt distress. Another 12 V20 countries face moderate risk of debt default. Debt sustainability can be expected to worsen as the effects of the COVID-19 crisis affects economic output and public finances. Over the last decade, the creditor base of V20

countries has shifted toward commercial lenders and non-Paris club members. This has not only reduced the transparency of public debt; it is also complicating the negotiation of debt relief in case countries face solvency problems.

As discussed, debt sustainability is further threatened because of climate vulnerability. Table 3 shows indicators for Vulnerability and Readiness from the Notre Dame Global Adaptation Initiative (ND-GAIN) (Chen et al. 2015). The NG-GAIN Vulnerability indicator measures a country's exposure, sensitivity and ability to adapt to the negative impact of climate change. ND-GAIN measures the overall vulnerability by considering vulnerability in six life-supporting sectors – food, water, health, ecosystem service, human habitat and infrastructure. The ND-GAIN Readiness indicator measures a country's overall readiness by considering three components – economic readiness, governance readiness and social readiness. Both indicators are in the 0-1 range. For Vulnerability, lower scores are better, while for Readiness, higher scores are better. There is some variation in terms of Vulnerability and Readiness scores among the V20 group, but overall, all V20 members are exposed to considerable vulnerability to climate change, whereas the capacities to respond are limited. Figures 7 and 8 illustrate that that there is a high concentration of public and private debt risk with countries being more vulnerable to the effects of climate change.

Table 3: Selected macroeconomic and climate vulnerability indicators for V20 countries

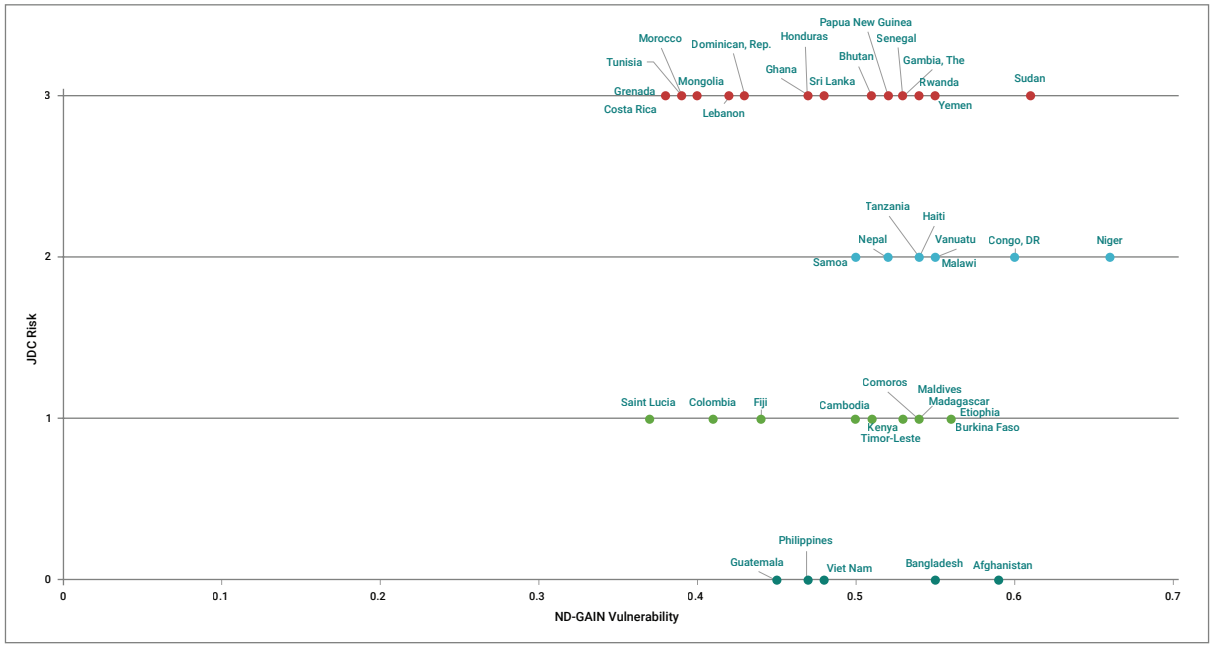
Country	GDP per capita (current prices/ PPP USD 2019)	World Bank country classification (2020)	JDC Risk (2020)	IMF Risk (2020)	Government external debt payments (2020), in percent	Net creditor / debtor (2019), in percent	Private external debt (2019), in percent	Current account balance as percent of GDP (2019)	ND-GAIN Vulnerability (2018)	ND-GAIN Readiness (2018)
Afghanistan	502	Low income	No risk identified	High	2.3	36	20.8	2.0	0.59	0.22
Bangladesh	1,856	Lower-middle income	No risk identified	Low	11.9	-12	4.2	-2.0	0.55	0.27
Barbados	18,148	High income	N/A	N/A	N/A	N/A	N/A	-3.9	0.39	0.51
Bhutan	3,243*	Lower-middle income	In debt crisis	Moderate	49.0	-91	137.2	-12.5	0.51	0.46
Burkina Faso	775	Low income	Risk of private debt crisis	Moderate	5.7	-47	116.5	-5.7	0.56	0.28
Cambodia	1,643	Lower-middle income	Risk of private debt crisis	Low	6.9	-83	184.8	-12.5	0.50	0.29
Colombia	6,432	Upper-middle income	Risk of private debt crisis	N/A	7.8	-48	26.2	-4.2	0.41	0.38
Comoros	1,394	Lower-middle income	Risk of public debt crisis	Moderate	8.4	1	N/A	-8.0	0.54	0.28
Congo, DR	545	Low income	Risk of public & private debt crisis	Moderate	11.1	-40	56.5	-3.4	0.60	0.21
Costa Rica	12,238	Upper-middle income	In debt crisis	N/A	18.7	-53	33.6	-2.4	0.38	0.47
Dominican Rep.	8,282	Upper-middle income	In debt crisis	N/A	16.9	-62	84.7	-1.3	0.43	0.37
Ethiopia	858	Low income	Risk of public debt crisis	High	14.2	-26	3.0	-6.0	0.56	0.30
Fiji	6,220	Upper-middle income	Risk of private debt crisis	N/A	19.0	-84	116.0	-7.3	0.44	0.44
Gambia, The	751	Low income	In debt crisis	High	21.4	-28	N/A	-9.4	0.53	0.32
Ghana	2,202	Lower-middle income	In debt crisis	High	50.2	-40	53.0	-3.6	0.47	0.35
Grenada	10,966	Upper-middle income	In debt crisis	In debt distress	19.0	-113	186.0	-11.3	0.38	0.54
Guatemala	4,620	Upper-middle income	No risk identified	N/A	13.9	-15	49.0	0.6	0.45	0.32
Haiti	755	Low income	Risk of public & private debt crisis	High	14.1	-17	54.0	-3.3	0.54	0.23
Honduras	2,575	Lower-middle income	In debt crisis	Low	15.7	-67	108.0	-4.2	0.47	0.28
Kenya	1,817	Lower-middle income	Risk of public debt crisis	High	14.5	-24	1.2	-4.7	0.53	0.28
Kiribati	1,655	Lower-middle income	No risk identified	High	2.4	543	N/A	13.2	N/A	0.45
Lebanon	7,784	Upper-middle income	In debt crisis	N/A	40.3	-66	69.2	-26.4	0.42	0.30
Madagascar	522	Low income	Risk of private debt crisis	Moderate	8.2	-58	100.4	-1.6	0.56	0.27
Malawi	412	Low income	Risk of public & private debt crisis	Moderate	6.6	-40	55.8	-14.3	0.55	0.26

Country	GDP per capita (current prices/ PPP USD 2019)	World Bank country classification (2020)	JDC Risk (2020)	IMF Risk (2020)	Government external debt payments (2020), in percent	Net creditor / debtor (2019), in percent	Private external debt (2019), in percent	Current account balance as percent of GDP (2019)	ND-GAIN Vulnerability (2018)	ND-GAIN Readiness (2018)
Maldives	10,791	Upper-middle income	Risk of public debt crisis	High	13.7	-28	1.7	-20.4	0.54	0.42
Marshall Islands	3,788*	Upper-middle income	N/A	High	9.6	- 45	N/A	4.1	N/A	0.38
Mongolia	4,295	Lower-middle income	In debt crisis	N/A	19.4	-262	315.3	-14.4	0.40	0.44
Morocco	3,204	Lower-middle income	In debt crisis	N/A	15.8	- 67	31.9	-4.5	0.39	0.43
Nepal	1,071	Lower-middle income	Risk of public & private debt crisis	Low	3.2	9	23.1	-8.3	0.52	0.34
Niger	555	Low income	Risk of public & private debt crisis	Moderate	15.1	- 98	121.8	-20.0	0.66	0.31
Palau	15,859*	High income	N/A	N/A	N/A	N/A	N/A	-25.4	N/A	0.44
Papua New Guinea	2,845	Lower-middle income	In debt crisis	High	22.3	-66	58.1	23.0	0.52	0.28
Philippines	3,485	Lower-middle income	No risk identified	N/A	6.6	-10	13.5	-2.0	0.47	0.34
Rwanda	802	Low income	In debt crisis	Moderate	19.2	-49	69.5	- 9.2	0.54	0.40
Saint Lucia	11,611	Upper-middle income	Risk of private debt crisis	Moderate	5.9	-45	140.6	2.5	0.37	0.45
Samoa	4,316	Upper-middle income	Risk of public & private debt crisis	High	14.5	-33	55.2	-0.6	0.50	0.44
Senegal	1,447	Lower-middle income	In debt crisis	Moderate	20.4	-48	84.0	-8.5	0.53	0.35
South Sudan	1,120**	Low income	In debt crisis	In debt distress	18.9	N/A	N/A	2.3	N/A	N/A
Sri Lanka	3,853	Lower-middle income	In debt crisis	N/A	37.5	-58	24.3	-2.6	0.48	0.40
Sudan	442	Low income	In debt crisis	In debt distress	19.6	-276	289.6	-7.4	0.61	0.26
Tanzania	1,122	Lower-middle income	Risk of public & private debt crisis	Low	13.1	-48	60.1	-4.1	0.54	0.29
Timor- Leste	1,294	Lower-middle income	Risk of private debt crisis	Low	1.0	636	23.8	1.1	0.51	0.39
Tunisia	3,318	Lower-middle income	In debt crisis	N/A	21.5	-147	47.5	-10.4	0.39	0.43
Tuvalu	4,059	Upper-middle income	No risk identificied	High	6.1	N/A	N/A	29.9	N/A	0.57
Vanatu	3,058	Lower-middle income	Risk of public & private debt crisis	Moderate	8.2	-32	136.7	6.1	0.55	0.36
Viet Nam	2,715	Lower-middle income	No risk identified	N/A	8.5	-20	13.3	2.2	0.48	0.42
Yemen	968*	Low income	In debt crisis	Moderate	26.4	N/A	N/A	-4.0	0.55	0.24

Source: Compiled with data from the World Bank's World Development Indicators; Jubilee Debt Campaign (JDC)'s Debt Data Portal (https://data.jubileedebt.org.uk); and Notre Dame Global Adaptation Initiative (ND-GAIN) (Chen et al. 2015).

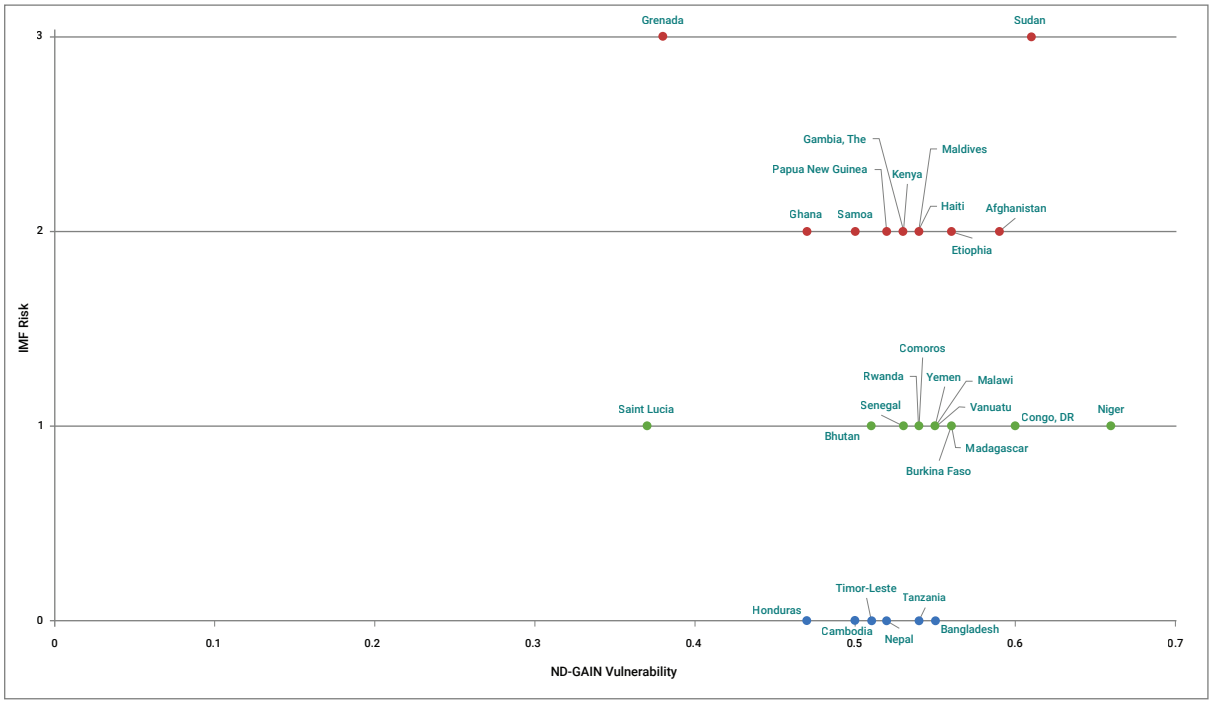
Note: N/A stands for not available. Palestine is not included in this table because of lack of data. *GDP/capita data for Bhutan, Marshall Islands, Palau, and Yemen is for 2018; **GDP/capita data for South Sudan is for 2015. The JDC risk classification is based on metrics of public and private debt.

Figure 7: JDC Risk vs ND-GAIN Vulnerability



Note: JDC risk data, as shown in Table 3, was translated as follows: 0 (no risk identified), 1 (risk of private debt crisis or risk of public debt crisis), 2 (risk of public & private debt crisis) and 3 (in debt crisis). Those without information are not included.

Figure 8: IMF Risk vs ND-GAIN Vulnerability



Note: IMF risk data, as shown in Table 3, was translated as follows: 0 (low), 1 (moderate), 2 (high) and 3 (in debt crisis). Those without information are not included.

4. The IMF's current policy frameworks and analytical tools relating to climate change

The IMF recognised climate change as an emerging structural issue in 2015 (Bretton Woods Project 2019). In November 2015, Christine Lagarde, the IMF's Managing Director at the time, acknowledged that "[t]he Fund has a role to play in helping its members address those challenges of climate change for which fiscal and macroeconomic policies are an important component of the appropriate policy response" (Lagarde 2015: 1). Lagarde asserted that, while the Fund is "is not an environmental organization […] climate change poses significant risks for macroeconomic performance and several of the appropriate policy responses lie within the Fund's expertise" (ibid.). Lagarde identified six roles that the Fund should play: (i) analytical work; (ii) technical assistance, surveillance and training; (iii) promoting dialogue, (iv) integrating natural disaster risks and preparedness strategies in macroeconomic forecasts and debt sustainability analyses; (v) helping countries incorporate adaptation strategies in medium-term budget frameworks; and (vi) working closely with other institutions to encourage consistent climate-related disclosures, prudential requirements, and stress testing for the financial sector (Table 4).[7]

Table 4: The IMF's role in addressing climate change according to Christine Lagarde, 2015

Analytical work underpins the Fund's contributions	The IMF draws on the specialist analysis of others contributing within their mandates (e.g., the Intergovernmental Panel on Climate Change, the International Energy Agency, the World Bank) and focuses on the practical design and administration of fiscal instruments for climate policy and broader energy policy. For example, Fund staff work has quantified, for over 160 countries, the environmental, fiscal, and economic benefits of energy pricing reform, including the removal of subsidies. This information helps policymakers craft the specifics of legislation to meet environmental and fiscal objectives and enlightens stakeholders on the case for reform. An overarching issue, which staff intends to analyse, is the growth impact of transitioning to a less carbon-intensive economy.

7 Lagarde's piece draws from an IMF Staff Discussion Note by Farid et al. (2016).

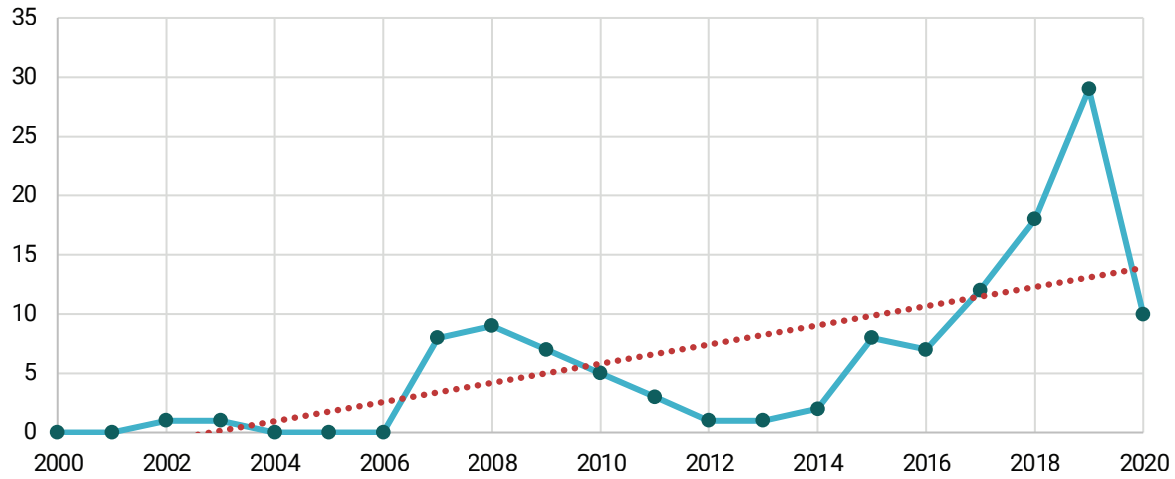
Technical assistance, surveillance and training	The Fund is well positioned to provide technical assistance and training, given its global membership and expertise in fuel tax design, tax administration, and energy price reform. Climate and energy policy developments are sometimes discussed in Article IV consultations, and this seems likely to become increasingly common. Next steps on further integration in surveillance will be informed by assessing experience with selected pilot countries.
Promoting dialogue	The Fund collaborates with other international organizations (e.g., World Bank, Organisation for Economic Co-operation and Development, and United Nations Environment Programme) to promote policy dialogue among finance ministries, emphasizing the benefits of carbon pricing as one component of an effective tax structure.
Integrating natural disaster risks and preparedness strategies in macroeconomic forecasts and debt sustainability analyses	Low-income and small developing states are especially vulnerable to increasing risks of extreme weather events. Staff, collaborating with other international institutions, will work with countries to develop comprehensive risk management frameworks to assess risks and determine the right mix of building domestic buffers versus risk transfer through insurance or financial market instruments, while tailoring investment and growth policies to building resilience.
Help countries incorporate adaptation strategies in medium- term budget frameworks	More analysis of the macroeconomic implications of adaptation policies is needed. Where macro-critical, the fiscal costs of adaptation, and the effective use of climate-related financial flows, will need to be integrated in sustainable medium-term fiscal frameworks.

Work closely with other institutions to encourage consistent climate-related disclosures, prudential requirements, and stress testing for the financial sector	Staff work, in close coordination with other institutions, such as the World Bank. Financial Stability Board and International Association of Insurance Supervisors (IAIA) will: i) enhance understanding of the transmission mechanisms from climate risks to financial stability, ii) contribute to the design of appropriate disclosure rules for climate risk exposure, iii) provide technical assistance to promote safe and sound development of markets and instruments to help manage climate-related risks, iv) contribute to the development of best practices for stress-testing for climate risks, and v) support ongoing work on globally consistent prudential requirements for the insurance sector, including on a Global Insurance Capital Standard being developed by IAIS to allow for catastrophe risk in capital requirements.

Source: Lagarde (2015).

Although the IMF was rather slow to follow up on this agenda set out by Lagarde, there has been a steady increase in the number of publications and events with substantial reference to climate change since 2016 (Volz 2020a, Figure 9). The most notable outputs include a chapter on weather shocks on economic activity in low-income countries in the 2017 World Economic Outlook report (IMF 2017), volumes on 'Resilience and Growth in the Small States of the Pacific' (Khor et al. 2016) and 'Unleashing Growth and Strengthening Resilience in the Caribbean' (Alleyne et al. 2017), and a policy paper on 'Small States' Resilience to Natural Disasters and Climate Change – Role for the IMF' (IMF 2016). Still, only relatively few people at the IMF regarded climate change as a "macro-critical" factor, i.e., crucial to the achievement of macroeconomic and financial stability, which is at the core of the Fund's mandate.

Figure 9: Number of publications and events with substantial reference to climate change



Source: Volz (2020a).

Note: Publications which show at least ten references to 'climate change', 'climatic', 'climate risk' and/or 'climate-related' or provide at least one whole paragraph, box or section on the topic are categorised as having "substantial reference" to climate change.

The IMF's attention to climate change increased markedly in 2019. That year, IMF staff produced a growing number of working papers and reports addressing important dimensions of climate change, including the fiscal challenges of and responses to climate change (IMF 2019a, 2019b) and sustainable finance and environmental, social and governance reporting (IMF 2019c). The IMF also published a review of macroeconomic and financial policies for mitigating climate change (Krogstrup and Oman 2019). On top of this, the IMF became an observer of the Central Banks and Financial Supervisors Network for Greening the Financial System (NGFS), a group of 72 (as of 18 September 2020) central banks and supervisory authorities (and 13 observers) committed to better understand and manage the financial risks and opportunities stemming from climate change.[8]

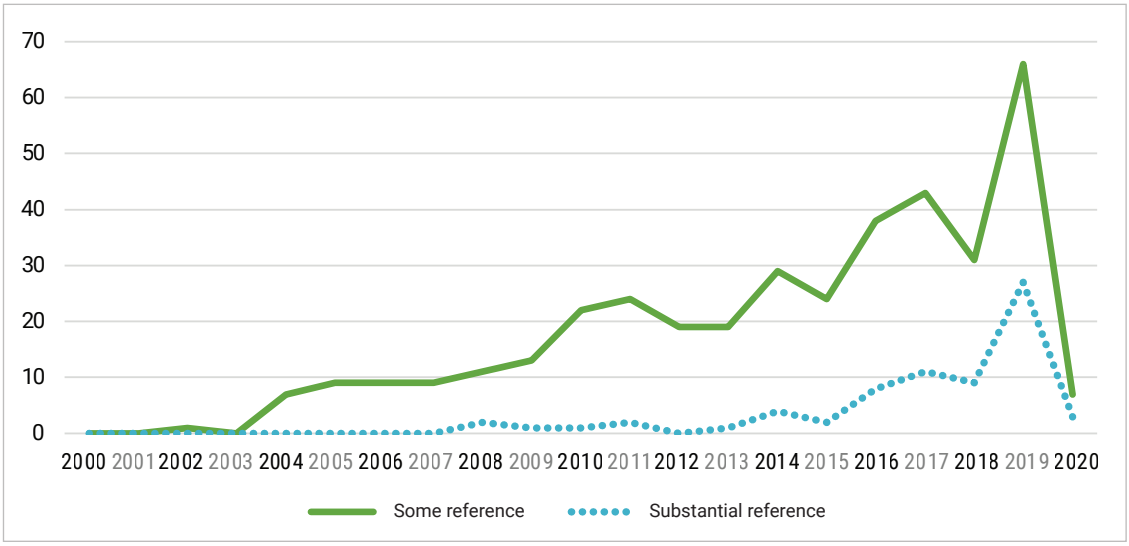
Upon taking up her role in October 2019, the new Managing Director Kristalina Georgieva made clear that she considers climate change a key responsibility for the IMF. At the 2019 Annual Meetings of the IMF and the World Bank Group in October, Georgieva acknowledged the centrality of climate risks for the Fund's work: "The criticality of addressing climate change for financial stability, for making sure that we can have sustainable growth, is so very clear and proven today, that no institution, no individual can step from the responsibility to act. For the IMF, we always look at risks. And this is now a category of risk that absolutely has to be front and centre in our work" (IMF 2019d).

In its operational work – comprising surveillance, technical assistance and training, and

8 Numbers as of 18 September 2020.

emergency lending and crisis support – the IMF has been rather slow to address climate-related financial risks (Volz 2020a). In its surveillance and monitoring operations, which are carried out at the global, regional and country levels, the IMF seeks to identify potential risks to macroeconomic and financial stability and puts forward policy adjustments that should support economic growth, promote financial and economic stability, and prevent the build-up of financial risks. At the country level, surveillance centres around the annual Article IV consultations. As can be seen in Figure 10 the IMF has only recently started to address climate change in some of its Article IV consultations with its member countries. Since the early 2010s, when climate change was still virtually absent from Article IV consultations, a small number of Article IV reports per year included substantial references to climate change. A large increase was recorded in 2019. However, in the vast majority of Article IV consultations, climate change and climate-related macroeconomic and fiscal risks still play no role.

Figure 10: Number of Article IV reports with reference to climate change, January 2000 – June 2020



Source: Volz (2020a).

Note: Included are all the published staff reports of Article IV consultations that took place between January 2000 and June 2020 that include the words 'climate change', 'climatic', 'climate-related' or 'climate risk'. Article IV reports which show at least ten references to 'climate change', 'climatic', 'climate risk' and/or 'climate-related' or provide at least one whole paragraph, box or section on the topic are categorised as making "substantial reference" to climate change. All others are categorised as making "some reference" to climate change. The year refers to the year in which the consultation was held, not the year of first publication as a staff report.

At the country level, the IMF conducts two surveillance activities jointly with the World Bank: Financial Sector Assessment Programs, and Debt Sustainability Analyses for low-income countries. To date, climate change has played no or little role in the Financial Sector Assessment Programs, and where it does, it is covered in the parts

produced by the World Bank. Likewise, the joint World Bank-IMF Debt Sustainability Analyses for low-income countries, which are structured examinations of developing country debt based on the Debt Sustainability Framework, do not systematically address climate risk analysis for the time being. The latest Debt Sustainability Analysis that was carried out for Somalia as part of the Enhanced Heavily Indebted Poor Countries Initiative in 2020, however, did include a simulation of a climate shock scenario (IMF 2020c).

At the regional level, the IMF has organised a number or regional dialogues for Pacific islands and the Caribbean.[9] Among the flagship publications for regional surveillance, the Regional Economic Outlooks (REO), to date only the 2020 REO for Sub-Saharan Africa had a special chapter dedicated to 'Adapting to Climate Change in Sub-Saharan Africa' (IMF 2020a).

The IMF's global surveillance has to date not systematically addressed climate-related macrofinancial risks in a major report or integrated this issue in its regular monitoring exercises. The IMF published the already-mentioned chapter on the impact of weather shocks on economic activity in low-income countries in the 2017 World Economic Outlook report (IMF 2017), a chapter on sustainable finance in the 2019 Global Financial Stability Report (IMF 2019c) and an analysis of mitigating climate change in the 2019 Fiscal Monitor, which focused on carbon pricing.

With respect to technical assistance, the IMF – together with the World Bank – has thus far conducted so-called Climate Change Policy Assessments for six countries: the Seychelles (June 2017), St. Lucia (June 2018), Belize (November 2018), Grenada (July 2019), the Federated States of Micronesia (September 2019), and Tonga (June 2020). Climate Change Policy Assessments provide "an overarching assessment of countries' climate strategies—as articulated in their Nationally Determined Contributions (NDCs) and other government documents" and "are intended to help countries build coherent macro-frameworks for responding to climate change, which could improve prospects for attracting external finance and put future revisions to NDCs on a sound footing" (IMF 2020b).

Regarding the IMF's third main area of work, supporting member countries facing balance of payments difficulties and providing temporary financing, the IMF has a Rapid Credit Facility (RCF) and a Rapid Financing Instrument (RFI) which can be each used in catastrophe situations including climate disasters. The RCF "provides rapid concessional financial assistance with limited conditionality to low-income countries (LICs) facing an urgent balance of payments need" (IMF 2020d). The RCF's concessional financial support is provided exclusively to LICs through the Poverty Reduction and Growth Trust (PRGT). Member countries that are not PRGT-eligible can access the RFI.[10] However, while both the RCF and RFI provide quick access to finance, they are both quota-based and provide only small emergency support. The IMF has not yet had a meaningful discussion about adjusting these facilities or create a new facility

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9 These included a High-Level Dialogue on 'Enhancing Macroeconomic Resilience to Natural Disasters in the Pacific Islands' in 2015, a workshop and High-Level Pacific Islands Dialogue on 'Building Resilience to Natural Disasters and Climate Change' in 2017, and a High-Level Conference on 'Building Resilience to Disasters and Climate Change in the Caribbean' in 2018.
10 The RFI replaced the Emergency Natural Disaster Assistance and Emergency Post-Conflict Assistance facilities.

that would be tailored to support members in responding to shocks related to climate change.

The IMF toolkit also comprises the Catastrophe Containment and Relief Trust (CCRT), which enables the Fund "to provide grants for debt relief for the poorest and most vulnerable countries hit by catastrophic natural disasters or public health disasters" (IMF 2020e). However, for the time being only 33 countries are eligible for support from the CCRT (IMF 2020f).[11] For the majority of member countries, including climate vulnerable developing countries, the IMF has no specific frameworks or instruments to deal with climate-related debt.

Overall, despite growing research evidence and financial supervisors' awareness of the materiality of climate-related financial risks (NGFS 2019), climate risk considerations have thus far been largely excluded from the IMF's policies. The IMF's own publications have established that "climate change is potentially macro-critical" (IMF 2019a), but also reveal that staff may still consider climate change to not be macro-critical in some countries. The macro-criticality standard as used by the IMF towards questions of engagement on macro-structural issues needs to be discussed, especially in the context of the IMF's dealing with climate vulnerable countries.

In the case of climate-related surveillance, the Fund has indicated it will focus on two principal types of climate risks: physical risks posed by the increasing severity of climate impacts, and transition risks posed by a change in the value of fossil-fuel assets. However, the Fund has also indicated that surveillance on climate issues will not be mandatory in Article IV consultations, raising the prospect of climate risk being evaluated from some countries, but not others. It is understood that a staff guidance note on operationalising climate issues at country level, in particular in surveillance, is in development.

5. Results from interviews and a survey among the V20

To explore the views and preferences of V20 countries regarding the IMF's role, a written survey was sent to all ministries of finance and central banks of V20 countries (as well as a few selected other climate vulnerable countries) in August 2020. The complete questionnaire is presented in Annex 1. The surveys were sent to the official V20 contact person at the respective institution. As of 23 September 2020, 12 completed surveys were returned by 6 ministries of finance and 6 central banks from 10 countries, including 2 non-V20 countries.

To complement the written survey, structured interviews were conducted with senior officials from finance ministries and central banks of several V20 countries between June and September 2020, including from institutions and countries that did not respond to the written survey. The responses in the interviews are in line with the written survey responses presented in the following. Given the small sample of respondents

11 The following 16 V20 countries are eligible for support from the CCRT: Afghanistan, Burkina Faso, Comoros, Democratic Republic of Congo, Ethiopia, The Gambia, Haiti, Madagascar, Malawi, Nepal, Niger, Rwanda, Republic of Tanzania, Republic of Yemen, South Sudan, and Timor- Leste.

and potential self-selection bias, the survey responses should not be seen as representative of the V20 group as a whole. Still, they provide interesting insights how finance ministries and central banks of climate vulnerable countries are coping with climate-related risks.

General questions

All institutions have already taken steps to understand potential climate impacts and risks over the next 10-20 years, although the majority stated that they have conducted only "some analysis". Only two respondents stated that their institutions had undertaken extensive/comprehensive analysis to date. All respondents stated that their organisation has been involved in efforts to reduce adverse impacts of climate change, e.g. through better planning and investing in a more climate-resilient economy, financial sector, and infrastructure. Seven organisations have already taken steps to better manage the residual impacts that can't be reduced, such as through scaled up reserves, contingency finance or financial safety nets. 7 institutions (from 6 countries) have thus far discussed climate impacts and risks in previous exchanges with the IMF, including in technical assistance discussions and Article IV consultations. Of those who did, most had the impression that IMF staff are knowledgeable in matters relating to macrofinancial risks of climate change, but one was not sure and one negated this.

Surveillance

8 out of 12 respondents expressed the view that the IMF should include a mandatory section on climate risks in its Article IV consultations with all member countries. One did not know, while 2 were against making climate risks section in Article IV consultations mandatory. One expressed that this should depend on the circumstances of each country, with some countries facing important macroeconomic risks that are driven by climatic factors while for others those risks are less significant. Using scarce Fund resources in the latter cases for this purpose could deviate attention from more pressing issues. There was, however, full consensus that the IMF should include a mandatory section on climate-related financial risks in the Financial Sector Assessment Program assessments it conducts together with the World Bank. Moreover, except for one respondent who was not sure, all agreed that the joint World Bank-IMF Debt Sustainability Framework for low-income economies should be enhanced by an analysis of the impact of climate-related financing needs and risks on debt sustainability.

Technical assistance and training

To date, only 4 institutions among the respondents had received technical advice on mitigating climate risks for public finances and the economy, or on developing disaster risk management from the IMF. Regarding technical support on the design of carbon taxes, 8 institutions would like to see support from the IMF for their country, 3 were unsure, and 2 were against IMF involvement in this. A large majority (10 institutions) said they would like to receive support from the IMF in developing a national approach for "greening" the financial sector and help them to better address climate-related financial risks; one central bank said that this would be an issue for the ministry of finance but thought that combined support by the IMF and the World Bank may be

desirable. One institution was negative regarding a possible role of the IMF in this. The picture was almost the same regarding potential support from the IMF in developing an energy transition scenario analysis, with 8 institutions indicating interest, while two institutions did not see a role for the IMF in this.

10 out of 12 respondents think the IMF should support its member countries' financial and monetary authorities in developing capacities to better assess climate risks, e.g. via climate stress-testing, to inform the design of fiscal, monetary or prudential policies, while two were against this. 11 out of 12 respondents believe the IMF should support member countries in strengthening public debt management to enable them to better account for climate risks in public budgets, with one opposing. 9 respondents think the IMF should support governments in developing contingency plans and securing pre-arranged contingent financing facilities from different sources, as well as insurance-based solutions. While one respondent was unsure, one was against IMF involvement and highlighted that it was a problem that contingencies are accounted for as expenditures, reducing the already limited fiscal space.

Emergency lending and crisis support

When asked about the biggest financing constraints countries face in terms of investing in pre-disaster resilience, disaster preparedness, and ex-post disaster response, several respondents highlighted a general constrained fiscal space and limited access to concessional funds. Among the 10 countries represented in the survey, only one country has to date received emergency support from the IMF in the context of a natural (geological/hydrological) disaster. On the question whether the IMF should adjust its lending facilities or develop new instruments to support climate vulnerable countries, 10 respondents answered yes, one no, and one wasn't sure. One respondent highlighted that vulnerable countries may need grants as opposed to changing lending conditions, as most of them have high debt already and are experiencing growing problems in managing debt payments. 8 respondents think that the IMF should raise access under the RCF and the RFI, 2 were unsure and two did not answer this question. 9 respondents thought the IMF should explore linking a new climate disaster facility to an issuance of Special Drawing Rights (SDRs), which would benefit only countries hit by climate disasters; 2 respondents were unsure about this; and 1 respondent did not answer this.

Debt sustainability

Regarding debt sustainability, 9 respondents expressed the view that the IMF should explore options for a special treatment of climate debt (i.e. public debt that has been incurred as a direct result of climate disasters or necessary adaptation measures), while one was unsure and one thought that there should be no special treatment of climate-related debt but new metrics for debt in general. 7 respondents think the IMF should promote the inclusion of natural disaster clauses in sovereign debt contracts, while 3 were unsure, one against, and one did not respond. 8 respondents think the IMF should promote the use of instruments such as GDP-linked bonds or catastrophe bonds that reduce debt burdens in case of a (climate) disaster, while 2 were unsure, one against, and one did not respond. The majority of respondents – 8 – also thought that the IMF should work on developing a sovereign debt restructuring mechanism, while 2

were unsure, one against, and one did not respond. Lastly, 9 respondents consider it helpful to have an overview of critical metrics on what can be considered "unsustainable debt" vs. "sustainable debt", with 2 respondents unsure on this and one did not respond.

Overall, the survey results – as well as the interviews – indicate that most V20 countries would like to see more support from the IMF in addressing climate vulnerabilities. Most finance ministries and central banks in V20 countries are still in early stages when it comes to analysing climate-related macrofinancial risks and would benefit from greater support in this area from the IMF. Most thought that the IMF should integrate climate risk analysis in its surveillance activities, including Article IV consultations as well as Financial Sector Assessment Program assessments and Debt Sustainability Framework analysis conducted together with the World Bank. There was also a widespread interest in receiving technical support from the IMF for climate-proofing public finances and developing disaster risk management. Last but not least, countries see a need for better frameworks for dealing with debt in general and climate-related debt in particular.

6. Considerations for a V20-IMF Joint Action Agenda

For mainstreaming climate-related financial risks assessment in its operations, the IMF needs to recognise that climate risks are different from the traditional type of risk addressed in financial risk analyses. Traditional financial risk evaluation and benchmarks are backward-looking, i.e. based on historical performances, while climate risks are forward-looking and characterised by deep uncertainty, non-linearity and endogeneity (Battiston and Monasterolo 2019). Importantly, climate risks can be amplified by the complexity of the financial system.

Ignoring forward-looking climate risks in policy design and implementation could lead to unintended effects on financial stability and inequality and broaden countries' distance to their climate and economic targets. This, in turn, may create new sources of risk for countries' macroeconomic and financial stability. Thus, assessing countries' exposures to climate-related macrofinancial risks should be at the core of the IMF's work (Volz 2020a). However, traditional financial risk approaches as currently used by the IMF are not designed to consider such characteristics and need to be complemented to assess the private and public sectors' exposure (either via the physical or transition risk channel) to forward-looking climate-related risks; to analyse the largest sources of macroeconomic and fiscal imbalances induced by countries' exposures to climate-related risks; and to design tailored measures to mitigate such risks, while addressing potential trade-offs on sustainable development and inequality.

A V20-IMF collaboration could establish a programme of work involving both the IMF and the V20 economies aimed at promoting actions to enhance resilience to climate change. A Joint Action Agenda has the potential to drive transformational action to minimise climate risks. Some questions to consider in the framing of the Joint Action Agenda include:

- What further steps could the IMF take to further strengthen the treatment of

climate risks in its operations, including in surveillance, policy support and financial assistance?

- What policy options are available to V20 members in order to accelerate efforts to tac kle climate risks to the economy during the pandemic response and recovery, as well as in the longer-term?
- What avenues of international support needs in terms of finance and policy assistance could the IMF explore in order to ensure highly vulnerable economies are effectively supported to pursue these policy options?

Building on the preceding discussion, the following ten areas could form the basis for a Joint Action Agenda by the V20 and IMF.

6.1 Mainstreaming Systematic and Transparent Assessment of Climate-related Financial Risks in all IMF Operations

The IMF should mainstream a transparent assessment of climate-related financial risks in its operations. As the availability and sophistication of science-based climate financial risk metrics and methods such as climate stress-testing and climate-financial pricing models increase, the IMF has a solid ground for starting its assessment of climate-related financial risks, in order to better anchor and inform its policy work. Given the role of the financial sector in the economy and society, the assessment of climate-related financial risks and opportunities should be implemented in a transparent and independent way.

6.2 Consistent, Systematic, and Universal Appraisal and Treatment of Physical Climate Risks and Transition Risks for All Countries in Article IV Consultations and Financial Sector Assessment Programs

By including a mandatory section on climate risks in its Article IV consultations with all member countries, the IMF can mainstream the assessment of climate risks in countries' financial stability analyses. A consistent, systematic, and universal treatment of climate risks in Article IV consultations will facilitate better management and mitigation of macrofinancial risks through governments and enhance the recognition of such risks by the financial sector.

The IMF could also introduce a mandatory section on climate-related financial risks to the Financial Sector Assessment Programs it conducts jointly with the World Bank. Importantly, the IMF should recognise the unique susceptibilities of climate vulnerable countries, stemming from both physical and transition risks, and support their financial and monetary authorities in developing capacities to better assess and respond to climate risks, e.g. via climate stress-testing to inform the design of prudential policies, when needed.

A better analysis of climate-related macrofinancial risks will not only enable better micro- and macroprudential policies to safeguard macrofinancial stability, it should also lead to better pricing of these risks by financial markets, which will contribute to

overcoming barriers to scaling-up sustainable investment (Monasterolo and Volz 2020).

6.3 Advancing Disclosure of Climate-related Financial Risks and Promoting Sustainable Finance and Investment Practices

Aligning financial markets with sustainable development and the Paris climate goals will be crucial for enhancing resilience of climate vulnerable countries. The IMF's 2020 Global Financial Stability Report highlights the way investors and equity markets have long ignored the growing risk of financial losses associated with climate risk (IMF, 2020h). The IMF could use its unique role in international finance to promote the disclosure of climate-related financial risks and the development of sustainable finance and investment practices. Well-developed financial markets that account for sustainability risks facilitate climate-friendly private sector investment.

Box 2: Assessing Financial Liabilities

Accurate assessments of financial liabilities is becoming more challenging due to the complex impacts of climate change. It is time to prioritise efforts to modernise and integrate into financial policy frameworks climate and transition risks in order to limit if not contain vulnerabilities to stranded risk and rapid onset and slow onset climate events. This is critical for developing policies tailored to crowd-in low-carbon and climate-resilient investments and value. Due to the fixed nature of conventional fossil fuel power contracts that "lock-in" long-term liabilities, countries may be at risk of stranded assets or stranded debt in the power sector which could lead to increased subsidy requirements or an increase in power tariffs which can negatively impact cost-competitiveness. Because many fossil fuel contracts are backed by sovereign guarantees to cover fixed capacity payments, power sector funding practices have a direct impact on public-sector balance sheets in terms of what the state owns and owes. Moreover, given the rapid pace of innovation in the power and energy sector, many of the conventional power facilities backed by export credit agencies (ECAs) from major economies are at risk of early obsolescence.

The IMF could help vulnerable developing countries determine which parties hold the affected assets and related liabilities. A mixed ownership dynamic can distort the traditional risk-reward dynamic for ECAs from major economies, especially if the project sponsor has failed to capture or reflect relevant market risks correctly and when an ECA steps in to support a failed project that could in turn exacerbate financial and climate risks at the country level. This also raises questions about risk management in the event the government or the IMF are called upon to support a bailout. Without intervention, bailout funds could be claimed to service contractual obligations related to loans or financing originating from or backed by the major economy.

The scenarios highlighted above underscore the importance of ensuring the IMF is positioned to engage proactively with countries in order to ascertain the degree of exposure of the financial

sector, the public sector, and relevant major economy export credit agencies to fossil fuel lock-in and its accompanying non-performance stranded risk. These risks should also be evaluated in the case of other public infrastructure, e.g. ports, pipelines, and transport systems that lack adaptive capacity to deal with physical climate risks. In other words, the IMF could explore providing the analytical resources needed to assist governments to understand the size and nature of public assets exposed to transition risk and physical climate risk, extending guidance on options governments can consider to better manage risk exposures.

This assessment would not only promote better understanding of financial system risk levels, but can be linked to other financing facilities to help reduce or relieve the fiscal pressures associated with transition risk and physical climate risk. For example, the analysis could support work by multilateral development banks to consider a stranded risk displacement financing facility for countries with fossil fuel contracts signed prior to 2020 that are causing fiscal pressures through refinancing or other means. Such a facility could be tailored to address fossil fuel displacement scenarios that occur when the average cost of new renewables is less than the variable cost of fossil fuel generation, and when the average cost of renewables and storage plus the capital recovery of an existing fossil fuel plant is less than the variable cost of the fossil fuel generation. This type of stranded risk displacement financing facility could also alleviate fiscal pressures and catalyse additional investment in climate-proofed infrastructure.

6.4 Exploring synergies between Fiscal and Monetary Policies

The IMF could explore synergies between fiscal and monetary policies as well as macroprudential regulations to identify an optimal policy mix that would enhance finance for development oriented towards just transition outcomes while improving economic competitiveness and ensuring macrofinancial stability. In this regard, closer collaboration between financial institutions acting on climate finance, including development finance institutions, central banks and financial regulators, would be crucial. By considering the materiality of forward-looking climate risks in the design of fiscal and financial policies, the IMF could support its membership in general, and climate vulnerable countries in particular, in building resilience to such risks while scaling up investments needed to achieve climate targets. Not doing so could lead to a disorderly transition leading to increasing liabilities and stranding risk for both public and private sector, generating adverse effects on financial stability and inequality.

6.5 Mainstreaming of Climate Risk Analysis in Public Financial Management and Supporting the Development of a Climate Disaster Risk Financing and Insurance Architecture

Through policy advice and technical assistance, the IMF can support climate vulnerable countries in climate-proofing public finances. In particular, the IMF can encourage and provide advice to finance ministries on how to analyse the potential impacts of climate

change on the medium- to long-term quality and sustainability of public finances and mainstream climate risk analysis in public financial management. Based on climate vulnerability assessments, the IMF can help finance ministries identify potential risks on the expenditure and revenue side. The IMF could also support V20 countries in incorporating fiscal buffers for climate-related risks in budget planning. In particular, it could help promote budgetary instruments for ex ante disaster financing, including contingency lines and disaster, reserve, or contingency savings funds (Cevik and Huang 2018).

Since debt sustainability can be affected by a country's ability to absorb shocks, it is important that governments of climate vulnerable countries are supported in developing contingency plans including options for securing pre-arranged and pre-agreed pricing of risk transfer instruments. The IMF could support the development of an international climate disaster risk financing and insurance architecture that addresses different layers of risks and provides vulnerable countries with instruments for climate and disaster financing (Ahmed et al. 2020).

To enhance debt sustainability, the IMF could promote a discussion around adding natural disaster clauses to sovereign debt contracts and the use of instruments such as GDP-linked bonds. Moreover, the IMF could seek to enhance transparency of public debt contracts, and support governments in asserting that assumptions and terms or clauses of debt contracts are realistic and sustainable.

By supporting climate vulnerable countries in strengthening public debt management, the IMF can contribute to enhanced debt sustainability and enable a better accounting for climate risks and investment opportunities that deliver high socio-economic and adaptation dividends in public budgets.

6.6 Supporting Climate Vulnerable Countries with Debt Sustainability Problems

The IMF could play an important role in supporting climate vulnerable countries that are facing debt sustainability challenges or are already in debt distress. As recently highlighted by Georgieva et al. (2020), a "reform of the international debt architecture is urgently needed". The IMF (2020i) has recently put forward reform options for the international architecture for resolving sovereign debt involving private-sector creditors. Together with the V20, the IMF could explore options for the treatment of climate debt, i.e. public debt that has been incurred as a direct result of climate disasters or necessary adaptation measures (Volz 2020). This is particularly relevant for Small Island Developing States, where single events can have devastating effects on the economy and public finances.[12]

The joint World Bank-IMF Debt Sustainability Framework for Low-Income Countries could be enhanced by a mandatory analysis of the impact of climate-related risks on debt sustainability. Such assessment could also be rolled out to climate vulnerable middle income countries.

12 For example, the total damage and losses resulting from Cyclone Winston in 2016 in Fiji was 31% of GDP (USD 1.38 billion).

The COVID-19 crisis has worsened public finances in V20 countries. Going forward, many developing countries will require debt relief to respond effectively to the crisis and undertake meaningful investment to climate-proof their economies. For now, the international financial architecture still lacks an adequate system for addressing situations where sovereign debt becomes unsustainable. The IMF could explore options for a sovereign debt restructuring mechanism, as was originally proposed by the IMF two decades ago (IMF 2003), to deal with debt crises. In this context, the IMF could also investigate options for developing a new framework for debt restructuring that facilitate a green recovery, including through tools such as debt-for-climate swaps (Akhtar et al. 2020).

6.7 Developing the IMF Toolkit for Climate Emergency Financing

The IMF can further develop its existing emergency financing facilities or generate options for a new climate emergency financing facility. This is particularly relevant for Small Island Developing States though options should be explored as well to include other climate vulnerable countries.

One option is to raise access under the RCF/RFI, e.g. up to 400-500 percent of quota. Moreover, options should be explored to convert these facilities into grants, particularly for PRGT-eligible countries. A further option would be to establish an entirely new climate emergency facility. The IMF could consider linking a climate disaster facility to the issuance of SDRs, which would benefit only countries hit by climate disasters.

6.8 Exploring Options to Use SDRs to Support Climate Vulnerable Countries

The IMF could consider the possibility of allocating new SDRs as a way of providing vulnerable countries with enhanced liquidity. While a general SDR allocation would primarily benefit large economies,[13] options could be explored where rich countries, whose historic carbon emissions are the main cause of anthropogenic climate change, make their SDRs available to a new multilateral swap facility or donate their SDRs to a trust fund at the IMF, which could use them in a way that benefits climate vulnerable countries. Another option would be to develop a mechanism where new SDRs are issued exclusively to climate vulnerable countries. Such an SDR issuance could be linked to exogenous shocks such as climate-induced disasters, eliminating problems with moral hazard. As climate vulnerable countries that have hardly contributed to global climate change suffer the biggest impacts, SDR issuances for climate vulnerable countries could be a way of enhancing resilience and global climate justice at the same time.

6.9 Supporting the Design and Implementation of Carbon Pricing Mechanisms

The second V20 Ministerial Dialogue in Washington, DC in April 2016 reiterated strong

13 SDR allocations are a function of GDP and country voting shares in the IMF. Only 3.44% of a new SDR allocation would benefit V20 countries, while G20 countries receive 79.27% of SDR allocation.

support for innovative revenue generating fiscal and financial measures to raise finance, stimulate technological innovation and redirect investment toward climate resilient and low-emissions development. In this respect, the V20 committed to support carbon pricing by working to establish pricing regimes by 2026 taking due consideration of each country's respective capabilities.

Building on its work on its work in using fiscal tools to mitigate climate change (IMF, 2019b), the IMF could support V20 countries in strengthening their fiscal framework and revenue outcomes through the design and implementation of appropriate carbon pricing mechanisms. Carbon tax revenues could be redistributed to support low-income households or communities affected by the low carbon transition or that are hit particularly hard by the physical effects of climate change.

6.10 Institutionalising Collaboration between the Fund and the V20

The current governance structure of multilateral development institutions, including the IMF, provides, for the most part, relatively little influence to vulnerable developing countries. This poor representation means that when agendas are set and decisions are made, vulnerable developing countries do not have the same voice as large countries or groups such as the G7 and G20. This matters not just in terms of securing robust country ownership of global financial responses but also in terms of establishing measures more responsive to distinct national circumstances.

The V20 has the ability to coordinate the position of vulnerable developing countries including small island developing states and nations that typically lack representation on monetary and development issues in the deliberations and decisions of the Bretton Woods Institutions. In particular, the V20 can feed into the agendas of the International Monetary and Financial Committee and the joint World Bank-IMF Development Committee, as well as in other relevant fora.

To provide a platform to climate vulnerable developing countries to articulate their views and interests, the IMF should recognise the V20 as an official stakeholder and hold regular consultations with the V20. Joint agendas are critical in order to develop a joint understanding and solutions to the problems created by climate change. Since October 2015, the V20 finance ministers have met biannually with the World Bank at the Annual and Spring Meetings of the IMF and the World Bank Group. The IMF could join the World Bank in holding regular, bi-annual meetings with the V20. A continuous exchange between the IMF and the V20 would provide the opportunity to develop and implement a joint action agenda.

7. Conclusion

The V20 economies face considerable macrofinancial risks that can undermine debt sustainability, constrain fiscal space, and worsen sovereign risk, among other effects. Most financial and monetary authorities of climate vulnerable countries are in the early stages of analysing these risks and incorporating them in their macrofinancial frameworks. They also face the urgent and growing need to develop more effective

approaches that climate-proof public finances and establish climate and disaster risk management structures.

The IMF has a critical role in addressing climate change through its policy advice and capacity building functions, surveillance, and the promotion of policy frameworks to mobilise investments. The IMF has recently started to put greater emphasis on climate risk and is in the process of developing its strategy and capacities in this area. There seems to be a clear demand among climate vulnerable countries for support from the IMF in all three areas of its operational work, i.e. surveillance, technical assistance and training, and emergency lending and crisis support. A partnership between the V20 and IMF could help climate vulnerable countries to better mitigate and manage systemic climate risks, and enable a macroeconomic environment that can facilitate investments in adaptation and development.

References

Acevedo, S. (2014), "Debt, Growth and Natural Disasters: A Caribbean Trilogy." IMF Working Paper No. 14/125, Washington, DC: International Monetary Fund.

Ahmed, S.J. (2020), "Now Is the Time. Early Fossil Fuel Displacement in South and Southeast Asia", Analysis & New Insights, Stanley Center for Peace and Security https://stanleycenter.org/wp-content/uploads/2020/10/CCAI-EarlyFossilFuelDisplacementinSouthSEA1020.pdf

Ahmed, S.J, V. Seifert and S. Kreft (2020), "Enhancement of Nationally Determined Contributions in the Context of Climate and Disaster Risk Financing", MCII Background Note, Bonn: Munich Climate Insurance Initiative, https://climate-insurance.org/wp-content/uploads/2020/04/MCII_Background_Note_Vulnerable_Countries_NDCs___CDRFI_19-04-2020.pdf

Akhtar, S., K.P. Gallagher, S. Griffith-Jones, J. Haas & U. Volz (2020), "Time to Add 'Debt for Climate Swaps' to the COVID-19 Crisis Toolkit", Project Syndicate, 17 August, https://www.project-syndicate.org/commentary/debt-for-climate-swaps-by-shamshad-akhtar-2-et-al-2020-08?barrier=accesspaylog.

Alcayna, T. (2020), "At what cost? How chronic gaps in adaptation finance expose the world's poorest people to climate chaos." Zurich: Flood Resilience Alliance.

Alleyne, T., Ötker, U. Ramakrishnan & K. Srinivasan (eds., 2017), Unleashing Growth and Strengthening Resilience in the Caribbean, Washington, DC: International Monetary Fund.

Athaves, S. (2018). "Five years on: How Haiyan shocked the world", Risk Managing Solutions (RMS), 8 November, https://www.preventionweb.net/news/view/61777

Bachner, G., B. Bednar-Friedl & N. Knittel (2019), "How Does Climate Change Adaptation Affect Public Budgets? Development of an Assessment Framework and a Demonstration for Austria." Mitigation and Adaptation Strategies for Global Change 24, 1325–1341.

Battiston, S. & I. Monasterolo (2019), "A Climate Risk Assessment of Sovereign Bonds." Mimeo. Zurich: University of Zurich.

Batten, S., R. Sowerbutts & M. Tanaka (2016), "Let's Talk about the Weather: The Impact of Climate Change on Central Banks. Bank of England Working Paper No. 603. London: Bank of England.

Batten, S., R. Sowerbutts & M. Tanaka (2020), "Climate Change: Macroeconomic Impact and Implications for Monetary Policy", in: T. Walker, D. Gramlich, M. Bitar & P. Fardnia, eds. Ecological, Societal, and Technological Risks and the Financial Sector. London: Palgrave Macmillan.

Beirne, J., N. Renzhi & U. Volz (2020a), "Feeling the Heat: Climate Risks and the Cost of Sovereign Borrowing", ADBI Working Paper No. 1160. Tokyo: Asian Development Bank Institute.

Cuadra, G., J. Sanchez & H. Sapriza (2010), "Fiscal Policy and Default Risk in Emerging Markets", Review of Economic Dynamics 13(2), 452–469.

Day, E., S. Fankhauser, N. Kingsmill, H. Costa & A. Mavrogianni (2019), "Upholding Labour Productivity under Climate Change: An Assessment of Adaptation Options", Climate Policy 19(3), 367–385.

Dellink, R., H. Hwang, E. Lanzi & J. Chateau (2017), "International Trade Consequences of Climate Change." OECD Trade and Environment Working Paper No. 2017/01, Paris: Organisation for Economic Co-operation and Development.

Development Finance International (2001), Overview of Debt Conversion, Washington DC: Development Finance International.

Farhi, E. & X. Gabaix (2016), "Rare Disasters and Exchange Rates", Quarterly Journal of Economics 131(1), 1–52.

Farid, M., M. Keen, M. Papaioannou, I. Parry, C. Pattillo, A. Ter-Martirosyan & other IMF Staff (2016), "After Paris: Fiscal, Macroeconomic, and Financial Implications of Climate Change", Staff Discussion Note No. 16/01, Washington, DC: International Monetary Fund.

Forni, L., M. Catalano & E. Pezzolla (2019), "Increasing Resilience: Fiscal Policy for Climate Adaptation", in: M.A. Pigato, ed. Fiscal Policies for Development and Climate Action. Washington, DC: World Bank, pp. 115–132.

Froese, R. & J. Schilling (2019), "The Nexus of Climate Change, Land Use, and Conflicts", Current Climate Change Reports 5, 24–35.

Gassebner, M., A. Keck & R. The (2010), "Shaken, Not Stirred: The Impact of Disasters on International Trade", Review of International Economics 18(2), 351–368.

Georgieva, K., C. Pazarbasioglu, and R. Weeks-Brown (2020), "Reform of the International Debt Architecture is Urgently Needed", IMF Blog, 1 October, https://blogs.imf.org/2020/10/01/reform-of-the-international-debt-architecture-is-urgently-needed/

GFDRR. (2015). Typhoon Yolanda Ongoing Recovery: Recovery Framework Case Study. Washington DC: World Bank.

Glemarec, Y. (2011), Catalysing Climate Finance: A Guidebook on Policy and Financing Options to Support Green, Low-Emission and Climate-Resilient Development. United Nations Development Programme, New York, NY, USA.

Global Commission on Adaptation (2019), Adapt Now: A Global Call for Leadership on Climate Resilience. Washington, DC: The New Climate Economy.

Global Commission on the Economy and Climate (2016), Unlocking the Inclusive Growth Story of the 21st Century: Accelerating Climate Action in Urgent Times. Washington, DC: The New Climate Economy.

Hallegatte, S., J. Rentschler & J. Rozenberg (2019), "Lifelines: The Resilient Infrastructure Opportunity", Washington, DC: The World Bank.

Harris, J., B. Imbert, P. Medas, J. Ralyea & A. Singh (2020), Government Support to State-Owned Enterprises: Options for Sub-Saharan Africa, IMF Fiscal Affairs, Washington DC: International Monetary Fund.

Hochrainer-Stigler, S., A. Keating, J. Handmer & M. Ladds (2018), "Government Liabilities for Disaster Risk in Industrialized Countries: A Case Study of Australia", Environmental Hazards 17(5), 418–435.

Huxham, M., M. Anwar & D. Nelson (2019), Understanding the Impact of a Low Carbon Transition on South Africa. San Francisco, CA: Climate Policy Initiative.

IDB.(2016), Contingent Lending Instruments. Washington, DC: Interamerican Development Bank.

IMF (1998), The Debt-Rescheduling Process: Pitfalls and Hazard, Washington, DC: International Monetary Fund.

IMF (2000), Reforming the International Monetary and Financial System, Washington, DC: International Monetary Fund.

IMF (2001), Government Finance Statistics Manual 2001. Washington, DC: International Monetary Fund.

IMF (2003), "Proposals for a Sovereign Debt Restructuring Mechanism (SDRM)", A Factsheet, Washington, DC: International Monetary Fund, https://www.imf.org/external/np/exr/facts/sdrm.htm

IMF (2004), The IMF's Contingent Credit Lines (CCL), Washington, DC: International Monetary Fund.

IMF (2011), Public Sector Debt Statistics: Guide for Compilers and Users, Washington, DC: International Monetary Fund.

IMF (2016), "Small States' Resilience to Natural Disasters and Climate Change – Role for the IMF", IMF Policy Paper, 4 November, Washington, DC: International Monetary Fund.

IMF (2017), World Economic Outlook, October 2017. Seeking Sustainable Growth: Short-Term Recovery, Long-Term Challenges, Washington, DC: International Monetary Fund, Chapter 3 on "The Effects of Weather Shocks on Economic Activity. How Can Low-income Countries Cope?".

IMF (2018a), Fiscal Transparency Handbook, Washington, DC: International Monetary Fund.

IMF (2018b), The Sovereign Debt Restructuring Process, Washington, DC: International Monetary Fund.

IMF (2019a), "Fiscal Policies for Paris Climate Strategies – from Principle to Practice", IMF Policy Paper No. 19/010, International Monetary Fund: Washington, DC.

IMF (2019b), Fiscal Monitor. How to Mitigate Climate Change, International Monetary Fund: Washington, DC, International Monetary Fund: Washington, DC.

IMF (2019c), Global Financial Stability Report, International Monetary Fund: Washington, DC, Chapter 6 on "Sustainable Finance. Looking Farther", International Monetary Fund: Washington, DC.

IMF (2019d), "Can Central Banks Fight Climate Change?", IMF Seminar Event, Annual Meetings 2019, October 16, Washington DC, URL: https://meetings.imf.org/en/2019/Annual/Schedule/2019/10/16/imf-seminar-climate-change-and-central-banks [accessed 31 July 2020].

IMF (2019e), Building Resilience in Developing Countries Vulnerable to Large Natural Disasters, International Monetary Fund: Washington, DC.

IMF (2020a), Regional Economic Outlook Sub-Saharan Africa. COVID-19: An Unprecedented Threat to Development, Washington, DC: International Monetary Fund.

IMF (2020b), "Climate Change", IMF website, URL: https://www.imf.org/en/Topics/climate-change/resilience-building [accessed 31 July 2020].

IMF (2020c), "Somalia: Enhanced Heavily Indebted Poor Countries (HIPC) Initiative-Decision Point Document", IMF Country Report No. 20/86, Washington, DC: International Monetary Fund.

IMF (2020d), "The IMF's Rapid Financing Instrument (RFI)", April 9, IMF website, URL: https://www.imf.org/en/About/Factsheets/Sheets/2016/08/02/19/55/Rapid-Financing-Instrument [accessed 31 July 2020]

IMF (2020e), "Catastrophe Containment and Relief Trust", 15 April, IMF website, URL: https://www.imf.org/en/About/Factsheets/Sheets/2016/08/01/16/49/Catastrophe-Containment-and-Relief-Trust [accessed 31 July 2020]

IMF (2020f), "Catastrophe Containment and Relief Trust: Policy Proposals and Funding Strategy", IMF Policy Paper, Washington, DC: International Monetary Fund.

IMF (2020g), Fiscal Monitor. Policies to Support People During the COVID-19 Pademic, International Monetary Fund: Washington, DC, International Monetary Fund: Washington, DC.

IMF (2020h), Global Financial Stability Report, International Monetary Fund: Washington, DC, International Monetary Fund: Washington DC.

IMF (2020i), "The International Architecture for Resolving Sovereign Debt Involving Private-Sector Creditors – Recent Developments, Challenges, and Reform Options", https://www.imf.org/en/Publications/Policy-Papers/Issues/2020/09/30/The-International-Architecture-for-Resolving-Sovereign-Debt-Involving-Private-Sector-49796

IPCC (2018), Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty. Edited by V. Masson-Delmotte, P. Zhai, H.O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen,

X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield. Geneva: Intergovernmental Panel on Climate Change.

IPCC (2019a), Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems. Edited by P.R. Shukla, J. Skea, E. CalvoBuendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, and J. Malley. Geneva: Intergovernmental Panel on Climate Change.

ILO (2019), Working on a warmer planet: The impact of heat stress on labour productivity and decent work. Geneva: International Labour Organization.

IPCC (2019a), IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. Edited by H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegria, M. Nicolai, A. Okem, J. Petzold, B. Rama, and N.M. Weyer. Geneva: Intergovernmental Panel on Climate Change.

IRENA (2020), Renewable Power Generation Costs in 2019, International Renewable Energy Agency, Abu Dhabi.

Islam, S.N. & J. Winkel (2017), "Climate Change and Social Inequality", DESA Working Paper No. 152. New York, NY: United Nations Department of Economic & Social Affairs.

Khor, H.E., R.P. Kronenberg & P. Tumbarello (eds., 2016), Resilience and Growth in the Small States of the Pacific, Washington, DC: International Monetary Fund.

Kling, G., Y.C. Lo, V. Murinde & U. Volz (2018), "Climate Vulnerability and the Cost of Debt." Centre for Global Finance Working Paper No. 12/2018, London: SOAS University of London.

Kling, G., U. Volz, V. Murinde & S. Ayas (2020), "The Impact of Climate Vulnerability on Firms' Cost of Capital and Access to Finance", World Development, forthcoming.

Klomp, J., & Valckx, K. 2014. "Natural Disasters and Economic Growth: A Meta-analysis", Global Environmental Change 26, 183-195.

Krogstrup, S. & W. Oman (2019), "Macroeconomic and Financial Policies for Climate Change Mitigation: A Review of the Literature", IMF Working Paper No. 19/185, Washington, DC: International Monetary Fund.

Lagarde, C. (2015), "The Managing Director's Statement on the Role of the Fund in Addressing Climate Change", 25 November, Washington, DC: International Monetary Fund.

McKibbin, W.J., A.C. Morris, A. Panton & P. Wilcoxen (2017), "Climate Change and Monetary Policy: Dealing with Disruption", Climate and Energy Economics Discussion Paper. Washington, DC: Brookings Institution.

Micale, V., B. Tonkonogy & F. Mazza (2018), Understanding and Increasing Finance for Climate Adaptation in Developing Countries. San Francisco, CA: Climate Policy Initiative.

Mitchell, T., R. Mechler & K. Peters (2014), "Placing Disaster Risk Management at the Heart of National Economic and Fiscal Policy." In: A. Markandya, I. Galarraga & E.S. de Murieta, eds., Handbook on the Economics of Adaptation, London: Routledge, 417-436.

Monasterolo, I., S. Battiston, A.C. Janetos & Z. Zheng (2017), "Vulnerable Yet Relevant: The Two Dimensions of Climate-related Financial Disclosure", Climatic Change 145(3-4), 495-507.

Monasterolo, I. & U. Volz (2020), "Addressing Climate-related Financial Risks and Overcoming Barriers to Scaling-up Sustainable Investment", T20 Briefing Paper of Task Force 2: Climate Change and Environment, Riyadh: T20 Saudi Arabia.

Munich Climate Insurance Initiative (2020), "Enhancement of Nationally Determined Contributions in the Context of Climate and Disaster Risk Financing", Bonn: MCII.

NDRRMC. (2013). "Final Report re Effects of Typhoon Yolanda", Government of the Philippines, 9 November. https://ndrrmc.gov.ph/attachments/article/1329/FINAL_REPORT_re_Effects_of_Typhoon_YOLANDA_HAIYAN_06-09NOV2013.pdf

Neufeldt, H., G. Sanchez Martinez, A. Olhoff, C.M.S. Knudsen & K.E.J. Dorkenoo (eds., 2018), The Adaptation Gap Report 2018. Nairobi: United Nations Environment Programme.

NGFS (2019), A Call for Action. Climate Change as a Source of Financial Risk. Paris: Central Banks and Financial Supervisors Network for Greening the Financial System.

Overseas Development Institute (2015), Debt Sustainability and Debt Management in Developing Countries., London: ODI.

PSA. (2014). PSA Annual Report 2014. Retrieved from https://psa.gov.ph/sites/default/files/2014%20PSA%20annual%20report.pdf

The Manila Times. (2014). "DTI Helps Hundreds of MSMEs rebuild after Yolanda", The Manila Times, 21 August. https://www.manilatimes.net/2014/08/21/business/dti-helps-hundreds-msmes-rebuild-yolanda/120531/120531/

Schuler, P., Oliveira, L.E., Mele, G., & Antonio, M. 2019. "Managing the Fiscal Risks Associated with Natural Disasters." In: Pigato, M.A., ed., Fiscal Policies for Development and Climate Action, Washington, DC: World Bank, 133–153.

Semieniuk, G., E. Campiglio, J.-F. Mercure, U. Volz & N. Edwards (2020), "Low-Carbon Transition Risks for Finance", WIREs Climate Change, forthcoming.

Skoglund, J. and Chen, W. (2015), Financial Risk Management: application in market, credit, asset and liability management and firmwide risk. Wiley Finance.

Tanner, T., S. Surminski, E. Wilkinson, R. Reid, J. Rentschler & S. Rajput (2015), The Triple Dividend of Resilience. Realising Development Goals Through the Multiple Benefits of Disaster Risk Management. London and Washington, DC: Overseas Development Institute and World Bank.

UN News (2019), "Climate Crisis Could See 'Collapse' of Some Economies without

Diversification, Warns UN Trade Chief." 11 September. https://news.un.org/en/story/2019/09/1046142.

UNCTAD (2019), The Commodities and Development Report 2019: Commodity Dependence, Climate Change and the Paris Agreement, Geneva: United Nations Conference on Trade and Development.

UNDP (2016), Climate Change and Labour: Impacts of Heat in the Workplace, Geneva: United Nations Development Programme.

UNDP (2017), Lebanon: Derisking Renewable Energy Investment, New York, NY: United Nations Development Programme.

Volz, U. (2020a), "Climate-proofing the Global Financial Safety Net", mimeo, London: SOAS University of London.

Volz, U. (2020b), "Investing in a Green Recovery", Finance & Development September, 28–31.

Volz, U., J. Beirne, N. Ambrosio Preudhomme, A. Fenton, E. Mazzacurati, N. Rhenzi & J. Stampe (2020), Climate Change and Sovereign Risk, London, Tokyo, Singapore, and Berkeley, CA: SOAS University of London, Asian Development Bank Institute, World Wide Fund for Nature Singapore, and Four Twenty Seven.

Wilbanks, T.J., P. Romero Lankao, M. Bao, F. Berkhout, S. Cairncross, J.-P. Ceron, M. Kapshe, R. Muir-Wood & R. Zapata-Marti (2007), "Industry, settlement and society", in: M.L. Parry, O.F.Canziani, J.P. Palutikof, P.J. van der Linden & C.E. Hanson, eds., Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge: Cambridge University Press, 357–390.

Waissbein, O., Glemarec, Y., Bayraktar, H., & Schmidt, T.S., (2013), Derisking Renewable Energy Investment: A Framework to Support Policymakers in Selecting Public Instruments to Promote Renewable Energy Investment in Developing Countries, New York, NY: UNDP

Ward, Murray (2010), Engaging Private Sector Capital at Scale in Financing Low-Carbon Infrastructure in Developing Countries, Auckland: Global Climate Change Consultancy.

World Bank (2020a), Debt Service Suspension and COVID 19, Washington, DC: World Bank.

World Bank (2020b), COVID 19: Debt Service Suspension Initiative, Washington, DC: World Bank.

World Bank (2020c), Debt Relief, Washington, DC: World Bank.

WTO and UNEP (2009), Trade and Climate Change. A Report by the United Nations Environment Programme and the World Trade Organization. Geneva and Nairobi: World Trade Organization and United Nations Environment Programme.

Annex 1: Survey questionnaire

V20 VULNERABLE TWENTY GROUP

FEEDBACK TO INFORM THE V20-IMF JOINT ACTION AGENDA

Survey Questions

Country _____
Agency (indicate one): *Ministry of Finance / Central Bank*

General questions

1. **Has your organisation taken steps to understand climate impacts and risks over the next 10-20 years?**
   Very little/Some analysis/ Extensive analysis/*Don't know*

2. **Has your organisation been involved in efforts to reduce these impacts, such as through better planning and investing in a more climate-resilient economy, financial sector, and infrastructure?**
   Yes/No/Don't know

3. **Has your organisation taken steps to better manage the residual impacts that can't be reduced, such as through scaled up reserves, contingency finance or financial safety nets?**
   Yes/No/Don't know

4. **Climate impacts and risks have been discussed in previous exchanges with the IMF, whether technical assistance discussions or Article IV consultations**.
   Yes/No/Don't know

5. **Do you have the impression that IMF staff are knowledgeable in matters relating to macrofinancial risks of climate change?**
   Yes/No/Don't know

Surveillance

6. **Should the IMF include a mandatory section on climate risks in its Article IV consultations with all member countries?**
   Yes/No/Don't know

7. **Should the IMF include a mandatory section on climate-related financial risks in the Financial Sector Assessment Program assessments it conducts together with the World Bank?**
   Yes/No/Don't know

8. **Should the joint World Bank-IMF Debt Sustainability Framework for Low-Income Countries be enhanced by an analysis of the impact of climate-related financing needs and risks on debt sustainability?**
   Yes/No/Don't know

Technical assistance and training

9. **To date, has the IMF offered any technical advice on mitigating climate risks for public finances and the economy, or on developing disaster risk management?**
   Yes/No/Don't know
   If Yes: Please provide details. _____

10. **Would you like to see support from the IMF in designing carbon taxes for your country?** *Yes/No/Don't know*

11. **Would you like to see support from the IMF in developing a national approach for "greening" the financial sector and help it to better address climate-related financial risks?**
    Yes/No/Don't know

12. **Is there interest to have support from the IMF in developing an energy transition scenario analysis?**
    Yes/No/Don't kno

13. **Should the IMF support its member countries' financial and monetary authorities in developing capacities to better assess climate risks, e.g. via climate stress-testing, to inform the design of fiscal, monetary or prudential policies?**
    Yes/No/Don't know

14. **Should the IMF support member countries in strengthening public debt management to enable them to better account for climate risks in public budgets?**
    Yes/No/Don't know

15. **Should the IMF support governments in developing contingency plans and securing pre-arranged contingent financing facilities from different sources, as well as insurance-based solutions?**
    Yes/No/Don't know

Emergency lending and crisis support

16. **What are the biggest financing constraints you face in terms of investing in pre-disaster resilience, disaster preparedness, and ex-post disaster response?**
Please provide details. _____

17. **Has your country so far received financial support from the IMF in the context of a climate-related disaster?**
Yes/No/Don't know
If Yes: Please provide details, including the facility/instrument. _____

18. **Do you think the IMF should adjust its lending facilities or develop new instruments to support climate vulnerable countries?**
Yes/No/Don't know
If Yes: Please provide details on what you may have in mind. _____

19. **Should the IMF raise access under the Rapid Credit Facility and the Rapid Financing Instrument?**
Yes/No/Don't know

20. **Should the IMF explore linking a new climate disaster facility to an issuance of SDRs, which would benefit only countries hit by climate disasters?**
Yes/No/Don't know

Debt sustainability

21. **Should the IMF explore options for a special treatment of climate debt, i.e. public debt that has been incurred as a direct result of climate disasters or necessary adaptation measures?**
Yes/No/Don't know

22. **Should the IMF promote the addition of natural disaster clauses to sovereign debt contracts?**
Yes/No/Don't know

23. **Should the IMF promote the use of instruments such as GDP-linked bonds or catastrophe bonds that reduce debt burdens in case of a (climate) disaster?**
Yes/No/Don't know

24. **Should the IMF work on a sovereign debt restructuring mechanism?**
Yes/No/Don't know

25. **Should the IMF work on debt-for-climate swaps?**
Yes/No/Don't know

26. **Would it be helpful to have an overview of critical metrics on what can be considered "unsustainable debt" vs. "sustainable debt"?**
Yes/No/Don't know

Final questions

27. **Besides the issues already discussed, what kind of support from the IMF would be helpful for your country for addressing climate risks?**
Please provide details. _____

28. **Are there any other issues you would like to highlight?**
Yes/No
If Yes: _____

Additional question (in relation to the World Bank) for IDA-eligible countries

29. **For IDA-eligible countries: What aspects of IDA's crisis finance toolkit (including core IDA, IDA Regional Window, Crisis Response Window, etc.) are working best? What aspects are not working? How could they improve?**
Please provide details. _____

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Annex 502

"V20 Statement on Debt Restructuring Option for Climate-Vulnerable Nations", Statement by the V20 Presidency, *The Vulnerable Twenty*, 27 October 2021

V20 STATEMENT ON DEBT RESTRUCTURING OPTION FOR CLIMATE-VULNERABLE NATIONS

STATEMENT BY THE V20 PRESIDENCY

27 October 2021

Climate vulnerability is driving up the cost of capital and undermining debt sustainability

Climate vulnerable countries face considerable macro-financial risks stemming from climate change that threaten debt sustainability and harm investment and development prospects[1]. A 2018 report on the relationship between climate vulnerability, sovereign credit profiles and the cost of debt commissioned by the UN in partnership with the V20 has shown that interest rates on debt of V20 countries are already higher than they would otherwise be, due to climate vulnerability[2]. It estimates that exposure to climate risks has increased the cost of debt for V20 countries by 117 basis points, on average. This means that for every ten dollars climate vulnerable developing countries spend on interest payments, they have to pay another dollar because they are climate vulnerable. In absolute terms, this translated into more than USD 40 billion in additional interest payments for 40 climate vulnerable countries over the the period 2007–2016 on government debt alone. Incorporating higher sovereign borrowing rates into the cost of private external debt, the cost of higher interest payments due to climate risks are estimated at over USD 62 billion. The report estimated these additional costs to expand to between USD 146 – 168 billion over the next decade. Subsequent research, including by the IMF, has corroborated the positive effect of physical climate vulnerability on the cost of government debt[3]. Equally important is to ensure that financing options have long tenors to match the investment profile of low-carbon and adaptation projects.

A higher cost of capital impeded investment in development and resilience

A higher cost of sovereign debt has a broad impact on an economy as it also raises the cost of capital that the private sector has to pay[4]. The worsening of both public and private financing costs will hold back crucial investments and the development prospects of societies that are already punished by climate change. Perversely, countries that have not contributed to climate change effectively end up paying twice, as a floor: for the physical damage their economies face and through higher costs of capital, which spreads even more thinly the already resource-challenged coffers of vulnerable countries.

As financial markets increasingly price climate risks, and global warming accelerates, the risk premia of climate-vulnerable countries, which are already high, are likely to increase further. The impact of Covid-19 on significantly increased debt and on public finances risks reinforcing this vicious circle. In many developing countries, increased debt service is obstructing decisive crisis and recovery responses to COVID, and worsening development prospects. Thus, a report in 2020[5] found that, external public debt service was greater than health care expenditure in at least 62 developing countries. It is a dire situation:

instead of being able to support their people to weather the COVID crisis and invest in sustainable recovery, governments are required to repay their creditors. Furthermore, climate-vulnerable countries face the unenviable task of managing the increased financial costs of climate change as the physical impacts of climate risks themselves accelerate. Furthermore, with the 2021 IPCC 6th Assessment Report, climate change is happening faster and with greater impact than was understood when financing contracts between debtors and creditors were established. Vulnerable countries are therefore faced with a "force majeure" situation, whereby climate damages now happening or expected have evolved in such a way as to threaten debt sustainability. Unaddressed, a major global default event could occur within the coming decade.

To prevent a spiral of worsening climate vulnerability and rising debt, V20 must invest heavily in climate resilience. However, as rich nations fail to keep their pledges on climate finance, and as the impacts of climate change escalate, many of the most vulnerable developing countries continue to fall deeper into a debt crisis, which has been aggravated by Covid-19. Many V20 countries have insufficient fiscal resources to finance much-needed responses to the health and social crises caused by the pandemic, as well as crucial investments in climate adaptation. The service of public debt crowds out room for crucial investments that countries require in order to climate-proof their economies and establish a resilient, sustainable, and equitable recovery.

Recalling debt support and flexibility from the 1st V20 Climate Vulnerables' Finance Summit

No single country or economy can unilaterally prevail in the climate crisis or COVID-19 pandemic. The expectations set out by the V20 on **debt support and flexibility** include debt forgiveness and suppression for highly- indebted climate vulnerable economies facing imminent liquidity crises, as well as Debt for Climate (DFC) swaps for interested middle-and-low-income vulnerable economies where new climate ambition and investments are restricted because of limited fiscal space. More flexibility on debt is required to enable V20 countries to finance climate action.

A major debt restructuring initiative for countries overburdened by debt is needed

Considering the pledge for an official mechanism to support debt sustainability issues, we propose a major debt restructuring initiative for countries overburdened by debt – a sort of grand-scale climate-debt swap where the debts and debt servicing of developing countries are reduced on the basis of their own plans to achieve climate resilience and prosperity. This could be achieved by agreement between debtors and creditors to redirect debt servicing payments towards new investments in rendering the underlying projects more resilient to climate change and compatible with the green transition. The freed-up resources from debt servicing could, for example, be invested in adaptation and nature-based solutions to render infrastructure projects more resilient to climate harm, while outdated thermal coal, diesel or other fossil power plants could, for instance, be recapitalized and transformed into hubs for green hydrogen production, waste to energy or biomass power generation facilities. Such a debt restructuring initiative should not only address short-term needs but also lay the foundation for inclusive, sustainable growth and development.

We suggest a concerted effort by multilateral agencies such as the World Bank Group and regional multilateral development banks to act as guarantors of restructured debt through guarantee facilities for inclusive, sustainable, and resilient recovery efforts. An example of such a proposal includes the Guarantee Facility for Green and Inclusive Recovery managed by the World Bank[6]. As proposed by the Task Force on Climate, Development and the International Monetary Fund[7], the IMF is encouraged to play a strategic role through the new Resilience and Sustainability Trust in debt restructuring by providing collateral to guarantee restructured debt. This may be helpful to countries that are not 'low-income' in terms of GDP but which may be interested to consider or expand debt restructuring options[8].

There is mutual interest for both creditors and debtors to enter into restructuring which would free up large-scale resources quickly for climate action and could help demonstrate that credible financial mobilization which goes beyond the $100 billion commitment is entirely possible, something vital to increasing confidence among developing countries for coming forward with new climate ambition.

Debt Sustainability Analyses need to account for climate and other sustainability risks and spending needs for climate action and achieving SDGs

Climate vulnerable countries need comprehensive, enhanced Debt Sustainability Analyses for low-income and middle-income economies conducted by the IMF and the World Bank that integrate climate and other sustainability risks, climate resilience benefits, as well as estimates of a country's financing needs for climate-change adaptation, mitigation, and achieving the broader goals set out in the 2030 Agenda for Sustainable Development Goals. These risks and spending needs must be included to properly assess a country's debt sustainability capacity in the face of the climate crisis and to drive investments toward climate resilience.

The debt restructuring framework needs to incorporate adequate incentives to ensure private creditors participate and bear a fair share of the burden

If a country is found to have unsustainable public debt, it should be eligible for debt relief involving both public and private creditors, with equal treatment of public and private creditors. The debt restructuring framework needs to incorporate adequate incentives to ensure that private creditors participate and bear a fair share of the burden. Those countries needing relief would be supported by multilateral agencies through guarantee facilities that would facilitate debt relief negotiations with private creditors. Guarantees on new debt issuance swapped for old and unsustainable debt proved very valuable to bring commercial creditors to come to the table and accept significant debt relief, as was the case with "Brady-bond" restructurings in the late 1980s.

For example, a guarantee facility could provide credit enhancements for new bonds that would be swapped for old debt with a significant haircut. A guarantee facility could ensure that commercial actors (whether bondholders or commercial banks) will receive up to 18 months' worth of interest payments in the case that the sovereign misses a payment, and provide a guarantee of the value of the new bonds. This can be attractive to the holders of those new bonds, as well as to those that may want to purchase those bonds on secondary markets. Moreover, bondholders and commercial banks can reduce their concentration risk by selling the bonds on secondary markets if they wish. This may not only be attractive to bondholders, but also to commercial banks that have longer term bank loans to distressed countries on their balance sheets. Those loans could be converted with a discount to bonds and then sold in order to reduce concentration risks and help the balance sheets of commercial banks.

Positive incentives for private creditor participation in debt restructuring need to be combined with other measures to ensure that private creditors grant debt relief. If the enhanced Debt Sustainability Analysis asserts that a country's sovereign debt is of significant concern, the IMF could make its programmes conditional on a restructuring process that includes private creditors. Moreover, the financial authorities of the jurisdictions in which the major private creditors reside should use strong moral suasion and regulations on accounting, banking supervision, and taxation to improve creditors' willingness to participate in debt restructuring.

Countries develop their own Climate Prosperity Plans to advance development and climate resilient outcomes

Debt relief is more than just a quick fix, it aims to empower governments to invest in strategic areas of development, including health, education, digitisation, cheap and sustainable energy, and climate-resilient infrastructure.

Governments receiving debt relief would develop their own Climate Prosperity Plans to map out the actions they will take to advance their development and climate goals. Natural climate solutions – the protection and enhancement of forests, mangroves and coral reefs – should be a central aspect of adaptation and resilience planning.

Some portion of the restructured repayments would be channelled into a Fund for Green and Inclusive Recovery or an already existing national fund that could be used for this purpose. The government would be free to decide how to spend the money from this Fund, as long as it is demonstrably helping achieve the goals set out in their Climate Prosperity Plan.

Ensuring a fair process through an independent and impartial mediator

In the complex and often conflictive process of debt restructuring, an independent and impartial mediator could help broker good and balanced outcomes. The mediator could be proposed by the UN Secretary-General and agreed upon by the debtor country and a majority of creditors. The mediator would chair the stakeholder hearings regarding the first draft of the Climate Prosperity Plan, broker the conversations on the Climate Prosperity Plan between debtor countries and creditors (including the IMF and the World Bank), and chair the steering committee to supervise the implementation of the Climate Prosperity Plans. On the steering committee, the independent mediator could have a tie-breaking vote.

A credit enhancement for new sustainability-linked debt would smooth re-access to capital markets after restructuring

Countries that have undergone a successful debt restructuring could be eligible to issue new sustainability-linked debt that would be partially guaranteed by the World Bank Guarantee Facility. This would support governments in regaining access to international capital markets and help address their deep-rooted reluctance to restructure unsustainable debt out of fear that a debt restructuring – and the concomitant declaration of a technical default by the rating agencies – would reduce their access to capital markets for extended periods of time. Evidence and ample precedent suggest that a restructuring would improve sovereigns' balance sheets and medium-term creditworthiness, and therefore allow them to access capital markets in better conditions. In any case, a credit enhancement would facilitate the issuance of new debt.

Debt restructuring should form a core component of the V20 Climate Prosperity Recovery Agenda

With a large-scale debt-for-climate swap and guarantees, as we propose here, the whole world benefits. Debtor nations are assisted in both adapting to climate damage and enhancing their own climate resilient and low carbon development, while creditor nations would reduce the level of down-line stranded assets on their books, given debt swaps would render existing investments resilient to climate shocks and the green transition. These creditors would also help raise the global level of mitigation ambition. We believe that debt restructuring should form a core component of a Climate Prosperity Recovery Agenda. We all know that nothing can happen unless it is paid for, which is why climate finance has become the key challenge now facing the world.

The technologies – renewables, storage, clean hydrogen and advanced fission – all now exist which will allow the world to rapidly escape from the age of fossil fuels. Whether this can be achieved in time to safeguard the 1.5-degree limit of the Paris Agreement, more than anything else, a question of finance and technology transfer. Can we afford to save our economies? Can we afford not to?

FOOTNOTES

[1] See Volz and Ahmed (2020), *Macrofinancial Risks in Climate Vulnerable Developing Countries and the Role of the IMF – Towards a Joint V20-IMF Action Agenda*. London, Rotterdam, and Bonn: SOAS Centre for Sustainable Finance, Global Center on Adaptation, and Munich Climate Insurance Initiative.

[2] See Buhr et al. (2018), *Climate Change and the Cost of Capital in Developing Countries*. London and Geneva: Imperial College London; SOAS University of London; UN Environment.

[3] Volz et al. (2020), *Climate Change and Sovereign Risk*. London, Tokyo, Singapore, Berkeley: SOAS University of London, Asian Development Bank Institute, World Wide Fund for Nature Singapore, Four Twenty Seven; Cevik and Tovar Jalles (2020), "This Changes Everything: Climate Shocks and Sovereign Bonds", IMF Working Paper No. 20/79, Washington DC: International Monetary Fund; Beirne et al. (2021), "Feeling the Heat: Climate Risks and the Cost of Sovereign Borrowing", *International Review of Economics and Finance*, forthcoming.

[4] See Kling et al. (2021), "The Impact of Climate Vulnerability on Firms' Cost of Capital and Access to Finance", *World Development*, 137, 105131.

[5] See Munevar, Daniel (2020), "A debt pandemic: Dynamics and implications of the debt crisis of 2020", *European Network on Debt and Development Asbl.*

[6] An example of such a proposal can be found here. See https://drgr.org. Details of the proposal can be found in Volz,U, Akhtar,S, Gallagher,K, Griffith-Jones,S, Haas, J, and Kraemer,M. (2021), *Debt Relief for a Green and Inclusive Recovery: Securing Private-sector Participation and Creating Policy Space for Sustainable Development*. Berlin, London, and Boston, MA: Heinrich-Böll-Stiftung; SOAS, University of London; and Boston University; and Volz et al. (2020), *Debt Relief for a Green and Inclusive Recovery*. Berlin, London, and Boston, MA: Heinrich-Böll-Stiftung; SOAS, University of London; and Boston University.

[7] The Task Force on Climate, Development and the International Monetary Fund is a consortium of experts from around the world convened to support the Intergovernmental Group of Twenty-Four and the Vulnerable Group of Twenty Ministers of Finance. The Task Force engages in and utilizes rigorous, empirical research to advance IMF policies that align international financial stability and growth with global climate goals. Core to the Task Force's mission is advancing a development-centered approach to climate change at the IMF.

[8] Task Force on Climate, Development and the International Monetary Fund (2021), *Re-channeling Special Drawing Rights for a Climate Resilient and Just Transition: Prospects for the Resilience and Sustainability Trust*.

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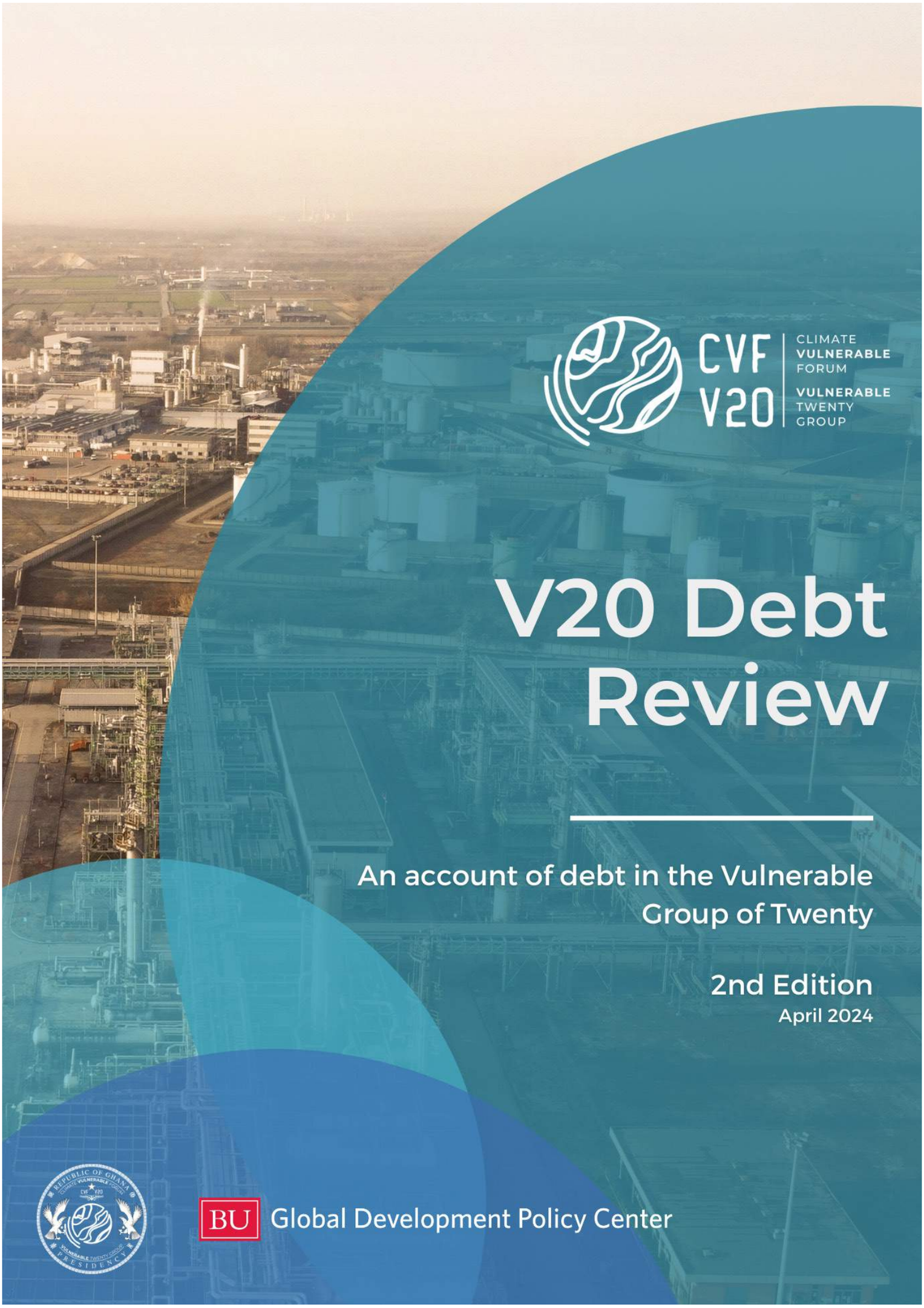
V20 Statement on Debt Restructuring

Annex 503

"V20 Debt Review: An account of debt in the Vulnerable Group of Twenty",
The Vulnerable Twenty, April 2024



CVF V20

CLIMATE VULNERABLE FORUM

VULNERABLE TWENTY GROUP

V20 Debt Review

An account of debt in the Vulnerable Group of Twenty

2nd Edition

April 2024

REPUBLIC OF GHANA CLIMATE VULNERABLE FORUM CVF V20 VULNERABLE TWENTY GROUP PRESIDENCY

BU Global Development Policy Center

V20 Debt Review

An account of debt in the Vulnerable Group of Twenty

2024

By Rishikesh Ram Bhandary and Nathalie Marins

Global Development Policy Center

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FOREWORDS

H.E. Mohammed Amin Adam, V20 Chair and Minister for Finance, Republic of Ghana

This report shows the critical situation on debt in some of the world's most climate-vulnerable countries. It is holding back the development prospects and worsening the exposure to extreme climate impacts for 3.3 billion people who live in countries which are paying more in debt service than they are in education, health and investment - at exactly the time we need to mobilise finances for a green transition to survive and thrive on the frontline of the climate crisis.

The main drivers of rising debt vulnerability have been recurring external shocks over the past three years—COVID-19, climate shocks, war and conflict—all severely accentuated by interest rate hikes in the advanced economies to stem inflation. This has caused capital flight, exchange rate depreciation, higher costs of capital and unsustainable levels of external debt relative to revenues. Not only is tighter fiscal space associated with climate vulnerability but climate vulnerable economies also face higher costs of borrowing, which unfortunately fuels a vicious debt cycle.

2024 is a critical period for debt solutions. We must respond adequately to the ongoing and imminent climate shocks inorder to safeguard our development gains and propel our prosperity ambitions as outlined in our Climate Prosperity Plans. To echo the Accra- to-Marrakech Agenda: It's time "to make debt work for climate" and it's time we make Debt Sustainability Analyses (DSAs) incorporate real investment and the spending needs of countries, whilst determining what it takes for each country to achieve them. Key to be introduced into the DSAs is the financing needed to respond to external shocks, as well as the investment needs for resilient, climate-positive development.

As we look to cooperation on debt solutions, I take this opportunity to highlight four key areas:

(1) Participation must be inclusive – in other words it has to involve all creditors for two reasons: no way forward can be sustainable if private sector is not included, and other creditor classes (e.g., other bilateral creditors) and multilateral development banks (MDBs) will find it challenging to participate because there is a possibility of subsidizing the private sector;

(2) We need quick financing and we cannot afford to wait the usual 18-36 months for MDB financing;

(3) Financing needs to be affordable - if we're adopting a case-by-case approach, the program for each country must be customized so that the interest rates are kept below the growth rates.

(4) New financing must be growth enhancing– it needs to be big and trigger growth so there is more revenue for investment and payback at the end of the program.

As we embark on the international financial reform journey, which includes debt reform, improvements in the voice and participation of countries of the Global South will be central to comprehensive systemic reform.

CVF Secretary-General, H.E. Mohamed Nasheed

The perspectives in this report represent the combined interests of a group of now 68 countries representing 1.74 billion people - so it is truly the 'voice of the climate vulnerable', and must surely be listened to by the international community.

We used to talk about "trade-offs" in development and climate, as if the two were necessarily opposed. This was a problem because no developing country should be expected to trade their development aspirations in the name of climate stability when the Global North has so clearly failed to do its fair share in mitigation ambition.

However, we now reject the trade-offs discourse. The 68 CVF members do not want high-carbon development: we now have Climate Prosperity Plans (CPPs), which show that with the right projects, programs and financing, climate action and development are no longer trade-offs.

Accordingly, we ask the financial community to invest in and support our CPPs. Clean development will need the world to pay serious attention to the investment needs of the climate vulnerables countries, starting with an urgent focus on reducing their debt burdens.

The CVF countries are not just victims in the climate picture. Our CPPs outline at the project level the investment opportunities that are needed in different sectors, from energy to transport to agriculture. We estimate that there are $2 trillion in investment opportunities for CVF countries for the remainder of this decade to achieve and deliver this climate prosperity agenda. We need to move from billions to trillions in this conversation, and we need to ensure that CVF countries are not locked out of investment flows because of debt and the high cost of capital.

I hope this report, which details the immediate debt crisis and the steps that are needed to avert it, can begin to move us in this positive direction. The G7 and G20 today have the opportunity to deliver the four pillars of the Accra-to-Marrakech Agenda and Bridgetown Initiative with timelines to restore trust, knowing far tougher decisions need to be made everywhere over this decade. As the Paris target of 1.5 degrees becomes ever harder to achieve, and global heating accelerates beyond control, there is no time to lose.

EXECUTIVE SUMMARY

Climate vulnerable economies are confronting multiple, intersecting crises. Economic growth has been slow to bounce back after the COVID-19 pandemic. The macroeconomic environment has become more challenging with high inflation, high costs of borrowing, and ongoing conflicts and geopolitical uncertainties. What is more, with climate impacts intensifying, the economic consequences of runaway climate change have never been clearer. However, the global community's efforts on climate change continue to fall short and are yet to demonstrate the urgent need for immediate action. There is now a growing convergence that a limiting factor of climate ambition is the sustainability of sovereign debt.

The Vulnerable 20 (V20) Group of Ministers of Finance includes 68 climate vulnerable economies. This debt review captures the external sovereign debt profile of V20 members. It explores the composition and distribution of the V20's external debt to identify where the international financial architecture needs to be improved.

KEY FINDINGS:

- The V20's total external public and publicly guaranteed debt stock amounts to $946.7 billion.
- External debt servicing is expected to escalate to $122.1 billion in 2024. V20 members are expected to pay $904.7 billion in debt service over 2022-2030.
- Eight countries spend more than 20 percent of their tax revenue servicing external debt.
- Based on the data available, only Costa Rica, Côte d'Ivoire, the Philippines and Viet Nam are estimated to be able to borrow from international capital markets on a sustainable basis, defined as economic growth rates exceeding borrowing costs. Another 18 countries have unsustainable borrowing costs in international capital markets and would face unsustainable debt levels if they borrowed on those terms.
- High levels of external sovereign debt across the V20 group are constraining the ability of these governments to make the investments that are required to achieve climate and development goals.

KEY POLICY RECOMMENDATION:

The V20's debt profile illustrates the need for a multi-pronged approach to tackling sovereign debt distress.

- First, debt solutions need comprehensive participation. The prominence of private bondholders and multilateral development banks as creditors indicates the importance of ensuring that debt restructuring efforts obtain their participation through appropriate incentives. Without the full engagement of all creditors, debt solutions will neither be effective nor lasting.
- Second, debt solutions must be ambitious. Debt relief should free up fiscal space so that countries can make the investments that they need to achieve their development and climate change goals. This will enable countries to focus on growth-enhancing investments. Relatedly, given the market access constraints and high cost of borrowing, finance must be affordable. Low-cost, long-term finance will be key.
- Finally, speed is of the essence. Debt solutions need to be rapidly deployed. The debt crisis is a development and climate crisis. Ambitious action is needed immediately so that countries can be on the path to climate prosperity.

Climate vulnerable economies have put forward ambitious Climate Prosperity Plans, nationally determined contributions, and national plans and policies. Without a supportive macroeconomic environment, undergirded by an effective sovereign debt architecture, not only will the goals articulated in national plans remain a distant reality, but the intensifying nature of climate change will roll back decades of progress made in development. Urgent action to alleviate debt distress will help secure benefits now and lay the foundation for shared prosperity - one that brings development-positive climate action.

INTRODUCTION

The urgency of addressing the climate crisis requires a rapid mobilization of resources towards climate-positive development. The Songwe report estimates that $2.4 trillion annually will be required by 2030 to meet climate change goals (Songwe, Stern and Bhattacharya 2022). The report of an Independent Expert Group (IEG) that was commissioned by the Indian Group of 20 (G20) Presidency estimates that $1.4 trillion will need to be mobilized domestically with $1 trillion from foreign sources. However, emerging market and developing economies are facing a challenging macroeconomic environment precisely when they need to be scaling up investments. Global economic growth is expected to remain weak, at 2.4 percent (World Bank 2024). What is more, 80 percent of the United Nations 2030 Sustainable Development Goals (SDGs) are off track. Long periods of under-investment will lead to a 'development crisis,' and development goals will continue to remain out of reach (United Nations 2023).

There is growing convergence on the need to reform the international financial architecture to achieve development and climate change goals. This policy message shone through major international summits that took place throughout 2023, including the UN SDGs Summit, the Africa Climate Summit, the Summit for a New Financing Pact and more. The Paris Agreement recently took stock of climate action through its Global Stocktake and recognized the close association between fiscal space and climate change investments (UNFCCC 2023).

The Vulnerable 20 (V20) Group is a bloc of 68 climate vulnerable economies. Climate vulnerable countries are already perceived to be risky compared to countries with similar macroeconomic fundamentals. This creates the condition for a vicious cycle between debt distress and climate vulnerability whereby underinvestment accentuates climate vulnerability and results in higher debt loads as countries recover and rebuild from climate impacts which in turn crowds out space for new investments. This vicious cycle dynamic is illustrated in Figure 1.

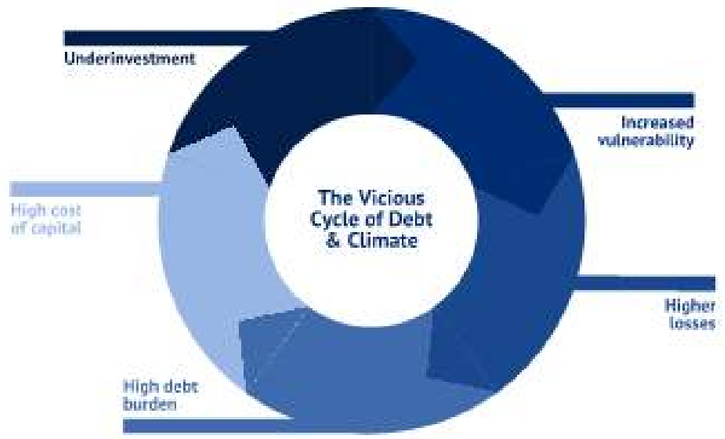

Figure 1: The Vicious Cycle of Debt Distress
Source: Gallagher et al. (2023).

By contrast, climate investments also reduce sovereign risk and help generate a virtuous, rather than a vicious, cycle (Chamon et al. 2022). Available evidence also suggests that investment in green spending has a multiplier effect of 1.1-1.7 compared to the multipliers for fossil-based energy that are significantly weaker at 0.4-0.7 (Batini et al. 2022). The Global Commission on Adaptation estimated that investing $1.8 trillion in adaptation over 2020-2030 would generate $8 trillion in net benefits (GCA 2019). Yet, the most recent estimate from the UN Environment Programme shows that the adaptation finance gap has widened (United Nations Environment Programme 2023). This gap underscores the urgency of immediate action in light of the climate-related losses that V20 members have already suffered over the last 20 years. According to the V20 Climate Losses Report V20 economies have already faced climate-induced losses amounting to $525 billion over the last two decades (Baarsch et al. 2022). Therefore, it is not a surprise that climate vulnerable economies are more likely to have a program with the International Monetary Fund (IMF) than less vulnerable economies (Task Force 2023).

The V20 has articulated a comprehensive agenda on international financial architecture reform in the Accra-to-Marrakesh Agenda (V20 2023b). 'Making debt work for the climate' is one of the four pillars of the framework. Recognizing the shortcomings of the existing sovereign debt architecture, the V20 launched the Emergency Coalition for Debt Sustainability and Climate Prosperity. The next section of this report reviews the external debt profile of the V20 membership with the goal of illustrating how the macroeconomic environment is shaping the space for climate action in climate vulnerable economies.

V20 EXTERNAL DEBT PROFILE

This section highlights major trends in external public and publicly guaranteed debt. In the World Bank International Debt Statistics (IDS) database, data are available for 59 of 68 V20 members. In 2022, the total external debt stock of V20 members was $946.7 billion. The largest creditor class is multilateral development banks (MDBs) at 39 percent, with the World Bank forming 19 percent of the total V20 debt stock. Paris Club creditors and China follow at 11 percent and 9 percent, respectively. Figure 2 depicts the composition of V20 external debt stock by creditor class.

Figure 3 shows how the V20's external debt stock has changed over time, from 2008 to 2018 and 2022. The evolving composition of the V20's debt stock is congruent with the changing creditor landscape more generally (Ramos et al. 2023). Private bondholders have risen in prominence. MDBs continue to be highly salient for the V20 membership. Furthermore, there is a noticeable shift in the importance of new creditors, such as China, whose share rose to 9 percent in 2022 compared to just 2 percent in 2008. The share of the Paris Club creditors has declined from 23 percent in 2008 to 11 percent in 2022.

Figure 2: V20 Debt Stock by Creditor

Source: Compiled by authors using World Bank IDS.

Note that data on external debt from IDS is not available for the following countries: Barbados, Kiribati, Marshall Islands, Namibia, Palau, Palestine, South Sudan, Trinidad and Tobago, and Tuvalu.

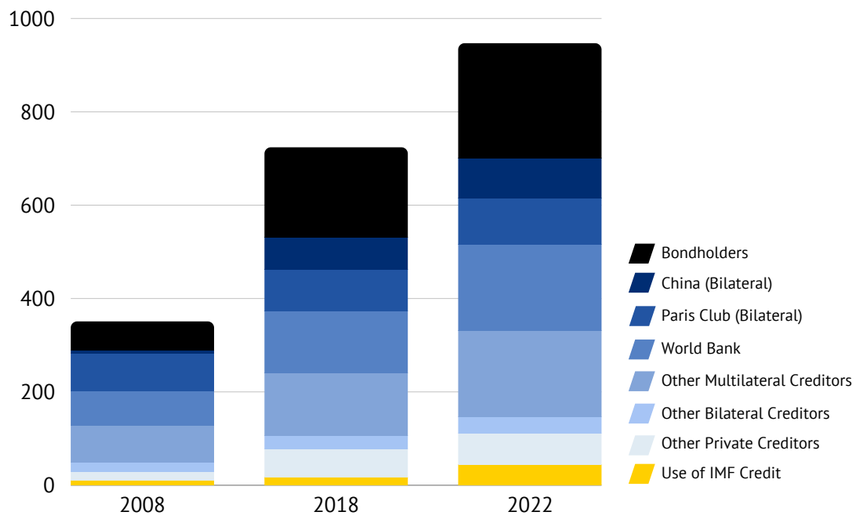

Figure 3: V20 Debt Stock Over Time

Source: Compiled by authors using World Bank IDS.

Over the period of 2022-2030, V20 members will be responsible for debt service payments totaling $904.7 billion. Figure 4 provides the breakdown in debt service payments by creditor class for the period of 2022-2030. Like debt stock, MDBs are the most significant credit class with payment obligations totaling 33 percent of the total. Bondholders come second with 25 percent, followed by Paris Club and China at 15 percent and 13 percent, respectively. In this period, private bondholders are owed debt service payments totaling $224 billion dollars (2022-2030). Multilateral creditors (World Bank and other MDBs) are owed $302 billion.

Figure 5 illustrates debt service payments by creditors over the 2022-2030 period. While the diagram depicts debt service payments peaking in 2024 at $122.1 billion, it is important to remember that the figure captures debt that has already been contracted. Countries are continuing to issue debt and a real time figure would capture recently issued debt as well.

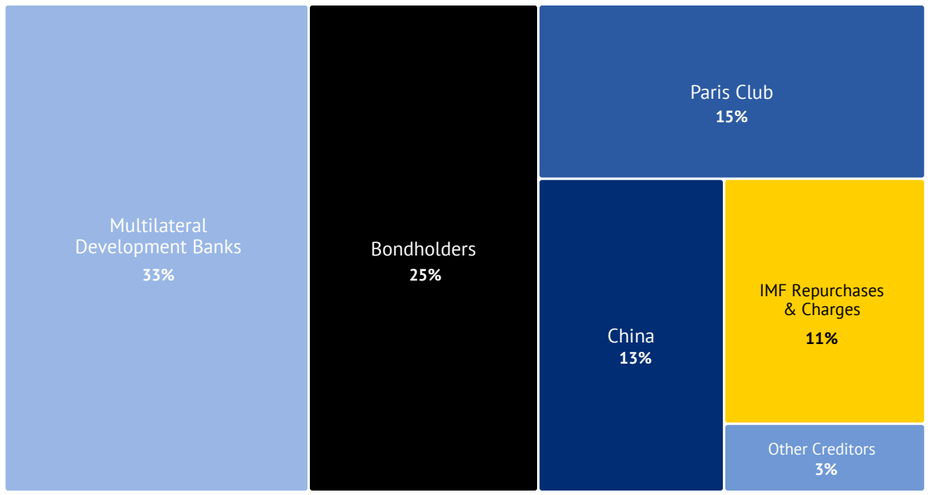

Figure 4: Debt Service by Creditors (2022-2030)

Source: Compiled by authors using World Bank IDS.

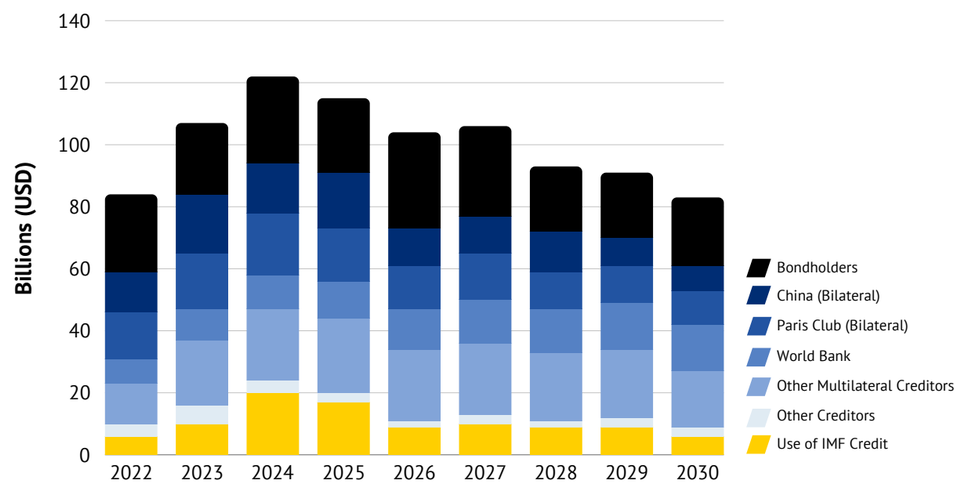

Figure 5: V20 Service Payments by Creditors (2022-2020), in billions USD

Source: Compiled by authors using World Bank IDS.

DEBT STRESS, CAPITAL MARKET CONSTRAINTS AND CAPITAL MARKET ACCESS

Based on the IMF's classification system, 18 of 68 V20 members are in debt distress or at a high risk of debt distress. We define market access countries as those that have sovereign risk spreads plus a risk-free rate higher than 1,000 basis points. We also identify countries that are facing unsustainable borrowing costs in international capital markets, defined as the cost of capital exceeding the economic growth rate.

Following Domar (1944), debt is considered sustainable when the ratio between liabilities and the repayment capacity does not grow indefinitely. In other words, if the growth rate of debt exceeds the growth rate of the country's ability to generate income to repay the debt, the debt burden becomes heavier. To estimate this cost of capital, we use data from the JP Morgan Emerging Market Bond Index (EMBI) and the Secured Overnight Financing Rate (SOFR) as the risk-free rate. For external debt, mostly denominated in foreign currency, a more appropriate indicator of repayment capacity would be exports (Medeiros and Serrano 2006; Bhering et al. 2019). However, since our projections are based on IMF World Economic Outlook data, which does not provide an estimate of nominal growth rate of exports, we use the domestic growth rate as a broadly informative indicator. Therefore, in this analysis, we offer a preliminary estimate of potentially unsustainable borrowing costs for external

debt. For a more comprehensive and precise evaluation of external debtsustainability, a deeper analysis is required. While the cost of borrowing in international markets can serve as a proxy for the highest cost of debt (which tends to increase its share in the weighted average sum over time), the absence of a reliable indicator of repayment capacity in foreign currency means that this analysis should be considered tentative (taken with a grain of salt) and supplemented with other measures of foreign currency access and with the inclusion of external liabilities more broadly.

Figure 6 captures the creditor breakdown of V20 members that are not eligible for the IMF Poverty Reduction and Growth Trust (PRGT). It captures the diversity of creditors which illustrates the complex credit landscape. These countries do not have access to concessional finance in the same manner that PRGT/International Development Association (IDA) eligible countries do.

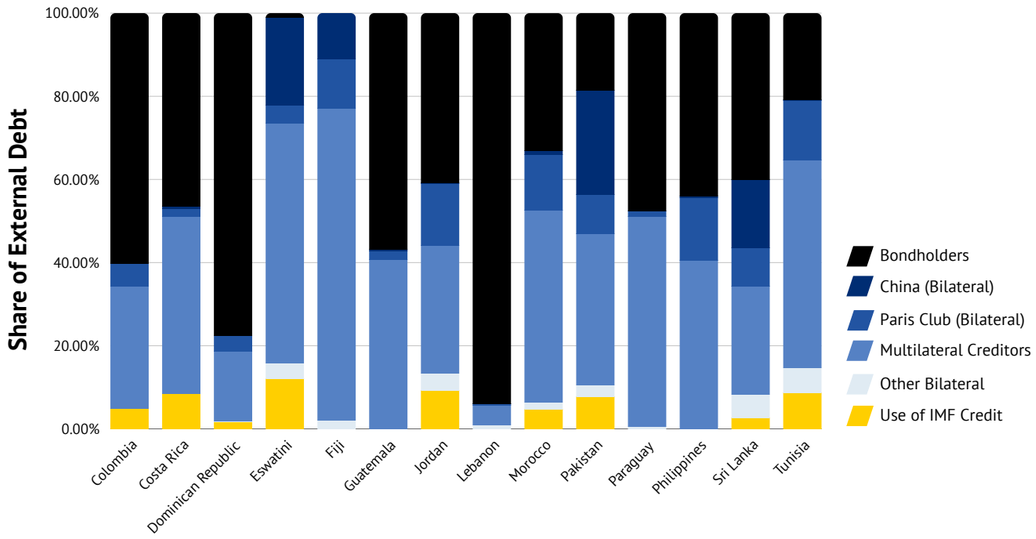

Figure 6: Main Creditors of PRGT Non-eligible Countries

Source: Compiled by authors using World Bank IDS.

The relationship between climate vulnerability and debt distress is also illustrated by Figure 7. In Figure 7, climate vulnerability as measured by the Notre Dame Global Adaptation Initiative (ND-GAIN) index score is plotted against debt service payments as a fraction of exports (over 2022-2028). The upward sloping trendline indicates a positive association between higher levels of climate vulnerability and higher levels of debt service payments as a fraction of exports, meaning that climate vulnerable countries are more likely to face higher debt service burden relative to their export earning.

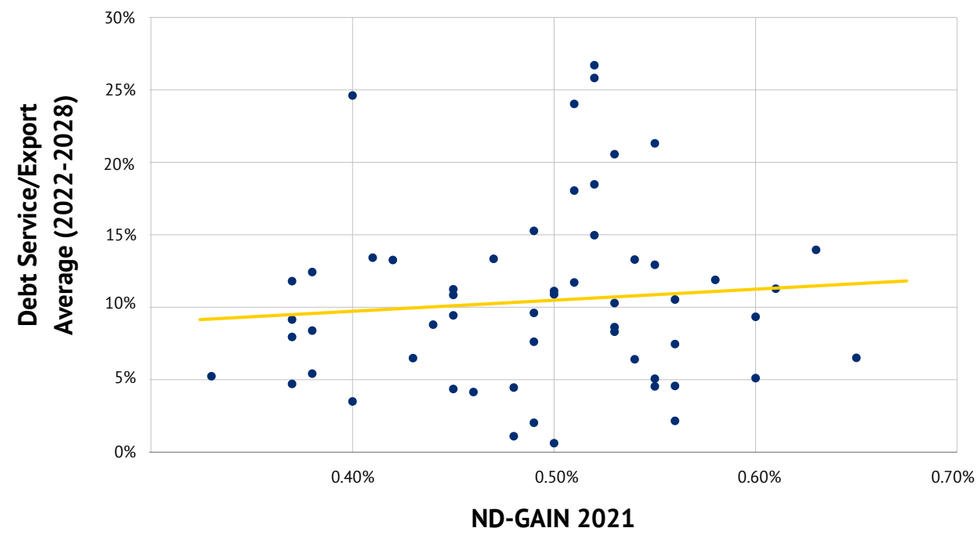

Figure 7: Climate Vulnerability and Debt Service

Source: IMF WEO database, World Bank IDS and ND-Gain (2022).

Figure 8 shows the evolution of the debt service-to-export ratio of the 10 countries with the highest ratio in 2022 (identified in Figure 8), and the navy line represents the average ratio of all 59 countries. For example, the debt service-to-export ratio for Mozambique, Pakistan and Colombia is 63 percent, 42 percent and 34 percent, respectively. The figure shows how there is considerable variation across the V20 members. 2022 marked the highest debt service-to-export ratio for these 10 countries; the average was 15 percent for the 59 countries. While the trend has slightly declined over the last two years, the debt service-to-export ratio remains large for many V20 members.

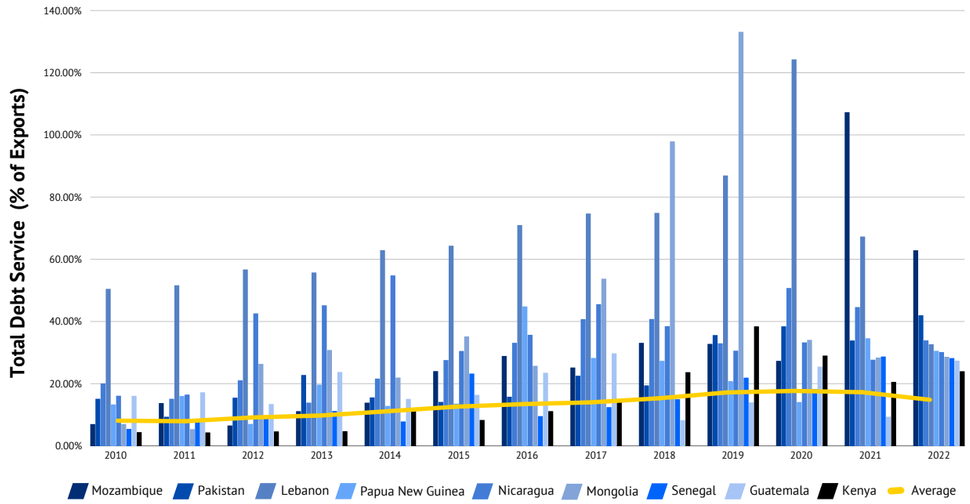

Figure 8: Debt Service/Exports Ratio Over Time

Source: Compiled by authors using World Bank IDS Data.

Note: The blue line is the average for the sample of 59 countries. The diagram depicts 10 countries with the highest ratio of debt service-to-exports.

Debt service payments as a fraction of annual tax revenue provides another lens of the relative size of debt burden. On average, debt service payments represent 13 percent of tax revenues garnered by all V20 members. For eight countries, debt service represents more than 20 percent of their tax revenue.

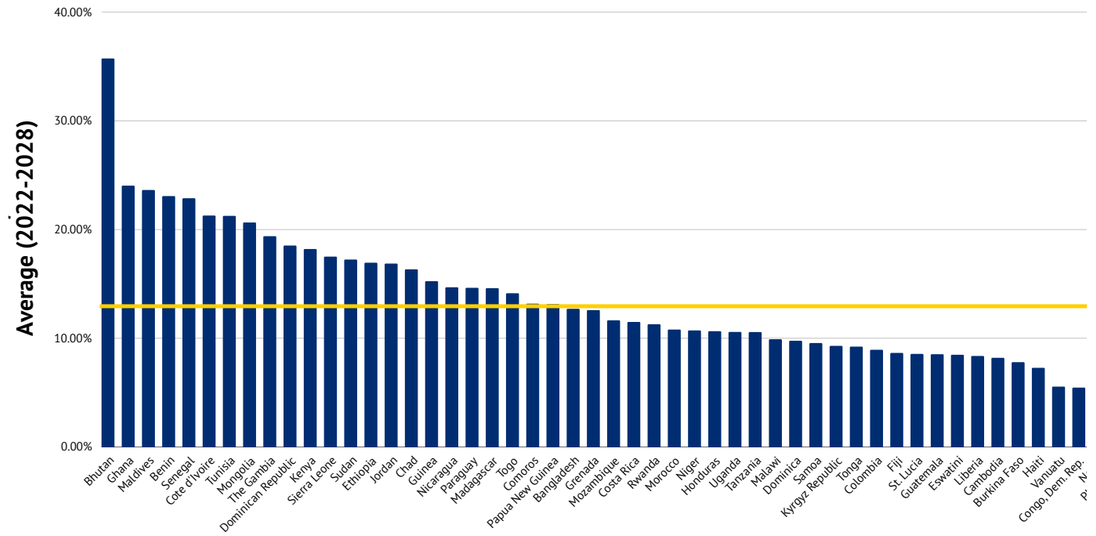

Figure 9: Tax Revenue vs. Debt Service Payments

Source: Compiled by authors using World Bank IDS and IMF Data.

The IMF identifies risk ratings for PRGT-eligible member countries. Eighteen V20 members are in external debt distress or have a high risk of external debt distress. Table 1 shows capital market access and borrowing costs for V20 members. Market access is defined as countries with sovereign spreads plus risk-free rates higher than the threshold of 1,000 basis points. The market access column in Table 1 identifies whether countries have market access or not based on this definition.

Table 1 also provides some insights about the sustainability of borrowing for V20 members. We define borrowing costs to be sustainable if the cost of capital is lower than the economic growth rate.

In other words, We define borrowing costs to be sustainable if the cost of capital is lower than the economic growth rate. In other words, if the cost of borrowing minus the nominal gross domestic product (GDP) growth rate projection is negative, borrowing is unsustainable, and the country is likely to witness an unsustainable debt load.

Further, data shows the capital market constraints faced by members. Apart from the countries facing debt stress, 18 countries as of January 2024 faced borrowing costs higher than their expected economic growth rates. Borrowing under such conditions is expected to lead to unsustainable debt burdens.

Country Name	EMBI Spread	US Rate	US + Spread	Market Access?	Avg. Nominal GDP Growth (Projected 2023-2028)	Growth Rates Less Borrowing Costs
Colombia	3.2%	5.3%	8.6%	Yes	4.8%	-3.5%
Costa Rica	2.4%	5.3%	7.9%	Yes	9.1%	1%
Côte d'Ivoire	3.6%	5.3%	9.0%	Yes	9.1%	0.1%
Dominican Republic	2.7%	5.3%	8.1%	Yes	6.9%	-1.2%
Ethiopia	51.6%	5.3%	59.6%	No	16.5%	-27.0%
Ghana	27.0%	5.3%	33.7%	No	4.4%	-21.9%
Guatemala	2.4%	5.3%	7.8%	Yes	7.7%	-0.1%
Honduras	3.9%	5.3%	9.4%	Yes	6.0%	-3.1%
Jordan	3.8%	5.3%	9.3%	Yes	5.5%	-3.5%
Kenya	5.9%	5.3%	11.5%	No	4.4%	-6.4%
Maldives	14.5%	5.3%	20.5%	No	8.5%	-10.0%
Mongolia	2.9%	5.3%	8.3%	Yes	4.5%	-3.5%
Morocco	1.9%	5.3%	7.3%	Yes	6.9%	-0.4%
Mozambique	8.1%	5.3%	13.8%	No	11.0%	-2.5%
Papua New Guinea	5.8%	5.3%	11.5%	No	2.0%	-8.4%
Paraguay	2.1%	5.3%	7.5%	Yes	5.9%	-1.5%
Philippines	0.9%	5.3%	6.2%	Yes	9.5%	3.1%
Rwanda	4.9%	5.3%	10.5%	No	5.1%	-4.9%
Senegal	4.7%	5.3%	10.2%	No	10.1%	-0.1%
Tanzania	3.7%	5.3%	9.2%	No	8.2%	-0.9%
Tunisia	12.9%	5.3%	18.9%	Yes	4.8%	-11.9%
Vietnam	0.6%	5.3%	5.9%	No	8.3%	2.3%

Table 1: Market Access and the Sustainability of Borrowing

Source: Author calculations based on JPMorgan Emerging Market Bond Index Global Diversified USD and IMF World Economic Outlook database.

Note: Bond spreads are current as of January 24, 2024. Countries with no projections of GDP or data on spread were excluded. A total of 22 countries are in the table. Four countries have g>r and 18 have g<r, where g is growth rate and r is the US interest rate plus the risk spread. Thirteen countries have market access defined as countries with sovereign spreads plus risk free rate higher than the threshold of 1,000 basis points.

DISCUSSION AND POLICY RECOMMENDATIONS

The debt profile of the V20 illuminates the macroeconomic constraints shaping climate action in these countries. As 18 PRGT-eligible countries are at risk of debt distress, there is an urgent need for comprehensive debt relief to ensure that these countries have the fiscal space necessary to pursue their development and climate change goals. Based on the trends identified, mobilizing resources to meet the development and climate change goals requires a multi-pronged approach.

First, effective debt solutions must be deployed urgently. Efforts to tackle sovereign debt distress will need to include the full range of creditors as the creditor landscape has shifted. It is critical, for example, for MDBs to be a part of solution, as they hold 40 percent of the total debt stock for V20 countries. This should include a wider participation of creditors in the G20 Common Framework, as well as broader reforms, such as ensuring middle-income countries have access and aligning the Common Framework with the Paris Agreement and the SDGs. Currently, 46 of 68 V20 countries have access to the G20 Common Framework.

To incentivize private creditor participation, the V20 has called for a guarantee facility to back new bonds (V20 2021). In exchange for taking a haircut comparable to other creditor classes, private creditors would be able to hold bonds that have payment streams guaranteed by the facility. This design encourages private sector participation and enables the debtor government to receive a steeper debt reduction. The freed fiscal space could be used to implement Climate Prosperity Plans and other nationally owned policies designed to achieve climate-positive development.

Debt restructuring discussions should be anchored by Debt Sustainability Analyses (DSAs) that incorporate climate shocks and the full benefits of transforming economies through development-positive climate investments and climate-positive development investments.

Second, V20 members face a high cost of borrowing in capital markets - only four countries have a cost of borrowing that is lower than the expected economic growth rate. Such high costs of borrowing are likely to lead to unsustainable debt paths. This underscores the need for scaled up concessional finance, grants and private sector participation. MDBs as providers of concessional, long-term financing will have an important role, particularly as the creditor landscape has shifted towards bondholders in recent years. Bondholders often require higher rates and offer shorter maturities. Development-positive climate investments require low rates with long-term horizons

Third, MDBs need a capital increase to ensure that they have the funds to support scaled up investments. Relatedly, debt vulnerabilities underscore the importance of concessional finance. The G20 IEG has called for a tripling of IDA resources during the replenishment round (G20 IEG 2023), and this was echoed by the V20 Finance Ministers in October 2023 (V20 2023a). While the World Bank has offered climate resilient debt clauses to borrowing governments (World Bank 2024),

it is critical that this does not increase the cost of capital and evolves to include options for debt relief. Climate resilient debt clauses are expected to provide governments with some breathing room if countries are faced with shocks so that they can focus on rebuilding and reconstruction. This is a welcome step forward, but the list of qualifying countries should be expanded to include all climate vulnerable economies. The IMF's Catastrophe Containment and Relief Trust (CCRT) could play a similar role; however, it needs to be urgently replenished. Its cash balance stands at Special Drawing Rights (SDR) 124 million (IMF 2024). Furthermore, the IMF should also expand eligibility to include climate vulnerable economies that are susceptible to rapid onset as well as slow onset shocks. A well-resourced CCRT should be one tool in the IMF's toolkit to help countries address loss and damage and build a more shock resilient international financial architecture.

Climate vulnerable economies have put forward ambitious Climate Prosperity Plans, nationally determined contributions, and national plans and policies. Without a supportive macroeconomic environment, undergirded by an effective sovereign debt architecture, not only will the goals articulated in national plans remain a distant reality, but the intensifying nature of climate change will roll back decades of progress made in development. Urgent action to alleviate debt distress will help secure benefits now and lay the foundation for shared prosperity - one that brings development-positive climate action.

REFERENCES

Baarsch, Florent., Awal, Issa, and Michiel Schaeffer. 2022. "Climate Vulnerable Economies: Loss Report. Economic losses attributable to climate change in V20 economies over the last two decades (2000-2019)."

Batini, Nicoletta, Mario Di Serio, Matteo Fragetta, Giovanni Melina, and Anthony Waldron. 2022. "Building Back Better: How Big Are Green Spending Multipliers?" Ecological Economics 193 (March): 107305. https://doi.org/10.1016/j.ecolecon.2021.107305.]

Bhering, G., Serrano, F., and Freitas, F. 2019. "Thirlwall's law, external debt sustainability, and the balance-of-payments-constrained level and growth rates of output," Review of Keynesian Economics, Edward Elgar Publishing, vol. 7(4), pages 486-497

Chamon, Marcos d., Klok, Erik, Thakoor, Vimal V., and Jeronim Zettelmeyer. 2022. "Debt-for-climate swaps: analysis, design and implementation." Working Paper 2022/162. International Monetary Fund: Washington, D.C.

Domar, E. D. 1944. "The 'Burden of the Debt' and the National Income." American Economic Review, 34(4): 798–827

G20 IEG. 2023. "Strengthening Multilateral Development Banks: The Triple Agenda." Report of the Independent Experts Group. Volume 1.

Gallagher Kevin .P., Bhandary, Rishikesh .R., Ray, Rebecca. and L. Ramos. 2023. "Reforming Bretton Woods institutions to achieve climate change and development goals." OneEarth 6 (10), 1291-1303

GCA. 2019. "Adapt Now: A Global Call for Leadership on Climate Resilience." Global Commission on Adaptation. https://gca.org/wp-content/uploads/2019/09/GlobalCommission_Report_FINAL.pdf.

International Monetary Fund. 2024. Quarterly Report on IMF Finances: for the quarter ended January 31, 2024.

Medeiros, C., and Serrano, F. 2006. Capital flows to emerging markets under the flexible dollar standard: a critical view based on the Brazilian experience. Monetary Integration and Dollarization, 218-42

Ramos, L., Rebecca Ray, Rishikesh R. Bhandary, Kevin P. Gallagher, and William Kring. 2023. "Debt Relief for a Green and Inclusive Recovery: Guaranteeing Sustainable Development."

Boston, MA: Boston University Global Development Policy Center; Centre for Sustainable Finance, SOAS, University of London; Heinrich-Böll-Stiftung. https://www.bu.edu/gdp/2023/03/31/debt-relief-for-a-green-and-inclusive-

recovery-guaranteeing-sustainable-development/

Ray, Rebecca, and B. Alexander Simmons. 2024. “Now or Never: Mobilizing Capital for Climate and Conservation in a Debt-Constrained World.” Boston University Global Development Policy Center. https://www.bu.edu/gdp/2024/02/02/now-or-never-mobilizing-capital-for-climate-and-conservation-in-a-debt-constrained-world/.

Songwe, Vera, Nicholas Stern, and Amar Bhattacharya. 2022. “Finance for Cliimate Action: Scaling up Investment for Climate and Development.” https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2022/11/IHLEG-Finance-for-Climate-Action-1.pdf

UNFCCC. 2023. “Outcome of the First Global Stocktake.” UNFCCC. https://unfccc.int/sites/default/files/resource/cma5_auv_4_gst.pdf.

United Nations. 2023. “The Sustainable Development Goals Report: Special Edition.” United Nations. https://unstats.un.org/sdgs/report/2023/The-Sustainable-Development-Goals-Report-2023.pdf.

United Nations Environment Programme. 2023. Adaptation Gap Report 2023: Underfinanced. Underprepared. Inadequate Investment and Planning on Climate Adaptation Leaves World Exposed. United Nations Environment Programme. https://doi.org/10.59117/20.500.11822/43796.

V20. 2021. V20 Statement on Debt Restructuring Option for Climate-Vulnerable Nations: Statement by the V20 Presidency. https://www.v-20.org/our-voice/statements/group/v20-statement-on-debt-restructuring-option-for-climate-vulnerable-nations

V20. 2023a. V20 Ministerial Dialogue XI Communique: Securing Shared Prosperity and Sustainable Development in a Climate Insecure World. https://www.v-20.org/v20-ministerial-dialogue-xi-communique#:~:text=We%2C%20the%20Ministers%20and%20Senior,the%20World%20Bank%20Group%20to

V20. 2023b. Accra-Marrakech Agenda. https://www.v-20.org/wp-content/uploads/2023/09/Accra-Marrakech-Agenda_Adopted_15October2023-compressed.pdf

World Bank. 2024. Global Economic Prospects, January 2024. Global Economic Prospects. The World Bank. https://doi.org/10.1596/978-1-4648-2017-5.

World Bank. 2024. Global Economic Prospects, January 2024. Global Economic Prospects. The World Bank. https://doi.org/10.1596/978-1-4648-2017-5.

APPENDIX

Figure A1 disaggregates creditor type for countries that are eligible to access the IMF’s Poverty Reduction and Growth Trust (PRGT). The figure depicts the external debt stock for these countries in 2022. Figure 6 illustrates the creditor classes for V20 members that are not eligible to access the PRGT.

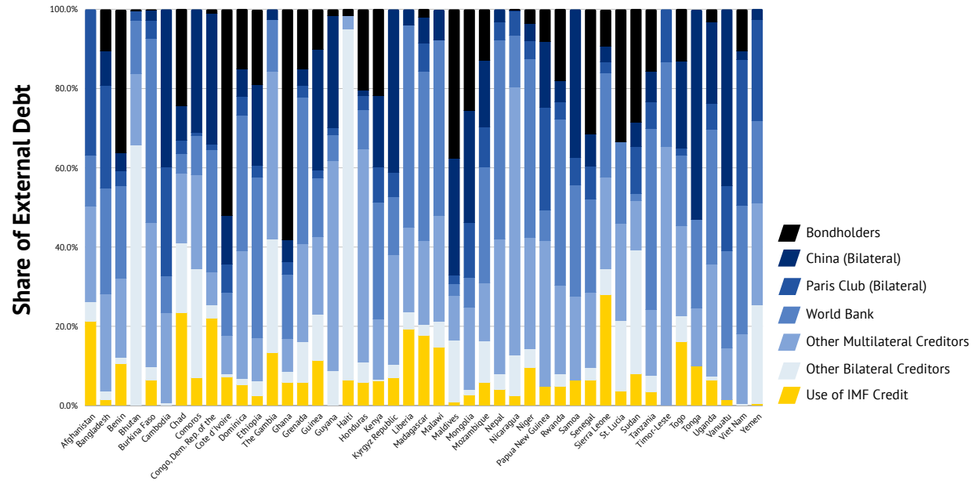

Figure A1: Main Creditors of PRGT-eligible Countries

Source: Authors’ calculations based on World Bank IDS data.

Methodology Note

This worked relied on the World Bank’s International Debt Statistic data for 59 of 68 V20 countries. Countries with missing data include Barbados, Kiribati, Marshall Island, Namibia, Palau, Palestine, South Sudan, Trinidad and Tobago and Tuvalu. For the analysis, we used public and publicly guaranteed external debt series and IMF credit. For debt service, we also used public and publicly guaranteed data series and IMF repurchases and charges. It is important to highlight that these amounts are estimated. The current values may differ due to new debt issuances, as well as interest and exchange rate fluctuations. All projected data are based on the latest IMF World Economic Outlook Database (October 2023).

CVF V20
CLIMATE VULNERABLE FORUM
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Annex 504

"Climate Change And Sovereign Risk: A Regional Analysis For The Caribbean", Working Paper Nº IDB-WP-01574, *Inter-American Development Bank*, April 2024

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Climate Change and Sovereign Risk: A Regional Analysis for the Caribbean*

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March 17, 2024

Abstract

Climate change is an existential threat to the world economy, with complex, evolving and nonlinear dynamics that remain a source of great uncertainty. There is a bourgeoning literature on the economic impact of climate change, but research on how climate change affects sovereign risks is limited. This paper provides forward-looking regional analysis of the effects of climate change on sovereign creditworthiness, probability of default and the cost of borrowing for the Caribbean economies. Our results indicate that there is substantial variation in the sensitivity of ratings to climate change across the region which is due to the non-linear nature of ratings. Our findings improve the identification and management of sovereign climate risk and provides a forward-looking assessment of how climate change could affect the cost of accessing international finance. As such, it leads to a suite of policy options for countries in the region.

JEL Classifications: C33, C53, G10, G18, H63, O44, O54, Q51, Q54**.**
Keywords: Sovereign credit rating, climate change, counterfactual analysis, climate-economy models, sovereign debt, physical risks, fiscal policy, transition risks, Latin America, Caribbean.

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1. Introduction

Climate change is an existential threat to the world economy, with complex, evolving and nonlinear dynamics that remain a source of great uncertainty. There is a bourgeoning literature on the economic impact of climate change, but research on how climate change affects sovereign risks is limited (IMF, 2020).

This paper provides a bespoke regional analysis of the effects of climate change on sovereign creditworthiness, credit ratings, probability of default and the cost of borrowing for the following countries: The Bahamas, Barbados, Guyana, Jamaica, Suriname, and Trinidad and Tobago[1]. The methods build on the world's first climate-adjusted sovereign credit rating by Klusak et al. (2023), but has been adapted to reflect the unique economic, geographic, and policy contexts within the region. This study can improve the identification and management of sovereign climate risk and provides a forward-looking assessment of how climate change could affect the cost of accessing international finance. As such, it leads to a suite of policy options for countries in the region.

As the physical and transition-related impacts of climate change become increasingly urgent, policy interest in understanding how they translate into macroeconomic and financial risks is growing. Globally, central banks have established the Network for Greening the Financial System, , and business leaders have established Taskforces on Climate- and Nature-related Financial Disclosure (TCFD and TNFD, respectively). Enthusiasm for 'greening the financial system' is welcome, but the fundamental challenge of mapping climate science onto real-world financial risks remains. As a result, climate risk is often mispriced, mismanaged, or ignored altogether by financial markets, regulators, and policy makers. Furthermore, the Bridgetown Initiative, led by the Government of Barbados seeks to reform the finance and trade by redesigning the International Financial Architecture by proposing the creation of new instruments enabling climate resilience action and the attainment of the Sustainable Development Goals (SDGs), while accelerating private sector investments. For example, it promotes the inclusion of "hurricane clauses", which have proven to be a relief and have been considered by the IDB since 2020.

The Regional Climate Change Platform of the Ministries of Economy and Finance of Latin America and the Caribbean supports finance ministries in aligning the public finances with climate objectives. Established by the Inter-American Development Bank in 2022, the Platform facilitates knowledge sharing, coordination, dialogue on best-practice, and expertise to support the pursuit of sustainable growth and fiscal sustainability across the region. Research shows that by 2030, changing temperatures could push 3 million people a year into extreme poverty in Latin America and the Caribbean (Jafino et al., 2020). But it also shows that by 2030 a green transition could create 15 million net new jobs in areas such as plant-based food production, renewable energy, and construction. Serving as Technical Secretary for the Platform, the IDB supports nations in navigating these risks and opportunities.

The consequences could be especially severe for the Caribbean region, characterised by extreme vulnerability, both to the physical impacts of climate change and the economic consequences of the low-carbon transition. Caribbean small island developing states (SIDS) and coastal states are highly

[1] The Country Department Caribbean (CCB) at the Inter-American Development Bank is responsible for the promotion and development of Bank country strategies and programming in The Bahamas, Barbados, Guyana, Jamaica, Suriname, and Trinidad and Tobago and via the Caribbean Development Bank (CDB), the countries of the Organization of Eastern Caribbean States (OECS).

exposed to storms, sea level rise, extreme temperatures, species loss, and water stress, with direct effects on key industries such as tourism, agriculture, and fishing (Eckstein et al., 2019; IPCC 2022a-b; IDB 2014). The area of cultivated land is expected to fall due to rising temperatures and increasingly variable rainfall (Rhiney et al., 2016). Climate change is already affecting Caribbean economies. Out of 511 natural disasters which hit the states with population smaller than 1.5 million worldwide since 1950, 324 occurred in the Caribbean (IMF, 2018). More than 27% of population in the Caribbean live in coastal areas with 6-8% classified as high or very high risk (WMO 2021). An estimated 22 million people in the Caribbean live below 6 meters elevation (IPCC 2022b). The US National Climate Assessment (USGCRP 2018) found that economic losses incurred by the Caribbean region due to hurricanes such as Irma and Maria in 2017 reached between $27 and $48 billion and have long-term consequences for state budgets and infrastructure supporting the most disadvantaged. Natural disasters have cost Jamaica alone an estimated $1.2bn from 2001 – 2010, with Hurricane Ivan costing US$350mn (World Bank 2021). Annual losses from catastrophic climate events in the Caribbean are estimated at USD 3 billion dollars and are expected to rise as climate change intensifies (ECLAC 2020). The IPPC (2022b, p2046) notes that even under a global temperature scenario of 1.5C, "the reduced habitability of small islands is an overarching significant risk".

Fiscal health across the region will be determined by both the impacts of climate change on economies and the ambition of decarbonisation policies. Caribbean countries were already highly indebted prior to the pandemic and having spent between 1-4% of GDP on COVID-19 response efforts has left the region with an average debt to GDP ratio of 99% (IDB 2022). But whilst moving towards a resilient, carbon-neutral economy by 2050 will require an annual expenditure of between 5-16% of GDP by 2030, recent research suggests the economic benefits will outweigh the costs[2] (Beating et al., 2022).

The region will need to diversify its tax base to compensate for falling revenues from fossil fuel production and consumption. Currently, taxes on fossil fuel production and consumption generate significant revenues for governments in the region (OECD et al., 2022). For example, in Barbados, taxes on petroleum products are estimated to generate about 2.4% of total revenue for FY2022/23. Although fuel and carbon taxes may generate revenues in the short run, these can be expected to fall through the transition as economies substitute away from fossil fuels. For instance, with a target of reducing fossil fuels by 49%, Barbados has an ambition for 100% electrification of all buses and the public vehicle fleet by 2030 (Viscidi et al., 2020). The shift to electric vehicles will reduce receipts from fuel duties, with direct repercussions finance ministries. Although a reduction in oil imports will enhance the current account and foreign exchange reserves, the taxes on fuel sales comprise an important source of revenue which will disappear once the target is reached. As renewables increasingly out-compete fossil fuels on price, finance ministries that fail to plan for this transition will be left with a fiscal hole.

The Caribbean also faces substantial transition-related risks, particularly around energy prices and tourism. The global surge in energy prices since the Covid-19 pandemic and exacerbated by Russia's war in Ukraine has brought about varying impacts across the Caribbean. Guyana, Trinidad and Tobago, and Suriname have benefitted from higher oil and gas prices, whereas The Bahamas, Barbados, and Jamaica have suffered (IDB 2022). Further, indirect effects may be expected as tighter carbon regulations abroad drive-up flight prices, impacting tourism revenues. In this context a just transition strategy is adamant to minimize and address impacts in different spheres such as labour markets,

[2] Galindo, Miguel, Hoffman, B., Vogt-Schilb, A. (2022) How much will it cost to achieve climate change goals in Latin America and the Caribbean? IDB Working paper 1310.

work, resilient agriculture, and social equity, among others to protect livelihoods. Decarbonization strategies in the Caribbean requires a sensitive management of an adamant shift, and will need to include active stakeholder participation, innovative skills development, and a reform of the existing safety nets.

Climate-driven GDP losses will also affect sovereign credit ratings, default probabilities, and the cost of borrowing. There is strong evidence that climate change has already raised the average cost of debt in vulnerable developing countries (Kling et al., 2018; Buhr et al., 2018; Volz et al., 2020; Beirne et al., 2021). However, credit ratings agencies do not yet formally incorporate future climate projections into creditworthiness assessments (Klusak et al., 2023).[3] This means current credit assessments for the region understate the effect of climate on public debt, and therefore the incentive to invest in adaptation and resilience.

Although the Caribbean is considered the most indebted region of the world with most indebted countries being Barbados, Suriname and the Bahamas the sovereign credit histories vary substantially across the region. For instance, Trinidad and Tobago has been considered investment grade for over 20 years, whereas The Bahamas and Jamaica hover just below the investment grade threshold, and Barbados and Suriname have both defaulted within the past five years. Trinidad and Tobago's investment grade reflects a favourable external profile and stable democracy. The rating also reflects solid government financial assets which mitigate the effects of economic cycles on fiscal and external performance. The hydrocarbon sector will continue to support Trinidad and Tobago's economy despite some softening in prices this year from high levels in 2022 (S&P 2023). It is the least dependent on the petroleum imports in the region with 0.3% as a share of GDP. Some of the highest are Saint Lucia (21.1%) and Bahamas (12.9%) followed by Guyana (9.8%), Barbados (6.2%) and Suriname (3.3%) (Viscidi et al., 2020). Climate-driven economic losses can be expected to deteriorate the public finances and credit assessments of all these countries even further.

Many global-scale climate and economic models struggle to provide detailed regional analyses for use in guiding policy.[4] The result is that bespoke regional analyses are needed to translate the physical and transition related risks presented by climate change into sovereign risk assessment and fiscal strategy in the region. Indeed, this is the only approach that can reflect the diversity of physical geography, natural capital endowments, economic structures, default risk and history, and policy priorities across the Caribbean. Physical risks include the direct physical damages to property, infrastructure, homes, human health, and agricultural land resulting from climate extremes.[5] Transition risks typically include asset stranding, skills obsolescence and resulting un- or under-employment, loss of competitiveness, and reductions in fiscal revenues from declining industries. Both physical and transition risks vary across regions, countries, and economic sectors. In the Caribbean, physical risks to transport and tourism-related infrastructure may combine with transition risks, if global demand for long-haul flights wanes or emissions taxes make flying prohibitively expensive, or

[3] Moody's notes that climate change might affect Economic Strength, however it is an "unusual" occurrence (Moody's 2019). Although S&P (2015a,b) estimate the effect of extreme weather and natural disasters on ratings of 38(48) sovereigns, respectively, it is not included in their standard methodology. They measure direct damages up to 2050 (2020) which would arise from 1-in-250 year disasters (earthquakes, tropical storms, floods, winter storms). Our study differs significantly from theirs as we are not restricted by narrow selection of perils but the overall aggregate effect of climate change which has not been considered before (see section 3.2.1 and 4.1).

[4] E.g in IPCC AR6 (2021), the Caribbean is often excluded from calculations due to the small number of full land grid cells.

[5] The global models, including the IAMs reviewed by the IPCC typically lack the spatial resolution and geographic/economic specificity to facilitate convincing country-level conclusions.

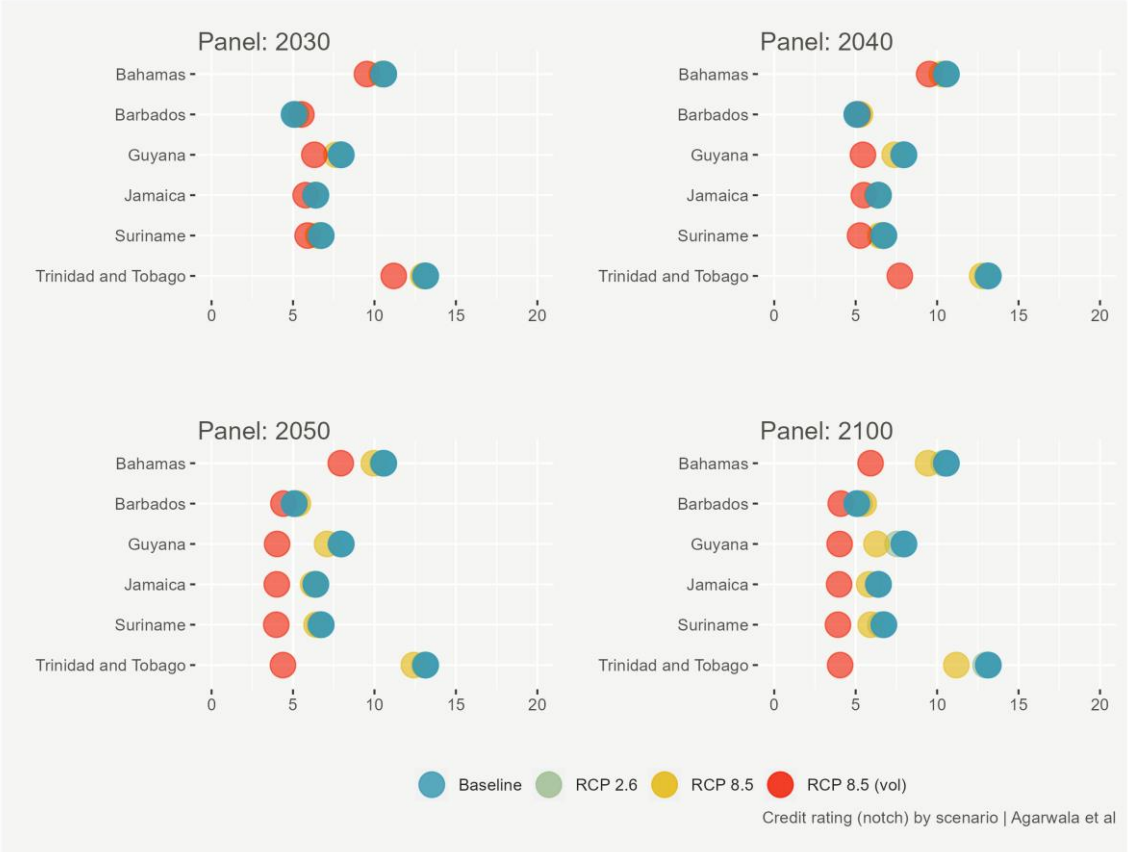
if changing temperatures and weather extremes shorten the peak season. For fossil-fuel rich economies, a global transition towards renewables will mean a shrinking export market and a reduction in the expected value of reserves.

The unique advantage of our approach is that it is inherently forward-looking. Empirical assessments of the effect of climate change on sovereign ratings and bond yields typically adopt a backwards-looking strategy, examining historical data to determine whether past climate change has affected current bond yields. But the climate science is clear: the past is a poor model for assessing future impacts. Economic analyses of climate change that rely solely on past data cannot tell us much about future risks and impacts. On the downside risk, even the severe climate impacts already experienced across the region in recent years would understate the likely consequences of unabated climate change. On the upside, estimates could overstate the consequences of future climate impacts if they rely on worst case scenarios that are ultimately avoided by successful global decarbonisation. In contrast, our approach is forward-looking, incorporating leading climate and economic models to investigate the climate-ratings-cost of capital relationship into the future under a range of warming scenarios. This is clearly a more useful analysis for guiding future policy and developing forward-looking fiscal strategies.

We used AI to simulate the effect of climate change on sovereign debt across the region under varying warming scenarios. Our results indicate that:

- Under a high emissions scenario, all studied countries could expect downward pressure on their sovereign credit ratings by 2050 (see Figure 1).
- Climate change is expected to increase annual borrowing costs across the region by 2050, under both high ($310 million) and low ($270 million) emissions scenarios.
- This could rise to over US$1 bn per year under a worst-case scenario that encompasses high global emissions, a loss of tourism revenues, and the economic consequences of rising temperature volatility.
- There is substantial variation in the sensitivity of ratings to climate change across the region. For instance, Barbados has a B- (highly speculative, non-investment grade) rating. Whilst climate change will lead to a deterioration of economic conditions, it is not expected that this will substantially affect the rating before 2030. In contrast, at BBB- (lower medium, investment grade), Trinidad and Tobago faces downgrades within the decade under the worst-case scenario.

Figure 1: Predicted Future Sovereign Credit Ratings by Climate Scenario



Notes: Simulated sovereign credit ratings under baseline, Paris compliant (RCP2.6), unmitigated climate change (RCP 8.5), and RCP 8.5 with temperature volatility included (RCP 8.5 vol) scenarios, at 2030, 2040, 2050, and 2100.

Our research has revealed a series of key policy implications:

- **Investing in statistical infrastructure and data gathering** will support improved economic analysis, including of the impacts and opportunities created by a transition to a low-carbon economy. Regular data collection and consistent publication will support efforts to identify and navigate specific climate-related risks and opportunities, including the potential to diversify into less climate-exposed sectors. It will also support macroeconomic strategy and planning across the board, including beyond the management of climate change.
- **Global climate scenarios can understate the actual climate risks faced by Caribbean economies** and should be augmented by bespoke, national and regional studies. Global scenarios are biased towards long-term economic risks that arrive along 'smooth' functions (Trust et al., 2023). This is a poor reflection of the reality of climate change in the region, which is already creating extreme, discrete hazards such as Hurricane Maria. Understanding the economic consequences of increasingly frequent and intense storms requires that these are modelled directly, as discrete, near-term events.
- **Innovative finance mechanisms may help plug the finance gap, but they are not a panacea.** Catastrophe bonds, sustainability linked bonds, disaster clauses, and similar green financial innovations can help smooth access to finance, but poor design can also erode incentive

compatibility and support greater risk taking. Extreme caution is needed to ensure that green finance supports investments in adaptation and resilience.

- **Diversification away from oil and gas,** with the goal of reorienting foreign investment towards growth industries in other sectors may help create alternative sources of fiscal revenues. Government revenues from oil and gas production as well as fuel duties and carbon taxes are expected to fall as economies decarbonise. Alternative revenue sources must be sought to avoid a deterioration in public finances as fossil fuels are phased out, as well as consider a just transition while designing decarbonization strategies.
- **Better quantification of the economic costs of climate change throughout the region can support demands for greater action at international climate summits and agreements.** A strong scientific and economic evidence base is needed to underpin negotiations relating to loss and damages as well as access to the green climate fund.

The remainder of this paper is organized as follows. Section 2 sets the scene, describing the physical and transition risks facing the Caribbean region and how these relate to sovereign debt markets. Section 3 discusses the role sovereign ratings play in managing risks and access to finance. Section 4 provides a non-technical description of the AI method we developed to assess the effects of climate change on sovereign credit ratings, borrowing costs, and default probabilities. Section 5 presents the empirical findings. Section 6 provides concluding remarks including key implications for finance ministries and economic decision makers. Finally, Section 7 provides further technical details of the modelling exercises.

2. Setting the scene: Why climate-related risks matter for sovereign debt

2.1. Climate change is already affecting Caribbean economies

Small island developing states including the Caribbean are considered the most vulnerable to climate change (Eckstein et al., 2019; Stennett-Brown et al., 2019; Nurse et al., 2014). In recent years, the region has already faced increasing frequency and intensity of extreme rain events, longer dry spells, higher and more volatile temperatures, and rising sea levels.[6] The key risks for the region include:

Sea-level rise: The Caribbean region is especially vulnerable to sea-level rise, which threatens to inundate coastal areas, disrupt tourism and fisheries, and increase the frequency and severity of coastal flooding. It is estimated that one meter sea level rise in the Caribbean region would place 49 – 60% of tourist resort properties at risk of beach erosion, and 29% would be partially for fully inundated. Losses of over 50% of coastal properties would be likely in Barbados, Bahamas and Trinidad and Tobago amongst others (Scott et al., 2012).

[6] Up to 2007 when Fourth Assessment Report (AR4) by IPCC was published sea level rise dominated vulnerability and impact studies of small island states. Mimura et al., (2007) mention lack of independent studies on the effects of climate on the region between 2001-2007 when Third and Fourth Assessment reports were published in comparison to the earlier period 1995-2001 when Second and Third reports came out. Since 2007 the literature deals with the issue in a multidimensional manner.

Coastal erosion and SLR: The combination of sea level rise, erosion, and growing populations place increasing pressures on coastal land use and related ecosystems (Gero et al., 2011; Mycoo, 2011). The result is a high concentration of infrastructure and human populations in vulnerable locations. More than 27% of the Caribbean population lives in coastal areas, with 6-8% classified as high or very high risk (WMO 2021). Approximately 14 million persons in the Caribbean currently live below 3m elevation and 22 million below 6m (Cashman and Nagdee, 2017).

Extreme weather events: The Caribbean is also prone to hurricanes and tropical storms, which are becoming more frequent and intense due to climate change. These events can cause widespread damage to infrastructure, crops, and homes, and result in billions of dollars in losses. Such events are more costly for smaller island states as they represent bigger proportion of the territory and greater per capita losses compared to larger countries (Anthoff et al., 2010). Amongst the most severely affected countries and territories in weather-related loss events of 2017 were Puerto Rico (63% loss in GDP) and Dominica (215% loss in GDP) (Eckstein et al 2019; IMF 2021). And these events have long lasting impacts; hurricanes in the Caribbean have a downward impact on unemployment, with lagged impacts of up to four years after a disaster strikes (ILO, 2021).[7]

Drought: Drought conditions are increasingly common in the region, leading to reduced crop yields, water scarcity, and increased competition for resources. The IPCC projects that a 1C increase in temperature from 1.7 – 2.7C of warming could result in a 60% increase in the number of people experiencing severe water stress from 2043 – 2071 (IPCC 2022b). Additional warming by 0.2°–1.0°C in the Caribbean could lead to a predominantly drier region with 5-15% less rain than the present day, impacting agricultural production and yield.

Coral reef degradation: Coral reefs are critical habitats for marine species and tourism, and amongst the most vulnerable to climate change. Warming waters and ocean acidification are causing widespread coral bleaching and death, with significant impacts on tourism and fishing industries. Reef surveys surrounding Barbados revealed that approximately 70% of corals have been affected by bleaching (Oxenford 2008). Resource degradation such as beach erosion or coral bleaching will have serious repercussions on tourism in Barbados. ECLAC (2011) estimated that the loss of coral reefs in Barbados could reduce tourism revenues by up to US$ 1.3bn by 2050. When combined with sea level rise and other climate impacts, lost tourism revenues could rise to US$ 7.6bn.

Human health impacts: Tropical areas are favourable to the transmission of diseases. For example, Caribbean region is amongst the most endemic zones for the leptospirosis. Trinidad and Tobago, Barbados and Jamaica face the highest annual incidences, which is tied to climatic as well as anthropogenic factors (Pappas et al. 2008). Moreover, outbreaks of Dengue in Trinidad and Tobago have been correlated with rainfall and temperature (Chadee et al., 2007). Climate change is also likely to increase the risk of vector-borne diseases such as dengue fever and chikungunya, as well as air pollution and heat stress, with negative impacts on public health.

The costs of these impacts can be significant, with some estimates suggesting that the Caribbean could face losses of up to 4% of its GDP by 2050 if no action is taken to mitigate the effects of climate change. The economic and environmental challenges faced by small island states are well documented (Eckstein et al 2019; Briguglio et al., 2009; Bishop 2012) with the Eastern Caribbean region considered amongst “most disaster-prone in the world” (IMF 2004). Economic vulnerability often lies outside control of the small island sovereign states as they depend on narrow range of exports and wide range of imports such as food and fuel (Briguglio et al., 2009). The risk and volatility in these economies is

[7] https://www.ilo.org/static/english/intserv/working-papers/wp026/index.html#ID0EZC

exacerbated by their small geographic size and low populations, which drive up costs per capita. The concentration of economic activity in a narrow set of climate vulnerable sectors such as tourism, fishing, and agriculture, means adaptation and diversification will be key to climate resilience.

Box 1. The Physical and Transition Risks of Climate Change in Caribbean

Climate change poses a range of physical risks to the Caribbean, including:

1. Increased frequency and intensity of hurricanes, tropical storms, and flooding.
2. Rising sea levels, leading to coastal erosion and saltwater intrusion into freshwater sources.
3. Coral bleaching and ocean acidification, which threaten marine ecosystems and fisheries.
4. Droughts and water scarcity, affecting agriculture, tourism, and human health.
5. Heat waves and extreme temperatures, leading to heat-related illnesses and death and increased energy demand.

These risks can cause damage to infrastructure, homes, and businesses, disrupt supply chains, and harm human health and wellbeing leading to reduced labour productivity and slower growth.

To mitigate these risks, governments, business, and markets are beginning to transition away from fossil fuels towards a low-carbon economy. This represents the largest deliberate transformation of the global economy in human history and the process introduces risks of its own. The transition risks of climate change in the Caribbean include:

1. Stranded assets in the fossil fuel industry, as the world moves towards renewable energy sources, rendering investments made in traditional energy sources obsolete.
2. Decline in tourism revenues due to the loss of coral reefs, a shortened season, and loss of tourism-related infrastructure (including resorts).
3. Financing costs of public and private investments to decarbonise energy, transport, buildings, and food.
4. The potential loss of export markets for carbon-intensive goods, or the introduction of border taxes.
5. Financial market risks, including exposure to high-carbon investments or carbon-intensive assets, which may lose value as the global economy transitions to a low-carbon future.
6. Pressure on the public finances owing to increased expenditure on disaster relief and recovery, or investments in adaptation and resilience. Additionally, tax revenues may change as climate reduces aggregate output and as transition to low-carbon alternatives reduces fuel levies and carbon taxes, specifically.

Despite these physical and transition risks, the economic consequences of unmitigated climate change and a failure to adapt are expected to be far worse, both in terms of economic damages and the human toll, which may include loss of life. Both the physical and transition risks can be minimised through dedicated progress towards emissions reductions, diversification, and investments in adaptation and resilience.

2.2. Link between climate change and sovereign debt

Climate change is considered ‘the biggest market failure the world has seen” (Stern 2008), with wide-ranging implications for stability along multiple dimensions, including financial, economic, political,

social, and environmental. Leading estimates place the economic losses from climate change at 2% - 22% of global GDP by 2100, though these will be highly unequally distributed (Dell et al., 2012; Burke et al., 2015; Kahn et al., 2021; Mohaddes et al., 2023). This paper extends cutting-edge analysis on how climate risks will impact sovereign debt markets to the Caribbean.

Sovereign debt is the world's largest asset class, and widely acknowledged as the 'safe asset' to which investors turn in times of turmoil. But because climate change reduces macroeconomic performance, even this safe asset is at risk from climate change. Reduced economic performance makes it harder for governments to service their debt or make productive investments. Volz et al. (2020) identify six interdependent channels through which climate change can amplify sovereign risk (see Section 2.2.1).[8] Ultimately, this can be expected to increase the riskiness of sovereign debt.

Credit rating agencies are beginning to take note, conducting internal analyses of the effects of climate on ratings factors. Meanwhile, investors are increasingly concerned with the climate exposure of their portfolios, and searching for environmental as well as financial returns. As sovereign ratings give information about the ability and willingness of sovereigns to service their debts, they are immediately linked with the cost of borrowing of governments. Sovereign downgrades increase the cost of both public and private debt, affecting overall economic performance and business conditions across sectors.

Empirical evidence shows that climate change is already increasing sovereign borrowing costs, especially for climate-vulnerable countries (Buhr et al., 2018; Kling et al., 2018,2021; Battiston and Monasterolo 2019; IMF 2020; Beirne et al., 2021; Mallucci 2022; Volz et al., 2020). Estimates of the effect of climate on sovereign borrowing costs vary depending on the sample of countries, specific definitions of climate vulnerability, and the time horizon under consideration. But the trend is clear. Climate change has already increased borrowing costs in the most climate-vulnerable economies by 117 – 275 basis points (Buhr et al., 2018; Bierne et al., 2021). IMF (2020) research extends the sample to 67 economies, including Barbados and Trinidad and Tobago, finding that a one percentage point increase in climate vulnerability is associated with a 0.69 percent reduction in creditworthiness in emerging markets. The cumulative effects of climate vulnerability have increased borrowing costs among the most affected economies by US$ 40bn – 62 bn over a 10-year period (Buhr et al., 2018; Kling et al., 2018). Focusing on seven Caribbean countries, Mallucci (2022) finds that disaster risk reduces governments' ability to issue debt and that climate change further restricts government's access to financial markets. In a scenario in which the frequency of high-category events increases by 29.2% and their intensity increases by 48.5%, debt-to-gdp ratios decline by at least 12% and spreads increase by at least 30%. Finally, the effects of climate on debt are not limited to government bonds. In an analysis of 15,265 firms across 71 countries between 1991-2017, Kling et al. (2021) find that climate vulnerability increases the cost of corporate debt by up to 0.68%.

These studies demonstrate that climate change is already adversely affecting bond yields, creditworthiness, and ultimately the public finances of climate-vulnerable countries. But these studies all depend on observed relationships between historical climate indicators and historical economic outcomes. But if there is a single, overarching lesson from climate science, it is that the future will not be like the past. The macroeconomic consequences of future warming cannot be proxied merely by examining recent history. Understanding the economics of climate change requires looking forward, through climate and economic modelling, to assess future risks and opportunities.

We build on recent research that integrates projections of future climate change into sovereign creditworthiness assessments (Klusak et al., 2023). However, this paper also entails several important extensions for the region. First, we go beyond sovereign ratings to assess impacts on default

[8] These include: 1) Fiscal impacts of climate-related natural disasters, 2) Fiscal consequences of adaptation and mitigation policies, 3) Macroeconomic impacts of climate change, 4) Climate-related risks and financial sector stability, 5) Impacts on international trade and capital flows and 6) Impacts on political stability.

probabilities. Second, we employ a more rigorous, market-based method for estimating the effects of ratings changes on the cost of borrowing allowing for greater alignment with financial market practice. Finally, we incorporate region-specific impacts, particularly around changes in the tourism sector.

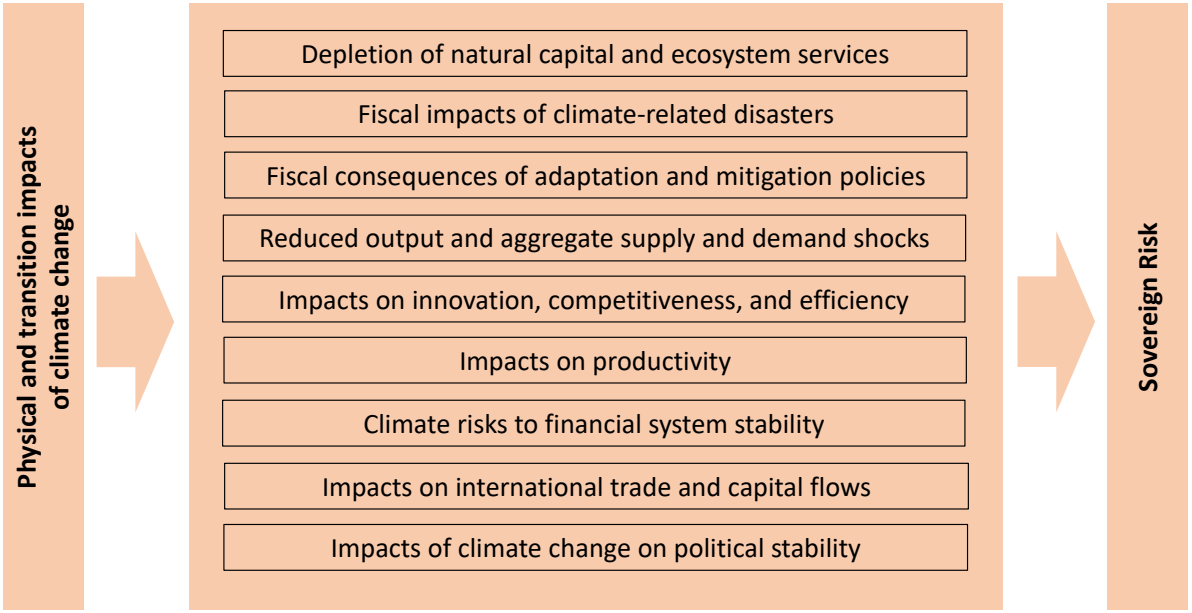
2.2.1. Physical and transition impacts of climate change

Whilst the direct physical impacts of climate change are increasingly understood, the links between climate risk and sovereign borrowing may be less familiar. Volz et al. (2020) and Agarwala et al. (2021) describe multiple channels through which climate risk might impact sovereign debt markets (see Figure 2). As Box 1 suggests, the fiscal consequences of climate change and the policy responses to it are not limited merely to the direct physical damages. Indeed, significant *near-term* impacts on aggregate output and public finances will derive from the climate transition, in addition to the physical risks from climate change itself.

The 'transition' reflects the process of decarbonisation and reorientation of national economies away from a fossil fuel-based energy system towards a low-carbon, climate resilient economy. Transition risks include those associated with changes in policy, consumer preferences, litigious actions, and technological development that accompany the drive to reduce emissions. In addition to decarbonisation, the transition includes investments to support resilience and adaptation, as warming and associated impacts are now unavoidable, even under the most ambitious transition pathways. Thus, 'transition risk' is a broad concept and represents the challenges associated with the structural transformation of the economy. Associated to this concept, a "just transition" is also a key dimension to consider as the challenges associated with transitioning to a more sustainable and low-carbon economy will also generate new pressures on the communities given their dependencies to tourism, fossil fuels, and imports. In Latin America and the Caribbean, a study from the IDB assessed that aligning infrastructure and social spending will represent 7% to 19% of annual GDP, representing from US$470 billion to US$1,300 billion in 2030. Nonetheless, it is important to underline that the benefits of this reallocation of resources will exceed its costs as it will avoid the worst impacts of climate change and generate economic, social, fiscal, and environmental benefits.

The physical impacts of climate change will deplete natural capital and undermine ecosystem service delivery, particularly with respect to fishing and agriculture. Substitution away from oil and gas will reduce fiscal revenues for fossil fuel producing economies such as Trinidad and Tobago, Guyana, and potentially Suriname. But it will also reduce revenues from fuel levies in countries such as The Bahamas, Barbados, and Jamaica. Moreover, early progress on mitigation and adaptation investments may require an expansion of public debt, for instance through green bonds. These changes will affect sovereign creditworthiness.

Figure 2: Climate change to sovereign risk: a review of impact pathways



Sources: Adapted from Agarwala et al. (2021) and Volz et al. (2020).

Sovereign debt markets also present opportunities for financial innovation, spurring a green recovery that builds forward toward a more sustainable and resilient future (Agarwala et al. 2021). First, public debt is an important means through which economies can invest in themselves and their futures. It enables governments to crowd-in private investment in key industries such as renewable energy, and low-carbon infrastructure. This is especially important as such industries are characterised by high up front capital costs, for instance in constructing wind farms, followed by long-term low production costs. Green public debt can also signal to financial markets that the government is committed to sustainability. This signalling effect can be important because the returns to many green investments accrue over long time horizons, meaning that regulatory uncertainty and changes in government priorities can become substantial obstacles to private investment. Finally, green public debt can stimulate growth in the financial services sector by creating a new asset class of green bonds, encouraging the growth of green investment funds, and creating jobs in monitoring and reporting, which provides an additional benefit of improved transparency.

Box 2. Contingent Credit facility for Natural Disaster Emergencies

In 2009, the IDB created The Contingent Credit Facility for Natural Disaster Emergencies (CCF) as one of its main tools to help countries develop effective strategies for natural disaster financial risk management.

The CCF offers contingent loans that are prepared in advance but are disbursed after the IDB has verified the occurrence of a disaster event in terms of type, location, and intensity. This is part of the IDB's effort to help countries move from a primarily after-the-fact approach to managing disaster and climate risks to one that includes greater prevention, mitigation, and preparedness measures taken before disasters strike.

The CCF's objective is to provide countries with cash following a natural disaster of severe to catastrophic proportions for humanitarian relief and to restore basic services. Proceeds from CCF Loans are used to cover extraordinary government expenditures incurred six months after the disaster. Examples of eligible expenditures include emergency sanitation equipment, medications and vaccines, temporary shelter equipment and installations, water and foodstuffs for displaced or distressed populations, and debris removal, among others.

All IDB's borrowing member countries are eligible to receive financing through the CCF, provided they have in place a Comprehensive Natural Disaster Risk Management Program (CDRMP) approved by the IDB. The CDRMP includes measures on governance, risk identification, risk reduction emergency preparedness and response, and financial protection and risk transfer. The CDRMP has measurable output and annual indicators to allow regular monitoring.

The coverage limit of the CCF per country is up to US$300 million or 2% of the borrowing member country's GDP, whichever is less.

The country, through the project executing agency, submits to the IDB a Request for Verification of Eligibility of the disaster event. The IDB will then apply a previously agreed calculation methodology to produce an Eligibility Verification Report.

If the assessment concludes the event is eligible for disbursement, the IDB will include in the Eligibility Verification Report the maximum disbursement amount. The borrowing country must confirm in writing its intention to disburse.

Box 3. The hurricane clause

Given the frequency and destruction caused by these extreme weather events, Caribbean countries have been demanding climate-resilient debt instruments and other innovative means to build financial resilience. The IDB has introduced for this purpose the hurricane clause which also considers similar disaster-linked clauses in their loan agreements.

The hurricane clause is designed to provide cash flow relief at the crucial period after a natural disaster event, when financing needs are high and new sources of funding are limited. By embedding "hurricane-linked clauses" in debt contracts, countries can tap into extended maturity periods in the event of a natural disaster. As part of IDB loans, a country hit by a predefined disaster can chose to defer principal payments for two years. In the region, Barbados has recently included this clause in its loans. When well-managed, such clauses can offer crucial relief and support economic stability in times of turmoil.

Box 4. How catastrophe bonds can help reduce vulnerability

Catastrophe bonds, also known as "cat bonds," are a type of insurance-linked security that allows countries to transfer the risk of natural disasters, such as from hurricanes and tropical storms, to investors. They are typically issued by insurance or reinsurance companies, or multi-lateral development banks.

One example is the World Bank's 2021 US$185 million cat bond to provide Jamaica with disaster relief insurance against named storms over three hurricane seasons ending in December 2023.* The World Bank issued a bond to investors with a fixed yield, which is paid by Jamaica. For Jamaica, this is like an insurance premium. In the event of a named storm that meets the pre-arranged criteria, the cat bond is triggered and the bond principal is reduced by the amount of the pay-out.

The benefits to Jamaica are that much-needed finance is quickly released in the event of a disaster, without increasing Jamaica's public debt. The benefits to investors are a higher yield than would typically be available in traditional bond markets. However, if a qualifying catastrophic event occurs and triggers the policy, the bond may be partially or completely written down, and the investors lose some or all of their investment. All parties benefit from the World Bank's AAA credit rating and access to international financial markets, reducing the risk premia and associated transaction costs.

*The World Bank's first-ever cat bond was issued in 2014 to insure 16 Caribbean nations against earthquake and cyclone risk. In 2021, Jamaica became the first government in the Caribbean region and the first of any small island state to independently sponsor a cat bond.

There are of course risks involved in expanding green public debt. If stringent reporting criteria are not enforced, 'green' investments are not selected on the basis of scientific evidence, or debt is used to subsidize current consumption rather than investments in long-term productive capacity then there is a risk of greenwash and a severely disruptive market correction. Mallucci (2022) warns that when green financial instruments are poorly managed, they can reduce financial incentives to mitigate and adapt to climate change and induce governments to take excessive risks, including borrowing more. Even with well-managed green debt, it remains a real possibility that investments in adaptation and resilience cannot keep pace with climate risks if international climate targets are not met. That is, green debt can be a useful tool to accelerate the transition and increase adaptation and resilience, but only if it is complemented by successful global emissions reductions and adherence to

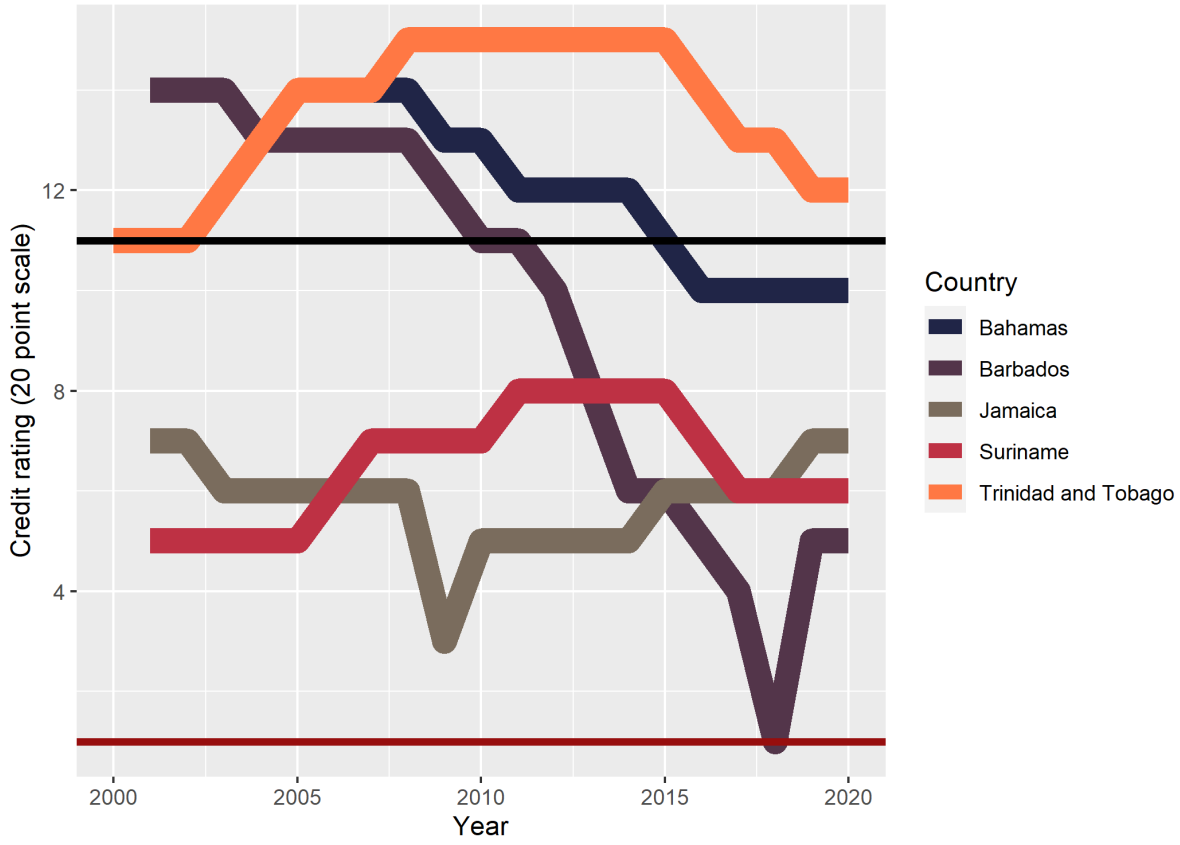
international climate agreements. Whilst some of these concerns can be addressed within the region through good governance, others require the active participation of the global community.

Ultimately, market and public opinion are shifting such that investors and financial institutions are increasingly determined to 'green' their portfolios. With little fiscal space remaining, governments must crowd-in private finance to stimulate growth- and resilience-enhancing investments. Many governments started tackling this issue by releasing climate and nature-linked bonds (Volz, 2020).

2.2.2. Historical ratings of the Caribbean region

Sovereign credit ratings vary substantially across the region, with direct repercussions for the cost of public borrowing. Trinidad and Tobago consistently falls within the investment grade range, whereas all other countries operate within the speculative grade (see Figure 3).

Figure 3: Sovereign Ratings 2000 – 2020 (S&P)



Sources: S&P Ratings Direct. Authors own calculations.
Notes: Guyana is excluded from the figure since it has never been rated by S&P. The black and maroon lines represent the investment grade and default rating thresholds, respectively. The investment grade threshold is equal to or above BBB- and translates to 11 on the 20-notch scale. The extremely speculative risk and default is observed with 1 point on the rating scale.

Although Barbados and The Bahamas held investment grade ratings until 2010 and 2015, respectively, our modelling exercise focuses on the years 2015 – 2020[9], as in (Klusak et al., 2023). Trinidad and Tobago is the only sovereign that maintained an investment grade rating for the duration of our sample period (2015-2020) with 13 notches, or BBB+. The second highest rated sovereign on average is The Bahamas with 10 notches, or BB+. During the study period, one sovereign (Barbados) defaulted on its foreign currency obligations in 2018 and is amongst the lowest rated sovereigns in the sample. Barbados received rating of 4 notches, or CCC+, on average. Table 1 presents the distribution of historical credit ratings for the sample of 5 sovereigns over the period 2000-2020.

Table 1: Rating distribution of the sample 2000-2020

Country	Obs	Mean	Std. dev.	Min	Max
The Bahamas	18	12.1667	1.6539	10	14
Barbados	21	9.7619	4.1341	1	14
Jamaica	21	5.8095	0.9284	3	7
Suriname	21	6.4286	1.1650	5	8
Trinidad and Tobago	21	13.5238	1.5040	11	15

Notes: This data provides historical sovereign long-term foreign currency ratings issued on 5 Caribbean sovereigns in the period 2000-2020 by S&P. Guyana is not shown because it has not been rated by S&P. Data available from Ratings Direct.

Additionally, this exercise faces a number of limitations, including the unavailability of credit ratings for many countries, as well as their low variability (i.e., See Figure 3) during the analysis period. Therefore, our results should not be extrapolated outside the sampled countries, and even in those countries, they should be taken with caution as such data limitations could imply that some relevant information in the formation process of credit ratings may not be fully captured. Yet, it is also worth emphasizing that this paper has been originally motivated precisely by the lack of data regarding Caribbean countries. Further, even in the presence of the observed low variability, our results do suggest that climate risks would increase risk premiums for countries that already face high costs of debt.

3. The role of ratings in managing risks and accessing finance

3.1. Sovereign ratings and their methodology

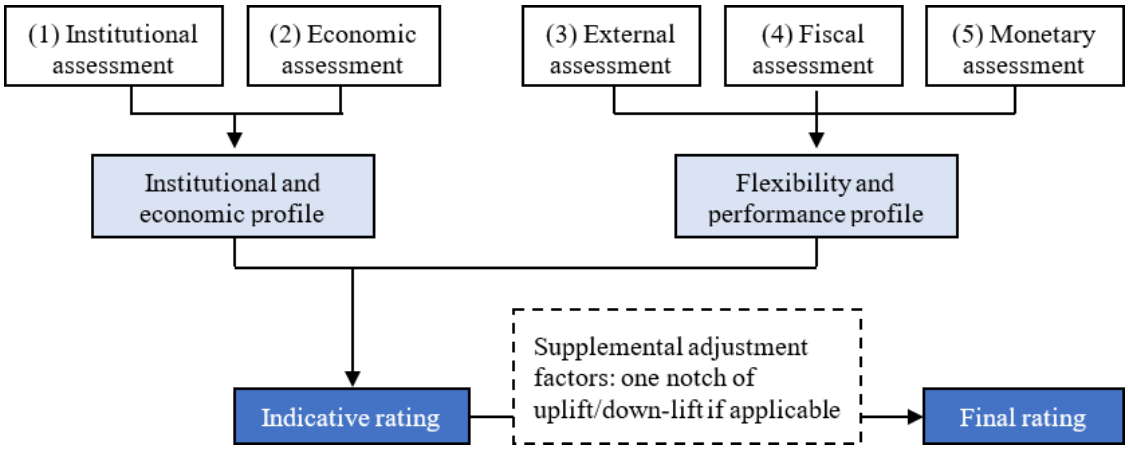
As key intermediaries between the supply and demand for finance, credit ratings agencies (CRAs) play a central role in markets by providing standardised information about the creditworthiness of national economies. Sovereign ratings combine objective data with subjective assessments of the ability and willingness of sovereigns to service their debt. Although several agencies issue sovereign ratings, we use S&P's because they have the widest country coverage over the assessment period and their ratings

[9] This is because the ratings prediction model provided the strongest predictive accuracy over this period. Extending the sample period introduced noise from the 2008-2009 financial crisis and the subsequent Euro crisis, which ultimately undermined model performance.

actions have the strongest own-country stock market impact (Almeida et al 2017; Brooks et al 2004; Kaminsky and Schmukler 2002).

According to the sovereign rating methodology published by S&P—a leading rating agency — ratings are based on five key determinants: (1) institutional assessment, (2) economic assessment, (3) external assessment, (4) fiscal assessment, and (5) monetary assessment (Figure 4). These five factors are measured on a six-point scale based on quantitative factors and qualitative considerations (S&P 2017). An institutional and economic profile is constructed by averaging the scores in (1) and (2), and a flexibility and performance profile calculated as the average of scores in (3), (4), and (5). The resulting profiles are then merged using a matrix to assess the indicative rating, which is typically adjusted depending on additional adjustment factors (S&P 2017).

Figure 4: Sovereign Issuer Criteria Framework



Sources: Standard & Poor's Global (2017).

Although CRAs make their ratings methodologies publicly available, the subjective inputs mean that sovereign ratings are not perfectly replicable by outsiders.[10] Empirical researchers have attempted to 'hack' sovereign ratings methods, using publicly available macroeconomic and governance indicators to 'reconstruct' sovereign ratings based on objective data, thus eliminating the subjective component and making ratings replicable.

Traditional approaches to modelling credit ratings often rely on parametric estimation. However, due to the unique nature of ratings (the fact that they are captured by incremental scale) it is difficult to model them this way. Incremental shifts through the rating scale do not represent equally meaningful changes in creditworthiness. For instance, if Country A moves from one high grade rating to another, this change would not be as significant as if Country A moved from a lower medium grade to a non-investment grade. Second, sovereign credit ratings are not characterised by the same distributional properties we may observe in other variables. There are typically far more observations at the top-end of the ratings scale than throughout the rest of the rating categories. These features make linear modelling of credit ratings difficult and subsequently lead to error. Therefore, researchers have considered non-parametric approaches to model sovereign ratings. The central benefits associated

[10] One of our authors of Klusak et al. (2023) served as Global Chief Rating Officer, Sovereign Ratings at S&P (2013 – 2018).

with these approaches are much better handling of non-linear outcomes in the data and the potential for superior fit. Because sovereign ratings may be subject to thresholds in country-level predictors, such as GDP per capita (S&P 2017), methods capable of handling non-linearities are essential.

To mitigate these issues and ensure the reliability of our estimates, we employ machine learning approaches to predict credit ratings for the Caribbean region. Please refer to section 4.1. for non-technical summary of our method or Appendix 7.1-7.3 for the technical description.

3.2. Why are sovereign ratings important?

We focus on sovereign ratings for several reasons. First, they are readily interpretable and familiar indicators of creditworthiness that are already used by investors, portfolio managers, financial institutions, and regulators in a range of decision contexts. For instance, ratings are 'hardwired' into decisions over which securities investors can hold: institutional investors may be committed by their charter not to hold debt below a certain rating (Fuchs and Gehring 2017). Similarly, under Basel II rules, ratings directly affect the capital requirements[11] of banks and insurance companies (Almeida et al 2017). Moreover, sovereign debt, which was expected to top $92 trillion in 2021 (IIF, 2021) is by far the world's largest asset class. It is the safe haven to which investors flee in times of turmoil, and its sustainability is what determines the capacity of nations to weather shocks, from Covid-19 to climate change. As measures of the creditworthiness of this debt, sovereign ratings act as 'gatekeepers' to global markets, significantly influencing the cost and allocation of capital across countries (Cornaggia et al 2017). Sovereign downgrades increase the cost of both public and private debt, influencing overall economic performance and with potentially significant implications for business across all sectors (Chen et al., 2016). If the economic effects of climate change reduce sovereign creditworthiness, there could be indirect impacts on other asset classes. One potential mechanism is

Box 5: The role of sovereign ratings in sovereign debt markets

Investors and market actors interested in 'greening the financial system' face a fundamental challenge: despite growing evidence of the economic consequences of climate change, there is still no agreed strategy for translating environmental degradation into material risks for investors.

Credit ratings agencies (CRAs) work to identify, assess, and quantify risks, offering investors an 'inside-look' into the creditworthiness of sovereign issuers. They help translate relevant information into material risk assessments, and the ratings they assign affect both the cost and allocation of debt finance around the world.

Although sovereign ratings assess the creditworthiness of governments, their influence also impacts private debt markets. The well-known 'ceiling' and 'spillover' effects describe how sovereign ratings effectively impose a cap on ratings in other asset classes, and how sovereign downgrades often trigger corporate and financial institution downgrades (Almeida et al 2017). Such ratings are part of the DNA of global debt markets, affecting banks' capital requirements and determining which bonds institutional investors (pension funds) can hold.

[11] Basel II 'hardwires' ratings into the capital requirements imposed on banks and insurance companies holding specific sovereigns or firms. The rating bins on sovereign claims and their corresponding risk weights are as follows: AAA to AA− (0%), A+ to A− (20%), BBB+ to BBB− (50%), BB+ to B− (100%), and below B− (150%) (Almeida et al., 2017).

the 'sovereign ceiling effect,'[12] whereby sovereign ratings implicitly place an upper bound on ratings in other asset classes (Adelino and Ferrera 2016). A second and closely related mechanism is the observed 'sovereign spill-over effect', whereby sovereign downgrades are quickly followed by downgrades in other asset classes (Augustin et al., 2018). Because both the ceiling and spillover effects are more pronounced for firms and financial institutions whose ratings are closest to the sovereign's, any climate-induced downgrades are likely to have a greater impact on the highest rated firms.

A further motivation for focusing on sovereign ratings is the observation that climate change does not just affect firms individually, it affects countries and economies systemically. Narrow, firm-level assessments that ignore broader climate impacts are necessarily incomplete. For instance, major floods, storms, and fires have impacts across sectors rather than just hitting individual firms. Combined, the sovereign ceiling, spillovers, size of the sovereign bond market, and the indiscriminate nature of climate change means no corporate climate risk assessment is complete without also considering the effect of climate on sovereigns. Finally, because sovereign ratings impact bond yields (i.e., the cost of public borrowing), understanding how they might be affected by climate change is central to long-term fiscal sustainability.

3.2.1. Climate change - a gap in current rating methodology

Existing ratings methodologies do not explicitly incorporate climate-related risks[13]. The methodologies published and applied by leading CRAs largely focus on governance, economic, external, monetary, and fiscal factors, but do not explicitly incorporate climate and nature-related risks, and recent changes have rather taken a broader ESG approach than a climate specific focus. However, it is possible that environmental factors could indirectly affect ratings through their impact on the factors already included in the ratings model. For instance, there is strong evidence that climate change has already raised the average cost of debt in vulnerable developing countries (Kling et al., 2018; Buhr et al., 2018; Volz et al., 2020). Ratings agencies do however recognise that climate change and environmental risks CRAs recognise that climate and environmental factors "could have significant implications for sovereign ratings in the decades to come… [although they] pose a negligible direct risk to sovereign ratings in advanced economies for now, on average, ratings on many emerging sovereigns (specifically those in the Caribbean or Southeast Asia) will likely come under significant additional pressure" (S&P 2018).

Conceptually, incorporating climate- and nature-related risks into sovereign ratings is no different from incorporating geopolitical or other highly uncertain risks. All sovereign methodologies include

[12] For example, following a sovereign downgrade of Italy on the 28th April 2020, Fitch downgraded four Italian banks: UniCredit S.p.A.'s, Intesa Sanpaolo's (IntesaSP), Mediobanca S.p.A.'s , and Unione di Banche Italiane S.p.A.'s (UBI). https://www.fitchratings.com/research/structured-finance/covered-bonds/fitch-downgrades-four-italian-banks-following-sovereign-downgrade-12-05-2020. Similarly, Moody's downgraded 58 sub-sovereign entities after UK's sovereign action 16th October 2020. https://www.moodys.com/touupdated.aspx?isAnnual=true&lang=en&cy=global&ru=%2fresearch%2fMoodys-has-taken-rating-actions-on-58-sub-sovereign-entities--PR_434579

[13] There is some debate over this point. Notably, CRAs claim to have incorporated climate risk into sovereign ratings already. It is conceivable that climate concerns may affect subjective assessments, or that as climate change reduces GDP (e.g. due to catastrophic storms) this GDP loss places downward pressure on ratings. However, this would be a backwards looking analysis and is only capable of telling an economy that the catastrophic hurricane they've just faced is bad for business. Fundamentally, climate risk is not reflected in mainstream credit ratings. Indeed, ESMA, the financial regulator, has not supported the integration of climate risk into sovereign ratings.

efforts to quantify potential liabilities that are hard to anticipate in either scope or timing. For example, contingent liabilities related to bailing out a failing financial sector or strategic or state-owned enterprises are part of the standard repertoire of sovereign risk factors. Similarly, assessing the vulnerability to geopolitical risk is a common feature of established sovereign methodologies. In some cases, a negative adjustment is made to a sovereign's rating for outsized exposure to geopolitical risks, even if those risks have not materialised for many years or decades. CRAs use specific proxies, or simply judgement, to incorporate those risks into the final ratings profile of a sovereign.

A common excuse for excluding climate and nature-related risks from credit risk assessments is that the scientific uncertainty is allegedly too high. In fact, that uncertainty is not fundamentally different from the uncertainties surrounding issues of geopolitical risks or contingent liabilities. What is different, however, is that nature-related risks have emerged only more recently. Methodologies have not yet caught up with this new trend. But that is no valid reason to ignore these emerging risks. At least one leading rating agency has recently acquired a company specialising in assessing cyber risk, another superficially amorphous risk. This research is aimed at helping CRAs to make similar steps into the hitherto underappreciated field of climate and nature-related risks.

The omission of climate and nature risks in sovereign assessments is no small matter. Some estimates suggest that almost half of the world's value added is 'moderately or highly dependent' on nature and its services to humanity (World Economic Forum 2020). That share can be significantly higher for individual countries. Some developing countries are particularly dependent on natural capital. According to World Bank estimates (Johnson et al., 2021), the cost of national GDP loss following a hypothetical collapse of the services hitherto provided for free by nature would exceed the GDP loss caused in 2020 by the Covid-19 pandemic in around half the countries for which data is available. In other words, a collapse of biodiversity would in many instances have a more severe economic impact than what has been arguably the biggest global economic shock in living memory. The pandemic has also been the biggest single trigger for an unprecedented wave of sovereign downgrades during 2020 (Tran et al., 2021). A pandemic is impossible to predict for rating agencies, both in epidemiological and geographical scope. It would therefore be unreasonable to expect a quantification of pandemic risk in sovereign risk methodologies to be applied to individual issuers. The risk of climate change, on the other hand, can be more precisely quantified and geographically localised. Given the potential size of the related economic risk for individual sovereigns, overshadowing anything so far observed in peace times, the inclusion of nature risks into sovereign risk frameworks is not only expedient, but inevitable.

4. Incorporating climate change into sovereign ratings in the Caribbean

4.1. Sovereign ratings estimation

The effect of climate change on sovereign ratings is likely to be mediated through a weaking of the fundamental factors which determine sovereign creditworthiness, "including economic, external, fiscal, monetary and institutional assessments" (S&P 2015a). The available evidence on the effects of climate change on sovereign creditworthiness is that high climate vulnerability and low resilience increase sovereign borrowing costs, especially for lower income countries (Beirne et al., 2021; Kling et al., 2018). But rising costs are also found in developed countries (Painter 2020; Zenios 2021).

IMF (2020) use OLS and ordered response models to regress past sovereign ratings on climate vulnerability, resilience, and the usual macroeconomic indicators for a panel of 67 countries between 1995 and 2017. They find a positive statistically significant effect of climate resilience on ratings, but only mixed results for vulnerability. We advise caution in interpreting these results for several reasons. Many of the countries in their sample were not rated by CRAs until the mid-2000s and may not have many ratings events in the panel. Moreover, the effect of climate change over the period 1995 – 2017 is likely to be small compared to what is expected over the coming decades. It could therefore be difficult to identify an appropriate signal of climate-specific impacts on ratings in the past. More importantly, their approach only considers the effects of climate change on ratings through climate vulnerability and resilience, but ignores the effect of climate change on GDP per capita, GDP growth, or indeed any of the other macroeconomic variables in their model.

One of the first forward looking pieces (S&P 2015b) highlighted that "sovereigns most vulnerable to natural hazards are likely to be small island states with next to no 'geographical diversification' and a narrow economic base. Countries in the Caribbean are thus among the most disaster-prone in the world in terms of incidence, percentage of population affected, and relative extent of damage" (p.4). Subsequent simulations showed that the effects of natural perils such as tropical cyclones (storm surges) and floods on the economic activity ad credit of the Caribbean are amongst the most severe (S&P 2015a). The study finds potential direct economic damages of over 1 percentage point increase in value compared to non-climate scenario for sovereigns such as The Bahamas, Barbados, and Jamaica. The projected additional negative ratings impact for these sovereigns up to 2050 was estimated at almost 0.3 notches compared to the non-climate-change scenario (p.11).

Our approach differs in two ways from S&P's studies. Firstly, we do not focus on a narrow selection of natural perils, but instead estimate the wide-ranging effects of climate change on macroeconomic aggregates such as GDP per capita, growth, and other governance performance indicators which take part in the rating assessment. By applying the most up to date scientific modelling approaches, we can translate the changes in temperature and precipitation into the expected changes in GDP outcomes across nations under various climate scenarios. This allows us to simulate future credit ratings with scientific rigour. Secondly, we are able to provide simulated results for any year from 2030 – 2100, meaning the research can be used for economic analysis in the short- and long-run. Finally, our modelling approach enables us to incorporate economies that have never been studied before in climate and credit ratings research. For example, we are the first to not only project ratings, probabilities of default, cost of financing due to climate for all six Caribbean sovereigns in the sample, but for the first time estimate the sovereign rating for Guyana.

4.1.1 Non-technical description of the method

In this section we outline the methodology for estimating the impact of climate change on sovereign credit ratings of the Caribbean. Our conceptual framework builds on that of Klusak et al. (2023) and focuses on 'soft-linking' climate science with climate economics, leading sovereign credit rating methods which are then translated into additional costs of interest on public debt. Our goal is to remain as close as possible to climate science, economics, and real-world practice in the field of sovereign credit ratings. To the best of our knowledge, Klusak et al. (2023) were the first to simulate the effect of future climate change on sovereign credit ratings, and our approach enables us to evaluate these impacts under various policy and warming scenarios. This process is summarised in Figure 5.

Our model makes use of a machine learning technique referred to as random forest classification. Our modelling approach is split into three steps. In step 1, we collect macroeconomic data for a range of

countries and their associated credit ratings released by S&P between 2015-2020[14]. In this step we try to 'hack' the ratings model by training an algorithm on the past ratings to maximise its predictive accuracy. Our ratings prediction model is parsimonious, incorporating just six macroeconomic indicators[15]. This approach is motivated by a desire to avoid overfitting, and most importantly, to ensure our model inputs remain as close as possible to the underlying climate science and economic models. This process enables us not only to replicate the past ratings with high accuracy but gives high predictive capacity to make predictions about credit ratings with new data in step 3. Thanks to the learning capacity of our algorithm and a big data history globally we are able to estimate ratings of sovereigns which previously have not been rated (e.g., Guyana).

In step 2, we combine climate economic models and S&P's own natural disaster risk assessments to develop a set of climate-adjusted macroeconomic data (government performance variables) to feed the ratings prediction model created in step 1. First, we adjust our macroeconomic data, which is considered crucial in predicting credit ratings historically, to account for climate change using climate economic models. This step involves a complex macro econometric modelling approach described in Kahn et al. (2021). Kahn et al. (2021) link deviations of country-specific climate variables (temperature and precipitation) from their historical norms to growth in real output per capita. Their approach reveals country-level climate impacts and explicitly model changes in the *distribution* of weather patterns (that is, not only *averages* of climate variables, but also their *variability*). For these reasons, we utilise their results to adjust two of the ratings factors in our model for climate change: GDP and GDP growth. The detail available in Kahn et al. (2021) enables us to provide details results under three warming scenarios (known as Representative Concentration Pathways, or RCPs). First we consider RCP 2.6, which describes a future that largely aligns with meeting the goals set out in the Paris Climate Agreement and limits warming to less than 2°C. Second, we consider RCP 8.5, which describes a future characterised by higher emissions and warming of about 4.5-5°C by 2100. Finally, we acknowledge and incorporate recent climate and economic research which demonstrates: (i) that as the average temperature rises, so does the volatility of temperature, and (ii) that the economic costs of climate change rises even more as temperature becomes more volatile. This enables us to consider a third scenario, RCP 8.5 + volatility, which describes a high emissions world with rising average temperature and rising variability of temperature. Refer to Appendix 7.3 for technical description.

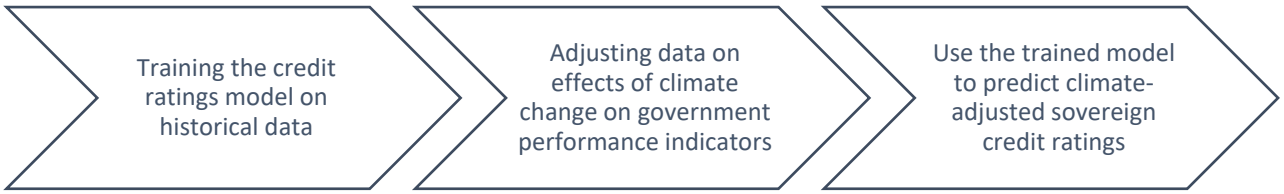
Of course, sovereign ratings encompass more information than simply GDP level and its growth. They incorporate a wide range of objective macroeconomic data and subjective assessments by rating agencies. For example, sovereign ratings include a range of government performance indicators including net general government debt/GDP, narrow net external debt/current account receipts, current account balance/GDP, and general government balance/GDP. Although the science, economics, and politics of climate change are widely studied, we do not have a reliable source of information on how climate change will impact every variable included in the sovereign ratings methodology. To construct climate-adjusted versions of the four government performance variables, we construct statistical models based on data from S&P's own assessments (see Appendix 7.4 for details).

[14] This time horizon excludes the 2008-2009 financial crisis, the subsequent European debt crisis, and the Covid-19 pandemic. This is deliberate. It is precisely because these events had significant impacts on sovereign ratings and debt markets that we want to exclude them from our sample. Including them would confuse their turbulence with that which can be attributed to climate change. At this point in the modelling exercise, our sole objective is to maximise the predictive accuracy of the model. The procedure is explained in Klusak et al. (2023), including the fact that including 'noisy' years in the model *reduced* predictive accuracy.

[15] There are three core criteria for inclusion in our model. Variables must be: (i) relevant to sovereign credit ratings, (ii) there must be a scientific and economic evidence base for adjusting the variable to reflect climate risk, and (iii) data must be available for a broad range of countries. These three criteria exclude some potentially important ratings factors, including default history (in this instance because there is no scientific or economic explanation of how default history changes with climate).

Finally, in step 3 we feed our newly created climate-adjusted macroeconomic indicators to our sovereign ratings model to simulate the effect of climate on ratings. For comparability with the literature and to demonstrate the effect of strict climate policies that are consistent with meeting the Paris Agreement, we present results under four warming scenarios: RCP 2.6, RCP 8.5, and both of these are estimated in different time horizons starting from 2030 up to 2100.

Figure 5: Model building and prediction process

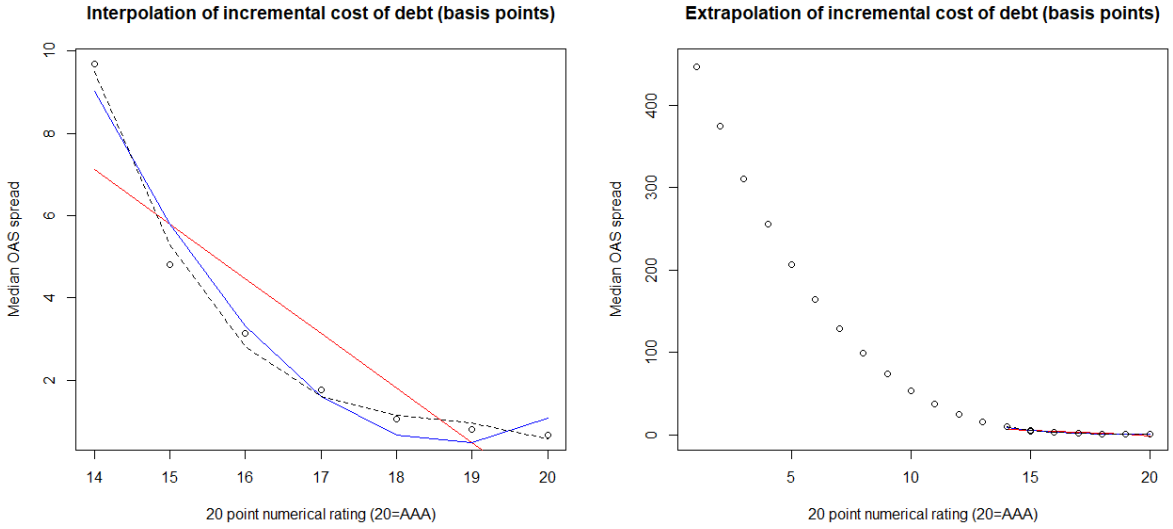


4.2. Cost of debt

Once we obtain the climate-adjusted credit ratings we can translate them into additional costs of borrowing of sovereigns and corporates. Our method of calculating cost of debt relies on option-adjusted spreads. This data provides the interest cost for each rating category applicable to sovereigns, over and above the risk-free rate. This data, taken from the Federal Reserve, provides us with the additional interest cost for AAA through to CCC. Here we take the spread increase for the downgrade we estimate in an earlier step and multiply it through by gross sovereign debt. For the spreads we take the median spread for the ratings given (which vary between AAA to CCC), which allows us to use a value slightly lower than the mean, revealing a lower bound. We then interpolate the data to produce a function which will be the best at describing a relationship between ratings and spreads (namely we fit a 3rd level polynomial; see the left panel of Figure 6). Once that function is established, plug in the relevant estimated downgrades under each scenario.[16] Finally, we calculate the difference in spreads between the scenarios, which represent an increase in the cost of debt due to climate change. Cost of debt amounts to the change in the spread divided by 10,000 and multiplied by the amount of outstanding debt. Additionally, since sovereigns impose a direct ceiling and spill over onto other assets classes incorporated in the country (banks, corporations), we are able to translate the effect of sovereign changes into corporate cost of debt. Taking data on outstanding corporate debt accessed through the Bank of International Settlements (BIS), we produce a similar calculation for the impact these downgrades could have on corporate debt within the country.

[16] Note, we extrapolate the values of the ratings scale which are not observed in our dataset using this function (Figure 6 to the right).

Figure 6: Interpolation and extrapolation of incremental cost of debt



Notes: This figure presents how we interpolate (extrapolate) the cost of debt function using our data. The left panel plots median OAS spreads (vertical axis) against each rating level (horizontal axis). We fit polynomials of increasing order until we find a function that best describes the spreads. The right panel plots the exponential incremental rise in the OAS spread as we move down the ratings scale (from right to left).

4.3. Probability of default

The relatively low ratings found across our sample (see Section 2.2.2) suggest that our results should be considered lower-bound estimates. Ratings are an ordinal rather than a cardinal ranking of credit risk. Credit risk does not rise and fall proportionately as we move along the rating scale.[17] Instead, as ratings move down the scale, default probabilities rise exponentially. For historical reasons (initially only highly creditworthy issuers sought ratings) there is far more granularity at the top of rating scale than at the very bottom. In other words, a sovereign with a very low rating in the B category does not have much further to fall, even if credit fundamentals deteriorate (for numerical interpretation of ratings scales see Appendix 7.5). That is why ratings tend to be stickier in the B category.[18] It takes a bigger shift in fundamentals to move these rating categories than others. This can explain why sovereigns starting off in the B category might appear to be better shielded from downgrades.

To partly correct for this technical bias that underestimates the impact on creditworthiness for lower-rated sovereigns, we convert the alphabetical ratings into empirically observed probabilities of default (PD). Rating agencies publish on an annual basis default and transition statistics for all asset classes, including sovereigns. In those publications the agencies described how the ratings have performed over time. In doing so they apply different time horizons, with five and 10 years being the most commonly used.

[17] This implies that the creditworthiness does not move linearly with the probability of default. Therefore, if Country X is downgraded by one notch it does not infer an equivalent effect on probability of default to what Country Y might experience.

[18] According to transition data by S&P Global (2021b, Table 39) spanning 1975-2020, 17.1% of all sovereigns rated B-, B, or B+ still had the same rating 10 years later. That proportion is lower for sovereigns rated in other categories except for the ones at the top of the scale. The corresponding numbers for BB, BBB, and A are 10.2%, 15.8% and 14.3%, respectively.

4.4. Data sources

This section outlines the data sources used to simulate credit ratings, default probabilities, cost of borrowing, and tourism losses. Where the project team has estimated or simulated data, the technical description of these processes is available in Section 7. We begin by describing the ratings data used to construct and calibrate the ratings prediction model (Section 4.4.1) based on Klusak et al. (2023). Section 4.4.2 describes how these data are adjusted to reflect the physical and transition risks from climate change in the region, based on Kahn et al. (2021), S&P (2015), Klusak et al. (2023), and the authors' own calculations.

4.4.1 Credit ratings data

Historical sovereign long-term foreign currency ratings are obtained from S&P's Ratings Direct. Following the procedure developed by Klusak et al. (2023), we use six macroeconomic indicators to reconstruct ratings:

- Current account balance / GDP
- Net general government debt / GDP
- General government balance / GDP
- Narrow net external debt / current account receipts (CARs)
- Real GDP growth
- GDP per capita

All six variables have been collected from Ratings Direct Sovereign Risk Indicators platform for The Bahamas, Barbados, Jamaica, Suriname, and Trinidad and Tobago between 2015-2020.

One exception to this procedure is the production of results for Guyana. Guyana is currently un-rated and access to data on their performance variables is limited. All variables except Narrow net external debt to CARs are collected from the IMF WEO database.[19] For General government balance to GDP, we take General government revenue, and subtract General government total expenditure to GDP using IMF data. Because the IMF does not provide a measure of Narrow net external debt to CARs for Guyana, we use random forest imputation. This technique leverages the methodology we employ for predicting credit ratings in our model to predict missing values in our dataset. The process constructs a random forest model from the complete data and uses this to predict the missing values. We make use of the algorithm designed and discussed by Stekhoven (2012).

5. Results

5.1. The physical costs of climate change

As described in Klusak et al. (2023), country-specific projections of climate-adjusted GDP and GDP growth rates under varying warming scenarios are taken from Kahn et al. (2021). They develop a stochastic growth model that links deviations of country-specific climate variables (temperature and precipitation) from their historical norms to real output per capita growth. Analysing data between 1960 and 2014 across 174 countries, they find that persistent deviations of temperature from the country's historical norm reduces per capita output growth, amounting to around 7% reduction in gross world product by 2100 in the absence of mitigation policies. However, these losses are unevenly distributed across countries. These results can be considered a lower bound estimate of the country-specific physical costs of climate change that can be expected under a range of warming scenarios.

[19] World Economic Outlook Database: October 2021 (imf.org)

The Kahn et al. (2021) model also enables us to go beyond temperature *levels* to examine how changes in the *volatility* of temperature – the height of the highs and depth of the lows – affects GDP losses by country. This is an important scientific innovation, because as temperature *levels* rise, so does this *volatility,* and with it, the physical costs of climate change. On average, incorporating the effect of the effect of increasing temperature volatility increases the global losses to 13% of gross world product by 2100.

We examine and report results for the GDP losses arising from the physical impacts of climate change under three warming scenarios, RCP 2.6, RCP8.5, and RCP 8.5 (Vol)[20]. The RCPs were developed by the IPCC and the international climate science community to facilitate benchmarking and comparison across models. In simple terms:

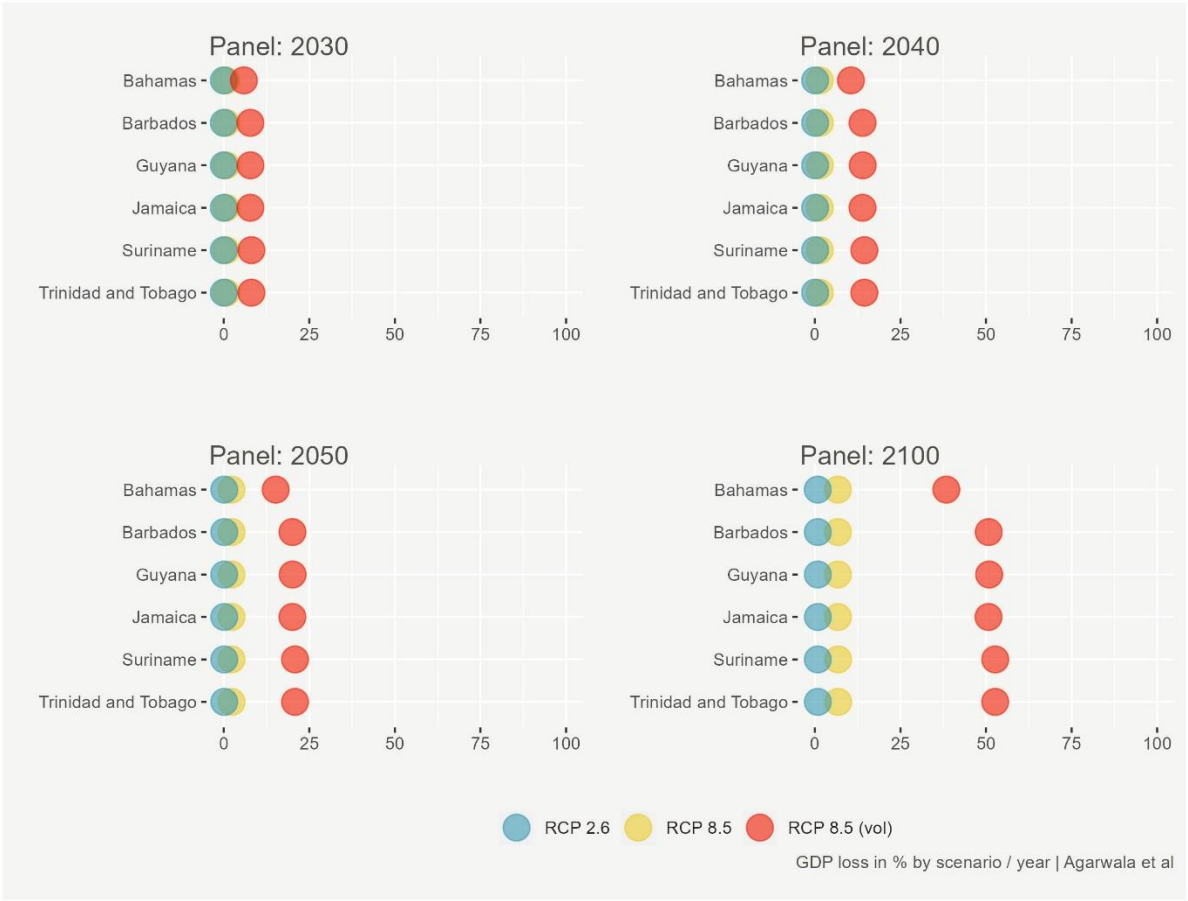
- **RCP 2.6** corresponds to a future in which the global community meets the commitments under the Paris Agreement and warming is limited to below 2°C over pre-industrial levels.
- **RCP 8.5** is often considered a 'worst case scenario' in which emissions continue to grow and warming rises to 4.5°C above pre-industrial levels by 2100.
- **RCP 8.5 (vol)** is a bespoke scenario created by Kahn et al. (2021) and Klusak et al. (2023). It is identical to RCP 8.5, except that it additionally allows for the volatility of temperature to rise commensurately with the level of temperature, and for the added costs arising from this volatility to be reflected in GDP losses, ratings changes, default probabilities, and the cost of sovereign borrowing.

Figure 7 shows the percentage loss of GDP by country arising from the physical impacts of climate change under each scenario, by 2030, 2040, 2050, and 2100 as estimated by Kahn et al. (2021). A notable feature is that if the global community meets the Paris Agreement and limits warming to below 2°C, the GDP losses associated with the physical damages of climate change will be relatively minor, especially over the long term. This does not mean that these economies are immune to the effects of 2°C warming. Indeed, Section 2 summarizes the economic consequences of climate change that have already occurred, at a level of only 1.11°C compared to the 19th century average (NASA 2023). However, over the long-term it is expected that if no further warming were to occur, countries would increasingly adapt to past warming and the costs of these damages would fall over time. In stark contrast to RCP 2.6, near-term GDP losses are substantial under RCP8.5, especially as increased volatility (RCP 8.5 vol) is considered.

There are some important caveats to these figures. First, there is an ongoing debate within the scientific community over which scenarios are most likely. One school of thought is that the scale of investment in renewable energy is already so large that RCP 8.5 is an unlikely scenario for describing 2100. Indeed, some argue that researchers should stop reporting on it altogether. Another school of thought compares the emissions trajectories described in each scenario with the real-world emissions trajectories observed over recent years. This exercise reveals that the emissions trajectories described in RCP 8.5 are far closer to empirical observation over recent years (a difference of about 1%) than those described by RCP 2.6 (a difference of about 8%). We make no judgement over which scenario is 'most likely to occur'. One potential interpretation is that whilst RCP 8.5 may more closely describe the recent past, the purpose of transition is to bring the global economy more in line with RCP 2.6 over the medium term. Thus, the scenario that best describes today may not be the one that best describes the future.

[20] The abbreviation 'RCP' stands for Representative Concentration Pathway, and describes potential trajectories for the atmospheric concentration of greenhouse gasses. The numbers represent different degrees of 'radiative forcing' – a measure of the difference between the amount of energy entering Earth's atmosphere and the amount that leaves it.

Figure 7: GDP losses (%) by country under each warming scenario by 2030, 2040, 2050, and 2100



A further caveat is that these losses should be considered a lower-bound estimate of the costs of the physical damages from climate change. This is because the data describing the long-run relationship between temperature change and GDP that underpins their model covers 174 countries from 1960 – 2014. Whilst this coincides with a rapid increase in global average surface temperature, it cannot capture fully the potential consequences of future warming, especially relating to runaway sea level rise, political unrest, and mass migration of 'climate refugees'. Each of these would substantially increase the costs of climate change and associated impacts on sovereign debt markets, but cannot be accurately assessed on the basis of existing evidence. Ultimately, this means that both the GDP losses and all simulations of future credit ratings, default probabilities, and costs of borrowing reported here can be considered conservative estimates.

Moreover, the analysis in Kahn et al. (2021) relies on studying growth as a function of temperature deviations from baseline. Under their study, cold countries experience a greater growth impact as a result of temperature increase, because of the heightened rate at which these countries experience warming above their baseline. Therefore, the Kahn et al. (2021) study generally underestimates economic damages to countries that already have a high temperature baseline. The Caribbean region fall within this sample of countries. We address this issue by leveraging the rich data provided by Kahn et al. (2021) to train a K-nearest neighbour model which estimates economic losses given a combination of economic and spatial data. With this combination, relying on nearby countries and similarities of economic condition, we estimate economic damages.

Our estimates of the physical climate damages are given in Table 2. These damages reveal that even under high warming scenarios, climate damages are limited to roughly 2% across the Caribbean region

on average. However, we also show that under an increased temperature variability scenario these losses could exceed 20% by 2050 across some jurisdictions.

Table 2: KNN estimated climate damages

Country	GDP losses (%) RCP 2.6	GDP losses (%) RCP 8.5	GDP losses (%) RCP 8.5 w/variability
Panel A: 2030			
Bahamas	0	-0.007	-0.059
Barbados	0	-0.007	-0.078
Jamaica	0	-0.007	-0.078
Suriname	0	-0.007	-0.081
Trinidad and Tobago	0	-0.007	-0.081
Guyana	0	-0.007	-0.078
Panel B: 2050			
Bahamas	-0.002	-0.023	-0.152
Barbados	-0.002	-0.023	-0.201
Jamaica	-0.001	-0.023	-0.201
Suriname	-0.001	-0.023	-0.208
Trinidad and Tobago	-0.001	-0.023	-0.208
Guyana	-0.001	-0.023	-0.201

Notes: This table presents estimated climate damages using a K-nearest neighbour algorithm under three scenarios. RCP 2.6, RCP 8.5 and RCP 8.5 with temperature volatility. Panel A(B) considers scenario up to 2030 (2050) respectively.

5.2. The transition costs of climate change

The transition risks associated with climate change are notoriously difficult to model. There are several reasons. First, a transition to net zero would so fundamentally transform the structure of the economy that any model capable of credibly describing today's economy cannot also credibly describe a net zero economy. That is, today's models cannot describe the destination we are moving towards. And models that can describe the destination cannot describe how we get there from here. This is largely due to the path dependencies, non-linearities, and tipping points – social, technological, and ecological – that such a transition would require.

A second challenge is that the costs of transition are endogenous to decisions made today. Early investment in decarbonisation and the roll-out of low carbon technologies and business practices can 'jump-start' a green innovation machine, unleashing the dynamics of 'learning-by-doing' that can rapidly reduce costs. One important example of this is the rapid deployment and reduction in costs of renewable energy generation, which have consistently outpaced modelled expectations for nearly a quarter century.

The result of these challenges is that there is no comprehensive economic model of the country-level transition risks associated with climate change. This means that the inclusion transition risks into our analysis necessarily entails stronger assumptions and due caution in interpreting the results.

The IPCC (2022, Ch 15) notes that many small island states are highly dependent on tourism revenues and are increasingly facing "crises associated with climate-related disasters and more recently COVID-19 disruptions of travel" (Sheller, 2020). Here, we exploit the natural experiment imposed by the

COVID-19 pandemic, associated lock-downs, and reductions in international travel to develop a proxy scenario for transition risk across the region. Our scenario is based on the potential impact of a reduction in tourism revenues associated with a combination of climate change, changes in consumer preferences, and the possibility that fuel taxes, 'flight shaming' and international policy lead to substantial reduction in the demand for flights and travel to the region.

There are several pathways through which climate transition risk might affect the region. First, extreme weather events including heat waves and a higher frequency and intensity of storms may shorten the tourist season or damage and ultimately reduce tourism infrastructure (including airports, ports, roads, and hotels). Second, climate change could damage key coastal and coral reef ecosystems that attract tourists. Over and above the direct costs of these damages, the potential shift in foreign demand for tourism away from the Caribbean represents a form of transition risk. Third, further demand reductions could arise due to changes in consumer preferences for long-haul flights, for instance due to 'flight shaming'. Fourth, international policies including carbon taxes or individual carbon budgets could make travel to the region more expensive, thus reducing demand. Finally, Caribbean economies for whom fossil fuel exports represent a significant share of output could see a reduction in resource rents, investment, and employment, as well as an increase in stranded assets.

It is beyond the scope of this research to model each pathway independently, but the turmoil associated with the COVID-19 pandemic offers some insight into the potential effects of a reduction in tourism revenues. Of the countries in the sample, all but one suffered severe economic contractions in the year 2020. Guyana is the outlier, which grew at an anomalous 43% in the year 2020, due to an unprecedented rapid expansion of oil production (World Bank 2023). GDP losses in 2020 are shown in Table 3.

Table 3: GDP losses in 2020, by country

Country	GDP loss
Barbados	14%
Bahamas	23.8%
Suriname	15.9%
Jamaica	10%
Trinidad and Tobago	7.4%

Sources: World Bank (2023).

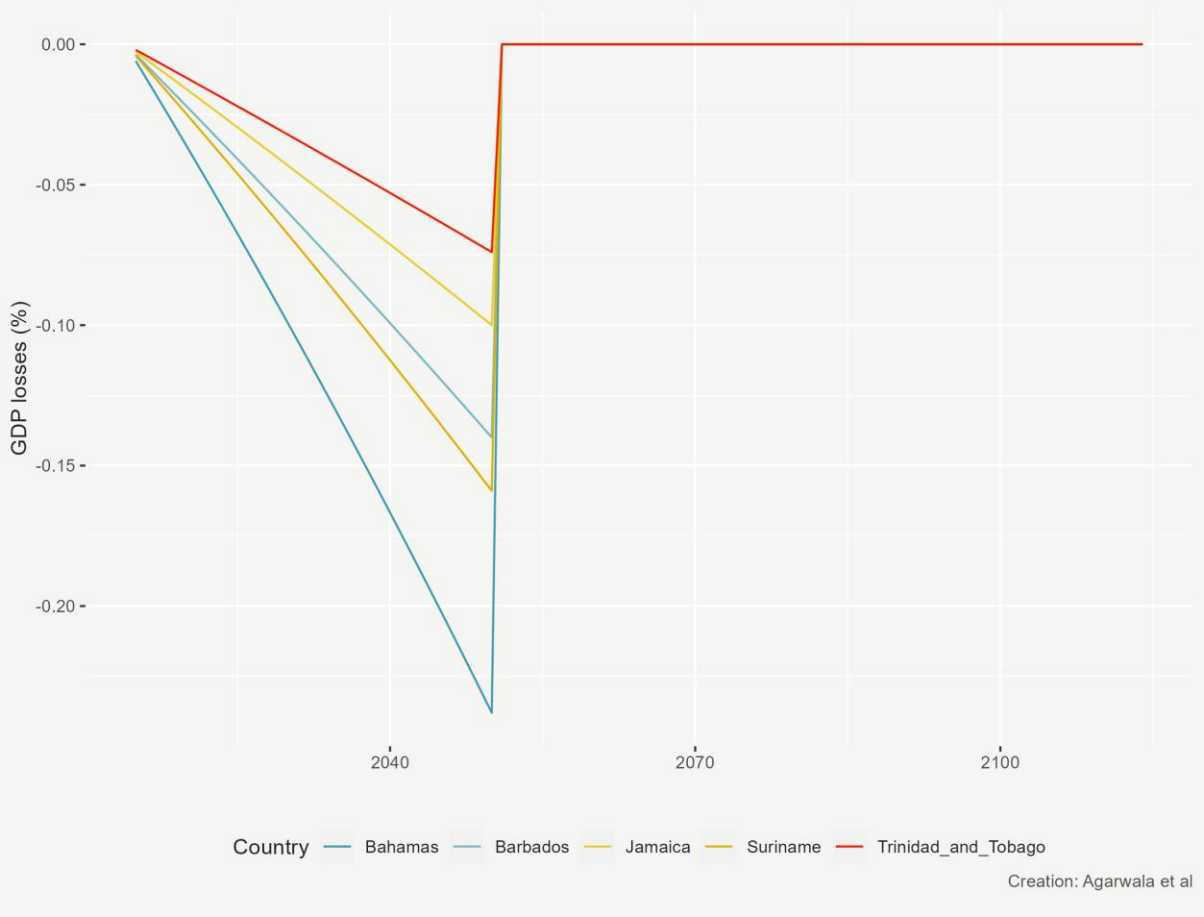
The GDP losses described in Table 3 reflect the combined impact of COVID-19 across all sectors in 2020. To construct an 'upper-bound', worst case scenario, we examine how ratings would be affected if the impact of climate transition on tourism was equal to the impact of COVID-19 on the entire economy in 2020.

The next question is over what time horizon these losses would be realised. Whilst COVID-19 lockdowns and travel restrictions were imposed overnight, it is unlikely that climate policy, consumer preferences, and local conditions would change in such an instantaneous manner. It would therefore be an extreme assumption to impose the same magnitude of losses all in one year. A more reasonable assumption is that these transition risks would manifest over the course of the transition to net zero. We therefore assume that the by the year 2050, the percentage loss in GDP due to transition would equal that of the pandemic in 2020.

It is unlikely that the trend in GDP losses from a reduction in tourism would continue indefinitely. Economies would adapt, resources would be reallocated, and alternative industries or climate-friendly tourism practices would be developed. We therefore assume that beyond 2050, there is no further

loss in tourism revenues. As the IPCC (2022) notes, "tourism system transitions can enable the sector to contribute to climate resilient development pathways through managing climate risks and improving ecological, economic and social outcomes for small islands (medium evidence, high agreement) (Loehr, 2019; Mahadew and Appadoo, 2019; Loehr et al., 2020; Sheller, 2020)." The adaptive capacity and innovations demonstrated by SIDS during COVID-19, moving beyond dependence on 'extractive' international tourism, demonstrate the potential benefits of diversified and sustainable economies (and ecologies) for the enhanced resilience of both human and ecological communities (Sheller, 2020). This scenario for GDP losses is depicted in Figure 8.

Figure 8: A scenario for transition-related GDP losses from tourism



Notes: This figure depicts one potential scenario describing transition-related losses in the tourism sector. It is assumed that transition away from carbon intensive tourism is increasingly costly as net zero policies are pursued to 2050, by which time each country's shortfall in GDP is equal to the 2020 impact of COVID-19. Beyond 2050, it is assumed that there is no further reduction in GDP due to tourism transition.

Prior to the year 2050, we assume tourism losses accumulate in a compounded fashion. We begin in 2015 to remain consistent with the model of Kahn et al. (2021). Some number, X, represents the annual tourism loss. This number is compounded for each period t. This is done in such a way that when we reach t=2050, the losses are equal to those experienced because of the Covid-19 pandemic.[21]

[21] The script for this process has been produced in R, and can be made available upon request to enable full scrutiny.

We justify this by arguing that the heightened physical risks across the region and potential reduction in aviation demand limits or makes tourism prohibitively expensive.

In Table 4 we show how the tourism scenario interacts with the physical risk GDP losses.

Table 4: GDP losses compounded with tourism scenario

Country	GDP losses (%) RCP 2.6 w/tourism	GDP losses (%) RCP 8.5 w/tourism	GDP losses (%) RCP 8.5 w/variability+tourism
Panel A: 2030			
Bahamas	-0.1	-0.106	-0.153
Barbados	-0.06	-0.067	-0.133
Jamaica	-0.043	-0.05	-0.118
Suriname	-0.068	-0.074	-0.143
Trinidad and Tobago	-0.032	-0.039	-0.11
Panel B: 2050			
Bahamas	-0.239	-0.255	-0.354
Barbados	-0.141	-0.16	-0.313
Jamaica	-0.101	-0.121	-0.281
Suriname	-0.16	-0.178	-0.334
Trinidad and Tobago	-0.075	-0.095	-0.267

Notes: This table presents GDP losses compounded by tourism scenario. In columns 1-2 we observe RCP 2.6 and 8.5 respectively, whereas in column 3 we observe RCP 8.5 with temperature volatility. Panel A(B) considers scenario up to 2030 (2050) respectively.

5.3. Sovereign ratings results

This section presents results describing how the tourism scenario interacts with each warming scenario to impact sovereign credit ratings, default probabilities, and the cost of debt across the region. Table 5 reveals estimates of the sovereign downgrades for 2030 and 2050 compounded by the tourism scenarios with RCP 2.6, 8.5 and 8.5 with temperature volatility. Countries' simulated downgrades are generally not parallel to their economic losses. This is because the impact on ratings is non-linear, and largely dependent on the starting point for each country. Thus, ratings impacts appear less severe for sovereigns at the lower end of the spectrum (i.e. non-investment grade). This observation does not suggest that the lowest rated sovereigns have little to worry about when it comes to depletion of their natural resources. As in section 4.3, sticky ratings at the low end of the scale do not imply lower economic or human impacts from climate change, merely that these impacts may not drive ratings.

A corollary of this finding is that the countries that suffer the most severe downgrades are usually those that begin with the highest rating. Figure 9 makes this dynamic clearer by showing the country's starting point and estimated rating under given scenarios. Figure 9 shows that Trinidad and Tobago and the Bahamas generally suffer the worst outcomes from their associated economic damages in terms of their sovereign rating. Results become more severe under RCP 8.5 in 2050, especially for The Bahamas and Guyana. Adding increased temperature volatility (scenario RCP 8.5 +vol) reveals a marked shift in downgrades, with all sovereigns facing a deterioration of creditworthiness. Trinidad and Tobago is the most affected with a downgrade of nearly 9 notches, followed by Guyana with 4 notches, Suriname and Bahamas with nearly 3 notches and Jamaica with 2.4 notches. Although Barbados is the lowest rated sovereign in the sample is not spared and it will receive a downgrade

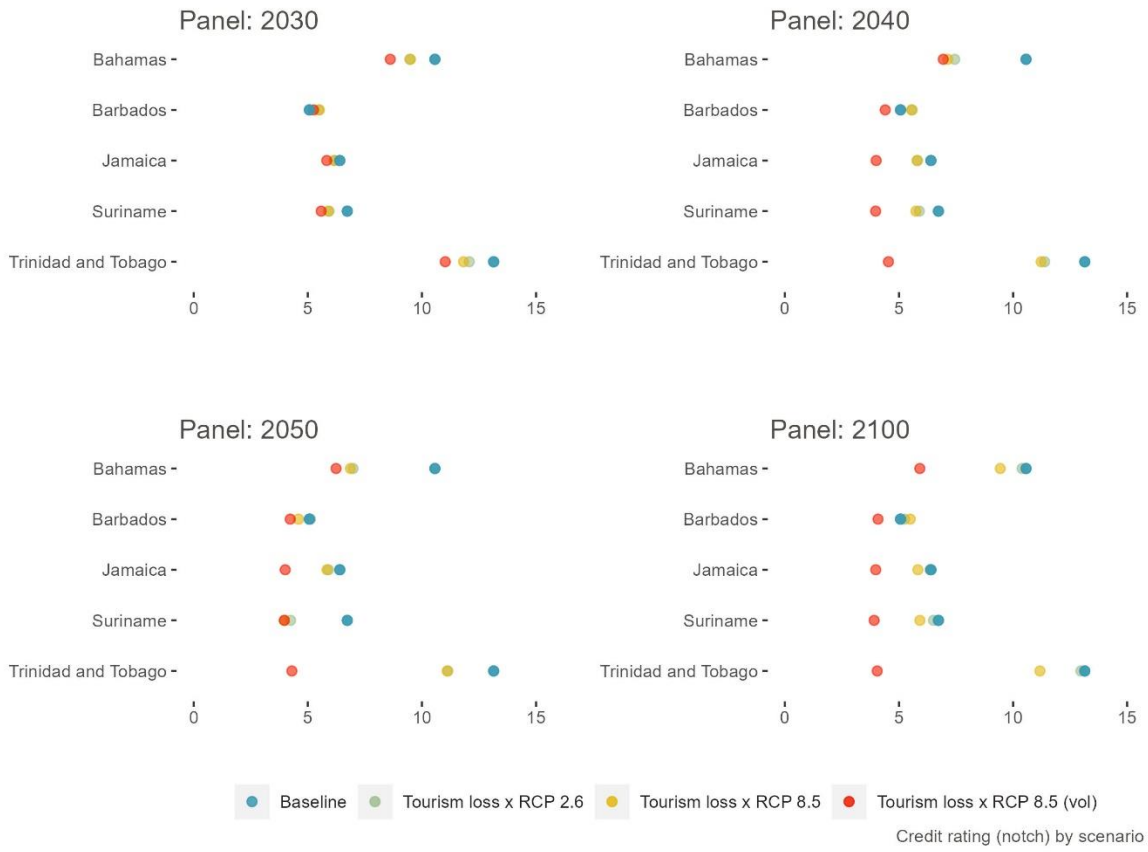
approaching a notch.

Table 5: Sovereign downgrades

Country	Rating downgrade RCP 2.6 w/tourism	Rating downgrade RCP 8.5 w/tourism	Rating downgrade RCP 8.5 w/volatility+tourism
Panel A: 2030			
Bahamas	0.1	0.1	1
Barbados	-0.1	-0.1	-0.4
Jamaica	0	0	0.6
Suriname	0.1	0.2	0.8
Trinidad and Tobago	0.1	0.1	2
Guyana	0.1	0.3	1.7
Panel B: 2050			
Bahamas	0.1	0.6	2.6
Barbados	-0.1	-0.2	0.7
Jamaica	0	0.2	2.4
Suriname	0.1	0.3	2.8
Trinidad and Tobago	0.1	0.7	8.8
Guyana	0.1	0.9	3.9

Notes: This table presents sovereign rating downgrades associated with climate change under various scenarios. In columns 1-2 we observe RCP 2.6 and 8.5 respectively compounded by tourism scenario. In column 3 we observe RCP 8.5 with temperature volatility compounded by tourism losses. Panel A(B) considers scenario up to2030 (2050) respectively.

Figure 9: Simulated ratings by scenario



5.4. Probabilities of default results

Table 6 reveals significant increases in the probability of default (PD) across the spectrum of scenarios. The relationship between ratings and probabilities of default is non-linear (See Appendix 7.4). Countries generally experience minimal economic impact when downgrading from AAA to AA+, whereas in the sub-investment grade category, changes in default probability are very sensitive to changes in the rating. Guyana does not feature in the combination of transition and physical scenarios due to anomalous GDP growth (due to oil production) during Covid-19, meaning their experience is not appropriate for modelling transition risk in this manner. Suriname and The Bahamas face the greatest increases in default probability. Under the RCP 8.5 + vol scenario, combined with tourism losses all five sovereigns would experience increased PD of more than 10% by 2050.

Table 6: Increased probability of default

Country	Increased PD RCP 2.6 w/tourism	Increased PD RCP 8.5 w/tourism	Increased PD RCP 8.5 w/volatility+tourism
Panel A: 2030			
Bahamas	3.17	3.07	6.7
Barbados	-4.5	-4.81	-2.03
Jamaica	2.08	2.15	5.26
Suriname	7.03	7.26	10.42
Trinidad and Tobago	0.67	0.93	2.11
Panel B: 2050			
Bahamas	16.58	17.46	22.68
Barbados	-0.55	5.73	10.46
Jamaica	4.55	5.14	26.81
Suriname	26.28	30.02	30.1
Trinidad and Tobago	1.91	1.96	47.1

Notes: This table presents probability of default results arising due to climate change under various scenarios. In columns 1-2 we observe RCP 2.6 and 8.5 respectively compounded by tourism scenario. In column 3 we observe RCP 8.5 with temperature volatility compounded by tourism losses. Panel A(B) considers scenario up to 2030 (2050) respectively.

5.5. Costs of debt results

Returning to our estimates of sovereign downgrades, induced by physical and transition costs observed in Table 5, we calculate the additional costs of borrowing incurred by sovereigns. Table 7 presents the anticipated increase in interest payments following an option-adjusted spreads methodology (see Section 4.2). This approach reflects a higher cost of debt for an incrementally lower rating. For example, in case of Trinidad and Tobago, which faces a simulated downgrade of approximately 9 notches by 2050 (under RCP 8.5 + vol), the knock-on effect on its additional costs of borrowing will be approximately US $450mn. This is followed by Jamaica where a nearly 2.5 notch downgrade is associated with an increase in annual debt service costs of US$ 270mn. Although Suriname experiences slightly more severe downward pressure with nearly 3 notches, the country has significantly lower debt levels. Collectively, climate change will negatively affect borrowing costs across the region. Under the worst-case scenario (RCP 8.5 + vol and tourism losses) by 2050 it will increase interest payments by over US$ 1 bn per year. Although the effect without the volatility under RCP 8.5 is expected to be three times smaller with US$310 ml (Column 3) per year it is not much lower than the aggregate effect under RCP 2.6 (Column 2). This further sheds light on the importance of taking actions early to mitigate the effect of temperatures to align with Paris Agreement's 2C limit, before borrowing costs rise.

Table 7: Increased interest payments

Country	Outstanding debt	Increase interest RCP 2.6 w/tourism	Increase interest RCP 8.5 w/tourism	Increase interest RCP 8.5 w/volatility+tourism
Panel A: 2030				
Bahamas	7.4	0.03	0.03	0.06
Barbados	5.2	0	0	0
Jamaica	11.2	0.02	0.02	0.06
Suriname	1.7	0.01	0.01	0.02
Trinidad and Tobago	9	0.02	0.02	0.04
Panel B: 2050				
Bahamas	7.4	0.14	0.14	0.18
Barbados	5.2	0	0.03	0.05
Jamaica	11.2	0.05	0.05	0.27
Suriname	1.7	0.04	0.05	0.05
Trinidad and Tobago	9	0.04	0.04	0.45

Notes: This table increased interest payments in US$ bn arising due to climate change under various scenarios. In columns 1-2 we observe RCP 2.6 and 8.5 respectively compounded by tourism scenario. In column 3 we observe RCP 8.5 with temperature volatility compounded by tourism losses. Panel A(B) considers scenario up to 2030 (2050) respectively.

6. Concluding remarks

It is likely that political leaders and economic decision makers are already familiar with the importance of credit ratings, the physical impacts of climate change, and transition risks, in isolation. The primary added value of this paper is to consider how these issues interact, and to provide scientifically and economically rigorous simulations of the financial consequences of those interactions. Our research and results lead to a range of important considerations for finance ministers, central banks, and economic policy makers across the Caribbean region.

A general concern across the region is that global scale models are likely to underestimate the economic consequences of climate change in our target economies. Global assessments tend to be biased towards long-term risks that arise along a smooth path with the main economic impacts accruing in the distant future (Trust et al., 2023). But this fairly benign view does not match the observed reality in the region, which is already facing a combination of slow growing risks (such as sea level rise), punctuated by catastrophic climate-related shocks (such as major storms). As a result, economic decision makers in the region may especially benefit from analyses of discrete hazard events, including sectoral impacts, as these could help identify potential priorities for resilience and economic diversification.

Turning specifically to the impacts of physical and transition risk, the results described in Section 5 reveal a challenging story for finance ministries. Even with these conservative, largely lower-bound

estimates, the consequences across the region of a high global emissions scenario are severe. Beyond the human toll, the key implications for finance ministries across the region include:

1. **The importance of global progress on mitigation:** Many of the economies studied here are heavily dependent on tourism, agriculture, and related industries. These are heavily exposed to physical and transition risks from climate change. The increased frequency and intensity of extreme climate events can undermine the capital infrastructure, labour productivity, and global demand for these goods and services. The risks from the global crisis are especially acute in these economies, so championing international efforts to radically and swiftly reduce global emissions remains a primary objective.
2. **Capital markets, exchange rates, and inflationary pressures:** Sovereign downgrades, falling investor sentiment, and the risk of stranded assets arising from climate damages and reduced tourism demand can place pressure on foreign direct investment and foreign exchange earnings. Ultimately, this could lead to difficulties in maintaining currency pegs or lead to depreciation of free-floating currencies, and subsequently inflationary pressures on imports.
3. **Deteriorating investor sentiment and rising borrowing costs:** As investors and ratings agencies increasingly recognise the vulnerability of these economies to climate change, they may expect to extract higher interest rates to cover the additional climate-related risk premium. The combination of falling ratings, rising default probabilities, and increased yield spreads found under higher emissions scenarios can be expected to increase borrowing costs in all studied countries. Our results indicate that under a worst-case scenario, annual interest payments across the six economies we studied could rise by US$ 1 billion. However, this finding is sensitive to the effects of temperature volatility and assumptions regarding the potential decline in tourism revenues.
4. **Reduced fiscal capacity for investing in adaptation and resilience.** Increasing borrowing costs driven by climate change could undermine the ability of governments to invest in adaptation and resilience in the future. This provides further evidence that the net returns to such investments are higher in the near term, to avoid higher borrowing costs in the future.
5. **Diversification presents both opportunities and risks for Caribbean economies:** the transition away from fossil fuels both reduces emissions and improves air quality (with substantial benefits for human health and labour productivity). However, it also reduces important fiscal revenues from fuel duties, carbon taxes, and oil and gas production. Finance ministries should prepare for associated receipts to fall and seek alternative sources of revenue. Beyond carbon, diversification into climate-resilient sectors and industries will be key to reducing vulnerability.

One general lesson that arose during our research was the importance of data quality and availability across the region. Economic statistics are the lens through which we view the economy and are key inputs into sound economic strategy and management. International best practice requires that these should be compiled regularly by politically independent national statistical offices and made easily and publicly available. Doing so improves transparency and accountability, but also facilitates economic modelling and internationally peer-reviewed research. Throughout the project, we found on several occasions that mainstream macroeconomic indicators were unavailable and therefore had to be simulated. Sectoral data would enable economists to be more specific in the identification of risks and opportunities, and offer more targeted policy advice. Finally, these benefits are not limited merely to the management of public finances in the face of climate change. Investing in the statistical infrastructure of nations can benefit all areas of economic policy.

7. Appendix

7.1. Technical description of our method

Random forest algorithms are variously identified as the optimum machine learning technique in the application of credit rating prediction (Ozturk et al., 2016; De Moor et al., 2018; Agarwala et al., 2022; Klusak et al., 2023). Figure A.1 provides an overview of the mechanics of this algorithm. Random forests can be thought of as a collection of decision trees. Decision tree algorithms work through the construction a series of nodes represented by the circles in Fig. A.1. At each node, the algorithm selects the feature which provides the best split of the data. Once the data has been split on the first feature, it then attempts to split the data again such that the resulting splits are as different from the other split as possible, but as similar to each other as possible. This process continues until the data can no longer be split on the features provided.

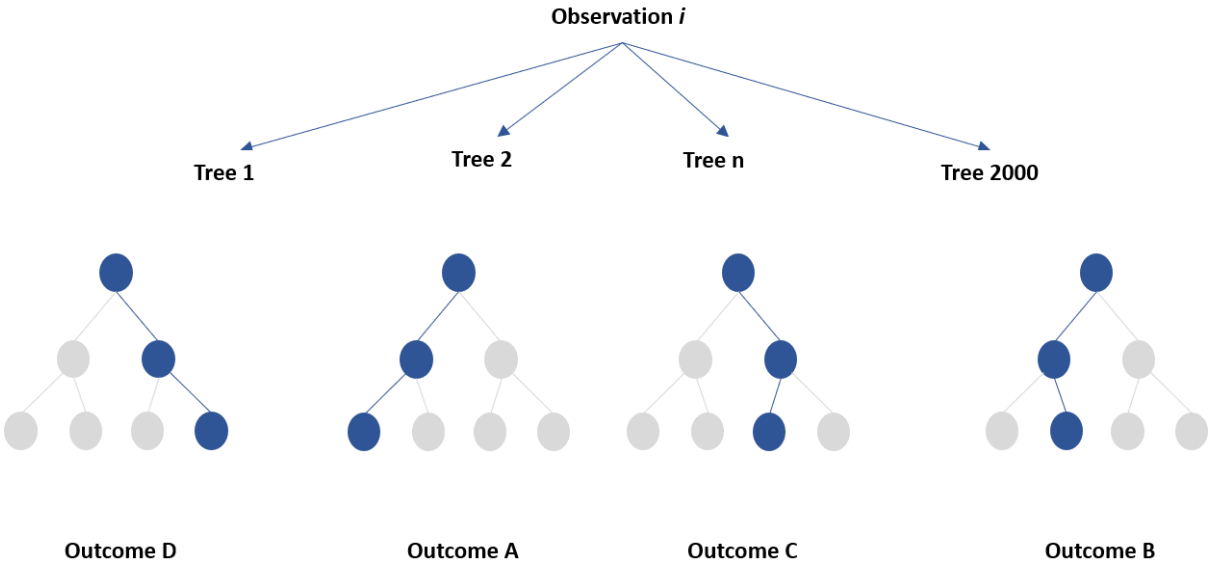
Random forest algorithms can be thought of as extensions of decision trees, but differ in two key ways. First, decision tree algorithms can be highly sensitive to the data on which they have been trained. Random forests improve upon this by enabling each tree within the forest to be trained upon a randomly selected sub-sample of the data, with replacement. Second, in an ordinary decision tree process, the algorithm selects the feature (from all available features) which provides the best split. A random forest algorithm enables the tree to select from only a random subset of features. The intuition behind each of these two modifications is that the prediction made by a forest is an average of the decision made by each tree, and consequently is much more reliable and robust as a collection.

Machine learning methodologies are becoming increasingly popular in the sovereign ratings literature. Research variously employs these techniques to model the impact of the informal economy (Markellos et al., 2016), predict sovereign debt crises (Fioramanti 2008), provide accurate predictions of credit ratings (Bennell, 2006; De Moor et al., 2018; Ozturk et al., 2016; Van Gestel et al., 2006) and explain variance in ESG ratings (Berg et al., 2022). Evidence across the literature supports the view that machine learning techniques outperform traditional parametric approaches in each of these applications. Furthermore, in applications of rating prediction, research reports an improvement of accuracy of approximately 30% above parametric approaches (De Moor et al., 2018; Ozturk et al., 2016). This research supports the use of random forest techniques in ratings prediction application.

This approach differs from the existing literature in one primary way. That is, our goal is to estimate sovereign credit ratings in various climate change scenarios. A common theme throughout the literature is the inclusion of a wide range of determining variables. Inclusive amongst these are economic indicators, trade relations, and measures of institutional quality. In our application, we only make use of variables which we can readily predict under climate change scenarios. As such, we sacrifice some predictive capacity in order to stay as close to the climate research as possible.

Since some of the metrics are not quantifiable and due to proprietary rights weights of the exact (numerous) variables are not known it is difficult to closely replicate the rating. Because sovereign debt has a pronounced economic and financial effect many researchers attempted to find an exhaustive suite of sovereign rating determinants using publicly available information to then mimic and forecast them into the future.

Figure A.1: Random forest classification process



There are four central benefits behind the implementation of a random forest model over other techniques. First, we implement the above-described process thousands of times with slightly modified versions of the original data set each making use of a varied pool of the original six variables. This means that our model, which we later use for prediction, will perform much better when presented with new data. This training of our model adds precision to our estimates that no parametric approach such as regression can offer. Second, this approach enables us to model non-linearities with greater ease. Rating data is peculiar as it is discrete in nature (alphabetical ratings are translated into numerical scale such as the one we are using AAA=20, AA+=19, SD=1; with the AAA being the highest creditworthiness to SD being the lowest). Incremental shifts through the rating scale do not represent equally meaningful changes in creditworthiness. For instance, if *Country X* moves from one high grade rating to another on the scale (e.g., AAA to AA+), this change would not be comparable to a situation where *Country X* moved from a lower medium grade to a non-investment grade (BBB- to BB+).[22] Machine learning ultimately captures the dynamics of our variables with great accuracy and realism. The third advantage of this approach relates to the fact that sovereign credit ratings are not characterised by the same distributional properties we may observe in other variables. The case is that often far more observations are found at the top-end of the ratings scale than throughout the rest of the rating categories. These features make linear modelling of credit ratings difficult and subsequently lead to error. Finally, ratings are not merely quantitative assessments and involve element of subjective component which are difficult to be modelled using traditional approaches. Therefore, using methodology which can handle distributional properties, non-linearities and qualitative components is essential.

7.2. Out of sample tests and sensitivity analyses

Prior to incorporating climate change, a necessary step is to determine the predictive accuracy of the ratings estimation procedure described in Sections 4.1 and 7.1. The core model that underpins this

[22] Note that there is a fine line between investment (BBB-) and non-investment grade (BB+). For a conversion of alphabetical ratings into 20-notch scale see Appendix 7.5.

research has been peer-reviewed and published in a world-leading academic journal as Klusak et al. (2023). This sub-section presents out of sample tests and sensitivity analyses contained in that paper.

Out-of-sample tests are a critical component of machine learning and are used to evaluate model the performance and generalisability. These tests involve assessing how well a model, trained on a particular dataset, can make accurate predictions on new, unseen data that it was not exposed to during training. The objective is to ensure that the model's predictive power extends beyond the initial training data, indicating its robustness and reliability for real-world applications such as our prediction of sovereign ratings.

The steps include:

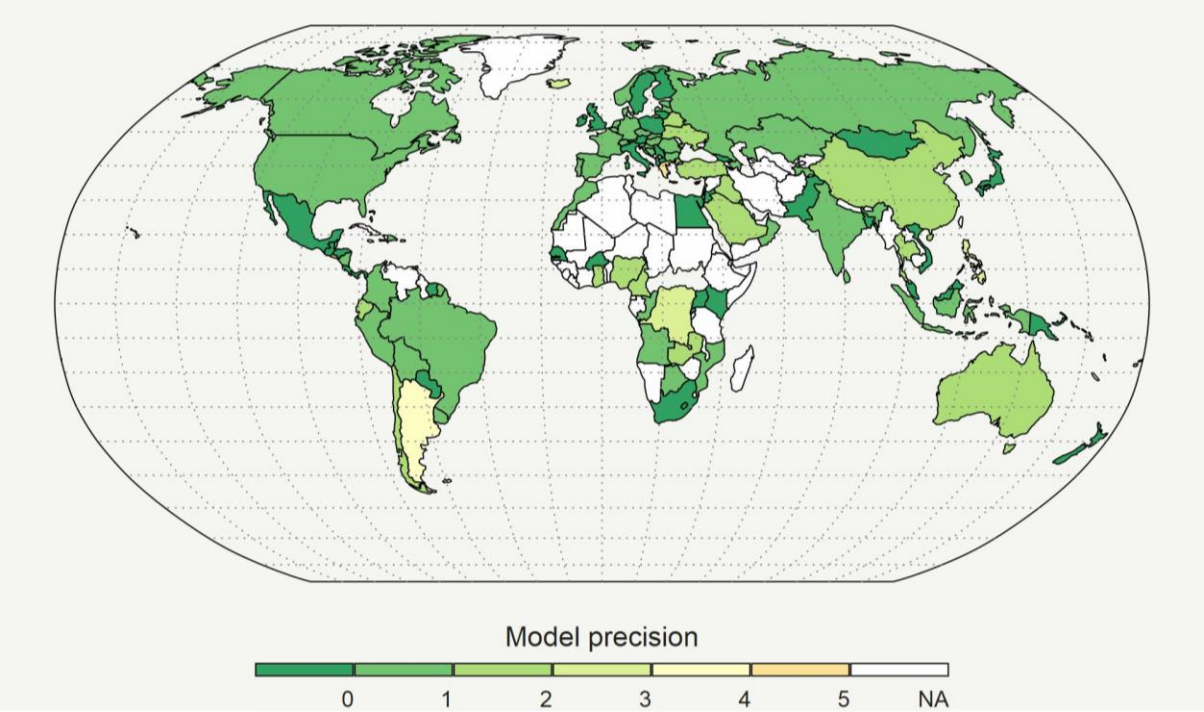
1. Splitting the original dataset into a *training set* and a *testing* or *validation* set. A common split (and the one we used here) is to use 80% of the data in the training set, reserving 20% for validation.
2. Use the training set to train the model, reserving the validation set for evaluating model performance.
3. Use the model developed with the training set to predict the outcomes that should found in the validation set.
4. Compare the model's predictions with the real-world observations found in the validation set.

Using the 80/20 split described above, Figure A.2 presents the headline results from our out of sample tests. Further results and details on model verification are found in Klusak et al. (2023). Recall that the objective here is to use 80% of the data to predict the remaining 20% of ratings, before making any adjustments for climate change. Also recall that the validation set contains observed ratings. The figure compares our predicted ratings against the real-world observed ratings. Dark green demonstrates a perfect match. Lighter colours indicate prediction errors of one, two, … , notches. The results indicate that there is strong predictive accuracy globally, including in hot and cold, developed and less developed, northern and southern, large and small, and coastal and land-locked economies.

In addition to out of sample tests, Klusak et al. (2023) also investigate the sensitivity of their results to the specific climate-economy model used in Step 1 (described in Section 4.1). For reasons described in Section 4.1 of this paper, and in further detail in Appendix C of Klusak et al. (2023), we use Kahn et al. (2021) as the baseline macroeconometric model. However, Appendix C of Klusak et al. (2023) also constructs results using alternative climate-economy models and varying time series of training data. These include models developed by Burke et al. (2015) and Kalkul and Wenz (2020). In both cases, results were qualitatively similar, though due to limitations of the underlying models, more restrictive assumptions were required. Despite this, T-tests indicated that results remained statistically significant at the 1% level. Further detail is available in Klusak et al. (2023) Appendix C. The conclusion from these investigations is that the results described here are broadly upheld even when using not just one, but three unique and independent climate-economy models, developed by different modelling teams, using different methods, and different samples. The stability of our results in the face of these sensitivity checks offers confidence in the appropriateness of our approach.

Validation sets, in the context of a Forest Model, are subsets of that sample of countries-rating used to evaluate project performance and, therefore, to find the parameters that optimize accuracy. 80% of the data is for training, and 20% of the data is for validation.

Figure A.2: Out of sample predictive accuracy of our sovereign ratings model



Notes: This figure 2 depicts out-of-sample predictive accuracy of our ratings prediction model. There is strong predictive accuracy across most of the world, including countries of varying size, latitude, coastal extent, political system, economic structure, and population. Some countries are not rated by S&P and so cannot be predicted.

The accuracy is evaluated in terms of the model successes to predict an observed rating. Therefore, an exact match (rating prediction equals the observed rating) is portrayed in dark green. A one-notch-off is portrayed in lighter green. The figure shows that, except for Argentina, the model does a good job in predicting the rating in all the sample countries.

7.3. Climate economy models

Macroeconomic climate models can be grouped into two categories: global integrated assessment models (IAMs) such as the DICE model for which Bill Nordhaus was awarded the 2018 Nobel Prize in Economics (for review see Diaz & Moore 2017), and a more recent strand of macroeconometric models to estimate the long-run impacts of changes in temperature and precipitation on aggregate output at the country level (Burke et al., 2015; Dell et al., 2014; Kahn et al., 2021). IAMs typically operate at the global scale and are used to evaluate economic impacts of various warming scenarios or climate policies, or to calculate the social cost of carbon for use in social cost-benefit analyses (Stern 2008). Although they have been useful in organising economists' thinking about climate-economic relationships, IAMs are notoriously sensitive to assumptions about discount rates, the shape and parameterisation of damage functions, the latency of greenhouse gases in the atmosphere, the degree of climate sensitivity, and the costs and efficacy of investments in mitigation and adaptation (Diaz & Moore 2017). Whilst some characterize such sensitivities as weaknesses (Pindyck 2013), others find their flexibility useful for integrating advances in economic theory and environmental science into climate policy (Bastien-Olvera & Moore 2020; Dietz & Stern 2015).

The primary limitation of IAMs for the current application – assessing the effect of climate on sovereign creditworthiness – is their high degree of spatial aggregation. Global analyses do not easily

translate into country-level risk metrics.[23] For instance, using DICE, Dietz et al. (2016) estimate the representative 'climate value at risk' of global financial assets to be US $2.5 trillion, but do not comment on the distribution of value at risk across countries. While their results demonstrate that restricting warming to 2°C or less make financial sense for risk-neutral and institutional investors, DICE prevents them from making statements about sovereign risk.

A new body of research that combines climate science with long-run macroeconometric analyses of relationships between temperature and GDP growth at the country-level is emerging (Burke et al., 2015; Dell et al., 2012; Kahn et al., 2021). Such models are increasingly used to assess country-level impacts of climate change and identify country-specific social costs of carbon (Ricke et al., 2018). In an early contribution, Dell et al. (2012) constructed a 53-year, 125 country panel of weather and macroeconomic data to show that warming significantly reduces growth in poor countries by 1.3 percentage points for each 1C increase in temperature, but that the results are not significant in rich countries. Relaxing Dell et al's (2012) assumption of linearity, Burke et al. (2015) find more extreme and unequal values for the impacts of climate change, with substantial winners and losers from climate change, summing to a net 22.6% of gross world product by 2100. Whilst these models can produce estimates of the economic effects of climate change, their macro structure means they cannot comment on the mechanisms through which these impacts are found (Burke et al., 2015). In contrast, Kahn et al., (2021) develop a stochastic growth model that links deviations of country-specific climate variables (temperature and precipitation) from their historical norms to real output per capita growth. Using data between 1960 and 2014 and 174 countries, they find that persistent deviations of temperature from time-varying and country-specific historical thresholds (i.e., the historical norm) reduces per capita output growth, amounting to around 7% reduction in gross world product by 2100 in the absence of mitigation policies (with the global losses being significantly higher at 13% if the country-specific variability of climate conditions were to rise commensurate to temperature increases). Due to their ability to assess country-level climate impacts (and explicitly modelling changes in the distribution of weather patterns; that is not only averages of climate variables that the climate-macro literature focuses on but also their variability), our baseline model uses Kahn et al. (2021) to inform our assessment of the effects of climate change on sovereign ratings.

7.3.1. RCP scenarios

RCPs describe potential trajectories for the annual flow and overall stock of greenhouse gases (GHGs), aerosols, and chemically active gases in the atmosphere to 2100 (Moss et al., 2010). Each RCP is named according to its corresponding level of radiative forcing in 2100. For instance, RCP 2.6 refers to a world of stringent climate policy that results in an end-of-century increase in radiative forcing of 2.6 Watts/m2 and corresponds to temperature rise well below 2°C, relative to pre-industrial conditions. In contrast, RCP 8.5 refers to an end-of century increase in radiative forcing (8.5 Watts/m2) and temperature of 5°C, relative to pre-industrial levels.

In terms of policy, the Paris Climate Agreement pledged to limit average warming to 'well below 2°C' and corresponds most closely to RCP 2.6. In contrast, RCP 8.5 is described as the 'worst case' high emissions scenario (Hausfather & Peters 2020; van Vuuren et al., 2011). For comparability with previous literature, we report results for warming scenarios under RCP 2.6 and RCP 8.5.

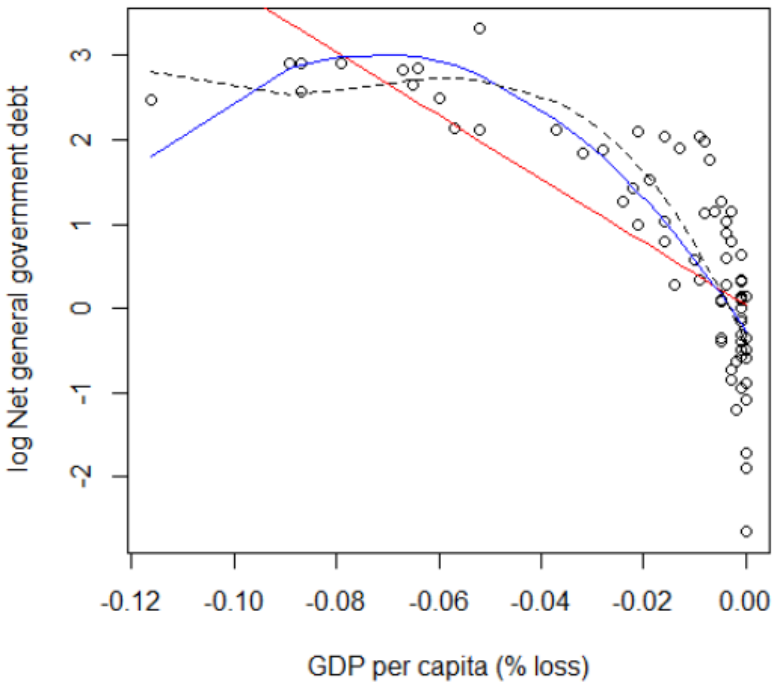
[23] Even the regional version of DICE (called RICE), aggregates to eight regions (Nordhaus & Boyer 2000).

7.4. Constructing climate-adjusted government balance variables

To construct climate-adjusted versions of the four government balance variables in our model, we extrapolate statistical models based on data from S&P (2015b). S&P produce estimates of the effect of various climate and natural disasters on our set of government balance indicators. For instance, using the scenario of a 1 in 250-year earthquake, they estimate the value of the damage caused in terms of impacts on GDP per capita. They repeat this analysis for tropical cyclones, floods, and winter storms. To make use of this data, we combine the tables in S&P (2015b) and assume homogeneity across the various events.

Figure A.3. illustrates the process. Data points combines values from tables in S&P (2015b) describing the relationship between disaster-induced losses in per capita GDP and the log of net general government debt (one of our four government performance variables). To adjust our government performance variables for the effect of climate change, we need a function describing the data in Figure A.3. To derive this function, we first fit a linear model (red line), followed by polynomials of increasing order until ANOVA tests indicate no further significance is achieved. Using the coefficients from the best fit polynomial, we apply GDP losses determined by Kahn et al. (2021) to derive climate-adjusted net general government debt for each country in the sample. We repeat the process for each government balance variable.

Figure A.3: Fitting models of the effect of GDP loss on government performance variables



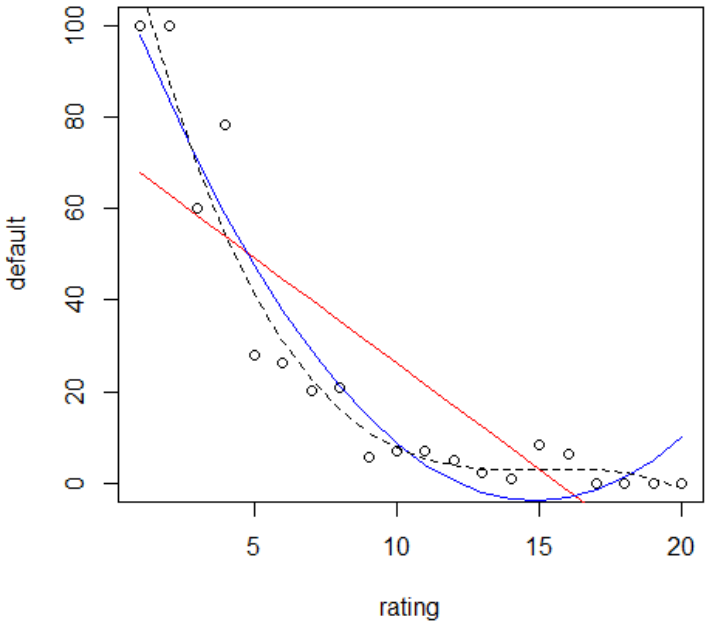
This approach is a simplification, as more sophisticated models of the effects of each type of disaster on GDP may be available. However, we believe this is justified for two reasons. First, in this step we are not interested in the effect of disasters on GDP, but rather the effect of the change in GDP on e.g. net general government debt. Our measure of the effect of climate on GDP comes directly from Kahn et al. (2021). Second, this approach provides practitioner evidence on the expected relationship between GDP losses and these macro indicators, keeping our approach as close as possible to real-world practice in CRAs. Finally, the approach enables us to continue to rely on the same direct links between climate science and climate economics that we use for adjusting GDP and its growth rate.

7.5. Probability of default

A transition table would follow the ratings changes off a static pool of ratings over the defined time horizon, say 10 years. For example, they look at all issues that were rated BBB on 1 January 1990. They then follow this static pool of BBB rated sovereigns to determine, which percentage has defaulted within the 10-year horizon. This exercise is repeated for every year, i.e. 1991, 1992, and so on. At the end they calculate the average of the percentage of defaulted issuers within the time horizon over all those static pools. This results in what is generally referred to as a BBB default probability. This default probability is not the ratio that rating agencies would deliberately target. Instead, it is the outcome of historical observations. Depending on the credit cycle, the percentage of defaulted sovereigns will vary between the different static pools. The BBB default probability is simply the average over longer time horizon. In the case of S&P, the average is calculated for the period 1975 to 2020. Ideally, the default probability would increase as the rating of different static pools declines. Given the relatively small universe of default observations for sovereigns, there are discreet jumps, however. This means that, against expectations, the probability of default could drop if we move down one notch. For classes with much larger number of issuers, such as corporates, such kinks are uncommon.

To correct for such outliers along the rating scale, we complete a best fit interpolation to create a monotonically rising probability of default as we move down the rating scale. Figure A.3. shows the rating on the x-axis and the default probability on the y-axis. The red, blue and dotted black line represent a linear, 2nd order and 3rd order polynomials, respectively. The third order provides the best fit and adding further terms does not provide a statistically significant 'better' fit. The equation representing the third order polynomial interpolation is then applied to assign smoothed (or 'unkinked') default probabilities to each rating level. It is important to understand that the change of the probability of default does not relate to the rating in a linear fashion. The probability of default increases exponentially as we move down the rating scale, and especially so once we cross into speculative grade ratings, i.e., ratings in the BB category or below. With this smooth default probability curve, we can then convert rating changes into changes of default probability at every rung of the rating ladder.

Figure A.4: Relationship between probability of default and ratings



7.6. Converting S&P's alphabetical scale to 20-notch numerical scale

Table A.1: Rating scale

Long-term foreign currency issuer rating symbol	Numerical rating	Rating grade	
S&P			
AAA	20	Prime high grade	
AA+	19	High grade	
AA	18		
AA-	17		
A+	16	Upper medium grade	Investment grade
A	15		
A-	14		
BBB+	13	Lower medium grade	
BBB	12		
BBB-	11		
BB+	10	Speculative	Non-investment grade
BB	9		
BB-	8		
B+	7	Highly speculative	
B	6		
B-	5		
CCC+	4	Substantial risks	
CCC	3		
CCC-	2		
CC	1	Extremely speculative	
C	1		
D/SD	1	In default	

Notes: This table presents S&P alphabetical categories translated into 20-notch scale based on S&P's Global Rating Definitions available from: https://www.standardandpoors.com/en_US/web/guest/article/-/view/sourceId/504352

References

Adelino, M., Ferreira, M.A. (2016). Bank ratings and lending supply: Evidence from sovereign downgrades. Review of Financial Studies, 29(7), 1709–1746.

Agarwala, M., Burke, M., Klusak, P., Mohaddes, K., Volz, U., Zenghelis, D. (2021). Climate change and fiscal sustainability: Risks and opportunities. National Institute Economic Review, 1–19.

Agarwala, M., Burke, M., Klusak, P., Kraemer, M., & Volz, U. (2022). Nature loss and sovereign credit ratings. Finance for Biodiversity Initiative. https://www.bennettinstitute.cam.ac.uk/wp-content/uploads/2022/06/NatureLossSovereignCreditRatings.pdf

Almeida, H., Cunha, I., Ferreira, M.A., Restrepo, F. (2017). The real effects of credit ratings: The sovereign ceiling channel. Journal of Finance. 72, 249–290.

Anthoff, D., Nicholls, R.J., Tol, R.S.J. (2010). The economic impact of substantial sea-level rise. Mitigation and Adaptation Strategies for Global Change, 15(4), 321-335.

Augustin, P., Boustanifar, H., Breckenfelder, J., Schnitzler, J. (2018). Sovereign to corporate risk spillovers. Journal of Money Credit and Banking, 50(5), 857–891.

Australian Bureau of Meteorology and CSIRO (2011). Climate Change in the Pacific: Scientific assessment and new research. Volume 1: Regional Overview. The Pacific Climate Change Science Program (PCCSP), a key activity under the Australian government's International Climate Change Adaptation Initiative (ICCAI), funded by AusAID, managed by the Australian Department of the Environment (DOE) and delivered by a partnership between the Australian Bureau of Meteorology (BOM) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), PCCSP, Aspendale, VIC, Australia, 257.

Bastien-Olvera, B.A., Moore, F.C. (2020). Use and non-use value of nature and the social cost of carbon. Nature Sustainability. 4, 101–108.

Battiston, S., Monasterolo, I. (2019). A climate risk assessment of sovereign bonds' portfolio. SSRN Electronic Journal, 1, 1.

Beating, G., Miguel, L., Hoffman, B., Vogt-Schilb, A. (2022) How much will it cost to achieve climate change goals in Latin America and the Caribbean? IDB Working paper 01310. https://publications.iadb.org/publications/spanish/document/Cuanto-costara-lograr-los-objetivos--del-cambio-climatico--en-America-Latina-y-el-Caribe.pdf

Beirne, J., Renzhi, N., Volz, U. (2021). Feeling the heat: Climate risks and the cost of sovereign borrowing. International Review of Economics and Finance, 76, 920-936.

Bennell, J.A., Crabbe, D., Thomas, S., ap Gwilym, O. (2006). Modelling sovereign credit ratings: Neural networks versus ordered probit. Expert Systems with Applications. 30, 415–425.

Berg, F., K¨olbel, J., Rigobon, R. (2019). Aggregate confusion: The divergence of ESG ratings. Review of Finance. 26(6), 1315–1344.

Bishop, M.L. (2012). The political economy of small states: enduring vulnerability? Review of International Political Economy, 19(5), 942-960.

Briguglio, L., G. Cordina, N. Farrugia, Vella, S. (2009). Economic vulnerability and resilience: concepts, measurements. Oxford Development Studies, 37(3), 229-247.

Brooks, R., Faff, R.W., Hillier, D., Hillier, J. (2004) The national market impact of sovereign rating changes. Journal of Banking and Finance. 28, 233–250.

Buhr, B., Volz, U., Donovan C., Kling, G., Murinde, V., Pullin, N., Lo, Y. (2018). Climate change and the cost of capital in developing countries. Assessing the impact of climate risks on sovereign borrowing costs. Imperial College Business School May 2018.

Burke, M., Hsiang, S.M., Miguel, E. (2015). Global non-linear effect of temperature on economic production. Nature. 527, 235–239.

Cambers, G. (2009). Caribbean beach changes and climate change adaptation. Aquatic Ecosystem Health and Management, 12(2), 168-176.

Campbell, J.D., Taylor, M.A., Stephenson, T.S., Watson, R.A., Whyte, F.S. (2010). Future climate of the Caribbean from a regional climate model. International Journal of Climatology. 31(12),1866–78.

Cashman, A., L. Nurse, Charlery, J. (2010). Climate change in the Caribbean: the water management implications. Journal of Environment and Development, 19(1), 42-67.

Chadee, D., Shivnauth, B., Rawlins, S., Chen, A. (2007). Climate, mosquito indices and the epidemiology of dengue fever in Trinidad (2002-2004). Annals of Tropical Medicine and Parasitology, 101(1), 69-77.

Charlery, J., Nurse, L. (2010). Areal downscaling of global climate models: an approach that avoids data remodelling. Climate Research, 43(3), 241-249.

Chen, S.S., Chen, H.Y., Chang, C.C., Yang, S.L. (2016) The relation between sovereign credit rating revisions and economic growth. Journal of Banking and Finance, 64(March), 90–100.

Cornaggia, J.N., Cornaggia, K.J., Hund, J.E. (2017) Credit ratings across asset classes: A long-term perspective. Review of Finance, 21(2), 465–509.

Diaz, D., Moore, F. (2017). Quantifying the economic risks of climate change. Nature Climate Change. 7, 774–782.

Dietz, S., Stern, N. (2015). Endogenous growth, convexity of damage and climate risk: How Nordhaus' framework supports deep cuts in carbon emissions. Economic Journal. 125, 574–620.

Dietz, S., Bowen, A., Dixon, C., Gradwell, P. (2016). "Climate value at risk" of global financial assets. Nature Climate Change. 6, 676–679.

Dell M, Jones BF, Olken BA (2012) Temperature shocks and economic growth: Evidence from the last half century. Amer. Econom. J. Macroeconom. 4(3):66–95.

De Moor, L., Luitel, P., Sercu, P., Vanpée, R. (2018). Subjectivity in sovereign credit ratings. Journal of Banking and Finance. 88, 366–392.

Eckstein, D., Hutfils, M.L., Winges, M. (2019). Global climate risk index 2019. Who suffers most from extreme weather events? weather-related loss events in 2017 and 1998 to 2017. German Watch. Dec 2018.

ECLAC (2011). An assessment of the economic impact of climate change on the coastal and human settlements, tourism and transport sectors in Barbados. October 4, 2011. LC/CAR/L.336.

Figueroa, J. (2008). The need to strengthen malaria control in the Caribbean in the era of HIV/AIDS. West Indian Medical Journal, 57(5), 425-426.

Fioramanti, M. (2008). Predicting sovereign debt crises using artificial neural networks: A comparative approach. Journal of Financial Stability. 4, 149–164.

Fuchs, A., Gehring, K. (2017) The home bias in sovereign ratings. Journal of the European Economic Association, 15, 1386–1423.

Gero, A., Méheux, K., Dominey-Howes, D. (2011). Integrating community based disaster risk reduction and climate change adaptation: examples from the Pacific. Natural Hazards and Earth System Sciences, 11(1), 101-113.

Greaver, T.L., Sternberg, L.S.L. (2010). Decreased precipitation exacerbates the effects of sea level on coastal dune ecosystems in open ocean islands. Global Change Biology, 16(6), 1860-1869.

Hall, T.C., Sealy, A.M., Stephenson, T.S., Kusunoki, S., Taylor, M.A., Chen, A.A., et al. (2013). Future climate of the Caribbean from a super-high-resolution atmospheric general circulation model. Theoretical and Applied Climatology. 113(1), 271–87.

Hausfather, Z., Peters, G.P. (2020). Emissions - the "business as usual" story is misleading. Nature. 577, 618–620.

IDB (2022). Caribbean Economics: Caribbean Year in Review in Graphs. February, 11(1). http://dx.doi.org/10.18235/0004018

IDB (2014). Background Paper: LAC Small Island development states. Oct 2014.

IDB (2014). Climate Change and IDB: Building Resilience and Reducing Emissions. Regional Study: LAC Small Island Developing States. Published by: Inter-American Development Bank. Washington, DC. https://publications.iadb.org/publications/english/document/Background-Paper-LAC-Small-Island-Development-States.pdf

IIF (2021). Global debt monitor. COVID drives debt surge—stabilization ahead? February 17. https://www.iif.com/Portals/0/Files/content/Global%20Debt%20Monitor_Feb2021_vf.pdf

IMF (2021). Dominica Disaster Resilience Strategy. IMF Country Report No. 21/182. https://www.imf.org/-/media/Files/Publications/CR/2021/English/1DMAEA2021001.ashx#:~:text=1%20In%202017%2C%20Hurricane%20Maria,in%202015%20(Annex%201)

IMF (2020). Feeling the heat: Climate shocks and credit ratings. By Cevik, S., Jalles, J. T. IMF Working Paper: WP/20/286.

IMF (2018). Bracing for the Storm. For the Caribbean, building resilience is a matter of survival. By Otker, I., Srinivasan, K. IMF Financial and Development.

IMF (2004). Macroeconomic implications of natural disasters in the Caribbean. By Rasmussen T.N. IMF Working Paper WP/04/224.

IPCC (2022a). Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: Climate

Change 2022: Impacts, adaptation and vulnerability. Contribution of working group II to the sixth assessment report of the intergovernmental panel on climate change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3–33, doi:10.1017/9781009325844.001.

IPCC (2022b). Mycoo, M., M.Wairiu, D. Campbell, V. Duvat, Y. Golbuu, S. Maharaj, J. Nalau, P. Nunn, J. Pinnegar, Warrick, O. 2022: Small islands. In: Climate change 2022: Impacts, adaptation and vulnerability. contribution of working group II to the sixth assessment report of the intergovernmental panel on climate change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 2043–2121, doi:10.1017/9781009325844.017.

IPCC (2021). Climate change 2021 - the physical science basis, contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, In Press, Published: 9 August 2021.

Johnson, J.A., Ruta, G., Baldos, U., Cervigni, R., Chonabayashi, S., Corong, E., Gavryliuk, O., Gerber, J., Hertel, T., Nootenboom, C., Polasky, S. (2021). Investing in nature can improve equity and economic returns. Proceedings of the National Academy of Sciences, 120 (27) e2220401120.

Jury, M.R., Winter, A. (2010). Warming of an elevated layer over the Caribbean. Climatic Change, 99(1-2), 247-259.

Kahn, M.E., Mohaddes, K., Ng, R.N.C., Pesaran, M.H., Raissi, M., Yang, J-C. (2021). Long-term macroeconomic effects of climate change: A cross-country analysis. Energy Economics. 104, 105624.

Kaminsky, G., Schmukler, S.L. (2002). Emerging market instability: Do sovereign ratings affect country risk and stock returns? World Bank Economic Review, 16(2), 171–195.

Karmalkar, A.V., Taylor, M.A., Campbell, J., Stephenson, T., New, M., Centella, A. et al. (2013). A review of observed and projected changes in climate for the islands in the Caribbean. Atmosfera. 26(2), 283–309.

Kling, G., Lo, Y.C., Murinde, V., Volz, U. (2018). Climate vulnerability and the cost of debt. Working paper, SSRN 3198093.

Kling, G., Volz, U., Murinde, V., Ayas, S. (2021). The impact of climate vulnerability on firms' cost of capital and access to finance. World Development. 137(105131).

Klusak, P., Agarwala, M., Burke, M., Kraemer, M., Mohaddes, K. (2023). Rising temperatures, falling ratings: The effect of climate change on sovereign creditworthiness. Management Science. Article in advance 1–24. ISSN 1526-5501 https://doi.org/10.1287/mnsc.2023.4869

Loehr, J. (2019). The Vanuatu Tourism Adaptation System: a holistic approach to reducing climate risk. Journal of Sustainable Tourism, 28(4), 515–534.

Loehr, J., Becken, S., Nalau, J., Mackey, B. (2020). Exploring the multiple benefits of ecosystem-based adaptation for climate risks and destination well-being. Journal of Hospitality and Tourism Research. 46(3), 518–543.

Mahadew, R. Appadoo, K. (2019). Tourism and climate change in Mauritius: assessing the adaptation and mitigation plans and prospects. Tourism Review, 74(2), 204–215.

Mallucci, E. (2022). Natural disasters, climate change, and sovereign risk. Journal of International Economics, 139, 103672.

McMichael, A.J., Lindgren, E. (2011). Climate change: present and future risks to health, and necessary responses. Journal of Internal Medicine, 270(5), 401-413.

Mimura, N., Nurse, L.A., McLean, R.F., Agard, J., Briguglio, L., Lefale, P., Payet, R., Sem, G. (2007). Small islands. In: Climate change 2007: Impacts, adaptation and vulnerability. contribution of working group II to the fourth assessment report of the intergovernmental panel on climate change [Parry, M.L., O.F. Canziani, J.P., Palutikof, P.J., van der Linden, Hanson, C.E. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 687-716.

Mohaddes, K., Ng, R.N.C., Pesaran, M.H., Raissi, M., Yang, J-C. (2023). Climate change and economic activity: evidence from US states. Oxford Open Economics. 2.

Moody's (2019). Sovereign ratings methodology. Nov 2019.

Moss, R., Edmonds, J., Hibbard, K., Manning, M., Rose, S., van Vuuren, D., Carter, T., Emori, S., Kainuma, M., Kram, T., Meehl, G., Mitchell, J., Nakicenovic, N., Riahi, K., Smith, S., Stouffer, R., Thomson, A., Weyant, J., Wilbanks, T. (2010). The next generation of scenarios for climate change research and assessment. Nature. 463, 747–756.

Mycoo, M. (2011). Natural hazard risk reduction: making St. Lucia safe in an era of increased hurricanes and associated events. Natural Hazards Review, 12(1), 37-45.

NASA Earth Observatory (2023). 2022 Tied for Fifth Warmest Year on Record. Jan 13, 2023.

Nordhaus, W.D., Boyer, J. (2000). Warming the world: Economic models of global warming. Cambridge, MA: The MIT Press.

Nurse, L.A., Mclean, R.F., Agard, J., Briguglio, L.P., Duvat-Magnan, V., Pelesikoti, N. et al. Small islands. In: Bar- ros VR et al., editors. Climate Change 2014: Impacts, adaptation, and vulnerability part b: regional aspects contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change (2014). Cambridge, UK; New York, USA: Cambridge University Press,1613–54.

OECD et al. (2022), Latin American Economic Outlook 2022: Towards a Green and Just Transition, OECD Publishing, Paris, https://doi.org/10.1787/3d5554fc-en.

Oxenford, H.A., Roach, R., Brathwaite, A., Nurse, L., Goodridge, R., Hinds, F., Baldwin, K., Finney, C. (2008). Quantitative observations of a major coral bleaching event in Barbados, South-Eastern Caribbean. Climatic Change, 87(3-4), 435-449.

Ozturk, H., Namli, E., Erdal, H. (2016). Modelling sovereign credit ratings: The accuracy of models in a heterogeneous sample. Economic Modelling. 54, 469–478.

Painter, M. (2020). An inconvenient cost: The effects of climate change on municipal bonds. Journal of Financial Economics. 135, 468–482.

Pappas, G., Papadimitriou, P., Siozopoulou, V., Christou, L., and Akritidis, N. (2008). The globalization of leptospirosis: Worldwide incidence trends. International Journal of Infectious Diseases, 12(4), 351-357.

Pindyck, R.S. (2013). Climate change policy: What do the models tell us? Journal of Economic Literature. 51, 860–872.

Rawlins, S.C., Hinds, A., Rawlins, J.M. (2008). Malaria and its vectors in the Caribbean: the continuing challenge of the disease forty-five years after eradication from the islands. West Indian Medical Journal, 57(5), 462-469.

Ricke, K., Drouet, L., Caldeira, K., Tavoni, M. (2018). Country-level social cost of carbon. Nature Climate Change.

Rhiney, K., Eitzinger, A., Farrell, A.D. (2016). Assessing the vulnerability of Caribbean farmers to climate change impacts: A comparative study of cocoa farmers in Jamaica and Trinidad. In E. Thomas-Hope (Ed.) Climate Change and Food Security: Africa and the Caribbean.

Simpson, M.C., Scott, D., Harrison, M., Sim, R., Silver, N., O'Keeffe, E. et al. (2010). Quantification and magnitude of losses and damages resulting from the impacts of climate change: Modelling the transformational impacts and costs of sea level rise in the Caribbean (full document), United Nations Development Programme (UNDP), Barbados, West Indies.

Sheller, M. (2020). Reconstructing tourism in the Caribbean: Connecting pandemic recovery, climate resilience and sustainable tourism through mobility justice. Journal of Sustainable Tourism, 29(9), 1436-1449.

Scott, D., Simpson, M.C., Sim, R. (2012). The vulnerability of Caribbean coastal tourism to scenarios of climate change related sea level rise. Journal of Sustainable Tourism, 20(6), 883-898

S&P (2023). Trinidad and Tobago. Credit Highlights. Jul 26 2023.

S&P (2021). Default, transition, and rating transition study sovereign default and recovery: 2020 annual sovereign default and rating transition study. Apr 2021.

S&P (2018). How environmental, social, and governance factors help shape the ratings on governments, insurers, and financial institutions. October 23, 2018.

S&P (2017). Sovereign rating methodology. Report, S&P Global Ratings, New York.

S&P (2015a). The heat is on: How climate change can impact sovereign ratings. Nov 2015.

S&P (2015b). Storm alert: Natural disasters can damage sovereign creditworthiness. Sept 2015.

Solano-Rodríguez, B., Pye, S., Li, P. H., Ekins, P., Manzano, O., & Vogt-Schilb, A. (2021). Implications of climate targets on oil production and fiscal revenues in Latin America and the Caribbean. Energy and Climate Change, 2, 100037.

Stekhoven, D.J., Bühlmann, P. (2012). MissForest—Non-parametric missing value imputation for mixed-type data. Bioinformatics, 28(1), 112-118.

Stennett-Brown, R.K., Stephenson, T.S., Taylor, M.A. (2019). Caribbean climate change vulnerability: Lessons from an aggregate index approach. PLOS ONE 14(7), e0219250. https://doi.org/10.1371/journal.pone.0219250

Stern, N. (2008). The economics of climate change. American Economic Review, 98, 1-37.

Taylor, M.A., Centella, A., Charlery, J., Bezanilla, A., Campbell, J., Borrajero, I. et al. (2013). The precis Caribbean Story: Lessons and legacies. Bulletin of the American Meteorological Society. 94(7),1065–73.

Tran, Y., Vu, H., Klusak, P., Kraemer, M., and Hoang, T. (2021). Sovereign credit ratings during the COVID-19 pandemic. International Review of Financial Analysis, 78, 101879.

USGCRP (2018). Impacts, risks, and adaptation in the United States: Fourth national climate assessment, volume II 55 [Reidmiller, D. R., C. W. Avery, D. R. Easterling, K. E. Kunkel, K. L. M. Lewis, T. K. Maycock, B. C. Stewart, 56 D. J. Wuebbles, D. W. Fahey and K. A. Hibbard (eds.)]. U.S. Global Change Research Program, W. D. C. U. S. 57 A.

Van Gestel, T., Baesens, B., Van Dijcke, P., Garcia, J., Suykens, A.K.J., Vanthienen, J. (2006). A process model to develop an internal rating system: Sovereign credit ratings. Decision Support Systems. 42, 1131–1151.

Van Vuuren, D., Edmonds, J., Kainuma, M., Riahi, K., Thomson, A., Hibbard, K., Hurtt, G., Kram, T., Krey, V., Lamarque, J.F., Masui, T., Meinshausen, M., Nakicenovic, N., Smith, S., Rose, S. (2011). The representative concentration pathways: An overview. Climatic Change. 109, 5–31.

Viscidi, L., Graham, N., Madrigal, M., Masson, M., Prado, V.R., Monticelli, J.C. (2020). Electrified islands. The road to e-mobility in the Caribbean. OAS, Inter-American Development Bank, The Dialogue.

Volz, U., Beirne, J., Ambrosio Preudhomme, N., Fenton, A., Mazzacurati, E., Renzhi, N. and Stampe, J. (2020). Climate change and sovereign risk, London–Tokyo–Singapore–Berkeley: SOAS University of London, Asian Development Bank Institute, World Wide Fund for Nature Singapore, and Four Twenty Seven.

Welsby, D., Rodriguez, B. S., Pye, S., Vogt-Schilb, A. (2021). High and dry: Stranded natural gas reserves and fiscal revenues in Latin America and the Caribbean. Inter-American Development Bank, Climate Change and Sustainable Development Sector.

World Bank (2023). World Bank national accounts data, and OECD National Accounts data files. https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2021&locations=GY&start=2011

World Bank (2021). World Bank catastrophe bond provides Jamaica with financial protection against tropical cyclones. July 19, 2021.

World Economic Forum (2020). Nature risk rising: Why the crisis engulfing nature matters for business and the economy. Cologny: World Economic Forum.

World Meteorological Organization (WMO) (2021). New report shows impacts of climate change and extreme weather in Latin America and Caribbean. 17 Aug 2021.

Zenios SA (2021) The Risks from Climate Change to Sovereign Debt in Europe. Bruegel Policy Contribution No. 16/2021, Bruegel.

Annex 505

"Reducing the Cost of Capital – Strategies to unlock clean energy investment in emerging and developing economies", World Energy Investment Special Report, *International Energy Agency,* February 2024

Reducing the Cost of Capital

Strategies to unlock clean energy investment in emerging and developing economies

International Energy Agency

World Energy Investment Special Report

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The IEA examines the full spectrum of energy issues including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, access to energy, demand side management and much more. Through its work, the IEA advocates policies that will enhance the reliability, affordability and sustainability of energy in its 31 member countries, 13 association countries and beyond.

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Table of Contents

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Clean energy investment in most emerging and developing economies has yet to take off: A high cost of capital is a major reason why

How emerging market and developing economies (EMDE[1]) meet their rising energy needs is a pivotal question both for their citizens and for the world. Cost-competitive clean energy technologies open the possibility to chart a new, lower-emissions pathway to growth and prosperity, but capital flows to clean energy projects in many EMDE remain worryingly low. Global clean energy investment has risen by 40% since 2020, reaching USD 1.8 trillion in 2023, but almost all the recent growth has been in advanced economies and in China. EMDE account for around 15% of the total, despite accounting for about a third of global gross domestic product and two-thirds of the world's population. India and Brazil are by a distance the largest EMDE clean energy markets.

All pathways to successful global energy transitions depend on expanding capital flows to clean energy in fast-growing EMDE. With growing international attention to this issue, the International Energy Agency (IEA) was tasked by the Paris Summit on a New Global Financing Pact in June 2023 to make recommendations on how to bring down the cost of capital for clean energy investment in EMDE. This report answers that request, building on previous IEA analysis and on new survey data collected for the IEA's Cost of Capital Observatory project.

Our survey of leading financiers and investors confirms that the cost of capital for utility-scale solar photovoltaic (PV) projects in EMDE is well over twice as high as it is in advanced economies. This reflects higher real and perceived risks in EMDE at the country, sectoral and project levels. An elevated cost of capital pushes up financing costs and makes it much more difficult to generate attractive risk-adjusted returns, especially for relatively capital-intensive clean technologies. As a result, EMDE can end up paying more for clean energy projects or they can miss out altogether. Solar PV plants and other clean energy projects tend to involve a relatively higher share of upfront expenditure and a lower share of operating expenses in total project costs. If countries cannot afford high upfront costs, they can be locked into polluting technologies that might initially be less expensive but require persistent spending on – and combustion of – fossil fuels for their operation.

Country and macro factors are a major contributor to the high cost of capital for clean energy projects, but so too are risks specific to the energy sector

Broad country-related risks and macroeconomic factors typically explain a large share of country-by-country variations in the cost of capital. These include the rule of law and sanctity of contracts, as well as concerns about currency fluctuations and convertibility. As the balance of capital spending on energy in EMDE shifts away from dollarised, globally traded commodities, such as oil, towards clean energy projects that rely on domestically generated revenues, the overall quality and predictability of the domestic business environment become even more important for investors. Mechanisms that mitigate these risks include guarantees against expropriation and facilities to reduce the cost of currency

[1] References to EMDE in this report exclude the People's Republic of China (hereafter, "China").

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hedging. However, over the longer term there is no substitute for efforts to tackle the underlying issues by strengthening national institutions, reducing inflation, and deepening local capital markets and financial systems. EMDE that have successfully scaled up clean energy investment, including India, Brazil and South Africa, have all relied heavily on domestic sources of capital.

There are also project- and sector-specific risks that can be addressed directly by energy policy makers and regulators; these are the focus of this report. In the case of clean energy generation projects in the power sector, key issues highlighted by survey respondents relate to sector regulations, the reliability of revenues – dependent mainly on the off-taker's ability to pay on time – and the availability of transmission infrastructure or land, and how all these issues are defined in contracts. Such project- and sector-specific elements can account for 20-30% of the higher cost of capital in EMDE. This report provides detailed insights into these factors, how they vary across parts of the energy sector, and what can be done to address them. There are plenty of positive examples in EMDE where clear regulation, a vision and intent to move ahead with clean energy transitions, and a readiness to work with the private sector have yielded impressive results.

The required increase in EMDE clean energy investment is huge, but almost all of it involves mature technologies supported by tried and tested policies

From USD 270 billion today, annual capital investment in clean energy in EMDE needs to rise to USD 870 billion by the early 2030s to get on track to meet national climate and energy pledges, and to USD 1.6 trillion in a 1.5-degree pathway. The increases are needed across a range of technologies and sectors, but three areas stand out: almost a quarter of the total clean energy investment over the next ten years goes to utility-scale solar and wind projects, and another quarter is made up of investment in electricity networks and in efficiency improvements in buildings together. A small fraction of the total investment spend – less than USD 50 billion per year – would be sufficient to ensure universal access to electricity and to clean cooking fuels.

The increase in spending is steep but almost all the required EMDE investment is in mature technologies and in sectors where there are tried and tested policy formulas for success. This would give EMDE a firm foothold in the new clean energy economy, with major benefits for energy access and security, sustainable growth, and employment, as well as for emissions and air quality. Only about 5% of the cumulative EMDE clean energy investment needs to 2035 are in sectors that depend on nascent technologies such as low-emissions hydrogen, hydrogen-based fuels, or carbon capture, utilisation and storage.

Key roles for enhanced international support and concessional finance

Investment on this scale will mean scaling up all sources of finance, with a vitally important role for well-coordinated, enhanced international financial and technical support. As part of the global push to expand and improve finance for sustainable development, we estimate that a tripling of concessional funding for EMDE energy transitions will be required to get EMDE on track for their energy and climate goals. Not all projects or countries require this

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kind of support, and it cannot replace needed policy actions or institutional reforms. But, used strategically, it can help countries remove barriers that are slowing clean energy investment – including weaknesses in project preparation, data quality, and energy sector policies and regulation that push up the cost of capital – and bring in much larger volumes of private capital. Targeted concessional support is particularly important for the least developed countries that will otherwise struggle to mobilise capital. Stronger coordination among governments, development finance institutions, private financiers and philanthropies will be essential to help EMDE navigate and understand the different financing instruments, risk-mitigation and credit enhancement tools that can help projects get off the ground.

Lowering the cost of capital by 1 percentage point could reduce financing costs for EMDE net zero transitions by USD 150 billion per year

Our analysis shows that capital costs – e.g. for land, buildings, equipment – are usually the largest single element in total clean energy project costs in advanced economies, whereas in EMDE the largest element is financing costs. Financing costs for utility-scale solar PV projects in EMDE, for example, can constitute around half or more of the levelised cost of electricity. Efforts to decrease the cost of capital in EMDE are not only crucial for investors but also for the overall affordability of energy transitions for consumers. We estimate that narrowing the gap in the cost of capital between EMDE and advanced economies by 1 percentage point (100 basis points) could reduce average clean energy financing costs in EMDE by USD 150 billion every year.

Recommendations on how to bring down the cost of capital for clean energy investment in EMDE

Multiple factors affect the cost of capital and many of the economy-wide risks lie outside the remit of energy decision makers, but the quality of energy institutions, policies and regulations still matters greatly. In this report, we highlight the importance of a clear vision and implementation plan for energy transitions, backed by reliable data and support with project preparation. We underscore the need for enhanced international support and collaboration. Using case studies and EMDE country examples, we also explore in detail some specific risks and applied solutions. Findings are presented here under four headings that reflect recurring themes from our discussions with investors and policy makers: the importance of good policy and regulation, reliable payments, timely permitting and availability of infrastructure, and tailored support for new and emerging technologies.

- **Policy and regulatory requirements** for clean energy projects vary widely across different parts of the energy economy, although a common denominator is the need for regulations to be technically sound, clear and predictable. Regulatory uncertainties in the power sector are a major concern, especially in new areas such as energy storage or privately financed grids. Strong regulatory frameworks for efficiency, including building codes and stringent minimum energy performance standards for appliances as seen in Chile, are a necessary condition to scale up investment in these sectors. South Africa's

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experience with well-designed, regular procurement programmes for renewables has been very effective to jump-start battery storage investment and deployment.

- **Payment and revenue risks** can be offset by wider availability and use of guarantees, alongside efforts to strengthen the underlying financial health of the entities involved. Delays in payment of power purchased by off-takers, generally state-owned utilities, have been a regular concern for investors and financiers of renewable generation projects in EMDE (except for more mature markets that have already seen considerable deployment of solar PV and wind). Greater availability of guarantees that cover such payment delays, which are being introduced in various African countries for example, can help to reduce risks and unlock more investment in countries that are seeking to scale up renewable power. This implies increasing the capital allocated for guarantees by international financial institutions.
- **Timely permitting and co-ordinated build-out of grids** increases the predictability of project timelines and avoids connection delays, a risk that worries investors more and more, including in EMDE with a good track record of clean power projects. In the case of hydropower for example, identifying viable sites and conducting environmental due diligence can cause significant construction delays. Similar issues are highlighted by investors for grids and utility-scale solar and wind, especially in countries with high shares of variable generation. India's experience with solar parks where tenders were put in place with land provided have reduced risks and enabled lower financing costs. Tenders to allocate transmission around green corridors are also on the rise. As the share of renewables increases, it is easier to earmark transmission lines as "green", given these are needed almost exclusively to evacuate existing or expected solar and wind. Their green characteristics can also help attract high levels of private international capital. Bringing in the private sector to build transmission lines through project finance structures (with contracts like those successfully applied in generation), as seen in Brazil and various other Latin American countries, has a proven track record and could be more widely applied.
- **Some new and emerging technologies and sectors require tailored support** to address specific risks, such as the lack of charging infrastructure for electric vehicles or technological risk associated with first-of-a-kind advanced biofuel projects. These sectors will need tailored solutions such as targeted tax credits or first loss guarantees, alongside complementary measures such as consumer access to low-cost auto loans for electric vehicles and pricing reforms that make electricity competitive with (often subsidised) transport fuels. As with other growth markets, governments should consider renewable fuel standards or biofuel mandates such as those applied in Indonesia to provide stable market conditions for investors.

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Unlocking clean energy investment

Why the cost of capital matters

SUMMARY

- Meeting national and global climate goals requires a massive scale-up in clean energy investments in emerging market and developing economies (EMDE). Annual clean energy investment to get on track for a 1.5-degree pathway needs to reach USD 1.6 trillion in EMDE (excluding China) by the early 2030s, up from around USD 270 billion today. These sums are way beyond the capabilities of public funding. All sources of finance will need to grow, but the largest growth will need to come from private sources, backed by strategic and judicious use of international public finance.
- A high cost of capital in EMDE makes it much more difficult to generate attractive risk-adjusted returns, especially for relatively capital-intensive clean energy technologies. Survey data collected by the IEA show that the cost of capital is well over twice as high in EMDE as it is in advanced economies.
- Country and macro risks are the largest contributors to this high cost of capital, but there are also energy sector and project-specific risks that are within the remit of energy policy makers to address. These energy-specific elements are the focus of this report, although efforts in parallel to tackle broader risks, such as currency risk, and to further develop domestic financial systems in EMDE are also essential.
- There is a wealth of country examples showing that predictable clean energy policy frameworks, based on a coherent vision for energy transition investments and finance, are prerequisites for scaling up investment. These are areas where national policy makers in EMDE should take the lead. But much greater international financial and technical support is also required, especially for the least developed countries and nascent markets where technology risks are higher.
- Mobilising private finance at the scale needed will require at least a tripling in international concessional funds to help improve the risk return profile of clean energy projects across the electricity, end-use and low-emission-fuel sectors. An estimated USD 90 billion to USD 110 billion per year in concessional funds is needed to get on a 1.5-degree pathway. These funds can help mobilise private capital in countries and sectors that do not have access to commercial finance.
- Lowering the cost of capital can substantially bring down the overall cost of transitions and reduce the costs paid by consumers. A one percentage point reduction in the cost of capital compared with current levels would save around USD 150 billion in annual clean energy financing costs (representing 20% of annual financing costs) for net zero transitions to 2050. Better risk management through strong policy frameworks and regulation as well as enhanced deployment of de-risking instruments are key.

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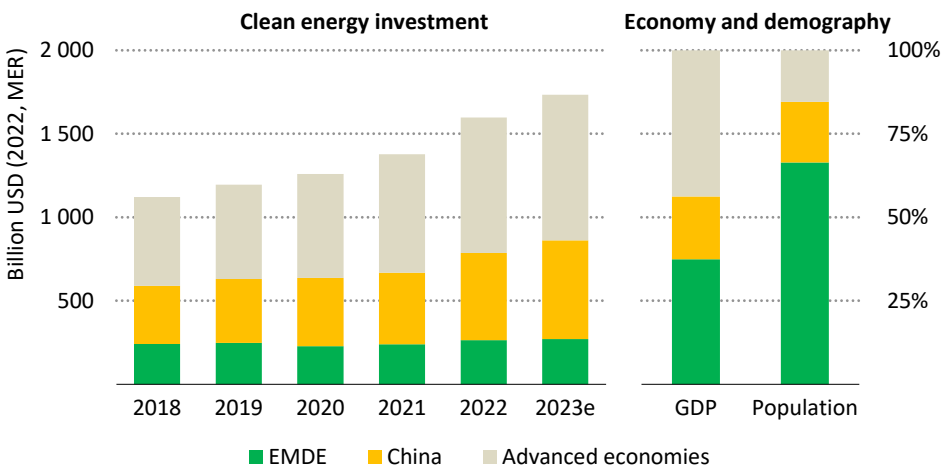
1.1 The clean energy investment gap

Clean energy investments have increased rapidly in recent years, rising by 40% since 2020 to reach an estimated USD 1.8 trillion in 2023. These investments encompass a range of technologies, including low-emissions power and fuels, energy efficiency improvements, electrification of mobility and heat, and grids and storage. Spending in these areas is now significantly higher than the USD 1 trillion going to unabated fossil fuels.

However, patterns of investment reveal a major geographical imbalance. More than 80% of clean energy investments – and the vast majority of the increase in recent years – is concentrated in advanced economies and in the People's Republic of China (hereafter, "China"). There are some bright spots in other emerging market and developing economies (EMDE[1]), but overall capital flows to clean energy in these economies remain flat and far below where they need to be to satisfy rising demand for energy in a sustainable way. These economies are home to two-thirds of the world population, and account for around one-third of global GDP but for only around 15% of clean energy investment (Figure 1.1). This report from the IEA explores the reasons for this imbalance, focusing on the high cost of capital, and what needs to be done to bring down these costs and scale up clean energy investments in the countries that need it most.

Figure 1.1 ▷ Clean energy investment, GDP and population by region



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EMDE make up over one-third of global GDP and two-thirds of the global population, but only around 15% of clean energy investment

Notes: MER = market exchange rate. Values for 2023 are estimates.

[1] References to EMDE in this report exclude China, unless otherwise specified, but include Chile, Colombia, Costa Rica and Mexico. The full list of countries included in the EMDE grouping is in Annex A.

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This report has been produced in response to a request from the Summit for a new Global Financing Pact in June 2023 (Elysee, 2023), which tasked the IEA by the time of its 50th Anniversary Ministerial Meeting in February 2024 to do as follows:

"Building on the IEA-IFC report to the Summit on "Scaling up Private Finance for Clean Energy in Emerging and Developing Countries", the IEA should make recommendations on how to bring down the cost of capital for clean energy investments in emerging and developing countries, taking into account the transparency and data availability to assess risks".

Since this analysis was asked of the IEA, its focus is on issues and solutions that lie within the remit of energy decision makers. We do so with reference to IEA scenarios that provide detailed insights on technology and deployment trends in net zero transitions (Box 1.1). However, risks that push up the cost of capital extend well beyond the energy sector, highlighting the need for a broad effort to create the conditions that will allow all countries to benefit from participation in the new clean energy economy.

Box 1.1 ▷ IEA scenarios used in this report

IEA analysis is based on scenarios that explore pathways based on various conditions, which in turn lead to differing outcomes. Three scenarios are referenced in this report:

- **The Net Zero Emissions by 2050 (NZE) Scenario** sets out a pathway to the stabilisation of global average temperatures at 1.5° C above pre-industrial levels, showing what is needed for the global energy sector to achieve net zero CO_2 emissions by 2050. It also meets the key United Nations (UN) Sustainable Development Goals (SDGs) related to universal energy access, alongside major improvements in air quality.
- **The Announced Pledges Scenario (APS)** assumes that governments will meet, in full and on time, all of the climate-related commitments that they have announced, including longer-term net zero emissions targets and pledges. The APS is associated with a temperature rise of 1.7° C in 2100.
- **The Stated Policies Scenario (STEPS)** explores the implications of today's policy settings, based on a detailed sector-by-sector assessment of what policies are actually in place or are under development by governments around the world. This scenario does not automatically assume that ambitious net zero or other climate targets are met. Emissions in the STEPS do not reach net zero and the rise in average temperatures associated with the STEPS is around 2.4° C in 2100.

1.1.1 Today's investment trends and future needs

A growing number of EMDE have announced net zero targets and clean energy goals, but these have yet to be translated in most cases into the policy environment and incentives needed to achieve a rapid acceleration in investments. For the moment, contrary to the situation in advanced economies and in China, the USD 270 billion invested in clean energy

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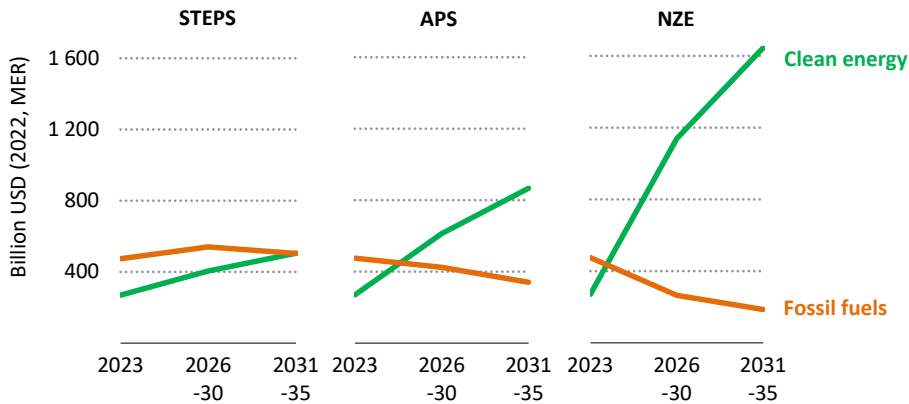
in EMDE in 2023 is considerably lower than the USD 475 billion that these countries invest in aggregate in unabated fossil fuels (Figure 1.2).

There are positive examples of the potential to scale up investments in different parts of the clean energy economy. In countries where clean energy investments continue to grow, markets are underpinned by sound and relatively predictable policy frameworks, highlighting the critical role that policy and regulation play in attracting finance and investment. For example, Brazil and India have successfully stimulated significant amounts of investment in renewable power through a variety of policy support schemes. Beyond the electricity sector, improvements in energy efficiency in India have been driven by strong policy signals (building codes, appliance standards, innovative use of public procurement) as well as mechanisms such as the Perform, Achieve and Trade scheme for industry. Some EMDE, including major producers of oil and gas, are leaning into investments in low-emissions fuels, including financial close of the world's largest electrolytic hydrogen plant, a USD 8.4 billion investment in Saudi Arabia.

Figure 1.2 ▷ **Annual average clean energy and fossil fuel investment in EMDE by scenario**



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Clean energy investment in EMDE picks up in all our scenarios but needs to accelerate dramatically to get on track for climate and other sustainable development goals

Notes: Values for 2023 are estimates. Fossil fuels represent unabated fossil fuels.

Unfortunately, there are too few of these success stories, especially among the least developed economies. While the underlying cost drivers for projects involving clean energy technologies such as solar photovoltaic (PV) and wind remain strong, the financing environment has become more complex in recent years in a world of higher interest rates. Moreover, investor attention has been drawn to new incentives and subsidy schemes (such

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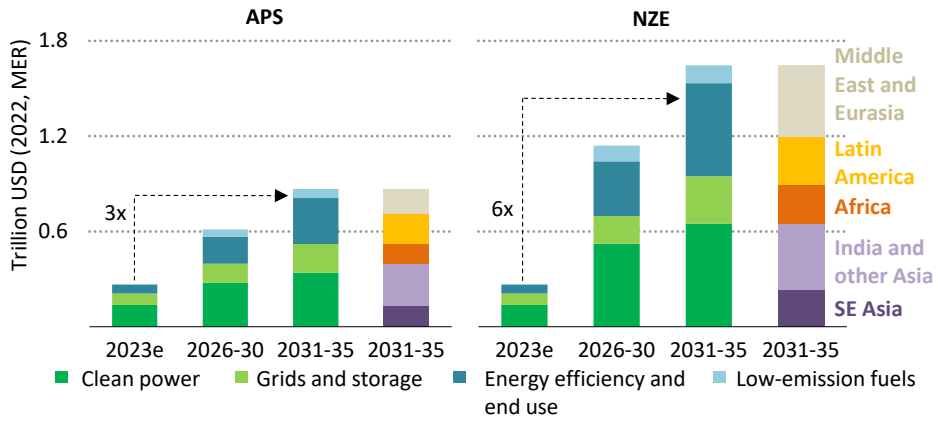
as the United States [US] Inflation Reduction Act) put in place by advanced economies that are very difficult for most EMDE to match.

A very rapid scale-up in clean energy investment will be essential if EMDE are to get on track for national energy and climate goals (as modelled in the APS) and an even more precipitous rise is needed to pursue a 1.5-degree pathway (as in the NZE Scenario). From USD 270 billion today, annual clean energy investments in EMDE need to reach USD 865 billion by the early 2030s in the APS, and over USD 1.6 trillion in the NZE Scenario. Such a scale-up would give EMDE a firm foothold in the new clean energy economy, with major benefits for energy access and security, sustainable growth, and employment as well as for a range of indicators for emissions and air quality.

1.1.2 Investment priorities to 2035

The power sector accounts for the largest share of clean energy investment needs over the next ten years in the APS and the NZE Scenario (Figure 1.3). Low-emissions sources of electricity generation alongside investments in grids and storage account for around half of the total. Around another third of the total is required for investments in electrification and efficiency, with the remainder going to low-emissions fuels, including deployment of carbon capture, utilisation and storage (CCUS).

Figure 1.3 ▷ Clean energy investments in EMDE by sector and region in the APS and the NZE Scenario



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A dramatic scale-up in all sectors and regions is essential to get on track for national energy and climate pledges and a global 1.5-degree pathway

Notes: SE Asia = Southeast Asia. Middle East and Eurasia includes EMDE countries in Europe.

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Box 1.2 ▷ How do IEA clean energy investment numbers compare with other sources?

The rapid increase in clean energy spending in EMDE over the next decade in the NZE Scenario is part of a much broader surge in global clean energy investment that encompasses continued growth in China and in advanced economies.

The IEA investment numbers are consistent with other estimates of the cost of getting the energy system on track for the Paris Agreement and the 1.5° C goal. The recent Synthesis Report of the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report concluded that "average annual modelled investment requirements for 2020 to 2030 in scenarios that limit warming to 2°C or 1.5°C are a factor of three to six greater than current levels, and total mitigation investment (public, private, domestic and international) would need to increase across all sectors and regions".

There are a few important considerations to have in mind when comparing energy-related investment projections:

Degree of ambition: Near-term capital expenditure tends to be higher in scenarios with greater ambition; scaling up investment quickly obviously comes with challenges, but these scenarios also deliver higher climate and other benefits, as well as more rapid reductions in spending on fossil fuels. The NZE Scenario is classified as a scenario that stays below 1.5° C with no or limited overshoot, the most ambitious of the categories assessed by the IPCC.

Coverage: The investment projections in this report cover the expenditure associated with the transformation of the energy system, but complete accounting of the investment required to tackle climate change and achieve the SDGs will generate higher figures. For example, the Report of the Independent High-Level Expert Group on Climate Finance (Bhattacharya et al., 2023) concluded that EMDE will need to spend around USD 2.4 trillion per year by 2030 to get on track for these goals, whereas the IEA clean energy investment requirement for EMDE in 2030 is USD 1.4 trillion. However, the higher number also allows for investment in adaptation and resilience (USD 250 billion), mechanisms to deal with loss and damage (USD 300 billion), and investment in sustainable agriculture and restoring the damage human activity has done to natural capital and biodiversity (USD 300 billion). Once adjusted for these categories, the numbers for clean energy are well aligned.

Treatment of demand-side investment: The methodology for supply-side and infrastructure investment is generally similar across different models. However, there is a much wider variation in the way that investment in efficiency and end-use sectors is defined. The largest variations in investment requirements are typically due to methodological differences on the demand side, for example how efficiency investment is calculated in different sectors or how investment in electrified end uses such as electric vehicles is included.

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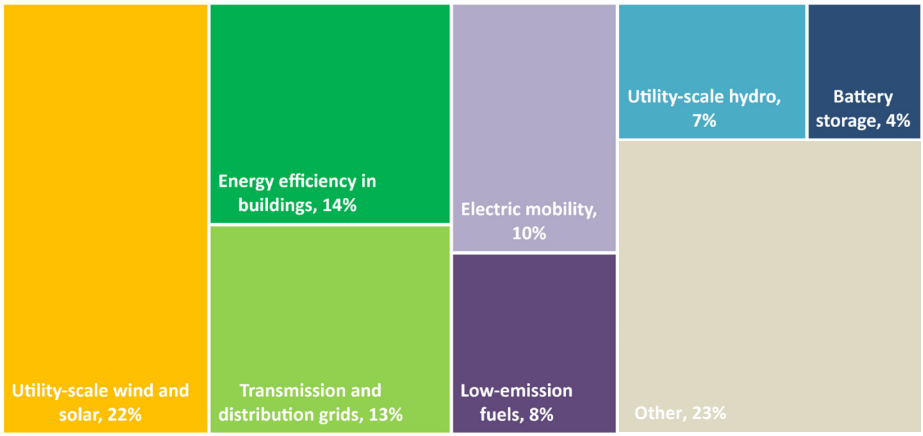
This report narrows its focus to specific high-priority sectors — **utility-scale solar PV** and **wind**, **grid infrastructure**, and **energy efficiency in buildings** — where reductions in the cost of capital can make a major difference. These three sectors collectively account for around half of the EMDE investment requirement between today and 2035 (Figure 1.4). In the NZE Scenario, almost a quarter of total clean energy investment to 2035 goes to utility-scale solar and wind projects, and another quarter to electricity networks and efficiency improvements in buildings combined. These sectors are therefore a natural focus for policy makers and for the analysis in this report.

Figure 1.4 ▷ Cumulative clean energy investment needs in EMDE in the NZE Scenario, 2024-2035



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Utility-scale solar PV and wind make up about a quarter of the cumulative investments to 2035 in the NZE Scenario, with an additional quarter in grids and efficiency in buildings

In addition to these three areas, we look in detail at some sectors that present strategic value for secure, affordable energy transitions and for sustainable development. **Electric mobility** has yet to take off in most EMDE except for two- and three-wheelers in India and a handful of other countries. **Low-emissions fuels** also deserve attention, as electricity cannot provide for all the needs of rapidly growing and industrialising economies that need to build out their national infrastructure: we take advanced-fuels as illustrative of investment issues in this sector. Finally, we explore two areas that are critical alongside modernised grids for the **flexibility and security of power systems: utility-scale hydro and battery storage**. Overall, these sectors account for almost 80% of the total EMDE clean energy investment to 2035.[2]

[2] This report does not focus on specific plans to phase out unabated fossil fuel power, which is covered in other recent IEA work, notably 'Phasing Out Unabated Coal: Current Status and Three Case Studies' (IEA, 2021a) and the 'World Energy Outlook Special Report on Coal in Net Zero Transitions' (IEA, 2022).

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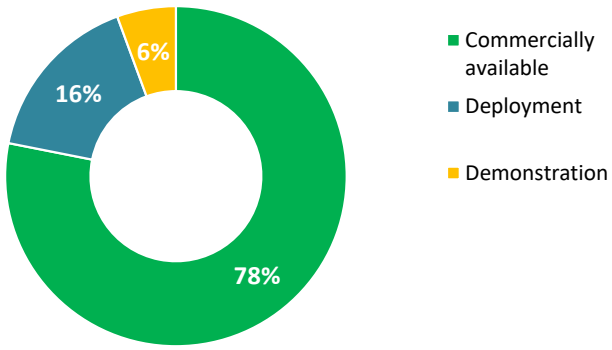
Sectors present different degrees and types of risks to investors, and every country has its own context and circumstances. There are different issues and business models in play for a large solar PV project with a long-term contract, transmission lines that are financed on balance sheet by a state-owned utility, and an electric car that is paid by a household with consumer finance. Risks can vary substantially for different projects within a single sector, depending on the financial situation of the entities involved (especially the creditworthiness and reliability of off-takers for renewable power) and the maturity of the market. We explore these elements in detail in Chapter 2.

Figure 1.5 ▷ Investment in EMDE by sector's commercial and technological readiness, cumulative 2024-2035



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Three-quarters of clean energy investment needs are in commercially proven technologies

Notes: "Demonstration" category includes hydrogen, hydrogen-based fuels, direct air capture, CCUS, ammonia, and marine power. "Deployment" includes large-scale heat pumps, concentrating solar power and investment in high-efficiency building envelope measures (excluding energy-efficient appliances that are commercially available in EMDE).

The increase in investment in clean energy in EMDE to get on track with national energy and climate pledges and global goals is extremely steep. But most of these investments are in mature technologies and in sectors where there are tried and tested formulas for success, both in advanced economies and in many EMDE (Figure 1.5). Only about 5% are in sectors that depend on nascent technologies such as hydrogen, hydrogen-based fuels or CCUS. Viable business models exist, and significant expertise has been developed globally that can be adapted to specific EMDE contexts.

1.1.3 Sources of finance

For the moment, around half of the financing for clean energy projects in EMDE comes from public finance, including development finance institutions (DFIs). The share of public financing is much lower in advanced economies, at around 20%. Funding from all sources needs to grow, but many EMDE have limited space to expand public support. Fiscal positions

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were weakened in many cases by the Covid pandemic and more recently by rising interest rates and concerns around debt sustainability.

Meeting sustainable development goals and climate pledges in EMDE will require a much greater effort to scale-up financing from private sources. Public and DFI funding needs to work more effectively to mobilise private capital from both international and domestic sources. Thus far, the record has been poor. For example, multilateral development banks mobilised only USD 18.6 billion in private finance compared with USD 60.9 billion in their own lending for climate action in EMDE in 2022 (EIB, 2023). In EMDE such as India where clean energy markets have grown, domestic sources of finance have accounted for most of the capital.

Mobilising more private capital will require an improvement in the risk-return profile of the sector with governments playing an active role in reducing real and perceived risks through strengthening domestic policies and regulation. While most EMDE are not able to replicate the strong incentives provided by some advanced economies, their markets represent much higher growth potential for investors. EMDE will need to reduce macroeconomic risks through the adoption of stable monetary and fiscal policies as well as investments in capacity building.

Financing for low-emissions power (renewable generation, electricity grids and energy storage) is predominantly debt financed, with public utilities dominating markets in the transmission and distribution sector in most EMDE. High debt levels and poor revenue sustainability of some of these public utilities make it particularly challenging to raise adequate and affordable capital for grid expansion that is critical to meet rising electricity needs while decarbonising the sector. Greater international support will be vital to ensure adequate access to capital. Measures to reduce financing costs and expand concessional funding will be key to ensure a just and affordable clean energy transition.

1.2 The cost of capital

1.2.1 What is the cost of capital?

The cost of capital is the minimum return that a company requires to justify a decision to invest (Box 1.3). As such, it is also a measure of real and perceived risk: the riskier the project, the higher the rate of return that would be required to justify investing. For the moment, the cost of capital is considerably higher in EMDE than in advanced economies and in China. This explains to a significant degree the variations in capital flows to clean energy seen across these regions. Mobilising much more capital to clean energy projects in EMDE will depend largely on reducing risks that push up the cost of capital.

The cost of capital is especially important for clean energy projects because of their capital intensity: they involve a relatively high share of upfront expenditure and a correspondingly low share of operating expenses in total project costs. Utility-scale solar PV and wind projects are a good example: they require significant initial spending but are then very cheap to run. Thermal power plants operating on coal or natural gas have a very different cost profile because of the continued expenditure over their operating lifetimes on sometimes volatile

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fuel inputs. A higher cost of capital can tip the economic calculation away from more sustainable choices. Other assets that are essential for clean energy transitions, such as grids, have higher operating costs but also require investing large amounts of money up front.

The cost of capital largely depends on the assessment of two sets of risks: country and macroeconomic risks, and risks specific to the project, or sector, or company(ies) involved. The portion of the cost of capital that relate to country and macroeconomic risks apply to any investment in a jurisdiction. Project- and sector-specific risks result in an additional premium. The focus of this report is on this second category, as these generally fall within the scope of actions by energy ministries, regulators and other energy-related policy makers. However, a comprehensive approach to bringing down the cost of capital requires attention to a broad range of factors.

Box 1.3 ▻ How to estimate the cost of capital

The **cost of capital** represents the expected financial return, or the minimum required rate of return, to justify an investment in a company or a project.[3] It plays a vital role in the financial decision-making processes of investors. The cost of capital serves as a benchmark to assess the risk and return preferences of investors and is also referred to as the **hurdle rate**. "Cost of capital" is also used interchangeably with "**financing cost**".

In the context of this report, the cost of capital is defined as the weighted average of costs associated with raising funds for investments. These funds can come from debt or equity. Unlike interest on debt, there is no commitment from a company or a project to repay equity to shareholders, who accept to take on higher risks in exchange for higher rewards in the form of dividends and capital appreciation. Debt providers have primary claim on assets in the case of solvency issues, while equity shareholders have a residual claim (IEA, 2021b). The weighted average cost of capital (WACC) factors in their respective contributions based on predetermined weights:

$$WACC = (cost\ of\ debt \times share\ of\ debt) + (cost\ of\ equity \times share\ of\ equity)$$

- The **cost of debt** is estimated as the after-tax interest rate that a company or project must pay on its debt. It comprises two components: a benchmark minimum cost of borrowing (like a 10-year EMDE government bond rate, when financing in local currency) and a premium that reflects the credit and other risks associated with the borrowing company or project cash flows.
- The **cost of equity** represents the financial return expected by shareholders as compensation for their capital investment and is commonly referred to as the expected return on equity.

[3] Note, however, that "capital cost" is a different concept, referring to the expenses incurred on the purchase of land, equipment and other assets that are needed for a productive asset.

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Estimating the cost of equity is generally more challenging than the debt component, primarily because the factors influencing it are not explicitly defined, and there is confidentiality around returns. For instance, when a company issues debt, the cost is relatively straightforward to find out, while determining the cost for the same company offering equity is more challenging. Estimating the cost of equity for projects in EMDE can be even more challenging, as capital markets are less developed, and there are fewer projects and a lack of transparency around risks.

This prompted the IEA and other partners to establish the Cost of Capital Observatory,[4] an initiative aimed at gaining a better understanding of and tracking the cost of equity and, consequently, the cost of capital, by surveying investors and financiers. Based on surveys and interviews with leading practitioners in EMDE, the Observatory not only provides investors with WACC values but also offers insights into the key underlying risks perceived by investors and financiers in each country.

An additional layer of complexity occurs because project financing – the provision of debt and the expected return on equity – in EMDE can be priced in domestic or foreign currency. Though many energy investment decisions in EMDE are still priced and evaluated in foreign currency (generally US dollars), domestic financing is important and has been increasing over the last decades as many EMDE have grown considerably and become more stable. Domestic financing is also set to increase in the energy transition, particularly in some countries. For instance, producer economies in EMDE will move from fossil fuels for export, denominated in foreign currency, to electricity-related investments largely based on domestic consumption and revenues in local currency. Power generation contracts in large EMDE for example tend to be denominated in domestic currency, with the financing done in the same currency. There are exceptions though, as in Argentina, where renewable power purchase agreements (PPAs) were defined in US dollars given high actual and perceived currency and other macroeconomic-related risks. In the next section, we will focus on country and macro risks.

Country and macro risks

The cost of borrowing in domestic terms depends on the macroeconomic policies of a country. In fact, a key issue in many EMDE is high domestic interest rates – stemming from high inflation – which set a high bar for investment and make it difficult to obtain financing. The cost of borrowing in hard currency is typically defined as the US borrowing rate plus the country risk premium for the country where the project is taking place.

Interest rates of long-term government bonds – a benchmark indicator used to estimate borrowing rates – rose considerably in many countries in both 2022 and 2023, with the notable exception of China (Figure 1.6). The ten-year yield of bonds issued by India and South Africa increased by about 1 percentage point since early 2021 and by at least twice

[4] For more information on the Observatory, see iea.org/reports/cost-of-capital-observatory.

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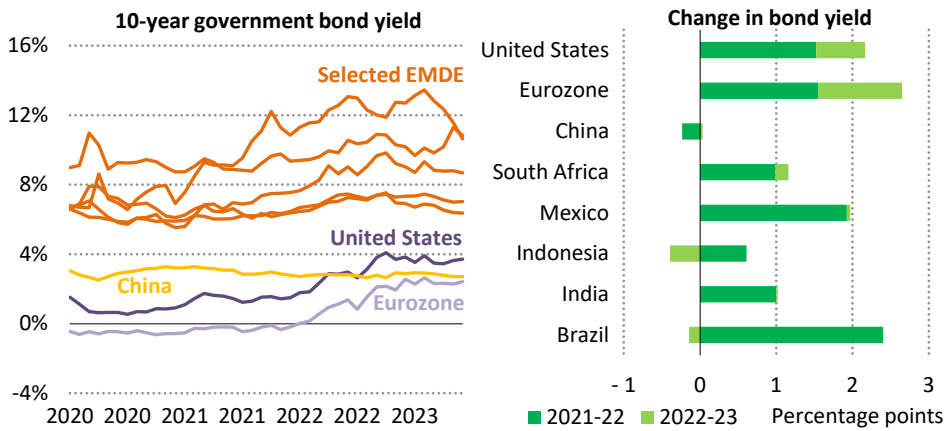
that in Brazil and Mexico. Yields of bonds issued by the US and European governments also rose by 2 percentage points or more since early 2021, affecting the cost of borrowing in external currency.

Figure 1.6 ▷ Indicators of economy-wide cost of debt (ten-year government bond yield), 2020-H1 2023



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Bond yields in emerging market and developing economies are significantly higher than those in advanced economies and China; in recent years, they have risen significantly

Notes: H12023 = first half of 2023. 2023 data include first semester only. "Selected EMDE" includes South Africa, Brazil, Mexico, India and Indonesia, listed from highest to lowest bond yields as on 30 June 2023.

A way to reduce the cost of capital in EMDE is by addressing country-level macroeconomic and political risks. This typically means bringing inflation down to low and predictable levels, improving the rule of law and strengthening institutions and governance. Efforts to develop domestic capital markets and the banking sector also help. By doing so, lending costs should reduce in both domestic currency (as countries no longer need to sustain high interest rates to face domestic inflation) and foreign currency (as country risk ratings improve). However, this is a long-term task for governments and would help attract investments across the economy.

There are instruments available to help mitigate these broad categories of risk: the World Bank's Multilateral Investment Guarantee Agency (MIGA), for example, provides insurance for projects against losses relating to breach of contract, expropriation, war or civil disturbance. Regional institutions, such as the African Development Bank, also offer alternatives to cover these risks, such as Partial Risk Guarantees. Another crucial element of macro risk for projects financed in foreign currencies relates to fluctuations in exchange rates. Improving the availability and affordability of hedging instruments – such as those

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offered by MIGA or The Currency Exchange Fund (TCX) – is not straightforward but can be crucial in attracting investment (Box 1.4).

Box 1.4 ▻ Tackling currency risks

Lending in local currency can be limited due to financial providers' concerns around capital controls – such as restrictions on currency repatriation – or due to local currency volatility. A strong track record of limited foreign exchange controls can help reduce perceived risk, but finance providers may also choose to adopt some form of currency hedging to reduce their exposure to currency volatility in projects that earn revenue in a different currency to the lending currency. Many hedging approaches and instruments exist, but those used most widely in EMDE are:

- **Natural hedging via portfolio diversification:** Investors with exposure to multiple currencies effectively create a natural hedge within their portfolio, with currency devaluations in one country mitigated by appreciations elsewhere.
- **Currency swap:** Under a currency swap, two parties agree to exchange the equivalent amount of a loan in one currency (in this context, the foreign currency) for a loan in another (the domestic currency). They will later re-exchange these equivalent loans at a predetermined rate and time.
- **Forward contracts:** Forward contracts are a one-payment swap via an agreement to buy one currency (in this context, the domestic currency) by selling another (the foreign currency) at a specified future date and rate.

Currency hedging instruments are not widely used in poorer EMDE and are generally limited to middle-income countries where the currencies are more liquid. These larger markets also tend to be the only ones where commercial swap or other hedging product providers operate, or where export credit agencies are financially strong enough to provide currency guarantees. Beyond these market limitations, currency hedging products are also complex to structure and add to the cost of projects, which can affect the level of interest in adopting such approaches.

Some international funders have sought to support hedging options to facilitate greater levels of local currency lending, for example the DFI and global currency hedging facility TCX. TCX offers a range of currency hedging products in more than 100 economies, which it can do by pooling currency risk within their own portfolio (i.e. via natural hedging). While TCX has been able to catalyse private currency markets, its products are still primarily used by other DFIs due, in part, to the additional costs hedging can add to a project and unfamiliarity of other lenders with the product offering. Blended finance can be utilised as a tool to expand currency hedging options, including reducing the costs.

Expanding the use of currency hedging products remains challenging. Alongside currency risk mitigation instruments, the durable solution is to build up domestic financial markets and support their capacity to finance infrastructure assets directly, via partnerships

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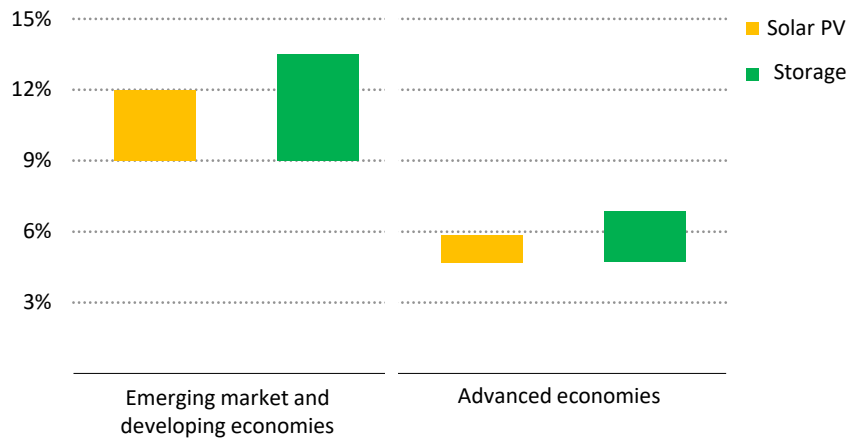
between international and domestic financial institutions and targeted products such as guarantees. There is approximately USD 17 trillion of domestic financial capital in EMDE, made up of household savings, pension capital, and corporate and local bank finance. Channelling this capital into clean energy projects and infrastructure is a major and, for the moment, largely untapped opportunity.

Project- and sector-specific risks

Variations in the base rate (long-term, locally denominated bond yields for borrowing in domestic currency or US risk-free rates plus country risk premium for borrowing in foreign currency) are typically the largest reason for differences in the cost of capital among EMDE. However, the premium associated with project- or sector-specific risks is the component that can be most readily reduced via targeted interventions from national policy makers, supported by international technical and financial assistance.

Figure 1.7 ▷ Cost of capital ranges for solar PV and storage projects taking final investment decision in 2022



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The cost of capital for solar PV and storage projects in EMDE is at least twice the value in advanced economies, despite relatively larger interest rate hikes in advanced economies

Notes: Values are expressed in nominal, post-tax and local currency. WACCs for solar PV projects represent responses for a 100 megawatt (MW) project and for utility-scale batteries a 40 MW project. Values represent average medians across countries. Advanced economies represent values in the United States and Europe.

Project- and sector-specific risks can vary widely across projects in different parts of the energy economy. On average, the premium on top of the base rate is around 20-30% of the overall cost of capital for power projects in EMDE. For a project in electricity generation, for example, the premium incorporates risk perceptions related to the sector regulations, the

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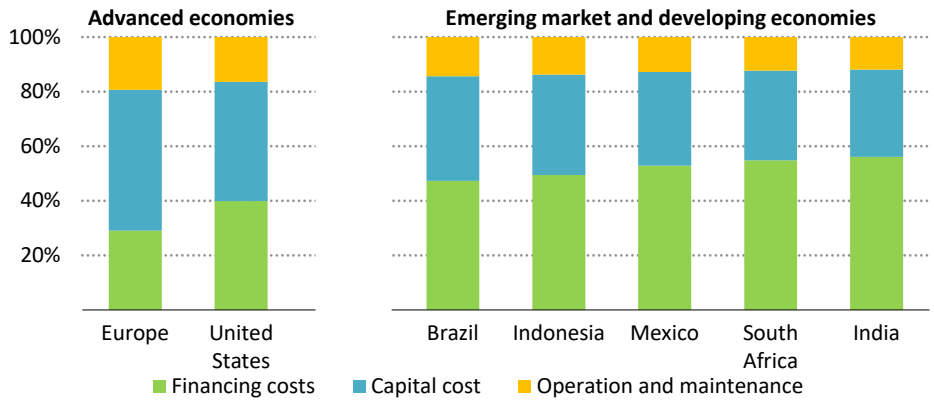
ability to collect revenues – generally set up by a contract and dependent on the creditworthiness of the off-taker (will it be able to pay, will it pay on time) – as well as risks around the availability of transmission infrastructure or land, and how all of these are defined in the PPA. The next section explores the reasons for a high cost of capital for such projects in EMDE and quantifies the benefits of action.

1.2.2 Why does the cost of capital matter for EMDE energy transitions?

The IEA collects data on the cost of capital in EMDE as part of its Cost of Capital Observatory initiative. The latest release of data shows that the cost of capital for utility-scale solar PV projects taking final investment decision in 2022 in major EMDE (average of Brazil, India, Indonesia, Mexico and South Africa) was at least twice as high as that in advanced economies (United States and various European countries, Figure 1.7). This year's survey also shows that nine out ten respondents expect increases in the cost of capital in EMDE in 2023 (IEA, 2023a).

Our findings also show that in almost two-thirds of cases, the WACC for utility-scale solar power projects was either the same as or lower than those for gas-fired projects. This means utility-scale gas-power projects are perceived to be at least as risky as utility-scale solar PV projects. This can be the result of greater uncertainty over fuel prices, transition-related risks for gas projects and their emissions, and more policy support for renewables and for solar PV. Project WACC for utility-scale batteries were also above or equal to those for solar PV projects, although stand-alone battery storage projects are relatively rare as solar and storage are increasingly being tendered together.

Figure 1.8 ▷ Composition of levelised cost of electricity for a utility-scale solar PV plant with final investment decision secured in 2022



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The cost of capital accounts for around half of the total levelised costs in EMDE, significantly more than in advanced economies

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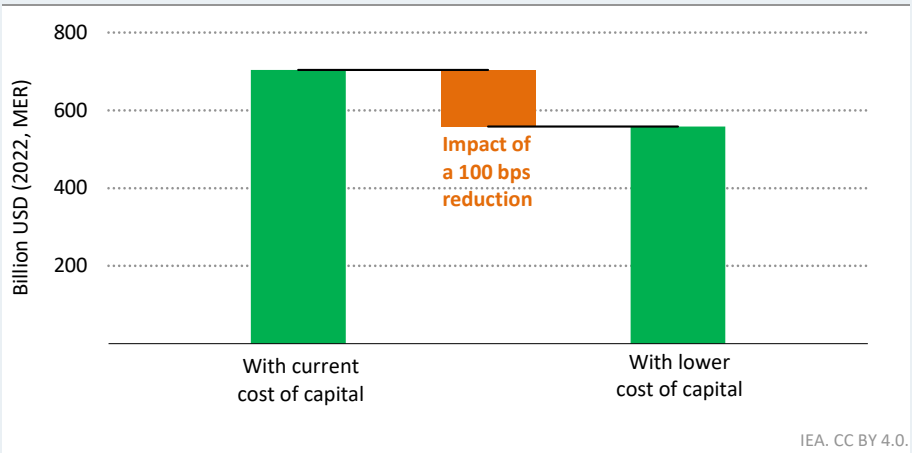
Financing costs constitute around half or more of the levelised cost of electricity (LCOE) for utility-scale solar PV projects taking final investment decision in 2022 in EMDE. This is considerably higher than in advanced economies (Figure 1.8). The impact of higher financing costs on LCOEs can be offset in some cases by lower capital costs, which are very competitive in countries such as India or Brazil. But efforts to decrease the cost of capital in EMDE are nonetheless crucial to the overall attractiveness of these investments, with knock-on effects on generation costs and the affordability of electricity – and of energy transitions – for consumers (Box 1.5).

Box 1.5 ▻ What difference would a lower cost of capital make for the overall cost of EMDE energy transitions?

Efforts to reduce the cost of capital for clean energy projects in EMDE can facilitate the achievement of multiple sustainable development goals. Narrowing the gap of the cost of capital between EMDE and advanced economies by energy-sector-specific interventions can also substantially bring down the overall cost of realising sustainable energy at scale. We estimate that a 1 percentage point (or 100 basis point) reduction in the cost of capital in EMDE leads to a reduction of USD 150 billion in average annual financing costs in the NZE Scenario between 2024 and 2050 (Figure 1.9).

Figure 1.9 ▻ Effect on annual average EMDE financing costs to 2050 in the NZE Scenario of a 1 percentage point reduction in the cost of capital



Lowering the cost of capital by one percentage point (100 basis points) could reduce annual average clean energy financing costs in EMDE by USD 150 billion

Note: bps = basis points; 100 basis points = 1 percentage point.

This reduction requires considerable efforts but is achievable and represents a 10-20% decrease in the cost of capital of the different sectors, compared with current values.

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This reduction is obtained in part given i) the large weight that the cost of capital has in the total investment of solar PV and wind; and ii) the fact that these two technologies represent 15% of the investment needs of the NZE Scenario. An even more ambitious lowering by 2 percentage points could almost double this reduction to USD 300 billion per year.

In 2023, USD 35 billion were spent on clean energy in Africa, so a USD 150 billion reduction in clean energy financing costs is equivalent to more than four times the clean energy investments in this region this year. Bringing down the cost of capital therefore represents a huge opportunity to move countries more quickly down the pathway to a safer and more sustainable energy future.

1.3 Bringing down the cost of capital

As discussed, there are a host of project- or sector-specific risks, alongside country and macro factors, that can push up the cost of capital for clean energy projects in EMDE. We analyse these in detail in Chapter 2 and summarise them in this section. Our analysis and the insights from the Cost of Capital Observatory reveals several themes and specific areas that need to be resolved by national policy makers in EMDE, assisted by much greater financial and technical assistance from the international community. These actions need to be co-ordinated and coherent; country-led platforms for engagement with international partners and investors can play a useful role in this context.

- **A clear vision and plan for investment in energy transitions, backed by reliable and timely data, and an emphasis on project preparation:** The transformation of the energy sector requires long-term goals that are tailored to EMDE country contexts and ambitious enough to align with the Paris Agreement. To be credible, they need to be accompanied by a strong focus on implementation, including near-term milestones that lead the way to the long-term goal and integrated planning for investments, anticipated sources of finance, employment, skills, supply chains and the social implications of change. Enhanced institutional capacity for ministries and regulators, with a particular focus on early-stage project feasibility and preparation, is essential to generate a regular flow of clean energy projects. Accurate and timely availability of data on the energy sector and the broader economy is also crucial to bring transparency and reduce uncertainty for clean energy investors.
- **Strengthened policy and regulatory frameworks:** Regulatory risk is one of the top three sector-related risks that practitioners identify in response to the IEA's Cost of Capital Observatory. These need to be addressed to reduce the cost of capital for clean energy projects in EMDE. It is worth noting that regulatory stability is hard to achieve, and regulation needs to change as sectors evolve: tenders for renewable capacity, for example, need to adjust as the share of renewables in generation increases. But investors should expect transparency, predictability and an open dialogue with

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stakeholders. Well-designed and standardised contracts are also key to ensure project bankability and, where possible, these should be set in local currency to reduce the currency mismatch for domestic off-takers. Pricing reform to phase out inefficient fossil fuel subsidies and to raise and expand the scope of carbon pricing can play a vital role to incentivise investment in the low-emissions economy.

- **Stepping up international co-operation and technical assistance**: EMDE do not always have the necessary institutional capacity or know-how to collect and disseminate relevant energy sector and economic data, and address the technicalities of regulation, contracts or business models in clean energy sectors. In such cases, co-ordinated technical assistance by donor institutions is vital to ensure transparency, sound data-driven decision-making, and robust policy and regulatory design that can help reduce the cost of capital. Increased transparency and accountability among donors could help avoid competing support and overlapping tasks. Policy makers in advanced economies should carefully assess the impact of their own domestic clean energy support programmes on incentives for investment in EMDE and ensure there are channels for increased international capital flows and for the participation of EMDE in emerging clean energy supply chains.
- **Targeted interventions for the least developed countries and nascent markets**: With low per capita incomes, a multiplicity of governance and development challenges, and a lack of bankable projects, least developed countries require targeted financial and technical support to kick-start clean energy investments, especially those that can help achieve universal energy access by 2030, alongside capacity building for administrations. As many countries are unable to take on more debt and have limited access to international financial markets, grant funding plays an essential role.
- **Expand the reach and ambition of institutions that provide payment guarantees**: Payment risk is another of the top three sector-related risks identified by investors in projects in EMDE, particularly renewables, storage and grids. Extending the provision of guarantees that cover payment delays, especially in countries with nascent or growing sectors, would reduce the cost of capital and enable a step change in investment. This could be done by increasing the reach and ambition of existing multilateral institutions such as MIGA or partial-risk guarantees by institutions such as the African Development Bank (which can cover non-honouring of financial commitments by state-owned or other entities) or using third-party creditworthy institutions such as Solar Energy Corporation of India (SECI) to manage off-taker risk.
- **Step up international financial support, including a tripling of concessional funds**: Used strategically and judiciously, international concessional funding is a crucial enabler for clean energy projects that might not otherwise attract private funding. Not all projects need this kind of support, and it is not a substitute for policy actions or institutional reforms. But it can help to move projects forward where they involve technologies that have yet to scale and are not yet cost-competitive in nascent markets; that are in frontier markets with higher levels of country and political risk; or that involve macroeconomic risks, such as foreign exchange risk, that raise the cost of the project. Our estimates

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show that concessional funding for clean energy needs to triple in EMDE over the next decade to realise the benefits of a Paris-aligned pathway (Box 1.6).

Box 1.6 ▻ How much concessional funding is required in EMDE?

Concessional funding includes a range of guarantees, senior or subordinated debt or equity, performance-based incentives, viability gap funding, and other investment grants. The IEA and International Finance Corporation (IFC) estimated in 2023 that USD 80 billion to USD 100 billion in concessional funding would be required in EMDE to mobilise the amount of private finance (USD 900 billion to USD 1 100 billion) required in the NZE Scenario by the early 2030s (IEA, 2023b).

Table 1.1 ▻ Concessional funding needs for EMDE in the NZE Scenario

	Annual average required (USD billion)	
	2026-2030	2031-2035
Total EMDE	89	111
By region		
Southeast Asia	8	11
India and other Asia	18	23
Africa	38	48
Latin America	13	15
Middle East & Eurasia	12	14
By sector		
Low-emissions power, grids and storage	33	41
Grids and storage	17	22
Low-emissions fuels	10	12
Efficiency and end use	29	36

Source: IEA (2023b).

This amount does not cover all potential concessional funding needs for the energy transformation,[5] notably for state-owned enterprises such as public utilities that rely entirely on public financing to modernise and expand grid infrastructure. In 2022, DFIs accounted for about 15% of total financing of grid investments in EMDE, as revealed in a detailed review of DFI financing of these public utilities. More than half of all funding to these utilities during that year was provided on concessional terms. On this basis, we estimate that meeting the investment needs under the NZE Scenario would require a further USD 10 billion in concessional funding by the early 2030s for grid investments by public utilities not able to access commercial finance.

[5] Areas beyond the energy transformation are also high priorities for concessional funding; adaptation and resilience-building projects are typically difficult to structure in ways that attract private financing.

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The NZE Scenario therefore requires an estimated USD 90 billion to USD 110 billion in concessional funding from the international community (Table 1.1). This represents at least a tripling in public climate finance for energy, transport and industry compared with the most recent climate finance data published by the Organisation for Economic Co-operation and Development (OECD). These concessional funds will need to leverage much greater amounts of private finance, aiming for a multiple of six to seven rather than the meagre multiple of 0.3 observed today.

In addition to the broad themes described above, there are risks in specific areas that need to be addressed (Table 1.2). Chapter 2 goes into detail on these sectors, bearing in mind that country contexts differ, and every country and jurisdiction will need to develop its own set of targeted measures for its prevailing circumstances.

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Table 1.2 ▷ Summary of key risks and measures to reduce the cost of capital of clean energy projects in EMDE

Key risks and barriers	Key recommendations to reduce the cost of capital
Utility-scale solar and wind	
Growing and maturing markets: • **Regulatory risk**: the level of clarity and predictability of policies and regulations • **Off-taker risk**: perceived and real risks related to the payment of power purchased by off-takers • **Transmission risk**: ability to access the transmission grid in a predictable manner	*Growing markets:* • **DFI and government:** Reduce off-taker risks by expanding credit enhancement mechanisms and payment guarantees • **Government:** Continue developing the market with procurement programmes tied to a clear long-term strategy • **Private and government:** Increase public funding to expand transmission infrastructure while testing business models for privately financed transmission *Maturing markets:* • **Government:** Incentivise grid flexibility, including via renewable capacity tenders that incorporate storage • **Government:** Ensure timely and full payments to generation companies with ad hoc solutions if needed • **Government:** Prepare tenders to allocate transmission lines around green corridors
Grids	
Publicly led markets: • **Financial sustainability risk**: poor financial well-being of state-owned corporations • **Tariff risk:** tariff design not being cost-reflective, further stressing the state-owned entity finances and sustainability • **Regulatory risk:** no robust procedure for private participation, business model, technical procedures and system planning	*Publicly led markets:* • **DFI and government:** Improve state-owned entities' financial health in collaboration with DFIs, by restructuring, involving private sector where feasible, and remunerative tariffs • **DFI and government:** Deploy blended finance strategically to mitigate project risk and unlock investments • **Government** Where private capital mobilisation is suitable, develop a robust regulatory framework that includes project preparation assessment with credible risk scenarios by clearly defining expected outcomes and cost allocation
Privately led markets: • **Remuneration risk**: poor adequacy of remuneration to reflect costs and adjust to macroeconomic circumstances • **Regulatory risk**: predictability and robustness of the regulatory framework • **Permitting risk:** lack legal framework that cause risk of delays	*Privately led markets:* • **Government:** Adopt cost-reflective and predictable remuneration in order to ensure profitability • **Government:** Establish transparent and reliable regulations, providing clarity on licensing, permits, cost allocation and revenues • **DFI:** Establish blended finance facilities to manage remuneration risk and mobilise private finance
Energy efficiency in buildings	
• **Regulatory risk**: lack of comprehensive building codes, low capacity to implement them, and the size of the "informal" construction sector	• **Government:** Strengthen regulatory frameworks for buildings efficiency, including through adoption of building codes and stringent minimum performance standards

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Key risks and barriers	Key recommendations to reduce the cost of capital
• **Difficulty accessing financing**: lack of financing options and appropriate models including for refinancing • **Skewed incentives**: lack of incentives due to subsidised energy; split incentives between owners and renters	• **DFI, government and private:** Allocate greater funds to on-lending programmes to promote local and easily available financing options • **Government:** Rationalise energy subsidies to curb inefficient energy use and encourage adoption of energy efficient solutions
Electric mobility	
• **Lack of financing options**: Lack of access to debt financing and high cost of borrowing • **Ecosystem risk**: lack of a vast electric vehicle charging infrastructure with proven business service models, and lack of dedicated private charging due to poorly defined property rights • **Regulatory risks:** Lack of clear policy signals on emissions reduction targets	• **Private and government:** Expand consumer access to low-cost auto loans, leasing models and a widely available charging network • **Government:** Phase out subsidies for transport fuels, and provide targeted support for the uptake of electric vehicles and related charging infrastructure • **DFI and government:** Increase concessional support for electrification of vehicles used in public transport
Advanced biofuels	
• **Technological risks:** first-of-a-kind advanced biofuel projects tend to have high risk premiums, with difficulties securing long-term offtake agreements or feedstock supplies • **Feedstock availability risks:** complexity in securing streams of waste or residue and long-term offtake contracts	• **Government:** Develop renewable fuel standards or biofuel mandates to provide stable market conditions for investors • **Government:** Provide targeted tax credits or first loss guarantees for first-of-a-kind projects • **DFI and government:** Encourage mutual recognition of emissions intensity assessments, based on clear definitions of sustainable feedstocks and third-party verification of life-cycle emissions
Utility-scale hydro	
• **Permitting delays:** Identifying viable sites and conducting environmental due diligence can cause significant delays to construction of dams • **Revenue risk:** Many dams have multiple uses beyond hydropower plants, but these uses are not reflected in most business models • **Off-taker risk:** Concerns over reliability of the off-taker	• **Government:** Improve long-term planning for hydropower projects, including site mapping with environmental data • **DFI and government:** Create robust, streamlined sustainability standards and monitoring procedures • **Private and government:** Ensure that business models reflect the multiple benefits of hydropower facilities
Battery storage	
• **Regulatory risk:** battery storage systems do not always have equal access to the power market, and a long-term strategy for flexibility might be missing • **Off-taker risk**: delayed payments by or under recoveries from distribution companies are a key risk	• **Government:** Establish clear and stable regulatory framework that defines the role of utility-scale battery storage and allows equal power market participation • **DFI and government:** Develop the market through well-designed and regular procurement programmes, with concessional finance where required • **DFI and government:** Expand off-taker guarantee and credit enhancement mechanisms by offering guarantees or establishing creditworthy intermediates

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Identifying risks that influence the cost of capital

A sector-by-sector analysis

SUMMARY

- This chapter considers seven strategic clean energy sectors in EMDE for individual analysis, recognising that business models, risks and policy solutions vary across different parts of the energy economy, as well as between economies at different stages of development.
- Regulatory risk is a major impediment to scaling up clean energy investments. Unclear targets, inconsistent application of policies, incomplete regulations or complex procedures to obtain project approvals increase risk perceptions and lead investors to demand higher expected returns on investment, or to invest their money elsewhere. The best ways to address these concerns vary by sector and cover an array of solutions – from expanding tenders for renewable generation capacity that incorporate storage and reward flexibility, to building codes and stringent minimum performance standards for efficiency in buildings or fuel standards for biofuels.
- EMDE governments are in the driver's seat, but enhanced technical support and capacity building by international donors – whether development finance or other institutions – is essential. Adapting solutions to the local context is key, but international actors have a lot of experience to share. For example, following Kenya's example, other African countries could – with the help of donors – test privately financed business models for power transmission (as Latin American countries did a few decades ago) to step up investments.
- Least developed countries have unique characteristics and challenges that demand additional attention and targeted support to kick-start clean energy investments. Grant funding needs to play an important role, including to strengthen institutions and administrative capacity, and to help achieve universal energy access by 2030.
- Delays in payment for power purchased by off-takers (generally state-owned utilities) are another major concern for investors and financiers of renewable generation and storage in many EMDE. Increasing the availability of guarantees that cover payment delays by public sector entities will be key to reduce the cost of capital and unlock much more investment in countries with nascent or growing sectors.
- Where technology risk is high, or market failures large, concessional funds will also be key. We estimate these funds need to triple current levels to kick-start commercially proven technologies in new markets, such as energy efficiency in buildings or the electrification of public transportation. These funds are scarce and should also be used strategically to mobilise more private capital to projects.

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2.1 Introduction

Reducing the cost of capital for clean energy projects in emerging market and developing economies (EMDE)[1] will mean addressing risks across various parts of the energy economy, for projects that are financed with different business models, where the scale of projects varies considerably, and where the most prevalent risks are not always the same. In Chapter 1, we highlighted that two of the largest investment requirements for EMDE in the period to 2035 are utility-scale solar and wind, and energy efficiency in buildings. These are, however, very different sectors for investors. Utility-scale solar and wind are financed largely on a project finance basis, for tens of millions of United States (US) dollars, and the biggest sector-related concerns for investors are off-taker and transmission-related risks. Investments in energy efficiency in buildings are generally financed by households or real estate developers, through their own savings or commercial loans. The biggest challenges are the lack of incentives due to subsidised energy, absence of building codes or weak financing models.

These examples highlight why it is essential to dig into the features of different parts of the energy sector to examine their specific elements, business models and risks. This chapter discusses seven large clean energy sectors that have significant strategic value for secure and affordable energy transitions in EMDE and that are also large in terms of cumulative clean energy investment needs between 2024 and 2035 in the Net Zero Emissions by 2050 (NZE) Scenario (the number in brackets).

- utility-scale solar PV and wind (22%)
- transmission and distribution grids (13%)
- energy efficiency in buildings (14%)
- electric mobility (10%)
- low-emissions fuels (8%)[2]
- utility-scale hydro (7%)
- battery storage (4%).

A summary of some key characteristics of these sectors is included on the next page (Table 2.1), followed by detailed consideration of each of them in turn. These individual sections describe first the current investment levels and trends in EMDE as well as the outlook for investments and the most common sources of finance. They then consider the factors influencing the cost of capital and the key recommendations to reduce the cost of capital in each area.

[1] References to EMDE in this report exclude the People's Republic of China (hereafter, "China"), unless otherwise specified.

[2] Low-emissions fuels include modern bioenergy (liquid biofuels and biogases), low-emissions hydrogen and low-emissions hydrogen-based fuels. We focus the discussion and recommendations on advanced biofuels as there is significant potential in EMDE to leverage agricultural residues and municipal waste as sustainable feedstocks, thereby moving away from conventional biofuels.

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Table 2.1 ▷ Key characteristics of clean energy projects by sector in EMDE

Sector	Dominant business model	Role of cost of capital
Utility-scale solar and wind	• Feed-in tariff or long-term physical power purchase agreement, financed on a project finance basis	Very important, as assets are capital-intensive (low operating expenses) and up to 75% debt financed
Grids	• Whole-of-grid concessions managed by public utilities (important presence of private utilities in Latin America, though less common in other EMDE)	Assets are capital-intensive with a high impact on affordability
	• Independent power transmission projects (a form of public-private partnership, used in various Latin American countries and in India)	Very important, as assets are capital-intensive and remuneration is fixed by the regulators
Energy efficiency in buildings	• Funded on balance sheets by developer or tenant, mainly using equity financing	Relatively low in the investment decision of consumers and small and medium-sized enterprises
Electric mobility	• Electric vehicles (EVs) financed by households or (public or private) transport companies through savings and some level of consumer finance • Enabling infrastructure financed mostly by public entities or utilities, financed on balance sheets	Quite important in EMDE for consumers. More important for the establishment of the charging infrastructure by public companies that need cheap access to finance
Low-emissions fuels	• Usually financed on balance sheets	Relatively low, as feedstocks and operations form largest share of cost
Utility-scale hydro	• Mainly developed by public sector entities on balance sheet, underpinned with power purchase guarantees and long-term contracts	Significant, but the primary obstacles relate to lengthy permitting, site identification and environmental concerns
Battery storage	• Remuneration from provision of battery storage services supported by feed-in tariffs or capacity payments (especially in areas with no wholesale markets), financed on a project finance basis	High, capital-intensive, leverage ratio is around 70-80%

2.2 Utility-scale solar PV and wind

Investment outlook, sources of finance and sector development

Deployment of wind and solar photovoltaic (PV) has seen impressive growth in recent years; these technologies witness the largest growth in capacity across IEA scenarios, delivering cost-effective sources of electricity for development and growth as well as emissions reductions. Since 2010, the share of wind and solar PV in electricity generation has grown from zero to 6% in 2022 among EMDE and is on track to rise to 23% by 2035 under the Stated Policies Scenario (STEPS). However, wind and solar PV generation in the STEPS is only one-third of what it is under the NZE Scenario.

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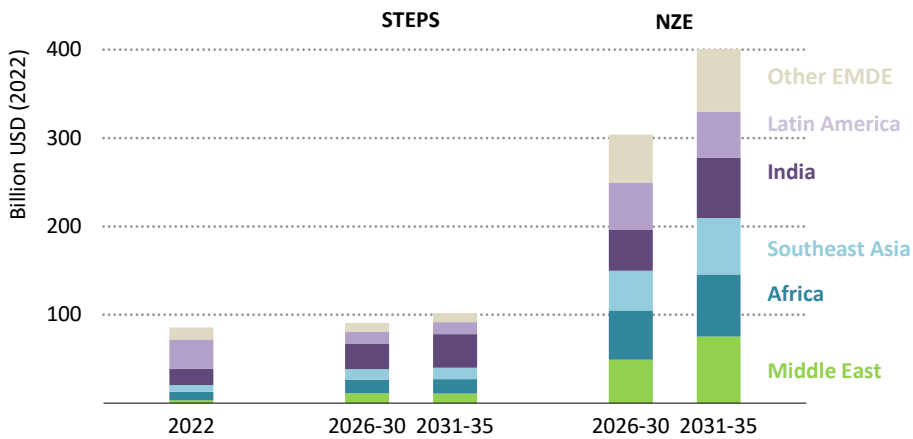
Investment in utility-scale solar PV and wind also makes up the largest share of future investment needs. Almost a quarter of clean energy investment needed from now to 2035 in the NZE Scenario is required in these two technologies. While investment stays relatively flat in the STEPS, it will need to quadruple in the NZE Scenario compared with current levels (Figure 2.1). Generally, solar PV and wind power assets have relatively high upfront investment costs but lower operating expenses over time, with basically no fuel expenditures, and rely on high levels of debt. For example, the share of debt of utility-scale solar PV and onshore wind in EMDE could be as high as 75%. Reducing the cost of capital is key to permit an accelerated buildout and to lower electricity generation costs as financing costs make up a large share of the levelised cost of electricity (LCOE) for solar PV and wind – about 50% of LCOEs in Mexico or South Africa, compared with about a third in advanced economies.

Figure 2.1 ▷ Investment in utility-scale solar PV and wind in EMDE in the STEPS and the NZE Scenario, 2022-2035



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Investment needs to quadruple in the next ten years to meet net zero emissions targets

Some EMDE have done much better than others at attracting capital to utility-scale solar and wind, especially from the private sector. The overall investment framework varies considerably among geographies. To capture these differences, we grouped countries into three (Figure 2.2):

- **"Nascent" markets**: countries that have very limited or virtually no deployment of solar PV and wind so far (e.g. various countries in Africa, the Middle East and the Caribbean). Countries in this group also tend to have the lowest income per capita among EMDE.
- **"Growing" markets**: countries that are experiencing an acceleration in deployment but where solar PV and wind still contribute only relatively low shares of generation (e.g. Mexico and South Africa)

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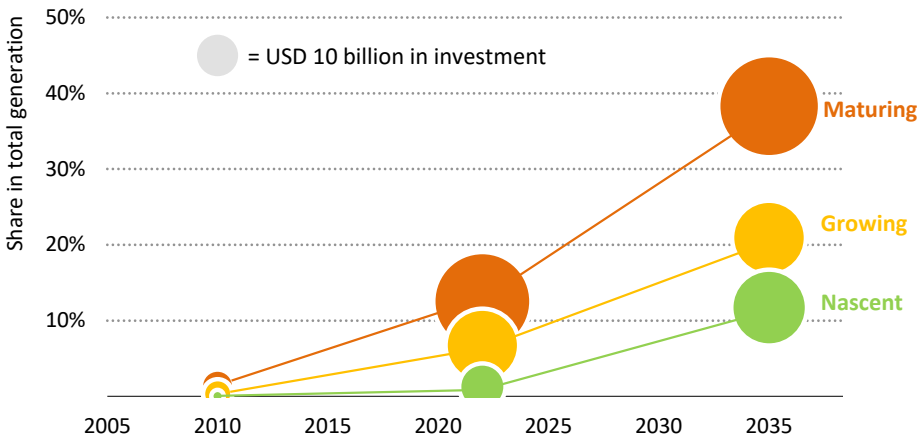
- **"Maturing" markets**: countries that have already had considerable growth in solar PV and wind (e.g. Brazil, Costa Rica and India).

Figure 2.2 ▷ Wind and solar PV generation and investments in EMDE in the STEPS, 2010-2035



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Maturing markets represent countries with a share of solar PV and wind of at least 10% of power generation and the largest growth investment potential

Note: The "nascent" group includes EMDE where wind and solar PV have a share in total generation that is less than 5% today, while the "growing" group has a share between 5% and 10% (or above but where regulatory and policy uncertainties remain high or have worsened), and the "maturing" group has a share of over 10% and a relatively supportive regulatory and policy environment.

While the share of wind and solar PV generation is a useful indicator of the maturity of markets, there are exceptions. Countries can have varying degrees of regulatory sophistication and policy clarity that do not always match the expected uptake of renewable sources in generation. For example, despite a share of wind and solar PV generation above 10%, Viet Nam is considered to be a growing market in this report as a result of associated policy and regulatory uncertainty that impact the outlook for investment in this sector. The country managed to attract considerable investment to the sector between 2018 and 2021, mainly through a relatively generous feed-in tariff, but the renewable deployment boom was not matched with increased investment in transmission. Other issues around infrastructure planning and regulations have also led to curtailment and a slowdown of new investment.

The cost of capital is typically not the binding constraint for accelerating deployment of solar PV and wind in the group of countries characterised as nascent markets. These countries generally have very weak investment frameworks alongside other overarching challenges such as conflict or post-conflict risks, and very little clarity, if any, on policies or targets for renewables or other conditions that are required for project development by the private

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sector. These markets represent only a small share of the overall investment. We also focus our discussion on solar PV and onshore wind only, as offshore wind is still a nascent sector across most EMDE (Box 2.1).

Box 2.1 ▻ Offshore wind in EMDE

In 2022, only 0.1% of the total electricity generation in EMDE came from offshore wind. This is on track to rise to just over 1% by 2035 in the STEPS. Owing to high capital costs and project complexity, only around a quarter of the USD 25 billion spent on wind power in EMDE was in offshore wind in 2022 – compared with around a third among advanced economies and in China. In the NZE Scenario, offshore wind investment in EMDE increases more than ten-fold to USD 65 billion per year between and 2031 and 2035, although its share of total EMDE wind power investment remains at around one-quarter. EMDE countries with significant offshore wind potential include countries that are growing rapidly such as Viet Nam, Indonesia and India, and where its development will be important to meet electricity demand growth.

Some of the key risks for offshore wind investment are not unique to EMDE, and include increased financing costs and supply chain constraints that have affected the whole value chain of the offshore wind sector. At present, 12 gigawatts (GW) of offshore wind capacity are facing delays or cancellation in the United Kingdom and United States alone. However, these factors are amplified by the nascent nature of offshore wind projects in the few EMDE that currently undertake them, especially in countries that still have ample sites available for onshore development.

Scaling up the offshore sector and reducing risk perceptions will require that auction designs have sufficient flexibility to accommodate changing macroeconomic conditions and increase investor confidence in the reliability of demand for projects through, for example, well-designed and regular auctions. EMDE countries will also have to provide greater policy certainty on the role of offshore wind in their respective clean energy transitions, ensure payment certainty by off-takers and create procurement programmes with significant use of concessional funds given the nascent nature of offshore wind in many of these markets. Moreover, governments will have to closely collaborate with wind developers to ensure the availability of adequate infrastructure and construction equipment especially when undertaking the first offshore projects. In addition, it also requires governments to integrate new aspects such as marine spatial planning and seabed survey licensing, which have historically not been part of energy planning processes.

Financing conditions for utility-scale solar PV and wind projects are influenced by both country- and sector-specific risks. The former includes issues around macroeconomic performance or debt management, as well as currency fluctuations and issues that affect all investment, not only energy. As explained in Chapter 1, this report focuses on sector-related risks. In the IEA's most recent Cost of Capital Observatory, when asked what the risk was to

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be addressed first to reduce the cost of capital for utility-scale renewable power projects in EMDE, investors identified the following three:

- **Regulatory risk**: the level of clarity and predictability of policies and regulations.
- **Off-taker risk**: perceived and real risks related to the payment of power purchased by off-takers.
- **Transmission risk**: ability to access the transmission grid in a predictable manner.

For maturing markets, currency risk is also critical, and it impacts their ability to attract international capital. Other risks, such as problems to obtain land or volume risk, are also prevalent, but were identified as less pressing. The following two subsections discuss these factors in more detail and provide recommendations to reduce the cost of capital in growing and maturing markets.

2.2.1 Utility-scale solar and wind in growing markets

The countries categorised as growing are those that have utility-scale solar PV and wind sectors that have been evolving over recent years, but these sources still represent a small share of the total generation (between 5% and 10%). These include, for example, Mexico, most countries in North Africa, South Africa and Thailand. Most countries in Africa are categorised as nascent, though there are some exceptions, such as Senegal and Kenya, where the share of solar PV and wind in generation is already high.[3]

Utility-scale solar PV and wind are generally financed by revenue-supporting mechanisms, such as feed-in tariffs or long-term physical power purchase agreements (PPAs), financed on a project finance basis. Competitive auctions are growing, but they are not universal still.

Key factors influencing financing costs

Most countries categorised as growing markets have targets for renewables, and some award long-term contracts through competitive auctions and have – or have had – multistage procurement programmes such as Mexico, Morocco and South Africa. However, many of these countries often do not have implementation plans in place or they are implemented with delays. In some cases, investment flows have fluctuated significantly due to the regulatory uncertainty in these markets. Investment for utility-scale projects stalled in Mexico in recent years, in part due to the Covid pandemic but also because changes in laws relating to electricity generation and supply that have restricted private sector operations and impacted renewable generation companies (Bloomberg Linea, 2023). Efforts to favour the state-owned utility company have led to the cancellation of permits of generation companies (Bloomberg Linea, 2022). There have also been issues with land-use and inconsistency of rules across local jurisdictions. The IEA's Cost of Capital Observatory found

[3] In Senegal, for example, this share was above 20% in 2022, but as its regulatory and policy environment is still under development, in this report we categorise Senegal as a growing market.

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that reducing regulatory risk was a key issue behind the relatively elevated cost of capital for utility-scale solar PV projects in Mexico.

Off-taker risk, another key concern for investors, refers to delays or arrears in the payment of power purchased by off-takers, often state-owned enterprises (SOEs) and in most cases in poor financial and operational conditions. These risks can be mitigated through mechanisms such as escrow accounts that earmark revenues to pay for the electricity generation, using for example creditworthy intermediaries as done by India or other risk-mitigation mechanisms offered by domestic or international institutions. In particular, the Multilateral Investment Guarantee Agency (MIGA) of the World Bank has been offering products to cover the non-honouring financial obligations by public sector borrowers as well as political risk insurance for private sector projects for more than 20 years. MIGA has a successful track record: it has issued USD 70 billion in guarantees since its inception and paid only 11 claims, all related to its political risk insurance product (CGD, 2023). Among the regional development finance institutions (DFIs), for example, the African Development Bank also offers guarantees for private investors.

An advantage of MIGA, compared with other private or public insurers, is that the host countries take into consideration the impact that calling on a MIGA guarantee could have over the perceptions of the World Bank Group or the international community, investors in particular. If arbitration happens, though, one improvement to MIGA's payment guarantee product could be to add a stand-by liquidity facility ensuring payments to investors while the process is in place (G20, 2023). There is significant potential to expand the use of MIGA's guarantees and insurance products as it supported on average less than 45 new projects every year across all regions and sectors of the economy over the last five years (MIGA, 2023). MIGA's coverage in lower income and riskier countries is limited, and guarantees take time to complete. A 2023 report by the G20 recommended tripling MIGA's annual guarantee and distribution activities (G20, 2023), an effort that will also require increasing the entity's administrative capacity to deliver.

Transmission risks are another element that can increase the cost of capital for utility-scale projects in EMDE. If a project cannot be connected to the transmission grid in a timely manner or investors are faced with issues around grid balancing and curtailment, it can create difficulties for the financial appraisal and the estimation of revenue generation. This is not a risk that is unique to EMDE, but it can be exacerbated by slow permitting processes, the deteriorating quality of existing grids and the low level of investment in grid infrastructure. In growing markets for solar PV and wind, this risk tends to increase with an increasing share of solar PV and wind in power generation.

These risks, together with higher base rates, translate into a high cost of capital. The weighted average cost of capital (WACC) for utility-scale solar projects in Mexico and South Africa was around twice that of advanced economies. For example, the average interest rate of a ten-year government bond in Mexican pesos was around 9% in 2022, and around 10% in South Africa, compared with 3% for a USD-denominated ten-year bond issued

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by the United States. Higher base rates and higher risk premiums result in higher financing costs in EMDE.

2.2.2 Utility-scale solar and wind in maturing markets

Maturing markets comprise countries where wind and solar PV already contribute to over 10% of the total electricity generation along with relatively strong policy and regulatory frameworks. They include countries such as Brazil, Costa Rica, Chile, India and Morocco. In maturing markets, investment into utility-scale wind and solar PV are 75% higher in 2035 in the NZE Scenario than in the STEPS.

These countries generally have had strong and relatively stable supporting regulatory policies for the good part of the past decade that have helped the rapid deployment of wind and solar capacity. These including measures to stimulate the demand for low-emissions electricity; such measures include India's Renewable Purchase Obligations that mandate the purchase of renewable electricity by distribution companies. Such markets also tend to have stated targets for the deployment of clean energy that provide a clear policy signal to the industry.

Countries with maturing markets for solar PV and wind also tend to have an array of supportive elements beyond sector-specific policies. This includes an active and often competitive private sector, strong or rapidly developing governing institutions, a strong judicial system that enforces the sanctity of contracts, and a growing domestic financial market that is a key source of investment flows. In such countries, the cost of capital associated with wind and solar PV deployment might be closer to the best country case among EMDE, although still higher than that in advanced economies. As an example, despite plenty of solar resources, domestic solar module manufacturing and steadily growing electricity demand, the cost of capital in India for utility-scale solar PV is still more than double that in Europe.

Key factors influencing financing costs

In maturing markets, regulatory risk relates mainly to unexpected changes or lack of clarity in regulation and tariff structures, as well as delays in permitting, licensing and approvals required to commence utility-scale projects. As an illustration, when India started levying a customs duty on the imports of solar PV modules to encourage domestic manufacturing starting in April 2022, it led to shortfalls in the supply of modules, impacting capacity growth (PV-Tech, 2023).

Off-taker risk forms a second major aspect influencing the cost of capital for countries with maturing solar PV and wind markets. For utility-scale electricity generation projects, distribution companies form the largest consumers of the generated electricity. Their ability to pay in full and on time is critical to the financial health of generation companies. However, many distribution companies in EMDE tend to be in precarious financial health for a variety of reasons, including the lack of tariff reform, transmission and distribution losses, power

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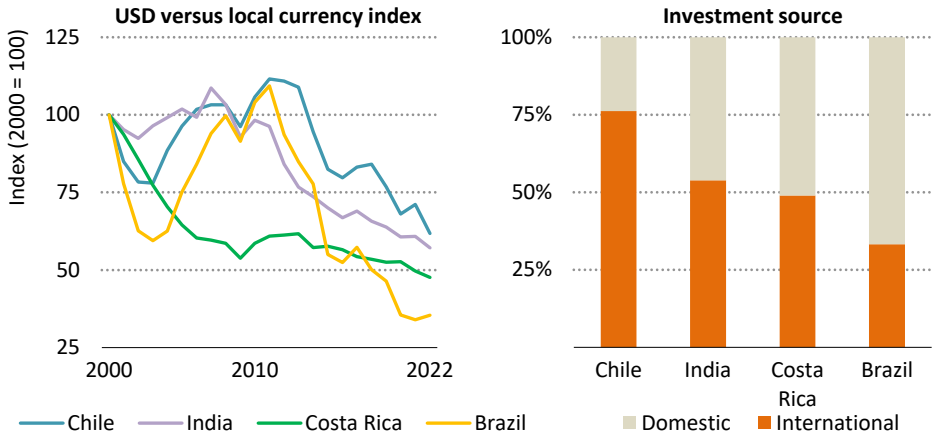
theft, and inefficient management. As a result, there is a risk that these off-takers are not always able to make payments on time, affecting the ability of generation companies to service their debt and meet their operational requirements.

India provides a useful illustration of this. As of November 2023, there were USD 9.6 billion in outstanding dues to electricity generation companies from distribution companies (DISCOMs) (Ministry of Power, 2023). On average, payments by DISCOMS were made 160 days late nationally, almost four times as high as the targeted 45 days (Government of India, 2023). Already in 2015, the Indian government initiated the Ujwal DISCOM Assurance Yojana scheme which allowed the financial restructuring of DISCOMs. In 2022, the government further adopted the Late Payment Surcharge rules that enforce a penalty on DISCOMs for late payments to generation companies and within a year of enforcement, the total outstanding dues by DISCOMs decreased by a third (Mercom, 2023).

Figure 2.3 ▷ Index of US dollars relative to the exchange rates of key countries in the maturing archetype, 2000-2022, and sources of investment for wind and solar PV generation, 2022



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Currency risk can be a key obstacle to attracting international capital, especially as local currencies continue to depreciate

In countries with maturing markets for utility-scale wind and solar PV, currency risk also plays a significant role, as domestic markets often are not deep enough to fully provide the capital required to meet clean energy deployment targets, and international capital becomes more important for further buildout. Among the selected countries in this group of countries, international investment spending – often made in currencies such as US dollars or euros instead of local currencies – is currently responsible for around half of the total investment for utility-scale wind and solar PV deployment. Looking forward, international investment spending will need to triple by 2035 compared with 2022 under the NZE Scenario, far

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outpacing the growth in domestic spending. Given these dynamics, local currency devaluation and exchange rate fluctuations contribute significantly to uncertainty around expected returns, and in turn increase the cost of capital. In addition, there is an associated transaction risk as procurement costs for imported equipment can rise unexpectedly as purchases are often made in US dollars or other internationally accepted currency.

In fact, local currencies of some countries with maturing markets have devalued by half against the US dollar since 2000 (Figure 2.3). The impact of this was particularly evident in Brazil, whose currency devalued by nearly half within five years starting in 2013 and which started to auction solar PV capacity for nearly 900 megawatts (MW) in 2014. However, as the Brazilian real plunged, the value of the PPAs that were awarded fell by 36%, resulting in the cancellation of several projects as they had become economically unviable (Warren, 2017).

As this report focuses on interventions within the remit of energy policy makers, the next section discusses key recommendations to reduce the cost of capital by measures within the energy sector. Meanwhile, Box 1.4 in Chapter 1 of this report discusses currency risks. In addition to these three key risk categories, a key factor that influences the cost of capital in this archetype includes the adequacy of grid interconnections and related infrastructure.

2.2.3 Key recommendations to reduce the cost of capital

Reducing the cost of capital requires addressing multiple risks and improving various dimensions of the investment proposition of utility-scale renewables in EMDE. Some of these considerations apply across various countries and also affect other power-related investments beyond generation such as grids. National governments, with the help of DFIs, need to strengthen efforts to improve the fiscal status of DISCOMs – especially in Africa and Southeast Asia, as well as in some Indian states. This can be done through financial restructuring, tariff rationalisation and reform, reduction of transmission and distribution losses, improved metering, and cost reductions. Other measures depend on the country's grouping:

Measures needed in countries with growing markets:

- **Reduce off-taker risk by expanding credit enhancement mechanisms**. Covering non-payment delays is key to help a sector where generally low-creditworthy SOEs are the main counterpart in PPAs to private investors. For instance, a capital increase for MIGA, or other similar institutions, could enable an increase in its ambition – provide more guarantees in a broader set of countries and slightly riskier projects – and get transactions done faster. Well-designed PPAs, following international standards, can also help to reduce risk perceptions and in turn lower the need for payment or other guarantees.
- **Continue developing the market with competitive procurement programmes tied to a clear long-term strategy**. Providing visibility over the project pipeline and bankability of long-term contracts is key to facilitate transparent price formation and learning that

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helps reduce the cost of capital. Where guarantees are needed, these should be incorporated in the packages offered at the procurement stage.

- **Expand transmission infrastructure that can enable renewable power projects and electricity integration between countries, while testing out business models for privately financed transmission**. (see recommendations in the Grids section).

Measures needed in countries with maturing markets:

- **Incentivise grid flexibility**. Introduce measures to deploy power system flexibility with appropriate regulation, market rules and technical standards. Further, adapt solar PV and wind tenders to incorporate and reward the supply of storage and solutions that improve the system flexibility, frequency regulation and demand response.
- **Continue ensuring timely and full payments to generation companies**. Off-taker risk is a relatively lower risk in various Latin American countries such as Brazil, Chile, Costa Rica and Uruguay, but remains a prevalent concern in countries such as Argentina and some states in India, where tailored risk mitigation solutions may be required.
- **Prepare tenders to allocate transmission lines around green corridors**. As the share of renewables increases, it is easier to earmark transmission lines as "green", given these are needed almost exclusively to evacuate existing or expected solar and wind. Their green characteristics could attract high levels of private international capital.

SPOTLIGHT

Achieving universal energy access by 2030

Today 760 million people lack access to electricity (80% of whom live in sub-Saharan Africa) and over 2 billion people lack access to clean cooking, primarily in developing Asia and sub-Saharan Africa. Providing access to these households requires spending of roughly USD 38 billion per year – which although a small number in terms of overall energy investment, reflects a fivefold increase on spending levels from today. The spending gap is particularly acute in Africa, especially in relation to clean cooking: around half the people without clean cooking are in Africa, but the region accounts for only 7% of clean cooking investments over the last five years (IEA, 2023a).

Under the NZE Scenario, which achieves the objective of Sustainable Development Goal (SDG) 7, for universal energy access by 2030, 45% of those currently lacking access to electricity are connected via the grid. For the remaining share, 30% rely on mini-grids and 25% will access electricity via stand-alone systems – mostly solar PV based. Nearly half – 45% – the households that gain access to clean cooking do so via liquefied petroleum gas and 12% via electric cooking, with improved cookstoves playing a key transitional role in rural areas where fuel and electricity infrastructure are lacking. The financing models for these distributed systems are significantly different from other parts of the energy system given their smaller scale and the concern around non-payment risks associated with the end users.

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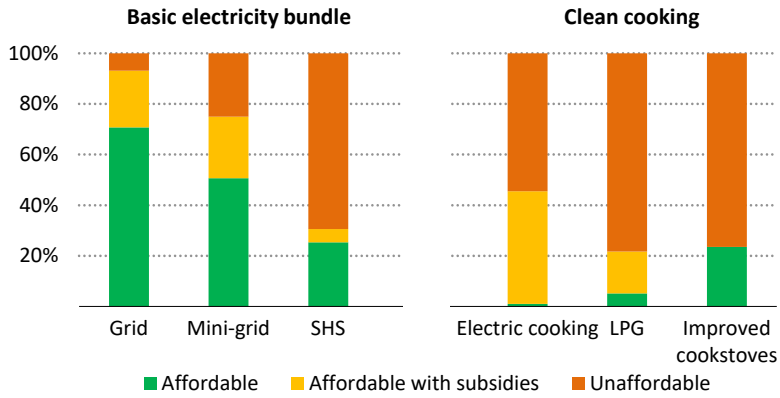
Affordability constraints act as a major brake on future energy access projects (Figure 2.4). For example, only around half of households receiving a new electricity connection in Africa would be able to afford the most basic electricity services without financial support; most clean cooking projects (except for improved cookstoves) would not be affordable (IEA, 2023b). Existing financial support for energy access comes in the form of reduced connection charges, social tariffs or, less frequently, subsidised appliances, often provided by governments and DFIs. However, rising debt levels in EMDE limit governments' ability to increase financial support, with concessional capital likely playing a larger role. Without this financial support, many projects would be rendered too expensive for households to maintain while also being not commercially viable for private sector involvement.

Figure 2.4 ▷ Affordability of energy access projects based on existing subsidy regimes in Africa



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Affordability acts as an increasingly significant constraint in achieving universal energy access, particularly in relation to clean cooking

Notes: SHS = solar home system; LPG = liquefied petroleum gas. "Basic electricity bundle" refers to a system with multiple light bulbs, a radio and a phone charger (IEA, 2023c). In the analysis it is assumed that upfront costs are spread over the infrastructure or product lifetime. The analysis is based on household income data by percentile (World Bank, 2023)and a solution is considered affordable if its cost is lower than or equal to 5% of household income.

Given the price sensitivity of consumers, keeping the cost of capital low is paramount. Taking advantage of climate finance and growing carbon markets can be one means to reduce equipment costs and increase the revenue streams of projects. However, many energy access projects involve local small and medium-sized enterprises (SMEs) that can struggle to access affordable capital. International companies have the resources and historical track record to facilitate access to concessional funding, notably grant support

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or blended private equity, that can allow them to keep costs down. But local SMEs rely on domestic commercial banks that are risk-averse and lack familiarity with energy access business models and offer cripplingly high interest rates and collateral requirements.

While reducing the cost of capital will help increase the involvement of the private sector for commercially viable projects, the reality is that grant or other highly concessional funding will need to play a substantial role. This is particularly true for clean cooking and electricity access projects for lower-income households including in fragile and conflict-prone states. In 2019 (latest available data), grants accounted for 37% of financing for mini-grids and off-grid projects, and 52% of clean cooking projects (SE4All, 2021). However, this grant support is often limited to a handful of large projects – for example, grant capital in 2019 supported only 12 clean cooking projects. To reach SDG 7, the scale and accessibility of this grant capital needs to expand, with an emphasis on the last mile.

2.3 Grids

Investment outlook, sources of finance and sector development

EMDE collectively invested USD 67 billion in electricity networks in 2022, a quarter less than before the pandemic. This level of spending falls well short of the amounts required to accommodate growing electricity demand and the expanding deployment of renewables, which have been experiencing annual growth of more than 10% since 2017 and which need to triple in the NZE Scenario by the early 2030s (Figure 2.5). The cost of not doing so would slow the development of renewables, raise costs and heighten security concerns (IEA, 2023d). Reducing the cost of capital is key to achieve the energy transition, given grids are very capital-intensive assets.

On a global scale, the financing for transmission and distribution from SOEs amounted to USD 45 billion in 2022, with DFIs contributing USD 6 billion, one-third of which was concessional. To mobilise sufficient capital required in the NZE Scenario, a yearly USD 20 billion in DFI financing will be needed over the 2031-2035 period, a significant amount of which would be concessional.

The market structure and financing of transmission and distribution grids varies globally, ranging from regions with vertically integrated state-owned national utilities (or SOEs) to regions more open to private participation. These variations result in unique financial frameworks, risks and financing costs that are contingent on the specific region (see Box 2.2 on Africa). Table 2.2 describes the most typical business models applied in the transmission and distribution sector in EMDE.

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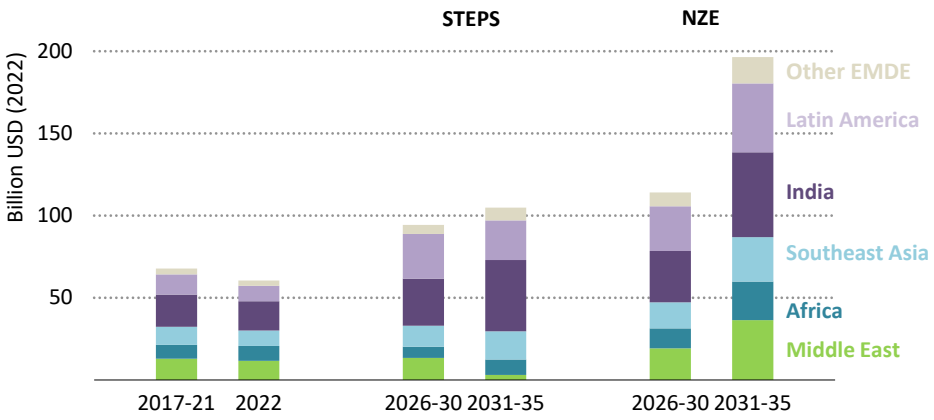
Figure 2.5 ▷ Investment in electricity grids in EMDE in the STEPS and the NZE Scenario, 2017-2035



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Investments in electricity grids in EMDE need to be scaled up to align with the NZE Scenario

Unbundling is more likely to be successful in a structure that ensures dependability of cash flow and affordability. Additionally, implementing a model with a higher private participation requires changes in legislation, redefining responsibilities across different entities such as regulatory bodies and transmission and distribution companies. However, there are numerous cases where introducing private sector participation led to increased investment in grids. This was the case in various Latin American countries, the Philippines and some portions of the Indian network. To be successful, these approaches need to be adapted to the local context.

The cost of capital in markets led by public entities and those with higher private participation is influenced by distinct factors, the reason we separate the discussion into two analytical groups. Many countries may fall into an intermediate stage rather than strictly aligning with one of these groups, but these two serve as reference points or guides for understanding the variations in cost of capital across different market structures:

- **Publicly led grid financing**: examining state-owned companies and their vertically integrated transmission and distribution business models, using the case of Indonesia.
- **Privately led grid financing**: exploring transmission and distribution business models in countries with substantial private sector participation, featuring concessions and independent power transmission (IPTs), using the case of Brazil.

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Table 2.2 ▷ Diverse models for transmission and distribution projects cater to country-specific contexts, and macro components

Main business model	Ownership and control	Financing	Cost of capital drivers	Countries
Mainly state owned	• Transmission and distribution owned by government/public entity • Vertically integrated • Pricing, investment and operational decisions controlled by government • No competition	• Infrastructure financed through SOEs/ government budget, so financial health of the system is key • Limited private participation	• Financial health of the SOE/government • Cost-reflective tariffs • Payment risk	Indonesia, Viet Nam, Thailand, Egypt, Morocco, most countries in sub-Saharan Africa, Uruguay
State owned and whole concessions	• Entity is granted a concession to operate and manage the transmission or distribution line • Vertical separation • Pricing, investment and operational decisions controlled by government • Low-medium competition	• Concessionaire responsible for financing its corresponding zone, which can be a mix of public and private financing • Medium private participation	• Regulation framework • Cost reflective tariffs • Visibility of grid enhancement investments and operation costs • Off-taker risk, demand risk	Philippines, Pakistan, Uzbekistan
Concessions and IPTs	• Sections of transmission/distribution are tendered to private entities • Flexible and modular approach to transmission extensions: ownership can be transferred to state or remain private • Medium-high competition	• Concessionaire responsible for funding, private-public joint ventures, special purpose vehicles • Project finance for IPTs: funding against project viability and cash-flow return	• Regulation framework • Cost-reflective tariffs	Brazil, Peru, Colombia, Chile, India (interstates)

Note: IPT = independent power transmission.

2.3.1 *Publicly led grid financing*

In publicly led grids, as observed in most African and Southeast Asian countries – notably Indonesia and Viet Nam – operations rely heavily on SOE balance sheets, and ultimately governments. Typically, it also involves concessional debt acquired through DFIs and export credit agencies. Where financial structure is not isolated from the corporate balance sheet, financing capacity and cost of funding are directly linked to the financial health and liquidity of the SOE rather than the grid project itself. The government's debt ratio and repayment ability play a crucial role in determining the level of the cost of capital. Grid investment costs are typically recouped through regulated tariffs (as in privately financed concessions), which are passed on to off-takers to cover operation, maintenance and financing costs. Thus, when evaluating the bankability and risks of a transmission investment, the design of tariffs also emerges as a significant factor.

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Capital structure of a transmission and distribution project development would typically rely on concessional finance from development banks and state-owned company loans. Additionally, grants and guarantees may also be part of the financial structure.

The most pressing risks affecting cost of capital in publicly led grid systems are identified as the following:

- **Financial sustainability risk:** level of financial well-being of state-owned corporations
- **Tariff risk:** tariff cost-reflectiveness and sustainability.
- **Regulatory risk**: related to planning, business model design and procedures for private participation.

Key factors influencing financing costs

Transmission and distribution projects in publicly led markets are generally funded through the balance sheet of SOEs and development finance debt, often at preferential rates contributing to an overall low cost of capital for these initiatives. Information on the overall cost of capital (excluding concessional sources) is very limited, though, making it challenging to assess the impact of risks on the currently low financing cost.

In considering the risks that impact on cost of capital, the financial well-being of state-owned corporations is crucial. State-owned entities' financial health is often poor, with grid returns being both insufficient and uncertain. Many government corporations depend heavily on concessional debt and a significant share of the revenues coming from subsidies. One example is Indonesia, which reported 20% of revenue coming from subsidies (PNL, 2022).

Mobilising private investment into publicly led sectors faces challenges because of the inherent weakness of regulatory frameworks. In Indonesia, despite the legal provision allowing the private sector to operate grids, as per the 2009 Electricity Law, there is no robust regulation concerning technical procedures and financial charges for network access, and this model has only been applied for generation projects in Indonesia. Moreover, the lack of a regulatory track record presents a significant obstacle in establishing trust from investors.

The predictability and planning of projects also translate into an important risk, as project closures deviate from the initial budget and scope. The uncertainties in these projects directly impact the perception of project risk and contribute to fluctuations in capital costs. However, this risk can be better managed if lending is directed towards specific objectives of the project development. Some projects in Indonesia, for example, have adopted a results-based lending approach, a first of its kind for grid projects, which prioritises delivering specific and measurable results and encourages performance improvements. Publicly led grids in EMDE face significant challenges including financial challenges of their state-owned corporations, uncertainties in project closures and a deficient regulatory framework. These factors collectively elevate perceived risks which ultimately translates into higher financing costs for SOEs.

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Box 2.2 ▻ Looking beyond financing costs to boost Africa's grid investments

Grid investments in Africa need to more than triple by 2030 to meet sustainable development goals, including universal access. This investment is essential to improve reliability of existing infrastructure and to support the growth of renewable power generation. However, it requires a major step change from the past, with grid investments in Africa growing at only 5% between 2019 and 2022. While strategies to lower the cost of capital will play an important role, a holistic approach is necessary that improves the financial health of utilities, protects vulnerable consumers while introducing market-based pricing signals, and upgrades the regulatory environment.

The vast majority of investment in grids in Africa today – nearly 90% – is carried out by SOEs. Many of these utilities are highly indebted with low liquidity and reliant on budgetary support. Only about one in three utilities in Africa recovers its operational and debt servicing costs, including subsidies from central government; excluding such subsidies, the ratio drops to one in four. High debt levels are often driven by low collection rates, the lack of cost-reflective tariffs and costly electrification projects.

Strengthening the financial position of these SOEs would be one of the impactful measures to increase spending on grids. Steps to support this can include the introduction of cost-reflective tariffs – currently present or under discussion in 26 countries in Africa - and the expansion of decentralised approaches, such as mini-grids and stand-alone systems, for energy access projects in rural areas that are costly to reach with a grid connection and often end up as loss-making for a utility due to low demand.

The private sector can also start to play a larger role in the sector. Today, although 30 countries allow private participation in generation, only four allow private participation in transmission. Many utilities in Africa also lack access to capital markets to raise private debt since their credit ratings are below investment grade. Innovative approaches are being tested, such as the first-of-its-kind IPT in Kenya. Under this approach, demand risk is effectively allocated to the state-owned transmission company. That said, the project is most likely to be successful if developed near industrial off-takers, which are considered less risky from demand and affordability perspectives. If successful, it could help reduce the perceived risk around private sector involvement in grids in Africa and serve as a model for other countries in the region.

2.3.2 Privately led grid financing

Countries classified as privately led are those where portions of the grid are tendered to private entities, and the concessionaire bears the responsibility for financing and operating the transmission and/or distribution infrastructure for a certain period of time. Unbundling and/or privatisation has been undertaken through various business models: concessions (private sector in charge of investing and operating current and new lines in an entire

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geographical zone for 25 years or more), privatisations (similar to a concession but generally for an indefinite period), IPT (private sector in charge of investing and operating a new line over 20-25 years) and merchant lines (taking full volume and price risk against the wholesale power market). Various countries in Latin America, India, and some countries in South and Central Asia such as Pakistan and Uzbekistan have substantial private sector participation in transmission or distribution grids, or both.

Unlike concessions, an IPT model is characterised by being modular and involves tendering for a specific transmission line, or a package of lines, offering more flexibility in terms of asset ownership and risk allocation. This is a model applied only to transmission though, not distribution. It is also a business model that can be tested while the majority of the grid continues to be operated and financed by the SOE. The IPT is similar to the independent power producer model in generation, which has been relatively successful at attracting private capital in various EMDE. Brazil, Colombia and Peru are examples of countries that apply the IPT model in transmission, and Kenya has also pioneered with two private transmission projects for around 230 kilometres that will start construction in 2024.

Common financing structures for these transactions include commercial lending, multilateral lending and bonds from local capital markets. Funding typically comprises a blend of public bank loans – backed by guarantees from commercial banks, bonds and shareholder capital.

In privately led grid systems, the main risks encompass:

- **Remuneration risk**: level of adequacy of remuneration to reflect costs and adjust to macroeconomic circumstances.
- **Regulatory risk**: predictability and robustness of the regulatory framework.
- **Permitting risk**: lack of legal framework that can cause risk of delays.

Key factors influencing financing costs

In the privately led financing models, revenues – and in turn financing costs – are determined differently:

- In the case of transmission and distribution concessions, revenues are set by the regulatory authority, typically based on operational performance, investment costs and a fair return on investment. Revenue is adjusted by a periodical tariff review, hence its reliability over time significantly affects the overall financing costs of the project.
- In IPTs, revenues are mainly determined upfront by the winning bid of a competitive tendering process. These are not adjusted over time so regulatory risk tends to be lower. Incentives are tied to the availability of lines during the contract period (above 95%) rather than usage, shifting demand risk away from the grid developer. These projects are also generally financed through project finance structures.

Latin America in particular has attracted a higher share of financing from private sources than many EMDE (IEA, 2023e), and Brazil is an example where the two privately financed models co-exist. In the case of concessions, the regulatory body determines a WACC that is used to

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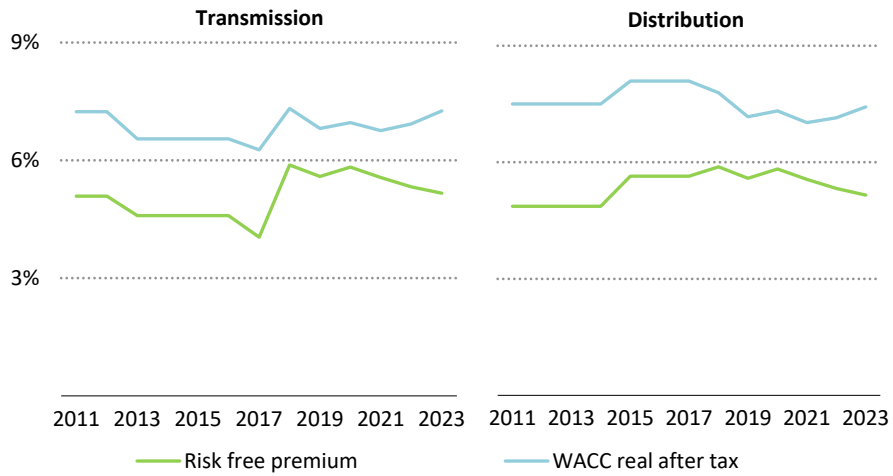
calculate the revenue cap. Argentina and Colombia also have concessions in power distribution and use similar WACC calculations to compute the regulated revenue. Other countries such as Bolivia, Chile and Guatemala regulate a return over assets using the industry as a proxy.

The returns in Brazil's concessions have proven to be quite stable over time (Figure 2.6), contributing to investors' confidence, attracting more players, and a greater success rate for auctioned lots after 2017. A regulated return that accurately captures risks in grid projects is likely to mobilise more investment and have a positive impact on the cost of capital.

Figure 2.6 ▷ Regulated WACC and risk-free premium in Brazil



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Brazil's regulatory body determines the WACC for concessions. Stable and predictable WACCs have been key to attract private investment to transmission and distribution

Sources: (ANEEL, 2023). Risk-free premium calculated by Brazil's regulator ANEEL, based on national treasury bond indexed to consumer index prices.

As for IPTs, the discount rates for the winning bids have been gradually growing since 2015, showing a more competitive environment and a greater success rate for auctioned lots.

Risks of permitting delays and legal access to projects also have a significant impact on financing costs, for both concessions and IPTs. Delays are frequently encountered, especially if the legal procedures are complex and there is a lack of solid regulatory infrastructure to facilitate the process. Project development delays are also a risk and can translate into a fine by the regulatory body, which ultimately affects the perceived risk of the investment.

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2.3.3 Key recommendations to reduce the cost of capital

Similar to some challenges faced in the power generation sector, addressing the financial predictability of projects is key for grid investments. Countries, particularly in Africa and Southeast Asia, require concrete efforts from national governments and DFIs to enhance the fiscal health of state-owned transmission and distribution companies. Some key measures include financial restructuring, cost-reflective tariff adequacy and developing a reliant regulatory framework.

Measures needed in publicly led grids:

- **Improve the financial health of SOEs in collaboration with DFIs.** Additionally, perform tariff reforms to ensure profitability crucial element for the financial sustainability of the SOE. Establish cost-reflective and predictable remuneration, ensuring off-taker affordability is the main objective.
- **Employ blended finance mechanisms that involve DFIs** as a strategic approach to mitigate project risks effectively and enable the unlocking of crucial additional investments in projects that are most needed. Use innovative financial approaches to help capture more commercial resources and cover financing gaps. Additionally, design targeted funding tied to specific and measurable results, encouraging performance and planning improvements.
- **Kick-start private finance participation** in order to increase investment and alleviate the financial burden of the public sector. While full restructuring or privatisation might not always be politically feasible, targeted investment programmes in transmission, such as those observed in Brazil and Kenya, enable the involvement of private capital to accomplish specific policy objectives. Private participation models such as IPTs can facilitate investments in grid infrastructure, offering investors certainty while remaining accountable to the government, and can be used to test the model in the market. It is crucial to supplement these models with robust regulatory monitoring tools to ensure the timely and cost-effective delivery of projects, as described below in the measures for a privately led grid sector.

Measures needed in privately led grids:

- **Introduce or maintain cost-reflective and predictable remuneration in order to mitigate risks of tariff regulation.** Developing a remuneration system that accurately reflects costs and aligns with appropriate incentives (e.g. grid performance in the case of concessions and line availability in the case of IPTs). Regular adjustments, synchronised with economic indicators and responsive to regional conditions, are essential elements, as demonstrated in the Brazilian context.
- **Set up a robust regulatory framework that encourages more power infrastructure development.** Maintain clear and transparent guidelines for concessions. A strong regulatory framework, intricately tied to comprehensive national planning with a clear project pipeline, has demonstrated the capacity to attract a substantial share of

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required financing from private sources. Also, simplifying permitting to effectively mitigate project risk.

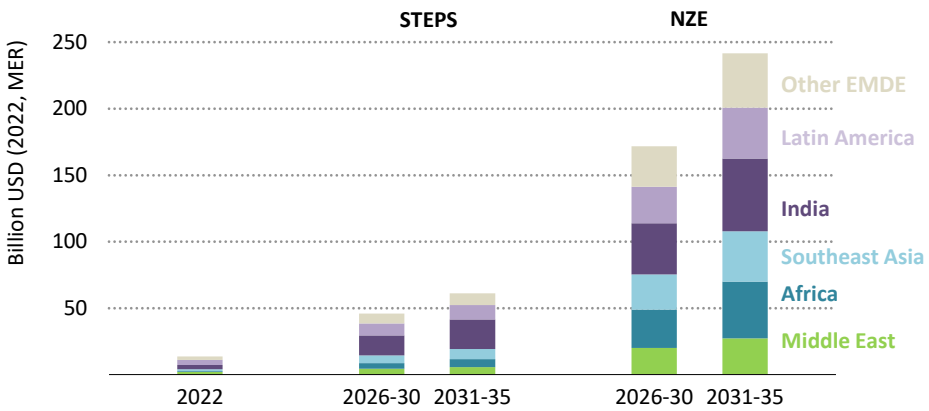
- **Use blended finance** to manage risks and mobilise private capital, particularly in regions that are in early stages of private participation. Direct the blended finance to specific projects in order to build a reliable track record and increase the overall attractiveness of investments in the region.

2.4 Energy efficiency in buildings

Investment outlook, sources of finance and sector development

In rapidly urbanising EMDE, investment in energy efficiency and electrification in the buildings sector is critical to keep the pathway of the NZE Scenario within reach, especially as urban residents tend to consume more energy than those in rural areas, in large part because of differences in income levels (Figure 2.7). Emissions from the buildings sector currently accounts for about 30% of the global energy sector CO_2 emissions. While STEPS points to a slight decrease at the global level, the scenario also anticipates a 10% increase of CO_2 emissions from the sector by 2035 in EMDE.

Figure 2.7 ▷ Investment in energy efficiency and electrification in EMDE in the STEPS and the NZE Scenario, 2022-2035



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Investment in electrification and energy efficiency in EMDE in the STEPS is well below what is needed under the NZE Scenario.

Buildings vary in size and scale, spanning from small residences to commercial skyscrapers. With a long lifespan, their design typically locks in emissions and energy consumption

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patterns for many decades, and the efficiency and emissions characteristics of the building inventory play a progressively crucial role in sustainable development in EMDE. However, investments in building efficiency and electrification in these regions notably lag those in advanced economies and fall short of the levels necessary by the end of the decade to align with an NZE Scenario trajectory.

Investment in buildings is typically carried out by either companies or households and can be classified in two main aspects: the initial envelope investment (i.e. when the building is built) and the retrofit of existing buildings. The split between these two varies by country, depending on the state of development of the housing sector, urbanisation and industrialisation. Investment in retrofitting the existing building stock accounts for a relatively small fraction of overall spending in buildings in EMDE.

Key risks associated with the buildings sector that impacts investments include:

- **Regulatory**: the lack of proper building codes, the capacity of regulatory institutions to implement them and the size of the "informal" construction sector in EMDE.
- **Subsidised residential energy prices** in some regions (e.g. Middle East).
- **Skewed incentives:** including split incentives between owners and renters, and lack of appropriate financing models.

Owing to the lack of adequate energy-efficient building stock in the region, this sector is considered as nascent in EMDE. Very few developing economies have introduced energy efficiency standards for new buildings; India is a notable exception.

Key factors influencing financing costs

The discussion around the cost of capital for financing energy efficiency and electrification in the buildings sector is less straightforward than for other sectors. Investment in buildings – including new construction, retrofits and appliances – is typically made on the balance sheet of the developer or the tenant, mainly using equity. And the cost of equity or the hurdle rate of a rather small entity, household or SMEs is difficult to accurately quantify.

Achieving greater levels of investment will necessitate increased utilisation of low-cost debt financing. But the extent to which the cost of financing influences investment decisions in the efficiency sector, relative to factors such as regulation or the challenges of implementing efficiency measures, remains uncertain.

In the NZE Scenario, about one-fifth of global investment in buildings, appliances or retrofits is made off balance sheet by 2030 either through energy service contracts or leasing agreements, while more than half is still financed through equity, as the development of green consumer finance (green loans/mortgages) does not yet allow households or companies to use more debt to fund investments in energy efficiency. Commercial banks that need to play a critical role in providing debt for energy efficiency in EMDE are experiencing difficulties in evaluating underlying credit quality for small companies and assets and aggregating loans in portfolios to access refinancing, for instance through green bonds.

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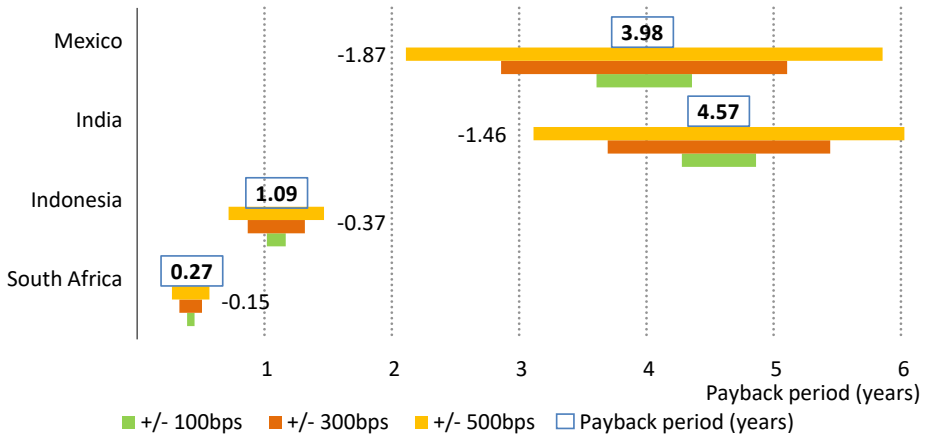
For tenants, the upfront cost of new and more efficient equipment is a significant barrier, despite savings over the lifetime of the product (Figure 2.8). The payment options available for consumers, such as on-bill financing schemes with utilities, are also less prevalent in EMDE than in advanced economies. Monetising energy savings into cash flows to secure lower-cost financing from commercial banks can help to reduce payback periods by months, or even years. Such savings can often be best valued through project structuring that aggregates efficiency measures into project sizes that facilitate due diligence and reduce transaction costs.

Figure 2.8 ▷ Payback period for investments achieving at least a 20% energy efficiency improvement and sensitivity to the cost of capital



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High borrowing costs can have a significant impact on the payback periods for resource efficiency in different economies

Notes: bps = basis points. Estimates assume at least 20% savings in energy, water and materials in the lower-middle-income segment, using the International Finance Corporation's Excellence in Design for Greater Efficiencies (EDGE) tool's default assumptions for each country. WACC: Mexico, 11%; India, 16%; Indonesia, 15%; and South Africa, 14%. Payback periods will be influenced by cost of financing (materialised by the WACC), but all countries do not start from the same baseline. Countries like India and Mexico that have started implementing energy efficiency measures earlier have already deployed the most cost-effective options. Additional implementation will require more investment with longer payback periods compared to countries that are less advanced in this space. Source: Calculations based on the EDGE online tool (2021).

In many cases achieving resource-efficient construction will be cost-effective, and studies point to improved financial returns stemming from investment in green buildings and better performance on indicators such as occupancy rate, time to sell and selling price overall. The upfront cost and the cost of capital of efficiency measures are of course two of the many barriers, but examples in advanced economies show that the cost of financing is not the only variable that determines the decision to undertake an energy efficiency investment (as

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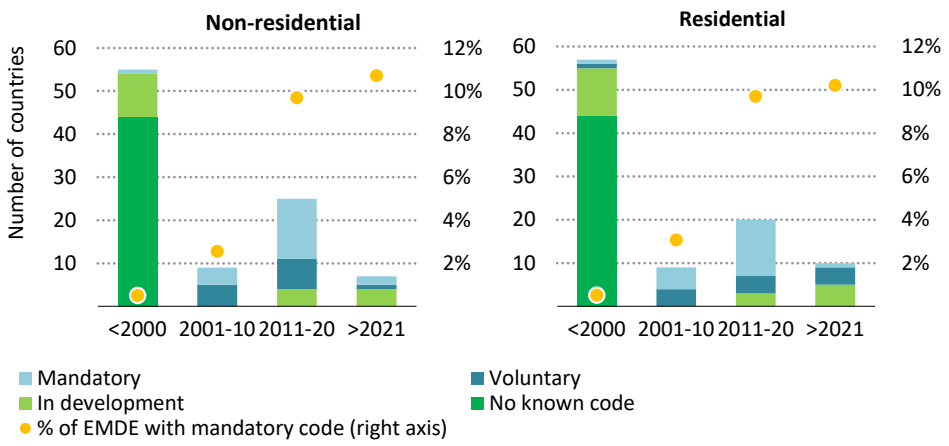
shown for example by the relatively low adoption rates of zero or low interest financing options in countries like France or the United States).

Local banks play a key role in financing green construction, but in many developing economies, they lack experience in project evaluation. Strengthening their understanding of the energy efficiency market and enhancing due diligence capabilities are crucial. These improvements enable them to allocate green financing effectively, aggregating funds into portfolios that appeal to a broader range of investors, potentially reducing capital costs. Expanding the offering of concessional guarantee mechanisms to energy efficiency portfolios would also help local banks secure cheaper financing.

Figure 2.9 ▷ Building energy codes in EMDE



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Despite recent progress, the adoption and enforcement of stringent and mandatory building codes in EMDE has been sluggish but yields the most impact on investment

Some banks have been established with the specific purpose of investing in assets that accelerate the transition to a low-emissions economy, offering green construction loans, first loss guarantees, or mortgages with a longer tenor or a lower interest. In Mongolia, for instance, the Mongolia Green Finance Corporation was established with support from the Green Climate Fund to help secure financing for building insulation, energy efficiency for businesses and mortgages for green affordable housing.

Green building certification schemes can also be harnessed to facilitate refinancing of green construction projects. For instance, in 2017, two banks in Colombia issued a substantial USD 260 million green bonds dedicated to financing certified green housing developments and two environmentally friendly office buildings. This initiative showcased the feasibility of securitising investments in green buildings, effectively marketing them to private investors

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and contributing to an overall reduction in the cost of financing. Such innovative financial instruments demonstrate the growing recognition of the value and sustainability of green building projects, paving the way for broader adoption and support from both public and private stakeholders.

2.4.1 *Key recommendations to reduce the cost of capital*

Lowering the cost of capital in buildings energy efficiency can improve the return profile and may tip the perception that investing in efficiency is expensive and offers low returns, even though the cost of capital itself is not the main barrier in this sector. The cost of capital will benefit from the overall improvement of the landscape for energy efficiency in any given region. Some of the key measures include:

- **Strengthen regulatory frameworks for buildings efficiency**, including through building codes and minimum performance standards. The key aspect of energy efficiency adoption remains enabling policies and the adoption of stringent mandatory building codes, explicitly covering energy efficiency. While encouraging progress has been made in recent years, many EMDE have yet to adopt building codes (Figure 2.9). Furthermore, the adoption of building codes has not necessarily led to effective implementation owing to the lack of capacity by regulatory and municipal institutions.
- **Promote a diversity of local and easily available financing options** to build capacity and lower the cost of capital. Reliance on public, highly concessional financing will be high in nascent, risky markets, where no return is expected. Transactions will typically be conducted by very specialised companies, such as energy services companies, often tied to public utilities. With a bigger market and appropriate enabling mechanisms in utility regulation, public companies can start using on-bill financing mechanisms with the support of credit lines from DFIs. In nascent markets, the signalling impact of procuring energy-efficient public buildings also serves as a pioneering influence.
- **Phase out inefficient energy subsidies** to curb inefficient energy use and encourage adoption of energy-efficient solutions. Subsidies, where necessary, can be better targeted to low-income households. Furthermore, with the active involvement of distribution companies, households can be incentivised to adopt energy efficiency measures through innovative financial tools and awareness-raising initiatives.

2.5 Electric mobility

Investment outlook, sources of finance and sector development

Electric mobility is the main vector to decarbonise transport, in particular personal mobility, yet EMDE currently make up only a small portion of the global electric car market (Figure 2.10). Despite a recent uptick in demand for electric vehicles (EVs), sales remain low. The primary mode of electrified urban road transportation in the majority of EMDE consists of two- and three-wheelers, which have experienced significant success and are commonly

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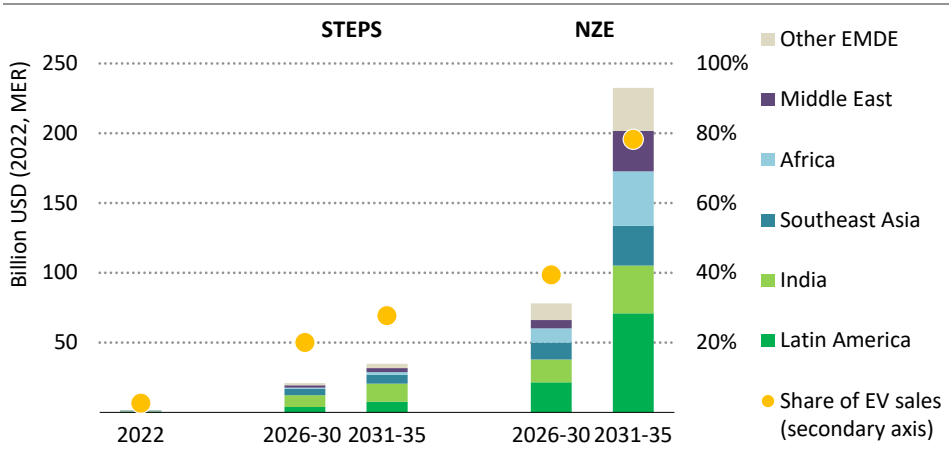
employed for shared mobility in regional commuting. Purchasing patterns for cars in most EMDE are characterised by low rates of personal car ownership and a trend of acquiring used cars. The key risks affecting the development of electric mobility in EMDE can be categorised as follows:

- **Financing risk and affordability**: including limited access to debt financing and high cost of borrowing in EMDE.
- **Ecosystem risk**: the absence of proper EV charging infrastructure and proven business models and lack of dedicated private charging due to poorly defined property rights.
- **Regulatory risks:** lack of clear policy signals on emissions reduction targets from the transport sector and support in the development of manufacturing capacity to boost the role of EMDE in the EV value chain.

In the NZE scenario, a combination of policy support and strong underlying economics drives the transition towards efficient and electrified vehicles with lowered manufacturing costs and expansion of debt-financing and auto-leasing services. India and Latin America become two of the largest EV markets in EMDE to 2030, from a low base. By 2035, all light duty road passenger vehicles (EVs and two- and three-wheelers) sold are electric.

Figure 2.10 ▻ Investment in electric vehicles in EMDE in the STEPS and the NZE Scenario, 2022-2035



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Investment in electric mobility ramps up significantly in the 2030s in the NZE Scenario, as adoption picks up in EMDE

Key factors influencing financing costs

Acquiring EVs poses a significant challenge for most consumers in EMDE, primarily due to the high upfront costs, including higher financing costs compared with advanced economies and a premium when compared with internal combustion engine vehicles. The value proposition

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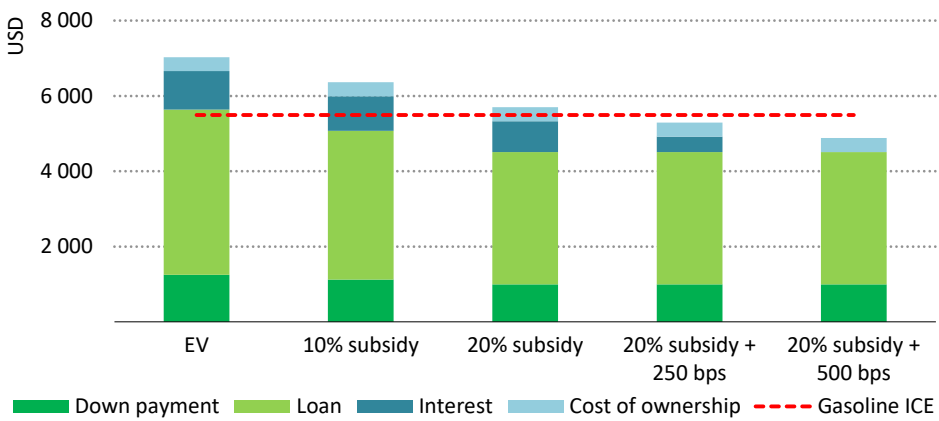
for EVs is distorted in some markets by subsidies for gasoline and diesel. Effective decision-making in investments related to swift energy transitions hinges on addressing the inherent risks to electric mobility listed above.

In advanced economies, the average EV purchase price is around 1.5 times higher than for comparable passenger vehicles. For the same price of EVs, the consumers in EMDE bear higher financing costs than those in advanced economies due to higher interest rates and lower availability of debt (Figure 2.11). They also have less access to service models such as leasing. While financing terms vary considerably by geography, the cost of consumer debt can range from 4% to 18% (in real terms). By contrast, consumers in other markets can often finance over 90% of the purchase cost with auto loans or pay less upfront capital with a lease contract though local service agencies or on commercial terms.

Figure 2.11 ▷ Annualised total cost of ownership for EVs in EMDE, by incentive level and financing cost reduction



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Lowering the cost of borrowing by just 100 basis points can move up the break-even point between EVs and ICEs by several years

Note: bps = basis points; ICE = internal combustion engine vehicles.

As with investment in energy efficiency in the buildings sector described above, the cost of financing is not the primary barrier to wider EV adoption in EMDE, but the lack of available cheap debt hinders deployment of an asset that is typically financed through consumers or SMEs' own equity. Deploying the right incentive mechanisms, including the availability of cheaper debt, can help to remove those barriers and foster wider adoption.

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2.5.1 Key recommendations to reduce the cost of capital

Reducing the cost of capital for electric mobility in EMDE requires addressing these key aspects:

- **Expand consumer access to low-cost auto loans, leasing models and widely available charging infrastructure.** While battery costs have been going down significantly, and manufacturers have tended to lower prices, acquiring an EV remains a very significant purchase for consumers in most of EMDE. Reducing financing costs through standardised low-cost financing or mainstreaming the use of leasing programmes, where customers pay a small rent per month, will increase EV adoption in EMDE.
- **Offer fiscal incentives and subsidies to promote the adoption of EVs while simultaneously initiating the gradual reduction of subsidies allocated to fossil fuels.** Several advanced economies have implemented fiscal measures, such as bonuses, to encourage the widespread adoption of EVs, and these initiatives have demonstrated notable success. Leveraging fiscal incentives as a strategic tool to accelerate the transition from internal combustion engine vehicles to EVs and develop a reliable charging infrastructure can effectively expedite the adoption process by advancing the break-even point between the two technologies.
- **Increase concessional support availability for electrification of mass transit public transportation.** Some successful concessional support has been directed to the electrification of public transit, especially in India, where DFIs have been working with the government on its e-bus procurement programme, which aims to eventually deploy 50 000 electric buses, along with the necessary charging infrastructure. Similar initiatives were carried out in other places such as Chile and Colombia. For private sector manufacturers, the support of concessional finance, combined with a relative certainty over e-bus orders, can help secure cheaper capital. Using the availability of the green debt market or blended finance mechanisms may also help lower the overall cost of financing at the system level.
- **Implement mandatory emissions reduction targets for transport.** Several EMDE have incorporated vehicle efficiency and the electrification of transport as integral components of their economic development plans. Nearly 70% of them have established targets for the deployment of EVs. In the NZE Scenario, strong policy measures such as mandatory emissions reduction targets for new cars and mandatory EV quotas are rapidly put in place. These aspirations face obstacles tied to securing initial capital from a segment of buyers, particularly consumers and SMEs, who face a more constrained access to finance. Direct support from policy makers will drive faster EV adoption and foster the development of a greater local EV manufacturing capacity. Some countries, mostly advanced economies, are considering low-cost leasing models to allow low-income households to access electric mobility (e.g. the EUR 100 a month lease programme in France).

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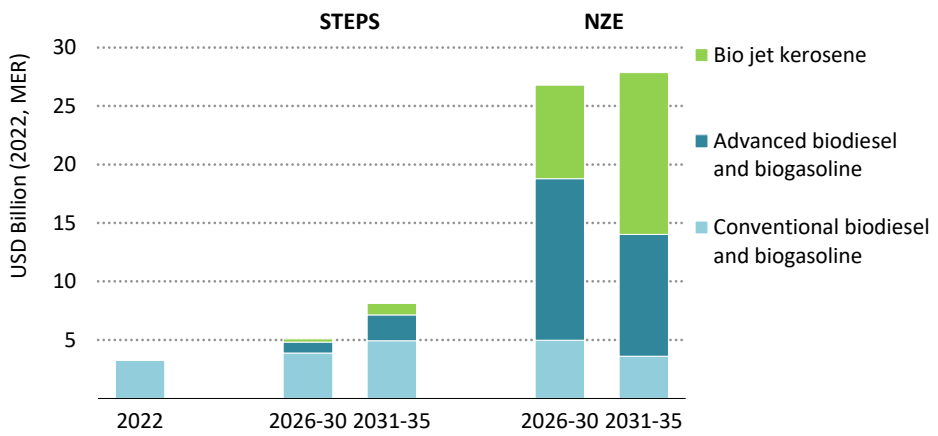
2.6 Advanced biofuels

Investment outlook, sources of finance and sector development

Liquid biofuels play an important role in decarbonising transport. They can often be used in existing engines with little to no modification, and there is growing interest and investment in "drop-in" biofuels that can entirely substitute for diesel and gasoline. Total liquid biofuel demand reached a record high of around 2.2 million barrels of oil equivalent per day (mboe/d) in 2022. Most of this production currently uses so-called conventional feedstocks, such as sugar cane, corn and soybeans. Expanding production to advanced feedstocks is critical to ensuring minimal impact on land use, food and feed prices, and other environmental factors. In the analysis below we focus the discussion and recommendations on advanced biofuels as there is significant potential in EMDE to leverage agricultural residues and municipal waste as sustainable feedstocks, thereby moving away from conventional biofuels.

Investment in liquid biofuels, excluding feedstocks, totalled USD 3 billion in 2022, comparable to the last five years. Around 35% of global spending was in EMDE. The largest producers are Brazil, Indonesia and Argentina, which collectively produced 0.60 mboe/d (or 30% of the global total). In the NZE Scenario, investment rises significantly to 2030, with a much larger share produced from waste and non-food crops. Aviation biofuels make the most dramatic strides between now and 2030 in this scenario (Figure 2.12).

Figure 2.12 ▷ Investment in liquid biofuels in EMDE in the STEPS and the NZE Scenario, 2022-2035



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Investment in liquid biofuels grows ten-fold in the NZE within a decade. Advanced biofuels lead growth, and require more financial support than conventional projects

Note: Figure shows advanced versus conventional biofuels production in EMDE rather than a regional breakdown to highlight the importance of directing investment in advanced feedstocks.

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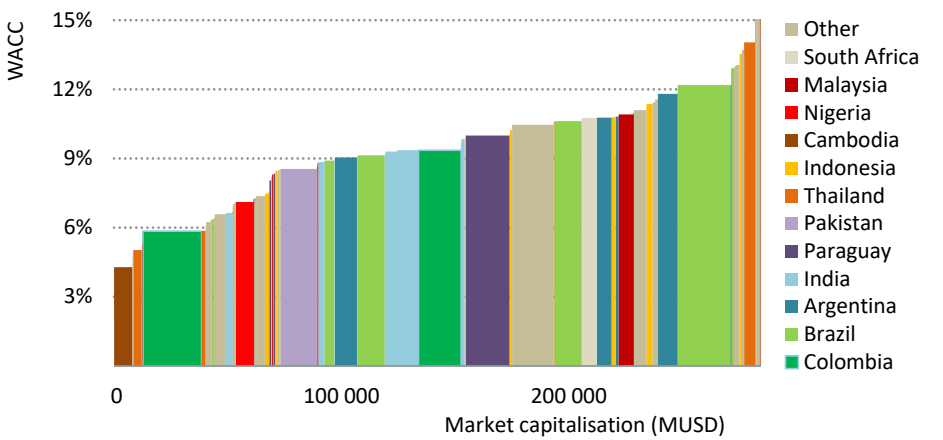
Blending mandates, low-emissions fuel standards and accompanying subsidies drive biofuel project economics, and these differ by jurisdiction and production pathway. Regulations that differentiate biofuels based on their life-cycle emissions (including indirect land-use change) are crucial to shift investment towards advanced projects that use sustainable feedstocks. There are many opportunities in EMDE; in Southeast Asia, for example, used cooking oil and residues from sugar production (such as bagasse) or from palm oil production (such as palm kernel shells) are a largely untapped, energy-rich resource. Shifting towards such feedstocks is important to avoid competition with food production and risks to biodiversity.

Key factors influencing financing costs

The cast of biofuel producers is diverse, ranging from farming co-operatives and small independents to large agricultural conglomerates and major oil and gas companies. Some companies are "pure-play" biofuels companies with a strong presence across the whole supply chain, whereas in other cases biofuels may make up a small part of a company's overall portfolio. The cost of capital naturally varies considerably across these different types of firms (Figure 2.13).

Figure 2.13 ▷ Weighted average cost of capital for a sample of biofuel producers in EMDE



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There is a wide variation in the cost of capital for biofuels producers, which range from small independent farming co-operatives to large-scale energy and agricultural firms

Notes: MUSD = million US dollars. Sample includes companies producing conventional and advanced biofuels domiciled in EMDE, with a market capitalisation up to USD 25 billion.

Source: IEA analysis based on (BNEF, 2023).

Most of the total costs of both conventional and advanced biofuels are taken up by feedstock procurement and ongoing operational expenditures, and so biofuel projects are less sensitive to changing interest rates than wind or solar projects. Capital and financing costs make up

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between 10% and 20% of the levelised cost of fuel for conventional biofuels, but for advanced biofuels these costs form a larger share. For example, cellulosic ethanol plants require more significant investment in processing equipment than fatty acid and methyl ester (FAME), and they also employ wastes and residue feedstocks which are generally plentiful and inexpensive. The share of capital costs in the total cost of fuel for cellulosic plants is 30-40%, compared with 20% for FAME, and financing costs are typically also higher (Williams, 2020).

There are two main risks that are liable to raise financing costs for sponsors of advanced biofuels. The first is technological risk: first-of-a-kind advanced biofuel projects tend to have high risk premiums. With difficulties securing long-term offtake agreements or feedstock supplies, project finance is typically out of reach. Instead, advanced biofuel developers often rely on unsecured loans with flexible repayment schedules or ones that can be converted to equity (IRENA, 2019). The second risk relates to feedstock availability: without a long-term offtake contract for a secure stream of waste or residue, investors may question the viability of a project. The possibility of a sustainable feedstock supply crunch also looms large over new projects (IEA, 2022).

Several countries that promote advanced biofuels offer financial support to manage these risks, such as grants, loan guarantees and tax incentives. These can have relatively large impact on early-stage projects: an IEA Bioenergy study found that reducing the financing rate from 10% to 8% and extending the financing term from 15 to 20 years would reduce overall production costs by up to 16% (IEA Bioenergy, 2019).

Clear, consistent and long-term biofuel support policies help reduce investor risk, and so lower financing costs, and are at the core of successful biofuel policies. To support advanced biofuels governments often include dedicated advanced biofuel targets, and additional incentives such as double counting towards regulated targets, limiting non-advanced feedstocks and rewarding greenhouse gas intensity improvements. Brazil's RenovaBio provides a framework for support to a wide range of biofuels, and ties the reward of tradeable decarbonisation credits to certified life-cycle assessments. Similarly, in the United States, the state-level Low-Carbon Fuel Standard in California and federal Inflation Reduction Act reward biofuel projects with lower greenhouse gas intensities, which often include advanced feedstocks.

There is also growing support for sustainable aviation fuels (SAFs), which are backed by environmental tax credits and a competitive grant programme under the US Inflation Reduction Act. In the European Union, the ReFuelEU Aviation directive sets minimum SAF blend-in shares, with sub-targets for synthetic fuels, through 2050. Bio jet made from food and feed feedstocks are not eligible under the directive. In 2022, following its announced Jet Zero pledge, the United Kingdom dedicated GBP 165 million to support SAF projects, with a plan to have at least five commercial SAF plants under construction by 2025.

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2.6.1 Key recommendations to reduce the cost of capital

- **Set up clear, consistent and long-term demand policies.** A robust renewable fuel standard with clear definitions of sustainable feedstocks and third-party verification of life-cycle emissions can create stable market demand for advanced biofuels, providing assurance to investors and lenders. It is essential to ensure that robust waste management policies are in place that identify wastes and residues that can be used for advanced biofuel production, and provide timelines for implementation.
- **Reduce the risk of first-of-a-kind projects.** Early-stage projects often require additional capital and carry great risk. Governments can provide targeted tax credits or first loss guarantees that directly reduce the cost of capital for producers.
- **Strengthen international collaboration.** Mutual recognition of greenhouse gas intensity assessments of advanced biofuels or their feedstocks is essential to scale up international partnerships and biofuels trade, including use in international aviation and shipping. International collaboration on setting consistent life-cycle intensity standards and what processes can comply with international targets can help reduce risk, and so cost of capital.

2.7 Utility-scale hydro

Investment outlook, sources of finance and sector development

Hydropower is the largest source of clean power globally today and is particularly prominent in EMDE, where it meets the majority of electricity demand in 28 countries (IEA, 2021a). There is still significant resource potential. For example, in Africa, only around 11% of hydropower's technical potential is currently utilised (International Hydropower Association, 2022). Investment in hydropower generation across EMDE has seen a gradual increase over the last five years, rising from under USD 20 billion in 2018 to nearly USD 25 billion in 2022 (Figure 2.14). However in some countries that have historically driven capacity expansion, such as Brazil, spending has slowed due to the limited number of economically viable sites available for greenfield projects as well as opposition to large projects from affected communities.

In low-emissions scenarios, hydropower is particularly valuable as a low-emissions source of flexibility and storage. In the NZE Scenario there is a fourfold increase in hydropower investment, driven by a dramatic rise in Southeast Asia and Eurasia, where hydropower plays an important role to replace the system services currently provided by thermal power plants. The vast majority of this is greenfield investment, although refurbishment and maintenance become more important with time, with the average lifespan of plants being 45-60 years before refurbishment becomes necessary.

Hydropower projects are both capital-intensive and highly site-specific. Many aspects are individually designed for a particular project, unlike in solar or wind investments that rely more on standardised inputs. In addition, many of the precise geotechnical conditions are

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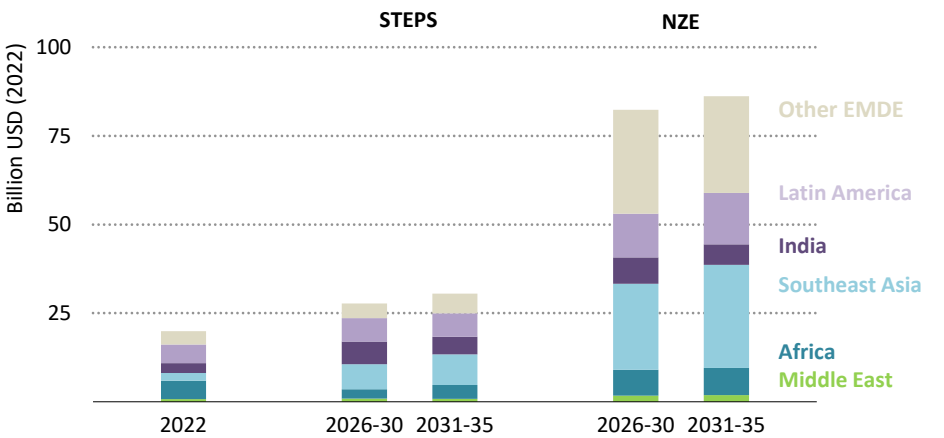
hard to predict, often resulting in costly delays. Given the high upfront costs and risks, financing is generally conditional on power purchase guarantees or long-term contracts. A further challenge is that there tends to be a mismatch between financial and economic value of hydropower projects, with some beneficial uses of the dam, such as support for flood management or irrigation, not resulting in revenue streams for the project. In some cases, important energy-related services such as the provision of flexibility to the power system are also not adequately remunerated.

Figure 2.14 ▷ Investment in hydropower in EMDE in STEPS and the NZE Scenario, 2022-2035



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Large-scale hydropower projects increase fourfold under the NZE Scenario, demonstrating their value for flexibility and storage

This strong economic benefit but challenging financing environment is one of the primary reasons the public sector dominates hydropower developments. Some 70% of all hydropower capacity globally installed between 2000 and 2020 were publicly owned and operated. In EMDE, these projects are often funded by large loans from multilateral development banks secured against the sovereign balance sheet. China also plays a very significant role in hydropower financing, generally via loans from export credit agencies that are tied to the use of Chinese state-owned contractors. Between 2021 and 2030, the IEA estimates that over half of all new hydropower projects in sub-Saharan Africa, Southeast Asia and Latin America are set to be either built, financed, partially financed or owned by Chinese firms (IEA, 2021a).

Given the financing landscape, some of the most significant risks influencing the cost of capital for hydropower projects are:

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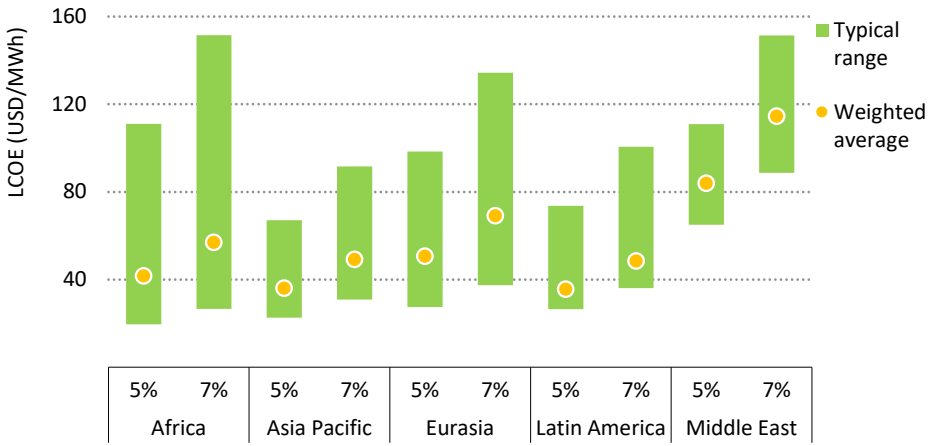
- **Environmental and social risks:** concern that these risks will trigger permitting delays and additional costs.
- **Revenue risk:** less predictable weather patterns and business models that fail to monetise the multiple uses of dams can reduce revenues.
- **Off-taker risk:** As with other sectors, hydropower financing costs can be driven up by concerns over the reliability of the off-taker.

Key factors influencing financing costs

The importance of bilateral finance from China, which is generally provided at attractive rates, and the challenges in identifying viable hydropower projects mean that financing costs are not necessarily the primary obstacle to growth of the sector. That said, given the high upfront costs to develop hydropower plants, the cost of capital can have a major impact on the LCOE. Analysis from the IEA Hydropower Special Market Report found that an increase in the WACC of just 1 percentage point can result in 7-14% higher generation costs (Figure 2.15).

Figure 2.15 ▷ Average LCOE of greenfield hydropower plants (>10 MW) at 5% and 7% WACC



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High upfront costs for hydropower facilities mean the WACC has a significant impact on generation costs, with a 1% increase in WACC resulting in an up to 14% increase in LCOE

Note: MWh = megawatt-hours; LCOE = Levelized cost of electricity; WACC = weighted average cost of capital.
Source: (IEA, 2021a)

One of the major steps to reduce financing costs, as well as to increase interest in hydropower investments, is to improve the policy environment for this sector. Today, fewer than 30 countries have policies directly targeting hydropower. These policies can support the

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complex pre-development and construction phases, with clear permitting processes to keep delays to a minimum.

The use of public-private partnerships (PPPs) to fund hydropower has grown in recent years and is likely to play a key role in order to meet the ambitious growth of the sector under the NZE Scenario. These PPPs tend to include a mix of government, DFIs and donors, and private corporations, and generally require long-term contract clauses to mitigate high off-taker risk and other risks such as low rainfall limiting power production. While PPP financing structures can involve lengthy preparation, the blended use of concessional and commercial capital results in cheaper capital without adding excessive fiscal pressure to the host government.

2.7.1 Key recommendations to reduce the cost of capital

Many of the obstacles to future hydropower development are in the pre-development stage, with long permitting times and regular delays in construction presenting some of the major challenges to investment. Under the NZE Scenario, with greenfield hydropower capacity ramping up, the identification of attractive sites is also set to become a key barrier. There are multiple steps governments can take to create a more attractive investment environment for hydropower projects:

- **Improve long-term planning for hydropower projects, including site mapping with environmental data**. Governments can include hydropower targets directly within long-term energy strategy and integrated resource planning. Where possible, targets can also be accompanied by efforts to identify viable sites for future projects, including where private partners are sought. Site identification is likely to be most beneficial if accompanied by publicly available, up-to-date environmental data. In countries where these data are unavailable, DFIs and donors can support studies to collect and publish this information.
- **Create robust, streamlined environmental and social processes and standards, alongside clear monitoring procedures.** Governments can support investment by ensuring a clear process on obtaining environmental and social impact assessments, as well as laying out standardised environmental monitoring and community support and relocation procedures. These should be in line with global standards such as the Hydropower Sustainability Guidelines on Good International Industry Practice and the Hydropower Sustainability Assessment Protocol, both from the International Hydropower Association. DFIs and donors can support these efforts through technical assistance and capacity-building grants.
- **Ensure that business models reflect the multiple benefits of hydropower facilities**. Currently business models for hydropower facilities often do not adequately reflect dams' multiple uses within their revenue expectations. Governments can seek to create business models that value additional services such as irrigation, water supply or flood control. Local governments can also work with local communities in proposed sites for future dams to help them take advantage of future developments.

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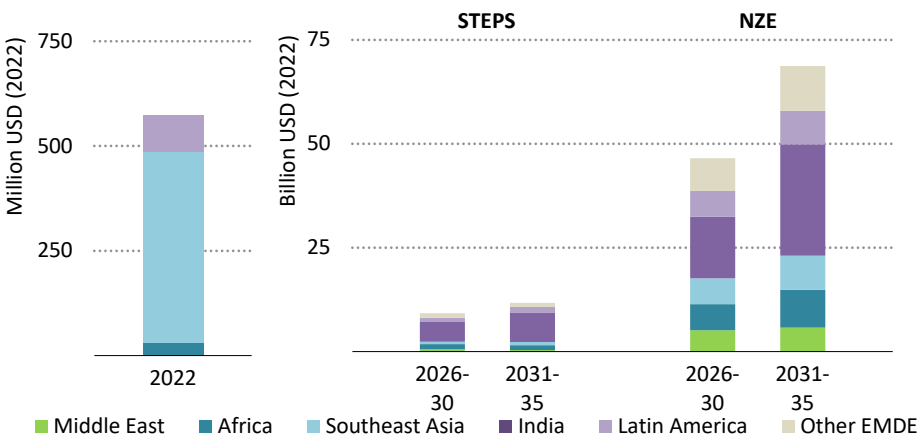
2.8 Battery storage

Investment outlook, sources of finance and sector development

Worldwide investments in battery storage have been going from strength to strength, but spending in EMDE is lagging behind. In the past five years, global investments in utility-scale batteries jumped sevenfold to USD 14 billion in 2022 and are expected to double again in 2023. However, the lion's share of this spending has been in advanced economies and in China: of the USD 14 billion invested in 2022, only USD 600 million (less than 5% of the total) was spent on batteries in EMDE.

Battery storage is a particularly important technology to ensure reliable electricity supply in EMDE that have significant renewables potential and the prospect of rapid growth in electricity demand. In the NZE Scenario, investments in battery storage increase by a factor of 120 in EMDE by 2031-2035 (Figure 2.16). About 40% of this spending occurs in India, with Africa, Southeast Asia, and Latin America and the Caribbean the other main markets.

Figure 2.16 ▷ Investment in utility-scale batteries in EMDE in the STEPS and the NZE, 2022-2035



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Spending in utility-scale batteries in EMDE increases by a factor of 120 in the NZE, especially in regions with fast electricity demand growth and need for flexibility

Utility-scale battery systems have distinct use cases that can provide meaningful revenue streams for project developers and battery storage operators:

- **Energy arbitrage**: storage of electricity at times when it is abundant for sale at higher prices, mostly in countries with existing wholesale power markets.
- **Frequency regulation**: provision of immediate power supply to maintain grid balance and prevent frequency fluctuations.

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- **Resource adequacy**: meeting of peak load demand.
- **Power reserve**: maintenance of electricity output during unexpected outages.

These use cases are further strengthened when utility-scale battery storage is integrated with solar PV and wind power projects because it allows charging of the batteries during times of excess supply, better aligns solar and wind power generation with system demand, reduces curtailment, and improves the quality and reliability of the services that projects can offer the power system.

As with other sectors, financing conditions for battery storage are influenced by country-specific risks such as debt management or currency fluctuations and by two sector-specific risks:

- **Regulatory risk**: battery storage systems do not always have equal access to the power market, and a strategy for remunerating flexibility services might be missing.
- **Off-taker risk**: delayed payments by or under recoveries from distribution companies for provided energy storage services.

Key factors influencing financing costs

While sharing many similarities with solar PV and wind power projects, the WACC for battery storage is often higher. This is due to the relatively innovative nature of battery storage systems and the fact that battery storage must be able to leverage several of the mentioned revenue streams at the same time. This amplifies the regulatory and off-taker risks prevalent in the sector.

Financing costs for battery storage in EMDE can be significantly higher than in advanced economies due to deficiencies in the policy and regulatory environment. Investors require strategic clarity from policy makers on the role of batteries. Detailed regulations that outline how battery storage operators will be remunerated for providing services such as frequency regulation and meeting of peak load demand, as well as their participation in power markets, are critical if battery storage is to be able to leverage the multiple potential revenue streams and become a profitable investment.

India is an example of an EMDE effectively addressing regulatory risks: the implementation of the General Network Access and other regulations in 2022 allowed battery storage systems the equal participation in the power market along with other energy sources and clarified the permissible use cases for battery storage. Strategic direction was provided by the Ministry of Power's announcement that more than 40 GW of battery storage capacity would be required by 2030 as well as the Government's Green Energy Corridor policy, which made battery systems a key element of India's future transmissions network. These ambitions are further supported by India's production-linked incentive scheme, which aims at the development of a domestic battery storage manufacturing industry.

"Round-the-clock" renewable energy auctions that combine battery storage with solar or wind power projects are becoming more and more common. While not being a substitute for adequate overall system planning and renewables integration, these are effective in

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lowering the cost of capital because they allow battery storage operators to charge the batteries with renewable electricity at times of excess production – thereby improving the project financials – while lowering the risk of curtailment for the involved solar or wind power projects. In fact, the IEA's Cost of Capital Observatory finds that the cost of capital for a battery storage project tends to be at the same level as a solar PV project if both are bundled. As a result of these reforms, India has jump-started investment in the battery storage market with 2.5 GW in utility-scale battery storage expected to be installed in 2023 – after seeing no additions in 2022 – and investment spending expected to grow strongly.

Off-taker risk for batteries relates to the payment to battery operators for the energy storage services they provide. In countries without wholesale power markets, this risk is often elevated because utility-scale battery storage operators are unable to realise their single largest revenue driver – energy arbitrage, or the charging of the batteries when electricity prices are low and the injection of stored electricity into the grid when prices are high. Moreover, for other storage services provided, operators are dependent on being quickly and predictably remunerated for the services they provide to the grid. However, as laid out in section 2.2, in many countries these are often transmission companies in poor financial state, which can be mitigated through creditworthy intermediaries or other risk mitigation mechanisms such as guarantees from development finance institutions.

An interesting example where concessional funding helped overcome regulatory and off-taker risks is a project in South Africa that will see the decommissioning of an ageing coal-fired power station with 220 MW of solar PV and wind power combined with 150 MW battery storage. Despite load-shedding and South Africa's public energy utility Eskom facing financial difficulties, as well as a weak regulatory environment for battery storage, a consortium led by the World Bank was able to structure a USD 500 million package – including some highly concessional financing – for the battery storage portion. The combination of variable renewables with battery storage aims to support adequacy of power supply and grid stability, and the concessional funding is estimated to lead to USD 80 million in debt servicing costs for Eskom. This illustrates the significance of blending concessional finance from DFIs in reducing the overall financing cost.

2.8.1 *Key recommendations to reduce the cost of capital*

Reducing the cost of capital for utility-scale battery storage in EMDE means a focus on three priority areas:

- **Establish a clear and stable regulatory framework** that defines the role of utility-scale battery storage, allows its equal participation in the power market, and defines the permissible use cases to ensure planning security and transparent revenue expectations for battery storage investors and operators. This also involves clarifying the role of battery storage in a country's clean energy transition, electricity mix and transmission system as well as capacity targets. In addition, and where feasible, this can also require the reform of the power market to establish wholesale markets which can be a

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significant revenue driver for battery storage projects – especially the greater the penetration of variable renewables and the need for short- and medium-term flexibility.

- **Develop the market through well-designed and regular procurement programmes, with concessional finance where required.** Implementing competitive capacity auctions that provide capacity payments at a fixed rate can significantly improve the financial viability of battery storage projects and lower their financing costs. In nascent markets, such capacity payments could be financed with concessional debt which would be reduced towards market-based rates with greater deployment. Such auctions would be especially impactful if combined with solar PV or wind power projects as they can further improve the financials of battery storage projects while reducing the curtailment risk of variable renewables projects.
- **Expand off-taker guarantee and credit enhancement mechanisms** by offering state or international guarantees or establishing creditworthy intermediates to reduce the risk of no or late payment for energy storage services. Covering non-payment delays is particularly important for battery storage operators given their reliance on multiple revenue streams and provision of system services for which the key benefactor – and therefore off-taker – would be in most cases state-owned transmission and distribution companies in poor financial state.

Box 2.3 ▷ Case studies that explore how EMDE have addressed risks to scale up clean energy investment

Measures to reduce the cost of capital are highly country- and technology-specific. A broad range of solutions is therefore necessary to support the overall goal of lowering the cost of capital for clean energy projects across EMDE. Across the diverse set of EMDE covered in this report, a series of success stories exist that can provide guidance for future measures. We explored eight examples in detail for this report. They are included in full in the 'Cost of Capital Observatory' on the IEA website available here: iea.org/reports/cost-of-capital-observatory.

The case studies include:

- **Developing a country-specific investment proposition in Senegal:** many international investors have limited exposure to African countries due to the high risk perceptions associated with the region as a whole. Senegal has been successful at attracting comparatively more investment into its energy sector and at a lower cost than in many of its regional peers. In part this is due to lower political and macroeconomic risks, including in relation to currency volatility thanks to the local currency's peg to the euro. But the country has also taken steps to improve the attractiveness of the energy sector, notably via programmes such as the International Finance Corporation-led Scaling Solar initiative.
- **Steps to reduce off-taker risk for renewables in India:** the cost of capital for utility-scale solar is 50% higher in India than in the European Union, despite the country's

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strong regulatory framework and the introduction of "reverse auctions." Off-taker risk is one of the key drivers, primarily due to non-payment risks from state owned DISCOMs. To reduce this risk, the government introduced a late payment charge on DISCOMs, and at both the state and federal level, measures have also been introduced to support debt restructuring and improved revenue collection at DISCOMs.

- **Strong regulatory framework and tariff system for grids in Brazil:** Brazil has succeeded in attracting significant private capital to its grid network thanks to a robust regulatory framework that has proven to be both sustainable and adaptable. The system allows for the use of both concessions and IPT projects. Importantly, the regulation includes a predictable and reliable remuneration system that is cost-reflective, and hence reduces revenue risks for investors.
- **Attracting more private capital to grids in Indonesia:** grid investments in Indonesia are dominated by the state utility PLN and financed by DFIs, but a diversification of financing sources will be necessary to meet ambitious energy transition targets. While there have been some successes, notably via novel financing approaches such as a results-based lending scheme, private sector investors are still deterred by the lack of robust technical regulations, uncertain project development and limited transparency around tariffs.
- **Tender programmes for battery storage in South Africa:** the South African government has developed two tender programmes to expand the use of battery storage in the country. The programmes target both utility-scale battery and hybrid projects and allow for competitive bidding, primarily from the private sector. While these steps are helping to lower the cost of capital for utility-scale battery projects, the poor financial health of the state utility Eskom and constraints on available grid capacity continue to pose major hurdles for hybrid projects.
- **Innovative banking products for green buildings in Colombia:** Colombia introduced green building codes in 2015 but, as elsewhere in EMDE, high upfront costs still acted as a brake on development. Since the introduction of the codes, multilateral development banks have worked with banks in the country to devise innovative products to provide lower-cost loans. Notably, these include the use of green bonds where proceeds were used to lend to developers of green buildings at lower-than-commercial rates and the development of green mortgages.
- **Procurement support for e-buses for public transport in India:** under the National Electric Bus Program in India, the government set ambitious targets to expand the use of e-buses in public transport. A bulk procurement model was adopted to reduce upfront costs, as well as the introduction of a pay-as-you-go leasing model. These steps have helped reduce the upfront purchasing costs, but further steps can be taken to widen adoption of the scheme.

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- **Refinancing hydropower projects to reduce end-user tariffs in Uganda:** one of the largest power plants in Uganda, Bujagali dam, was refinanced in 2018, marking one of the first arrangements of its kind in sub-Saharan Africa. The refinancing resulted in significantly reduced financing costs associated with the project by delaying debt repayments, resulting in a meaningful tariff reduction. The project also serves as a good example for how to leverage operational assets to bring in more private capital.

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Definitions

This annex provides general information on terminology used throughout this report including: units and general conversion factors; definitions of fuels, processes and sectors; regional and country groupings; and abbreviations and acronyms.

Units and measurements

GW	gigawatt
km	kilometre
mboe/d	million barrels of oil per day
MW	megawatt
MWh	megawatt-hour
TWh	terawatt-hour
Wp	watt peak

Definitions

Aviation: This transport mode includes both domestic and international flights and their use of aviation fuels. Domestic aviation covers flights that depart and land in the same country; flights for military purposes are included. International aviation includes flights that land in a country other than the departure location.

Battery storage: Energy storage technology that uses reversible chemical reactions to absorb and release electricity on demand.

Bioenergy: Energy content in solid, liquid and gaseous products derived from biomass feedstocks and biogas. It includes solid bioenergy, liquid biofuels and biogases. Excludes hydrogen produced from bioenergy, including via electricity from a biomass-fired plant, as well as synthetic fuels made with CO_2 feedstock from a biomass source**.**

Biogas: A mixture of methane, CO_2 and small quantities of other gases produced by anaerobic digestion of organic matter in an oxygen-free environment.

Biogases: Include both biogas and biomethane.

Biogasoline: Includes all liquid biofuels (advanced and conventional) used to replace gasoline.

Bio jet kerosene: Kerosene substitute produced from biomass. It includes conversion routes such as hydroprocessed esters and fatty acids (HEFA) and biomass gasification with Fischer-Tropsch. It excludes synthetic kerosene produced from biogenic carbon dioxide.

Buildings: The buildings sector includes energy used in residential and services buildings. Services buildings include commercial and institutional buildings and other non-specified

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buildings. Building energy use includes space heating and cooling, water heating, lighting, appliances, and cooking equipment.

Carbon capture, utilisation and storage (CCUS)**:** The process of capturing carbon dioxide emissions from fuel combustion, industrial processes or directly from the atmosphere. Captured CO_2 emissions can be stored in underground geological formations, onshore or offshore, or used as an input or feedstock in manufacturing.

Carbon dioxide (CO_2)**:** A gas consisting of one part carbon and two parts oxygen. It is an important greenhouse (heat-trapping) gas.

Chemical feedstock: Energy vectors used as raw materials to produce chemical products. Examples are crude oil-based ethane or naphtha to produce ethylene in steam crackers.

Clean cooking systems: Cooking solutions that release less harmful pollutants and are more efficient and environmentally sustainable than traditional cooking options that make use of solid biomass (such as a three-stone fire), coal or kerosene. This refers to improved cookstoves, biogas/biodigester systems, electric stoves, liquefied petroleum gas, natural gas or ethanol stoves.

Clean energy: In *power*, clean energy includes: renewable energy sources; nuclear power; fossil fuels fitted with CCUS; hydrogen and ammonia; battery storage; and electricity grids. In *efficiency*, clean energy includes energy efficiency in buildings, industry and transport, excluding aviation bunkers and domestic navigation. In *end-use applications*, clean energy includes: direct use of renewables; electric vehicles; electrification in buildings, industry and international marine transport; CCUS in industry; and direct air capture. In *fuel supply*, clean energy includes low-emissions fuels and measures to reduce the emissions intensity of fossil fuel production.

Coal: Includes both primary coal, i.e., lignite, coking and steam coal, and derived fuels, e.g., patent fuel, brown-coal briquettes, coke-oven coke, gas coke, gas works gas, coke-oven gas, blast furnace gas and oxygen steel furnace gas. Peat is also included.

Cost of capital: The expected financial return, or the minimum required rate of return, to justify an investment in a company or a project.

Conventional liquid biofuels: Fuels produced from food crop feedstocks. Commonly referred to as first-generation biofuels and include sugar cane ethanol, starch-based ethanol, fatty acid methyl ester (FAME), straight vegetable oil, and hydrotreated vegetable oil produced from palm, rapeseed or soybean oil.

Direct air capture (DAC)**:** A type of CCUS that captures CO_2 directly from the atmosphere using liquid solvents or solid sorbents. It is generally coupled with permanent storage of the CO_2 in deep geological formations or its use in the production of fuels, chemicals, building materials or other products. When coupled with permanent geological CO_2 storage, DAC is a carbon removal technology.

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Electric vehicles (EVs)**:** Electric vehicles comprise battery electric vehicles and plug-in hybrid vehicles.

Electricity demand: Defined as total gross electricity generation less own use generation, plus net trade (imports less exports), less transmission and distribution losses.

Electricity generation: Defined as the total amount of electricity generated by power only or co-generation plants including generation required for own use. This is also referred to as gross generation.

End-use sectors: Include industry, transport, buildings and other, i.e. agriculture and other non-energy use.

Energy sector greenhouse gas emissions: Energy-related and industrial process CO_2 emissions plus fugitive and vented methane and nitrous dioxide emissions from the energy and industry sectors.

Ethanol: Refers to bioethanol only. Ethanol is produced from fermenting any biomass high in carbohydrates. Currently ethanol is made from starches and sugars, but second-generation technologies will allow it to be made from cellulose and hemicellulose, the fibrous material that makes up the bulk of most plant matter.

Fossil fuels: Include coal, natural gas and oil.

Heat (end use)**:** Can be obtained from the combustion of fossil or renewable fuels, direct geothermal or solar heat systems, exothermic chemical processes, and electricity (through resistance heating or heat pumps which can extract it from ambient air and liquids). This category refers to the wide range of end uses, including space and water heating and cooking in buildings, desalination and process applications in industry. It does not include cooling applications.

Heat (supply)**:** Obtained from the combustion of fuels, nuclear reactors, large-scale heat pumps, geothermal or solar resources. It may be used for heating or cooling, or converted into mechanical energy for transport or electricity generation. Commercial heat sold is reported under total final consumption with the fuel inputs allocated under power generation.

Hydrogen: Hydrogen is used in the energy system as an energy carrier or as an industrial raw material, or is combined with other inputs to produce hydrogen-based fuels. Unless otherwise stated, hydrogen in this report refers to low-emissions hydrogen.

Hydrogen-based fuels: See low-emissions hydrogen-based fuels.

Hydropower: Refers to the electricity produced in hydropower projects, with the assumption of 100% efficiency. It excludes output from pumped storage and marine (tide and wave) plants.

Industry: The sector includes fuel used within the manufacturing and construction industries. Key industry branches include iron and steel, chemical and petrochemical, cement,

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aluminium, and pulp and paper. Use by industries for the transformation of energy into another form or for the production of fuels is excluded and reported separately under other energy sector. There is an exception for fuel transformation in blast furnaces and coke ovens, which are reported within iron and steel. Consumption of fuels for the transport of goods is reported as part of the transport sector, while consumption by off-road vehicles is reported under industry.

Investment: Investment is the capital expenditure in energy supply, infrastructure, end use and efficiency. Fuel supply investment includes the production, transformation and transport of oil, gas, coal and low-emissions fuels. *Power sector* investment includes new construction and refurbishment of generation, electricity grids (transmission, distribution and public electric vehicle chargers), and battery storage. *Energy efficiency* investment includes efficiency improvements in buildings, industry and transport. *Other end use* investment includes the purchase of equipment for the direct use of renewables, electric vehicles, electrification in buildings, industry and international marine transport, equipment for the use of low-emissions fuels, and CCUS in industry and direct air capture. Data and projections reflect spending over the lifetime of projects and are presented in real terms in year-2022 US dollars converted at market exchange rates unless otherwise stated. Total investment reported for a year reflects the amount spent in that year.

Levelised cost of electricity (LCOE)**:** LCOE combines into a single metric all the cost elements directly associated with a given power technology, including construction, financing, fuel, maintenance and costs associated with a carbon price. It does not include network integration or other indirect costs.

Low-emissions fuels: Include modern bioenergy, low-emissions hydrogen and low-emissions hydrogen-based fuels.

Low-emissions hydrogen: Hydrogen that is produced from water using electricity generated by renewables or nuclear, from fossil fuels with minimal associated methane emissions and processed in facilities equipped to avoid CO_2 emissions, e.g. via CCUS with a high capture rate, or derived from bioenergy. In this report, total demand for low-emissions hydrogen is larger than total final consumption of hydrogen because it additionally includes hydrogen inputs to make low-emissions hydrogen-based fuels, biofuels production, power generation, oil refining, and hydrogen produced and consumed on-site in industry.

Low-emissions hydrogen-based liquid fuels: A subset of low-emissions hydrogen-based fuels that includes only ammonia, methanol and synthetic liquid hydrocarbons, such as synthetic kerosene.

Mini-grids: Small electric grid systems, not connected to main electricity networks, linking a number of households and/or other consumers.

Modern gaseous bioenergy: See biogases.

Modern liquid bioenergy: Includes biogasoline, biodiesel, bio jet kerosene and other liquid biofuels.

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Natural gas: Includes gas occurring in deposits, whether liquefied or gaseous, consisting mainly of methane. It includes both non-associated gas originating from fields producing hydrocarbons only in gaseous form, and associated gas produced in association with crude oil production as well as methane recovered from coal mines (colliery gas). Natural gas liquids, manufactured gas (produced from municipal or industrial waste, or sewage) and quantities vented or flared are not included. Gas data in cubic metres are expressed on a gross calorific value basis and are measured at 15° C and at 760 millimetres of mercury (Standard Conditions). Gas data expressed in exajoules are on a net calorific basis. The difference between the net and the gross calorific value is the latent heat of vaporisation of the water vapour produced during combustion of the fuel (for gas the net calorific value is 10% lower than the gross calorific value).

Off-grid systems: Mini-grids and stand-alone systems for individual households or groups of consumers not connected to a main grid.

Offshore wind: Refers to electricity produced by wind turbines that are installed in open water, usually in the ocean.

Oil: Includes both conventional and unconventional oil production. Petroleum products include refinery gas, ethane, liquid petroleum gas, aviation gasoline, motor gasoline, jet fuels, kerosene, gas/diesel oil, heavy fuel oil, naphtha, white spirits, lubricants, bitumen, paraffin, waxes and petroleum coke.

Other energy sector: Covers the use of energy by transformation industries and the energy losses in converting primary energy into a form that can be used in the final consuming sectors. It includes losses in low-emissions hydrogen and hydrogen-based fuels production, bioenergy processing, gas works, petroleum refineries, coal and gas transformation, and liquefaction. It also includes energy own use in coal mines, in oil and gas extraction, and in electricity and heat production. Transfers and statistical differences are also included in this category. Fuel transformation in blast furnaces and coke ovens are not accounted for in the other energy sector category.

Other industry: A category of industry branches that includes construction, food processing, machinery, mining, textiles, transport equipment, wood processing and remaining industry. It is sometimes referred to as non-energy-intensive industry.

Passenger car: A road motor vehicle, other than a moped or a motorcycle, intended to transport passengers. It includes vans designed and used primarily to transport passengers. Excluded are light commercial vehicles, motor coaches, urban buses and mini-buses/mini-coaches.

Power generation: Refers to electricity generation and heat production from all sources of electricity, including electricity-only power plants, heat plants, and co-generation plants. Both main activity producer plants and small plants that produce fuel for their own use (auto-producers) are included.

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Renewables: Include bioenergy, geothermal, hydropower, solar photovoltaics (PV), concentrating solar power (CSP), wind and marine (tide and wave) energy for electricity and heat generation.

Residential: Energy used by households including space heating and cooling, water heating, lighting, appliances, electronic devices and cooking.

Road transport: Includes all road vehicle types (passenger cars, two-/three-wheelers, light commercial vehicles, buses, and medium and heavy freight trucks).

Shipping/navigation: This transport mode includes both domestic and international navigation and their use of marine fuels. Domestic navigation covers the transport of goods or people on inland waterways and for national sea voyages (starts and ends in the same country without any intermediate foreign port). International navigation includes quantities of fuels delivered to merchant ships (including passenger ships) of any nationality for consumption during international voyages transporting goods or passengers.

Solar: Includes both solar PV and CSP.

Solar home systems (SHS)**:** Small-scale photovoltaic and battery stand-alone systems, i.e. with capacity higher than 10 watt peak (Wp) supplying electricity for single households or small businesses. They are most often used off-grid, but also where grid supply is not reliable. Access to electricity in the IEA definition considers SHS from 25 Wp in rural areas and 50 Wp in urban areas. It excludes smaller solar lighting systems, e.g. solar lanterns of less than 11 Wp.

Solar photovoltaics (PV)**:** Electricity produced from solar PV cells including utility-scale and small-scale installations.

Stand-alone systems: Small-scale autonomous electricity supply for households or small businesses. They are generally used off-grid, but also where grid supply is not reliable. Stand-alone systems include SHS, small wind or hydro generators, and diesel or gasoline generators. The difference compared with mini-grids is in scale and that stand-alone systems do not have a distribution network serving multiple customers.

Transport: Fuels and electricity used in the transport of goods or people within the national territory irrespective of the economic sector within which the activity occurs. This includes: fuel and electricity delivered to vehicles using public roads or for use in rail vehicles; fuel delivered to vessels for domestic navigation; fuel delivered to aircraft for domestic aviation; and energy consumed in the delivery of fuels through pipelines. Fuel delivered to international marine and aviation bunkers is presented only at the world level and is excluded from the transport sector at a domestic level.

Unabated fossil fuel use: Consumption of fossil fuels in facilities without CCUS.

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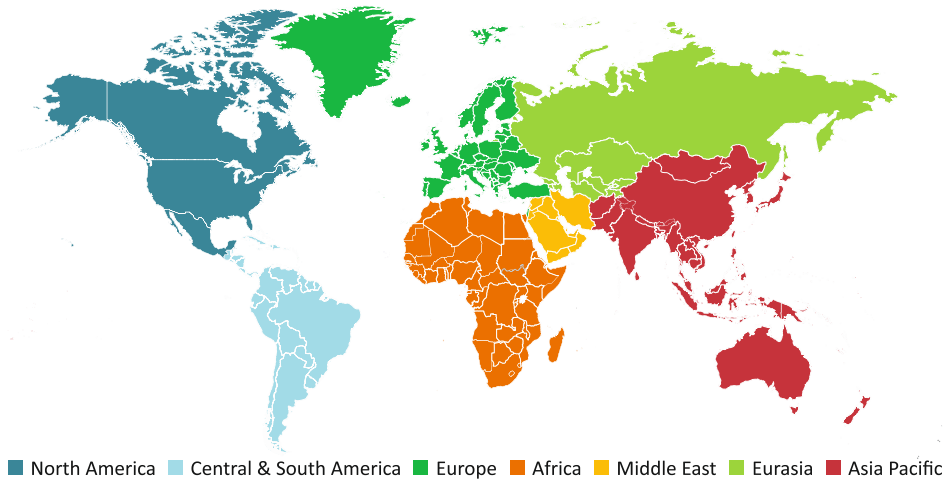
Regional and country groupings

Main country groupings



Note: This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Africa: North Africa and sub-Saharan Africa regional groupings.

Asia Pacific: Southeast Asia regional grouping and Australia, Bangladesh, the People's Republic of China (China), Democratic People's Republic of Korea (North Korea), India, Japan, Korea, Mongolia, Nepal, New Zealand, Pakistan, Sri Lanka, Chinese Taipei, and other Asia Pacific countries and territories.[3]

Caspian: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

Central and South America: Argentina, Plurinational State of Bolivia (Bolivia), Bolivarian Republic of Venezuela (Venezuela), Brazil, Chile, Colombia, Costa Rica, Cuba, Curaçao, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Peru, Suriname, Trinidad and Tobago, Uruguay, and other Central and South American countries and territories.[4]

China: Includes (the People's Republic of) China and Hong Kong, China.

Developing Asia: Asia Pacific regional grouping excluding Australia, Japan, Korea and New Zealand.

Developing Europe: Albania, Belarus, Bosnia and Herzegovina, Gibraltar, Republic of Kosovo, North Macedonia, Republic of Moldova, Montenegro, Serbia and Ukraine.

Emerging market and developing economies (EMDE): Africa, Developing Europe, Eurasia, Latin America, the Middle East, and South and Southeast Asia. For the purposes of this

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report, the EMDE grouping includes four member countries of the Organisation for Economic Co-operation and Development (OECD): Chile, Colombia, Costa Rica and Mexico.

Eurasia: Caspian regional grouping and the Russian Federation (Russia).

Europe: European Union regional grouping and Albania, Belarus, Bosnia and Herzegovina, Gibraltar, Iceland, Israel,[5] Kosovo, Montenegro, North Macedonia, Norway, Republic of Moldova, Serbia, Switzerland, Türkiye, Ukraine and United Kingdom.

European Union: Austria, Belgium, Bulgaria, Croatia, Cyprus,[4,5] Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, the Slovak Republic, Slovenia, Spain and Sweden.

Eurozone: Austria, Belgium, Croatia, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia and Spain.

IEA (International Energy Agency)**:** OECD regional grouping excluding Chile, Colombia, Costa Rica, Iceland, Israel, Latvia and Slovenia.

Latin America and the Caribbean: Central and South America regional grouping and Mexico.

Least developed countries: Countries that fall into a triple criteria of income, human asset index, and economic and environmental vulnerability index according to the United Nations. Africa: Angola, Benin, Burkina Faso, Burundi, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Niger, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Somalia, South Sudan, Sudan, Togo, Uganda, United Republic of Tanzania, and Zambia. Asia: Afghanistan, Bangladesh, Cambodia, Lao People's Democratic Republic (Lao PDR), Myanmar, Nepal, Timor-Leste and Yemen. Caribbean: Haiti. Pacific: Kiribati, Solomon Islands and Tuvalu

Middle East: Bahrain, Islamic Republic of Iran (Iran), Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syrian Arab Republic (Syria), United Arab Emirates and Yemen.

Non-OECD: All other countries not included in the OECD regional grouping.

North Africa: Algeria, Egypt, Libya, Morocco and Tunisia.

North America: Canada, Mexico and the United States.

OECD (Organisation for Economic Co-operation and Development)**:** Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye, the United Kingdom and the United States.

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Southeast Asia: Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic (Lao PDR), Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam. These countries are all members of the Association of Southeast Asian Nations (ASEAN).

Sub-Saharan Africa: Angola, Benin, Botswana, Cameroon, Côte d'Ivoire, Democratic Republic of the Congo, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Ghana, Kenya, Kingdom of Eswatini, Madagascar, Mauritius, Mozambique, Namibia, Niger, Nigeria, Republic of the Congo (Congo), Rwanda, Senegal, South Africa, South Sudan, Sudan, United Republic of Tanzania (Tanzania), Togo, Uganda, Zambia, Zimbabwe, and other African countries and territories.[6]

Country notes

[1] Note by Republic of Türkiye: The information in this document with reference to "Cyprus" relates to the southern part of the island. There is no single authority representing both Turkish and Greek Cypriot people on the island. Türkiye recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Türkiye shall preserve its position concerning the "Cyprus issue".

[2] Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Türkiye. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

[3] Individual data are not available and are estimated in aggregate for: Afghanistan; Bhutan; Cook Islands; Fiji; French Polynesia; Kiribati; Macau, China; Maldives; New Caledonia; Palau; Papua New Guinea; Samoa; Solomon Islands; Timor-Leste; Tonga and Vanuatu.

[4] Individual data are not available and are estimated in aggregate for: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bonaire, Sint Eustatius and Saba, British Virgin Islands, Cayman Islands, Dominica, Falkland Islands (Malvinas), Grenada, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Pierre and Miquelon, Saint Vincent and Grenadines, Saint Maarten (Dutch part), Turks and Caicos Islands.

[5] The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD and/or the IEA is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

[6] Individual data are not available and are estimated in aggregate for: Burkina Faso, Burundi, Cabo Verde, Central African Republic, Chad, Comoros, Djibouti, Gambia, Guinea, Guinea-Bissau, Lesotho, Liberia, Malawi, Mali, Mauritania, Sao Tome and Principe, Seychelles, Sierra Leone, and Somalia.

Abbreviations and acronyms

ANEEL	Agencia Nacional de Energia Eléctrica (Brazilian national electric energy agency)
APS	Announced Pledges Scenario
AT&C	aggregate technical and commercial
BNDES	Brazilian Development Bank
CCUS	carbon capture, utilisation and storage
CESL	Convergence Energy Services Limited
CO_2	carbon dioxide
CSP	concentrating solar power
DAC	direct air capture

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DFI	development finance institutions
DISCOM	distribution company
EDGE	Excellence in Design for Greater Efficiencies
EMDE	emerging market and developing economies
EV	electric vehicle
FAME	fatty acid and methyl ester
GDP	gross domestic product
HEFA	hydroprocessed esters and fatty acids
IEA	International Energy Agency
IFC	International Finance Corporation
INR	Indian rupee
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producer
IPT	independent power transmission
JETP	Just Energy Transition Partnership
LCOE	levelised cost of electricity
LEED	Leadership in Energy and Environmental Design
LPG	liquefied petroleum gas
MIGA	Multilateral Investment Guarantee Agency
MME	Ministry of Mines and Energy (Brazil)
NZE	Net Zero Emissions by 2050 (Scenario)
OECD	Organisation for Economic Co-operation and Development
PLN	Perusahaan Listrik Negara
PPA	power purchase agreement
PPP	public-private partnership
PV	photovoltaics
SAF	sustainable aviation fuel
SDG	Sustainable Development Goals (United Nations)
SECI	Solar Energy Corporation of India
SHS	solar home system
SMEs	small and medium enterprises
SOE	state-owned enterprise
STEPS	Stated Policies Scenario
TCX	The Currency Exchange Fund
UN	United Nations
US	United States
WACC	weighted average cost of capital

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References

Chapter 1: Unlocking clean energy investment

Bhattacharya, A., Songwe, V., Soubeyran, E., and Stern, N. (2023). *A climate finance framework: decisive action to deliver on the Paris Agreement*. https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2023/11/A-Climate-Finance-Framework-IHLEG-Report-2-SUMMARY.pdf

European Investment Bank (EIB). (2023). *Joint report on multilateral development banks' climate finance*. https://www.eib.org/en/publications/20230128-2022-joint-report-on-multilateral-development-banks-climate-finance

Elysee. (2023). *Summit for a new Global Financing Pact*. https://www.elysee.fr/admin/upload/default/0001/15/28685fb4160a73892d0eb1c990b3856c2dbb5ede.pdf

International Energy Agency (IEA). (2021a). *Phasing Out Unabated Coal: Current Status and Three Case Studies*. https://www.iea.org/reports/phasing-out-unabated-coal-current-status-and-three-case-studies

IEA. (2021b). *The cost of capital in clean energy transitions*. https://www.iea.org/articles/the-cost-of-capital-in-clean-energy-transitions

IEA (2022) *Coal in Net Zero Transitions.* https://www.iea.org/reports/coal-in-net-zero-transitions

IEA. (2023a). *Cost of capital survey shows investments in solar PV can be less risky than gas power in emerging and developing economies, though values remain high*. https://www.iea.org/commentaries/cost-of-capital-survey-shows-investments-in-solar-pv-can-be-less-risky-than-gas-power-in-emerging-and-developing-economies-though-values-remain-high

IEA. (2023b). *Scaling up private finance for clean energy in emerging and developing economies*. https://www.iea.org/reports/scaling-up-private-finance-for-clean-energy-in-emerging-and-developing-economies

Chapter 2: Identifying risks that influence the cost of capital

Agência Nacional de Energia Elétrica (ANEEL). (2023). *Annual reports*. https://www.gov.br/aneel/pt-br

Bloomberg Linea. (2022). H*ow Mexico Flipped the Switch on Self-Supply Power Generation Plants*. https://www.bloomberglinea.com/english/how-mexico-flipped-the-switch-on-self-supply-power-generation-plants/

IEA. CC BY 4.0.

Bloomberg Linea. (2023). *Mexico Grants Iberdrola Electricity-Generation Permit After Years of Stonewalling*. https://www.bloomberglinea.com/english/mexico-grants-iberdrola-electricity-generation-permit-after-years-of-stonewalling/

BNamericas. (2023). *Delays hit 65% of Colombian renewables*. https://app.bnamericas.com/article/section/all/content/xky8sel07-delays-hit-65-of-colombian-renewable-energy-projects

BNEF (Bloomberg New Energy Finance). (2023). *Weighted average cost of capital of biofuel producers* (database) accessed 2023. https://about.bnef.com/

Centre for Global Development. (CGD). (2023). *MIGA: The Little Engine That Should*. https://www.cgdev.org/publication/miga-little-engine-should

G20. (2023). *The triple agenda. A roadmap for bolder, bigger and better MDBs: Volume II*. https://icrier.org/g20-ieg/pdf/The_Triple_Agenda_G20-IEG_Report_Volume2_2023.pdf

Government of India. (2023). *11th Integrated Rating of power distribution utilities*. http://www.indiaenvironmentportal.org.in/files/file/11th%20Integrated%20Rating.pdf

IEA. (2021a). *Hydropower Special Market Report*. https://www.iea.org/reports/hydropower-special-market-report

IEA. (2022). *Renewables. Analysis and forecast to 2027.* https://iea.blob.core.windows.net/assets/ada7af90-e280-46c4-a577-df2e4fb44254/Renewables2022.pdf

IEA. (2023a). *A Vision for Clean Cooking Access for All*. https://www.iea.org/reports/a-vision-for-clean-cooking-access-for-all

IEA. (2023b). *Financing Clean Energy in Africa*. https://www.iea.org/reports/financing-clean-energy-in-africa

IEA. (2023c). *Guidebook for Improved Electricity Access Statistics*. https://www.iea.org/reports/guidebook-for-improved-electricity-access-statistics

IEA. (2023d). *Electricity Grids and Secure Energy Transitions*. https://www.iea.org/reports/electricity-grids-and-secure-energy-transitions

IEA. (2023e). *Latin America Energy Outlook 2023.* https://iea.blob.core.windows.net/assets/8d90228a-ef56-4985-b321-a791c4f74f7f/LatinAmericaEnergyOutlook.pdf

IEA Bioenergy (2019). *Annual Report*. https://www.ieabioenergy.com/wp-content/uploads/2020/05/IEA-Bioenergy-Annual-Report-2019.pdf

IRENA. (2019). *Advanced biofuels. What holds them back?* https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Nov/IRENA_Advanced-biofuels_2019.pdf

International Hydropower Association. (2022). *Region Profile: Africa*. https://www.hydropower.org/region-profiles/africa

IEA. CC BY 4.0.

Mercom. (2023). *Total Outstanding Dues of State Power DISCOMs Reduced by Half in a Year*. https://www.mercomindia.com/total-outstanding-dues-discoms-half

Ministry of Power. (2023). *Praapti Portal*. https://praapti.in/

Multilateral Investment Guarantee Agency (MIGA). (2023). *Political Risk Insurance and Credit Enhancement Solutions - 2023 Annual Meetings*. https://www.miga.org/sites/default/files/2023-09/MIGA%20PRI%20%26%20NH%20-%202023%20Annual%20Meetings.pdf

Perusahaan Listrik Negara (PNL). (2022). *Annual reports*. https://web.pln.co.id/en/stakeholders/financial-statements

PV-Tech. (2023). India facing solar project postponements amid module shortages. PV-Tech. https://www.pv-tech.org/india-facing-solar-project-postponements-amid-module-shortages/

SE4All. (2021). *Energizing Finance: Understanding the Landscape 2021*. https://www.seforall.org/data-and-evidence/energizing-finance-series/energizing-finance-2021

Warren, C. (2017). *Currency Risk Is the Hidden Solar Project Deal Breaker*. https://www.greentechmedia.com/articles/read/Currency-Risk-is-The-Hidden-Solar-Project-Deal-Breaker

Witcover and Williams (2020). *Comparison of "Advanced" biofuel cost estimates: Trends during rollout of low carbon fuel policies.* https://www.sciencedirect.com/science/article/pii/S1361920919312222

World Bank (2023). *Poverty and Inequality Platform.* https://pip.worldbank.org/home

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International Energy Agency (IEA)

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Reducing the Cost of Capital

World Energy Investment Special Report

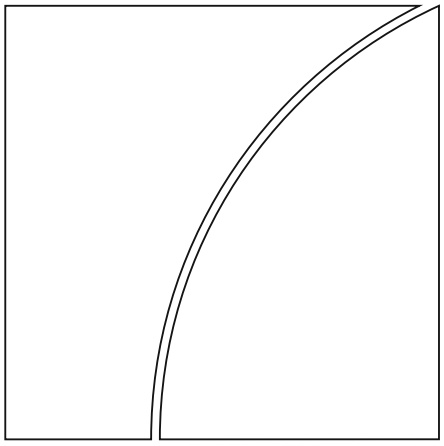
Investment in emerging and developing economies (EMDEs outside China) needs to increase more than sixfold by the early 2030s to get on track to limit global temperature rise to 1.5°C. A high cost of capital in these countries makes it much more difficult to attract investment. With growing international attention to this issue, the International Energy Agency (IEA) was tasked by the Paris Summit on a New Global Financing Pact in June 2023 to make recommendations on how to bring down the cost of capital for clean energy investment in EMDEs.

This report builds on previous IEA analysis and on new survey data collected for the IEA's Cost of Capital Observatory project. The cost of capital is particularly important for clean energy projects which typically have high upfront costs during development. In EMDEs, the cost of capital is far higher relative to advanced economies and China due to real and perceived risks. Country-related risks such as currency fluctuations or the rule of law, and sector- and project-related risks including revenue flows, regulatory uncertainty and access to the grids are among the main concerns for investors. Reducing these risks will be key to lowering the cost of capital and in turn unlocking clean energy investment in the parts of the world that most need it.

This special report provides detailed insights into the risk factors that affect financing costs across different clean energy sectors in EMDEs and provides recommendations of what can be done to address them.

Annex 506

"Pricing of climate risks in financial markets: a summary of the literature",
BIS Papers No 130, *Bank for International Settlements,* December 2022



BIS Papers

No 130

Pricing of climate risks in financial markets: a summary of the literature

by Egemen Eren, Floortje Merten and Niek Verhoeven

Monetary and Economic Department

December 2022

JEL classification: Q50, Q54, G10.

Keywords: Physical climate risks, transition climate risks, ESG, hedging.

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Pricing of climate risks in financial markets: a summary of the literature

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Abstract

This paper summarises the academic literature on the financial market pricing of physical and transition risks related to climate change. While studies find that these risks are starting to be priced, concerns are growing that current prices do not fully reflect the risks. Investors grapple with three major challenges when seeking to price climate risks adequately. First, the aggregate nature of climate risks limits the availability of risk-sharing arrangements and hedging instruments. Second, the high degree of uncertainty about climate risks and concrete policy actions to address them heightens modelling and measurement challenges. Third, the information available to investors about climate risks and their consequences is often incomplete or imperfect.

JEL classification: Q50, Q54, G10.

Keywords: Physical climate risks, transition climate risks, ESG, hedging.

* Bank for International Settlements

† Netherlands Bank

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Introduction

A fast-growing body of literature examines whether physical and transition risks related to climate change are adequately priced in financial markets. While there is growing evidence that financial markets have started to price in climate risks, many have expressed concerns that current prices do not fully reflect these risks (BIS (2020), IMF (2020), NGFS (2022), ECB (2021), OECD (2021), Campiglio et al (2022)). Uncertainty and imperfect information complicate pricing. Also, externalities associated with climate change and greenhouse gas emissions can lead to a disconnect between market prices and the true social costs (Nordhaus (2019)).

Uncertainty across multiple dimensions and the long-run nature of climate risks present significant challenges to accurately modelling these risks (Hansen (2022), Barnett et al (2020)). Investors grapple with uncertainty about the future path of climate change, and about the energy transition, policy parameters and adaptation by firms and households. Market pricing is also hampered by a lack of historical data, consistent methodologies, standardised metrics, and comparable disclosures around climate risks (BIS (2020)). Even if investors had perfect information, risks far into the future may not be reflected in asset prices unless discount rates are sufficiently low.

A survey of finance academics and professionals, public sector regulators and economists in July 2021 identified regulatory risk as the top risk over the next five years and physical risk as the top one over the next 30 years (Stroebel and Wurgler (2021)). An overwhelming majority of survey respondents believed that asset prices underestimated climate risks.

This paper summarises the main findings of the literature on the pricing of climate risks in financial markets, including some unpublished work not yet subjected to peer review. More comprehensive reviews of the literature can be found in BCBS (2021), ECB (2021), NGFS (2022) and Giglio et al (2021a).

Physical risks

Several microeconomic studies find evidence that physical risks are priced in certain markets. However, that evidence is often mixed and insufficiently comprehensive to conclude that physical risks are broadly and consistently priced across markets. According to the International Monetary Fund, the impact of large disasters on equity markets, bank stocks, and non–life insurance stocks has generally been modest over the past 50 years. In addition, as of 2019, aggregate equity valuations did not reflect predicted changes in physical risks under various climate change scenarios (IMF (2020)).

While there is some indication that physical risks are priced in credit and equity markets, the evidence is preliminary and sometimes mixed. In credit markets, investors seem to pay a premium for corporate bonds that tend to do better when bad news about climate arrives (Huynh and Xia (2020)). In addition, there are some signs of physical climate risks being priced in sovereign debt markets: for example, extreme weather conditions cause borrowing conditions to deteriorate for sovereigns in the Caribbean (Mallucci (2022)). On the pricing of municipal bonds, there is conflicting evidence. Some authors find that, since 2013, the bonds of US municipalities exposed to rising sea levels have sold at a slight discount (Goldsmith-

Pinkham et al (2022)), while others find no climate risk premium for municipal bonds (BlackRock Investment Institute (2019)). In equity markets, the elasticity of equity prices to temperature risks across global markets appears to be negative and increasing in magnitude over time along with the rise in temperature (Bansal et al (2016)). Acharya et al (2022) find that heat stress has been robustly priced in municipal and corporate debt, and equity markets since 2013, but do not find evidence of pricing for other physical risks.

There is microeconomic evidence for the pricing of physical risks in housing markets, but the findings are not always consistent. Following Hurricane Sandy, the relative prices of properties in flood zones in New York City fell and stayed low, even if they were not damaged by the hurricane (Ortega and Taspinar (2018)). Similarly, among houses with equivalent observable characteristics, those exposed to sea level rise sold at a 7% discount, suggesting that inundation risks are priced (Bernstein et al (2019)). However, another study using a different sample and a similar methodology finds no effect of inundation risk being priced into residential real estate valuations (Murfin and Spiegel (2020)). Some studies found that attention paid to climate risks and beliefs in climate change affect the pricing of physical risks in housing markets (Giglio et al (2021b), Baldauf et al (2020)).

Transition risks

Transition risks present challenges for firms operating in high-carbon sectors as they might erode valuations, increase operating expenses and lead to balance sheet deterioration through reduced collateral values and stranded assets. Even though there is some evidence that transition risks are priced in financial markets, it is unclear whether this pricing is sufficient to address transition risks effectively (Weder di Mauro (2021)).

Several papers find evidence that transition risks are being priced in equity markets. For example, Bolton and Kacperczyk (2021) find that stocks of firms with higher total CO_2 emissions (and changes in emissions) earn higher returns, which cannot be explained through differences in size, book-to-market ratio or other return predictors. This suggests that investors demand compensation for their exposure to these carbon-intensive companies. In a follow-up study using a broader sample of firms, Bolton and Kacperczyk (2022) corroborate this evidence. The authors also find that the short-term transition risk is greater for firms located in countries with a lesser degree of economic development, greater reliance on fossil energy, and less inclusive political systems. The long-term transition risk is higher in countries with stricter domestic, but not international, climate policies. In European equity markets, "greener" stocks trade at a premium, but only if the companies are transparent about environmental performance (Alessi et al (2021)).

Several studies document that investors are sensitive to transition risks in fixed income markets as well. Some evidence suggests that the bonds of firms with less room to mitigate transition risks trade at a discount (Seltzer et al (2022)). Moreover, firms with higher greenhouse gas emissions (mostly due to CO_2 emissions) and poorer environmental scores exhibit greater credit risk as measured by bond yield spreads and distance-to-default (Capasso et al (2020), Barth et al (2022)). Green bonds trade at a premium versus similar bonds without the green designation (Baker et al (2018), Zerbib (2019)) and can offer diversification benefits without forgoing returns (Fender

et al (2019)). Finally, evidence suggests that issuing green bonds acts as a signalling device for firms' commitment toward the environment (Flammer (2021)).

The pricing of transition risks reacts to climate policies. Some studies link the spread in average returns between high- and low-emission firms to uncertainty about environmental policy (Hsu et al (2022)). Similarly, the equity prices of firms exposed to transition risk are negatively affected when the likelihood of climate policy action is higher (Barnett (2019)). After the Paris Agreement, the firms most exposed to climate transition risk saw their credit ratings deteriorate whereas other comparable firms did not, with a larger effect for European than US firms, which might in part reflect different expectations around climate policy (Carbone et al (2021)). There is also evidence that, since the Paris Agreement, transition risks are priced in the syndicated loan market (Ehlers et al (2022)).

The salience of climate risks also impacts the pricing of transition risks. Carbon-intensive firms underperform during times with abnormally warm weather, when investor attention is high (Choi et al (2020)). The cost of option protection against downside tail risks is larger for firms with more carbon-intense business models, and this is magnified when the public's attention to climate change spikes (Ilhan et al (2021)). On the flip side, news about transition risks positively impacts the returns of renewable energy companies (Batten et al (2016)).

Studies also suggest that market participants are pricing the risk of stranded assets to a certain degree. They penalise oil exploration firms in the United States for expanding their undeveloped oil reserves, which suggests that these investments are expected to have lower returns than existing production or even that they may not be expected to pay off over the long run (Atanasova and Schwartz (2019)). Climate risks and the uncertainty of the energy transition appear to have already had major effects on capital expenditures. For example, investment in coal, gas and oil dropped from over $1.3 trillion in 2015 to $750 billion in 2020 (Americano et al (2022)). Underinvestment in fossil fuels is not compensated for by investment in renewable energies, which might lead to energy scarcity and more volatility in energy prices in the medium term. Jung et al (2022) create a stress-testing procedure to test the resilience of financial institutions to climate-related risks using information on the return on stranded assets.

While the literature has focused primarily on the impact of transition risks on firms in high-carbon sectors, several authors have highlighted the risks of a "green bubble" emerging if the scope and the speed of the transition are overestimated (Borio et al (2022)). Such mispricing could lead to misallocations and affect the trajectory of the transition.

ESG ratings

Environmental, social and governance (ESG) ratings are frequently used as a tool to provide information to investors about the alignment of company objectives with actions to mitigate climate risks. In particular, the 'E' pillar is increasingly used as a proxy for selecting assets aligned with a low-carbon transition (NGFS (2022)). However, opaque and unstructured methodologies make it hard for investors to extract information from ESG ratings. In addition, ESG ratings have attracted criticism

for their "catch-all" nature, by attempting to capture varied elements (from social benefits to biodiversity loss) in a single rating.

Investors seeking to extract information from ESG ratings often face a substantial amount of uncertainty about a firm's true ESG profile. The ESG ratings of different rating agencies vary substantially and persistently (Avramov et al (2022)). Moreover, ESG rating providers appear to give a higher weight to the existence of corporate policies rather than forward-looking climate metrics, such as reductions in greenhouse gas emissions and intensity (OECD (2022)). To ensure that relevant information is better incorporated into prices, it is important to have effective tracking and verification processes to ensure that market participants can verify and assess progress in line with a low-carbon transition. As a step towards improving information on climate risks, a new international sustainability standards board focused on climate-related disclosures was set up in 2021 (Reichlin (2021)).

Recent research shows that ESG ratings and green innovation may not fully align. In the United States, firms with lower ESG scores, which are excluded from the investment universe of ESG funds, tend to be important green innovators (Cohen et al (2022)). This misalignment might have implications for pricing and efficient capital allocation.

Hedging climate risks

Developed financial markets allow market participants to effectively hedge climate risks. Advanced economies tend to have deeper financial markets that allow investors to hedge a variety of risk exposures. Evidence from the United States indicates that some derivatives markets are being used to hedge climate risks. For example, US options markets are sensitive to climate regulation uncertainty (Ilhan et al (2021)) and to hurricane forecasts (Kruttli et al (2021)). A cross-sectional study finds that firms using weather contracts to hedge climate risks have higher valuations than others, especially among firms that are exposed to climate risks (Pérez-González and Yun (2013)). In financial markets elsewhere instruments to protect against climate risks are substantially less developed (Lesmond (2005) and Domowitz et al (2002)).

Financial losses due to natural catastrophes can be covered by insurance, although coverage rates vary across countries. According to Swiss Re (2020), only around half of global economic losses from natural catastrophes has been covered by insurance in recent years. The protection gap is wider for emerging markets, where insured losses are less than 10% of total damages (Munich Re (2022)). The insurability of catastrophe-related risks is of increasing concern in the light of climate change, which could result in a widening of the protection gap (BIS (2020), ECB (2021)).

Hedging climate risks presents unique challenges for insurance companies and investors. Many effects of climate change are so uncertain or so far in the future that neither financial derivatives nor specialised insurance markets are available to directly hedge these risks. Furthermore, while heterogeneity across exposures can in principle allow for certain risk-sharing arrangements, some climate risks are considered uninsurable (Charpentier (2008), BIS (2020)). For example, insurers retreated from some areas of the Caribbean after severe weather events that undercut mortgage lending and home prices (Carney (2015)). A loss in the availability of insurance might lead to further volatility in financial markets.

Insurance and reinsurance companies have developed insurance-linked securities (ILS) and catastrophe bonds to overcome some of the challenges in providing insurance. These instruments transfer the risks associated with natural disasters to investors through global capital markets. The investments from the proceeds as well as insurance premiums are then used to make coupon payments to investors (World Bank (2020)). Prominent examples of ILS include those with parametric payouts, where payouts are based on a trigger event, for example a measure of wind speed or rainfall, rather than a measure of loss. While the number of parametric catastrophe bonds is limited, their triggers can be determined quickly and with a lesser degree of technical expertise (Polacek (2018)). This allows their issuers to pay out quickly and cover the financial impact. The total size of outstanding catastrophe bonds and ILS risk capital was around $40 billion in 2020 (FSB (2020)).

Investors can partially overcome the lack of insurance through proxy hedges. The stocks of firms that score high on the environmental portion of ESG ratings have higher returns during periods with negative news about the future path of climate change (Engle et al (2020)). Using this information, investors can dynamically hedge their portfolios against climate risk through investments in companies that score high on the environmental portion of ESG ratings and continuously update the hedging portfolio using new information on climate risk exposures. Investing in a low-carbon index can also provide a hedge for investors (Andersson et al (2016)). Alternatively, investors can construct hedging portfolios that exploit information on the observed trading decisions of mutual fund managers. Portfolios comprising long positions in industries that mutual fund managers are disproportionately likely to buy after a localised extreme weather event combined with short positions in opposite industries can help investors hedge the arrival of bad national climate news (Alekseev et al (2022)).

References

Acharya, V, T Johnson, S Sundaresan and T Tomunen (2022): "Is physical climate risk priced? Evidence from regional variation in exposure to heat stress", unpublished working paper, July, https://pages.stern.nyu.edu/~sternfin/vacharya/public_html/pdfs/climate-risk.pdf.

Alekseev, G, S Giglio, Q Maingi, J Selgrad and J Stroebel (2022): "A quantity-based approach to constructing portfolios to hedge climate risk", unpublished working paper, November, https://pages.stern.nyu.edu/~jstroebe/PDF/AGMSS_QuantityClimateHedge.pdf.

Alessi, L, E Ossola and R Panzica (2021): "What greenium matters in the stock market? The role of greenhouse gas emissions and environmental disclosures", *Journal of Financial Stability*, vol 54, June, https://doi.org/10.1016/j.jfs.2021.100869.

Americano, A, J Johal and C Upper (2022): "The energy transition: where we are, who will gain, and who will lose", unpublished mimeo.

Andersson, M, P Bolton and F Samama (2016): "Hedging climate risk", *Financial Analysts Journal*, vol 72, no 3, pp 13–32, https://doi.org/10.2469/faj.v72.n3.4.

Atanasova, C and E Schwartz (2019): "Stranded fossil fuel reserves and firm value", *NBER Working Papers*, no 26497, November, www.nber.org/papers/w26497.

Avramov, D, S Cheng, A Lioui and A Tarelli (2022): "Sustainable investing with ESG rating uncertainty", *Journal of Financial Economics*, vol 145, August, pp 642–64, https://doi.org/10.1016/j.jfineco.2021.09.009.

Baker, M, D Bergstresser, G Serafeim and J Wurgler (2018): "Financing the response to climate change: the pricing and ownership of US green bonds", *NBER Working Papers*, no 25194, October, www.nber.org/papers/w25194.

Baldauf, M, L Garlappi and C Yannelis (2020): "Does climate change affect real estate prices? Only if you believe in it", *The Review of Financial Studies*, vol 33, no 3, March, pp 1256–95, https://doi.org/10.1093/rfs/hhz073.

Bank for International Settlements (BIS) (2020): *The green swan: Central banking and financial stability in the age of climate change*, January, www.bis.org/publ/othp31.htm.

Bansal, R, M Ochoa and D Kiku (2016): "Climate change and growth risks", *NBER Working Papers*, no 23009, December, www.nber.org/papers/w23009.

Barnett, M (2019): "A run on oil: climate policy, stranded assets, and asset prices", unpublished working paper, June, www.frbsf.org/wp-content/uploads/sites/4/Paper-7-2019-11-8-Barnett-240PM-1st-paper.pdf.

Barnett, M, W Brock and L P Hansen (2020): "Pricing uncertainty induced by climate change", *The Review of Financial Studies*, vol 33, no 3, March, pp 1024–66, https://doi.org/10.1093/rfs/hhz144.

Barth, F, B Hübel and H Scholz (2022): "ESG and corporate credit spreads", *Journal of Risk Finance*, vol 23, no 2, pp 169–90, https://doi.org/10.1108/JRF-03-2021-0045.

Basel Committee on Banking Supervision (2021): *Climate-related risk drivers and their transmission channels*, April, www.bis.org/bcbs/publ/d517.pdf.

Batten, S, R Sowerbutts, and M Tanaka (2016): "Let's talk about the weather: the impact of climate change on central banks", *Bank of England Working Papers*, no 603,

May, www.bankofengland.co.uk/working-paper/2016/lets-talk-about-the-weather-the-impact-of-climate-change-on-central-banks.

Bernstein, A, M Gustafson and R Lewis (2019): "Disaster on the horizon: the price effect of sea level rise", *Journal of Financial Economics*, vol 134, no 2, November, pp 253–72, https://doi.org/10.1016/j.jfineco.2019.03.013.

BlackRock Investment Institute (2019): "Getting physical: scenario analysis for assessing climate-related risks", *Global Insights series*, 4 April, www.blackrock.com/us/individual/insights/blackrock-investment-institute/physical-climate-risks.

Bolton, P and M Kacperczyk (2021): "Do investors care about carbon risk?", *Journal of Financial Economics*, vol 142, no 2, November, pp 517–49, https://doi.org/10.1016/j.jfineco.2021.05.008.

——— (2022): "Global pricing of carbon-transition risk", *Journal of Finance*, forthcoming, http://dx.doi.org/10.2139/ssrn.3550233.

Borio, C, S Claessens and N Tarashev (2022): "Finance and climate change risk: managing expectations", *VoxEU*, 7 June, www.bis.org/speeches/sp220607.htm.

Campiglio, E, L Daumas, P Monnin and A von Jagow (2022): "Climate-related risks in financial assets", *Journal of Economic Surveys*, July, https://doi.org/10.1111/joes.12525.

Capasso, G, G Gianfrate and M Spinelli (2020): "Climate change and credit risk", *Journal of Cleaner Production*, vol 266, September, https://doi.org/10.1016/j.jclepro.2020.121634.

Carbone, S, M Giuzio, S Kapadia, J Krämer, K Nyholm and K Vozian (2021): "The low-carbon transition, climate disclosure and firm credit risk", *ECB Working Papers*, no 2631, December, www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2631~00a6e0368c.en.pdf.

Carney, M (2015): "Breaking the tragedy of the horizon – climate change and financial stability", speech given at Lloyd's of London, 29 September, www.bankofengland.co.uk/speech/2015/breaking-the-tragedy-of-the-horizon-climate-change-and-financial-stability.

Charpentier, A (2008): "Insurability of climate risks", *The Geneva Papers on Risk and Insurance*, vol 33, no 1, January, pp 91–109, www.jstor.org/stable/41952975.

Choi, D, Z Gao and W Jiang (2020): "Attention to global warming", *The Review of Financial Studies*, vol 33, no 3, March, pp 1112–45, https://doi.org/10.1093/rfs/hhz086.

Cohen, L, U Gurun and Q Nguyen (2022): "The ESG-innovation disconnect: evidence from green patenting", *NBER Working Papers*, no 27990, June, www.nber.org/papers/w27990.

Domowitz, I, J Glen and A Madhavan (2002): "Liquidity, volatility and equity trading costs across countries and over time", *International Finance*, vol 4, no 2, December, pp 221–55, https://doi.org/10.1111/1468-2362.00072.

Ehlers, T, F Packer and K de Greiff (2022): "The pricing of carbon risk in syndicated loans: which risks are priced and why?", *Journal of Banking and Finance*, vol 136, March, https://doi.org/10.1016/j.jbankfin.2021.106180.

Engle, R, S Giglio, B Kelly, H Lee and J Stroebel (2020): "Hedging climate change news", *The Review of Financial Studies*, vol 33, no 3, March, pp 1184–216, https://doi.org/10.1093/rfs/hhz072.

European Central Bank (2021): *Climate-related risk and financial stability*, July, www.ecb.europa.eu/pub/pdf/other/ecb.climateriskfinancialstability202107~87822fae81.en.pdf.

Fender, I, M McMorrow, V Sahakyan and O Zulaica (2019): "Green bonds: the reserve management perspective", *BIS Quarterly Review*, September, pp 49–63, www.bis.org/publ/qtrpdf/r_qt1909f.htm.

Financial Stability Board (2020): *The implications of climate change for financial stability*, November, www.fsb.org/wp-content/uploads/P231120.pdf.

Flammer, C (2021): "Corporate green bonds", *Journal of Financial Economics*, vol 142, no 2, pp 499–516, https://doi.org/10.1016/j.jfineco.2021.01.010.

Giglio, S, B Kelly and J Stroebel (2021a): "Climate finance", *Annual Review of Financial Economics*, vol 13, pp 15–36, https://doi.org/10.1146/annurev-financial-102620-103311.

Giglio, S, M Maggiori, K Rao, J Stroebel and A Weber (2021b): "Climate change and long-run discount rates: evidence from real estate", *The Review of Financial Studies*, vol 34, no 8, August, pp 3527–71, https://doi.org/10.1093/rfs/hhab032.

Goldsmith-Pinkham, P, S, M Gustafson, R Lewis and M Schwert (2022): "Sea level rise exposure and municipal bond yields", *NBER Working Papers*, no 30660, November, www.nber.org/papers/w30660.

Hansen, L (2022): "Confronting uncertainty in climate policy", *Chicago Booth Review*, 26 July, www.chicagobooth.edu/review/confronting-uncertainty-climate-policy.

Hsu, P H, K Li and C Y Tsou (2022): "The pollution premium", *Journal of Finance*, forthcoming, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3578215.

Huynh, T and Y Xia (2021): "Climate change news risk and corporate bond returns", *Journal of Financial and Quantitative Analysis*, vol 56 no 6, September, pp 1985–2009, https://doi.org/10.1017/S0022109020000757.

Ilhan, E, Z Sautner and G Vilkov (2021): "Carbon tail risk", *The Review of Financial Studies*, vol 34, no 3, March, pp 1540–71, https://doi.org/10.1093/rfs/hhaa071.

International Monetary Fund (2020): "Chapter 5: Climate change: physical risk and equity prices", *Global Financial Stability Report*, no 2020/001, April, www.imf.org/en/Publications/GFSR/Issues/2020/04/14/global-financial-stability-report-april-2020#Chapter5.

Jung, H, R Engle and R Berner (2022): "Climate stress testing", *Federal Reserve Bank of New York Staff Reports*, no 977, June, www.newyorkfed.org/medialibrary/media/research/staff_reports/sr977.pdf.

Kruttli, M, B Roth Tran and S Watugala (2021): "Pricing Poseidon: extreme weather uncertainty and firm return dynamics", *Federal Reserve Bank of San Francisco Working Papers*, no 2021-23, March, https://doi.org/10.24148/wp2021-23.

Lesmond, D (2005): "Liquidity of emerging markets", *Journal of Financial Economics*, vol 77, no 2, August, pp 411–52, https://doi.org/10.1016/j.jfineco.2004.01.005.

Mallucci, E (2022): "Natural disasters, climate change, and sovereign risk", *Journal of International Economics*, vol 139, November, https://doi.org/10.1016/j.jinteco.2022.103672.

Munich Re (2022): *Risks posed by natural disasters: losses are trending upwards*, www.munichre.com/en/risks/natural-disasters-losses-are-trending-upwards.html.

Murfin, J and M Spiegel (2020): "Is the risk of sea level rise capitalized in residential real estate?", *The Review of Financial Studies*, vol 33, no 3, March, pp 1217–55, https://doi.org/10.1093/rfs/hhz134.

Network for Greening the Financial System (NGFS) (2022): "Enhancing market transparency in green and transition finance", *NGFS Technical document*, April, www.ngfs.net/sites/default/files/medias/documents/enhancing_market_transparency_in_green_and_transition_finance.pdf.

Nordhaus, W (2019): "Climate change: the ultimate challenge for economics", *American Economic Review*, vol 109, no 6, June, pp 1991–2014, https://doi.org/10.1257/aer.109.6.1991.

Organisation for Economic Co-operation and Development (OECD) (2021): *Financial markets and climate transition: opportunities, challenges and policy implications*, OECD, Paris, www.oecd.org/finance/Financial-Markets-and-Climate-Transition-Opportunities-Challenges-and-Policy-Implications.pdf.

——— (2022): "ESG ratings and climate transition: An assessment of the alignment of E pillar scores and metrics", *OECD Business and Finance Policy Papers*, no 06, June, https://doi.org/10.1787/2fa21143-en.

Ortega, F and S Taspinar (2018): "Rising sea levels and sinking property values: the effects of Hurricane Sandy on New York's housing market", *Journal of Urban Economics*, vol 106, July, pp 81–100, https://doi.org/10.1016/j.jue.2018.06.005.

Pérez-González, F and H Yun (2013): "Risk management and firm value: evidence from weather derivatives", *Journal of Finance*, vol 68, no 5, May, pp 2143–76, https://doi.org/10.1111/jofi.12061.

Polacek, A (2018): "Catastrophe bonds: a primer and retrospective", *Federal Reserve Bank of Chicago Essays on Issues*, no 405, https://doi.org/10.21033/cfl-2018-405.

Reichlin, L (2021): "Accounting for climate change", *Project Syndicate*, 11 November, www.project-syndicate.org/commentary/cop26-creation-of-international-sustainability-standards-board-climate-reporting-by-lucrezia-reichlin-2021-11.

Seltzer, L, L Starks and Q Zhu (2022): "Climate regulatory risks and corporate bonds", *Federal Reserve Bank of New York Staff Reports*, no 1014, April, www.newyorkfed.org/research/staff_reports/sr1014.

Stroebel, J and J Wurgler (2021): "What do you think about climate finance?", *Journal of Financial Economics*, vol 142, no 2, November, pp 487–98, https://doi.org/10.1016/j.jfineco.2021.08.004.

Swiss Re (2020): "Natural catastrophes in times of economic accumulation and climate change risks", *Swiss Re sigma*, no 2/2020, 8 April, www.swissre.com/institute/research/sigma-research/sigma-2020-02.html.

Weder di Mauro, B (ed) (2021): *Combatting climate change: a CEPR collection*, CEPR, https://cepr.org/about/news/new-cepr-ebook-combatting-climate-change-cepr-collection.

World Bank (2020): "What are catastrophe bonds?", https://treasury.worldbank.org/en/about/unit/treasury/ibrd/ibrd-capital-at-risk-notes#3.

Zerbib, O (2019): "The effect of pro-environmental preferences on bond prices: Evidence from green bonds", *Journal of Banking and Finance*, vol 98, January, pp 39–60, https://doi.org/10.1016/j.jbankfin.2018.10.012.

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Annex 507

"The effects of climate change-related risks on banks: a literature review", Working Paper 40, *Bank for International Settlement*, December 2023

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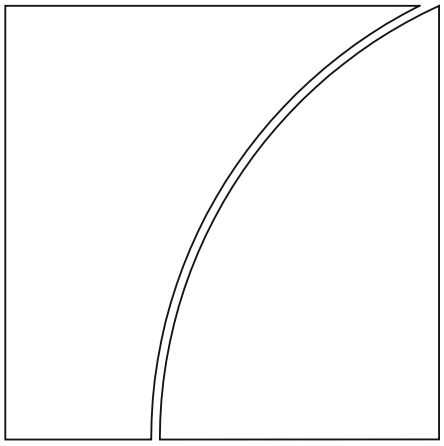

Working Paper 40

The effects of climate change-related risks on banks: a literature review

by Olivier de Bandt, Laura-Chloé Kuntz, Nora Pankratz, Fulvio Pegoraro, Haakon Solheim, Greg Sutton, Azusa Takeyama and Dora Xia

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Contents

The effects of climate change-related risks on banks: a literature review

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Executive Summary

As shown by IPCC (2023), the effects of climate change are likely to accelerate over the coming years, with a growing consensus among experts as surveyed by NGFS (2023).

The scope of the review is to describe the recent empirical literature in economics and finance focusing on how banks are affected by climate change, with a particular emphasis on microeconomic evidence.

Many of the studies which analyze the impacts of climate change on the economy and the financial system rely on modeling assumptions at the macroeconomic level. In order to improve upon these assessments, granular information is required on the effect of climate change on specific portfolios, which will then help calibrate the models used for stress tests.

The particular focus of the paper is to understand the reason why the impact on banks as observed so far is relatively moderate. We consider two alternative hypotheses: whether the risk is effectively small, or negligible, or whether it is mispriced by banks or markets, which would be more a source of concern for supervisors.

We investigate the effects of climate change on three metrics: credit risk, market risk and lending standards. We also discuss the impact of climate change on particular portfolios, namely residential and corporate real estate, as well as more generally the effects of climate change on non-financial corporates as well as central and local governments (states and municipalities). We also broaden the perspective by considering macroeconomic interactions, as well as second round effects, which are not negligible in the analysis.

All in all, the main contribution of the paper is to provide a distribution of impact of climate change across the papers under review, considering credit spreads, bond spreads, expected returns on non-financial corporate equity, and real estate prices.

The main conclusions are that:

1. Apart from a few outliers, according to the overall distribution of impact across academic studies, the microeconomic impact of climate change on particular portfolios is so far relatively small, below 50 bp on loan and bond spreads. Stock markets appear to react more significantly and have started pricing some, but maybe not all, the risks. There is some evidence of discount in real estate prices for high flood risk areas. As a consequence, significant uncertainty remains regarding the magnitude of the effects of climate change.

[1] The work stream was led by Olivier de Bandt. Comments by other members of the Research Group as well as from other Basel Committee groups are gratefully acknowledged, but remaining errors are from the authors.

2. There are various reasons that may explain why at the macro level banks may be able to manage risks from climate change, although the situation might change over time, as climate change accelerates. Several authors conclude that realized returns on assets related to companies vulnerable to climate-related risks are below expected returns, providing evidence of underestimation of risk.

3. New dimensions are uncovered, like the impact of Environmental ESG criteria for lenders and borrowers as well as the effect of reporting on exposures, which also help partly reduce uncertainty. However, the liquidity impact of climate risk is under-researched.

4. The overall impacts of climate change, which are multifaceted and affect various portfolios at the same time and in a correlated fashion, might be more significant.

5. There are still data issues, notably in terms of granularity, as well as methodological issues, which prevent a definite assessment of the situation, both for physical risk (lack of exact location of the exposures in many instances) and transition risk (notably the lack of evaluation for SMEs).

All in all, one may conclude that the overall balance is more in the direction of an underestimation of the risks from climate change from the perspective of banks, rather than a situation where the risks are likely to be fully measured and managed by banks. The main channel is the materialization of unexpected risk insufficiently priced in lending or bond spreads.

Keywords: climate change, banks, bond spreads, loan spreads, equity returns

JEL: Q54, Q52, Q51, G21

Introduction

While experts agree on the urgency of policy action to alleviate the effects of climate change (European Central Bank, 2022), the economic and financial literature often indicates that, so far, climate change has had ambiguous measurable effects on bank risk in advanced countries.

The scope of the review is the empirical literature published in top refereed journals in economics and finance, focusing on how banks are affected by climate change and the transition to a low carbon economy. The review includes 190 papers and covers the effects on both credit risk and credit supply; impacts on market risk are also examined.[2] This may let aside practitioners' results, but it allows us to be more confident and to trust results on the basis of a clear and transparent methodology.

While the IPCC concludes that there is a quasi-linear relationship between accumulated emissions and earth surface temperature (IPCC, 2022, 6th Report), global emissions are accelerating. Therefore, conclusions based on past evidence is likely to underestimate the amount of climate change-related damages, including the effects on banks' portfolios. In addition, there is evidence that some markets might ignore climate related information. There may be good reasons for limited reactions of participants in financial markets in some instances, for example when exposures have a short maturity (Acharya et al. 2023). Nevertheless, Eren et al. (2022) note that concerns are growing that current financial asset prices do not sufficiently reflect climate risks. There is thus a risk that future price corrections can be more pronounced in such areas, creating a risk to financial stability. That said, there are no clear benchmarks that quantify climate risks and fair pricing of such risks. Therefore, it is not feasible to gauge whether current asset prices underestimate or overestimate climate risks and the scope for repricing. It should also be noted that most of the empirical literature is concentrated on advanced economies – Europe, United States, Japan, and Australia. Only a few studies look at effects in emerging markets, despite these countries being potentially more vulnerable to both physical climate risk and the costs of transition.

Before going into detail on the evidence provided by the literature, it is useful to offer a general perspective of the issues at hand. The ultimate impact of climate-related risks, both physical and transition risks, on banks' credit exposures is not easy to quantify. This is true for a number of reasons. One is that conventional risk models do not capture potentially severe facets of climate-related risks, such as tipping points and outcomes such as climate-induced mass migrations and associated warfare. This omission is understandable, as these effects are extremely difficult to model; yet their omission is likely to lead to an underestimation of the impact of climate change on banking systems and economies more broadly (e.g., Stern (2013)). A second reason is the indirect nature of climate-related risks for banks, such as impacts to their customers' supply chains arising from climate physical risks, and the unpredictability of transition risks associated with political measures to mitigate climate change. Third, and perhaps the main reason why it is difficult to quantify the impact of climate change, is the related uncertainty. For example, as noted by Lenton et al. (2019), there is a lot of uncertainty about how much ice sheets will melt, given any assumed amount of global temperature rise. And, as noted by Pindyck (2020), considerable uncertainty remains about how much average temperatures will rise given any assumed path for greenhouse-gas emissions. For example, the extent of coastal flooding from future sea level rise (SLR) is likely to be substantial but highly uncertain, making it extremely difficult to estimate damages to coastal real estate from future SLR. All in all, the long-term forecasting horizons and data gaps only make the task of estimating the impact of climate-related risks more difficult.

[2] The analysis is based on papers published since 2010 in refereed economics and finance journals, as well as a few energy and environment journals. In order not to miss more recent contributions, we also consider working papers by the NBER, the BIS, the Board of Governors of the Federal Reserve System, the Federal Reserve Bank of New York, the European Central Bank, the Deutsche Bundesbank, the Banque de France, and CEPR Discussion Papers.

It is important for climate-related risks to differentiate between risk and Knightian uncertainty (Stern (2007, 2013)). For example, the uncertainty associated with SLR is arguably Knightian in nature, meaning that the probability distribution of future SLR is quasi-unknowable due to variation across climate models, uncertainty related to the level of emissions, as well as the translation of emissions into temperature increases. At the same time, probabilities associated with various levels of SLR are required for standard risk analyses. Despite this uncertainty, most research finds a measurable impact of climate risk on banks' credit exposure. Some research tries to capture the effects of this uncertainty, e.g., Ilhan, Sautner and Vilkov (2021) show that climate policy uncertainty seems to be priced in the option market. More precisely, the cost of option protection against downside tail risk is larger for S&P 500 firms with more carbon-intense business models.

Putting these pieces together and keeping in mind the uncertainty of the analyses as well as the lack of comprehensive analysis for banks' credit and market exposure as almost all papers focus on specific borrower types (see Kousky et al. (2020b) and Capasso et al. (2020)), it becomes apparent why climate risk in banks' credit exposures might not yet be well-understood.

Beyond these caveats, it is important to survey the available evidence, with a view to complementing past reviews,[3] given the significant acceleration of published works in the area of climate change-related risks. Moreover, the review concentrates on the transmission channels to banks.

Note that the regulation of banks regarding their exposure to climate change is not addressed in the paper. Although we rationalize the existing quantitative literature, uncertainties on the magnitude of the impact remain.

The paper is organized as follows. Part 1 discusses the effects of climate change on credit risk, market risk and lending standards. Part 2 investigates the specific impacts on real estate prices, both residential and corporate real estate, as well as more generally the effects of climate change on corporates as well as central and local governments (states and municipalities). Part 3 broadens the perspective by considering macroeconomic interactions. Part 4 concludes and makes suggestions for future research.

Part 1: Transmission channel of climate change on regulatory and lending standards

This part focuses on general issues related to the effects of climate change on credit risk and market risk, as well as lending standards (in particular lending volumes). Credit risk includes risk of default on loan and bond exposures, while our review of market risk mainly concentrates on equities and other non-bond exposures traded in securities markets (see also European Systemic Risk Board, 2021 and 2022).

1.1 Credit risk

Credit risk is an important dimension of banks' portfolio management. It is managed by banks through an assessment of the probability of default (PD) and may translate into lending spreads, or more generally bond spreads. As argued by Acharya et al. (2023), a key aspect of the risk sensitiveness of banks' banking books is the maturity of bank loans. To the extent that banks can reshuffle loan portfolios before climate change-related risks materialize, they will not be much affected by climate shocks.[4] There are nevertheless two caveats. First, banks do hold assets displaying long-term maturities, especially for real estate. This

[3] See BCBS (2021a) and BCBS (2021b).

[4] This may distinguish banks from insurance companies (see box below).

issue is discussed more fully in section 2.1. Second, banks' franchise values will be affected if their traditional customers and notably non-financial companies are threatened by climate change, as discussed in section 2.2.

Here we discuss general findings on credit risk, leaving these more specific issues notably the effect on real estate prices (and collateral value) for part 2. First, we cover physical risk (1.1.1), then transition risk (1.1.2).

We gather empirical evidence from around 30 papers with a quantitative estimate, that we summarize in charts on the distribution of the documented estimates. The charts distinguish between loan spreads (Figure 1) and bond spreads (Figure 2), and within each figure, between physical and transition risk.[5] Even if the estimates appear comparable, one should keep in mind a few limitations: climate shocks, notably physical, are of different kinds as explained below (with floods, sea level rise, drought, etc as opposed to public policies limiting GHG emissions) and the empirical results are backward-looking.

1.1.1 Impact on lending spreads due to acute and chronic physical climate risk

1.1.1.1 Loans to agriculture

The agricultural sector is directly affected by physical climate risks. In a comprehensive simulation, Brar et al. (2021) conclude that not accounting for climate change-related risks in agricultural loans leads to an underestimation of the riskiness of these loans. At the country level, Kraemer and Negrilla (2014) find that poorer countries are more exposed to climate risk, because agriculture sectors account for a larger share of GDP in these countries (see also de Bandt, Jacolin and Lemaire, 2021).

1.1.1.2 Floods

Physical risks not only destroy property and harvests, but also impact the probability of repayment of retail loans as Kousky et al. (2020b) show. After a flood event, the probability of default (of a non-insured moderately priced property) increases by 2.6 times after two years.

Correa et al. (2023) find that, following climate change-related disasters, banks charge higher spreads on loans to indirectly affected borrowers with recently high exposure to these types of disasters. This effect varies from 19 basis points for hurricanes to about 8 basis points for wildfires and floods. These changes in loan spreads are economically sizable, as they represent between 5% and 10% of the unconditional spread charged on loans included in the sample.

Garbarino and Guin (2021) study how lenders react after a flood event using UK data for the mid-2010s. In contrast to other studies, they find that "banks do not mark-to-market against local price declines and lenders do not offset the valuation bias by adjusting interest rates or loan amounts". The absence of effects of floods in their analysis may be explained by public flood subsidizing high income households, and high-income households self-select into high flood areas. Indeed, there is a general concentration of wealthy borrowers along rivers and seashores that are most affected by climate change-related risks.

1.1.1.3 Heat and droughts

The empirical analysis proposed by Do et al. (2021) shows that banks charge higher interest rates to borrowers located in drought-located areas. In addition, this higher premium is more pronounced for food

[5] The figures report the impact arising from a unit climate risk shock, i.e. $\frac{\Delta y}{\Delta x}$, where y is the credit or lending spread, measured in basis points, and Δx is a unit climate shock. The latter depends however on the nature of the risk, with a cross-sectional dimension for transition risk (e. g. difference in carbon emissions) and a time series dimension for physical risk (e. g. probability of flood occurrence or heat wave).

industry borrowers; a one standard deviation increase in their adopted drought measure induces an increase of 11 bp on the interest rate charged to food industry borrowers.

Acharya et al. (2022) show that heat stress is correlated with municipal bond yield spreads and document an increase of 15 bp per annum. The authors conclude that "the effect is larger for longer-term, revenue-only and lower-rated bonds, and arises mainly from the expected increase in energy expenditure and decrease in labor productivity". In particular they find that "among S&P 500 companies, a one standard deviation increase in exposure to heat stress is associated with yield spreads that are higher by around 40 bp for sub-investment grade corporate bonds".

Similarly, Javadi and Masum (2021) find empirical evidence that firms in regions exposed to droughts pay significantly higher spreads on their bank loans: loan spreads of firms in the top quartile of climate risk exposure are about 4.4% larger than those of firms in the bottom quartile. The authors follow Huynh et al. (2020) and use the location of a firm's headquarters to measure its exposure to climate risk. They assume, as observed in previous research, that a firm's headquarter location is usually close to its operations and core business activities. To alleviate the concern regarding the validity of this assumption, they also include information on the location of the customers of the borrowing firms They conclude that the interest rate spread on loans is significantly higher for firms when their customers are more exposed to climate risk. In addition, the authors conclude that "the effects are even more pronounced for long-term loans of poorly rated firms". For example, they assess that "loan spreads are about 5.8% higher for long-term loans of poorly rated firms in the top quartile of climate risk than those in the bottom quartile". The study also adds supporting evidence to the notion that climate risk is not fully anticipated as they find no significant difference between firms in the food industry and others (see 1.2. for similar results for equities).

1.1.1.4 Sea Level Rise (SLR)

As far as SLR risk is concerned, there is evidence on the effects of climate change, for loans and bonds.

For loans, Nguyen et al. (2022) show that lenders charge higher interest rates for mortgages on residential real estate exposed to more SLR. The main conclusion is that the interest rate spread for mortgages in a zip code where all residential real estate are exposed to SLR risk is approximately 7.5 bp higher than the interest rate spread for mortgages in a corresponding area where none of the properties are exposed to SLR risk.

For bonds, Goldsmith-Pinkham et al. (2021) show that chronic SLR risk, as well as acute flood risk, impact the price of municipal bonds of the affected counties. In general, the premium seems to be driven by the uncertainty of the impact of the SLR risk and not by a reduction in asset values. In addition, Auh et al. (2022) analyze whether the increase of frequency or intensity of natural disasters impacts the riskiness of the municipal bonds of the affected issuer-county. The authors find that the investor's loss (as holders of the municipal bonds) is around half of the estimated physical damage induced by the relevant natural disaster. This corresponds to a loss of around 31 bp for the investors in the weeks after a disaster.

1.1.2 Impact of the transition to a low-carbon economy on lending and bond spreads

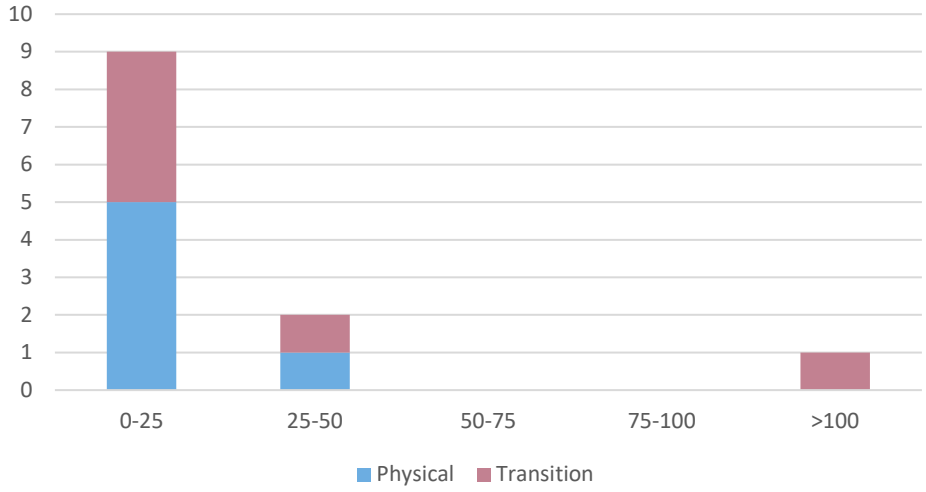
a) Bank loans

For higher risks and spreads on bank loans facing transition risk, there is evidence on both the corporate loan and mortgage markets. Some studies only consider default risk. Others offer a more complete analysis and also measure the implications of loan spread adjustment to higher risk.

Impact of climate change on loan spreads

12 entries

Figure 1

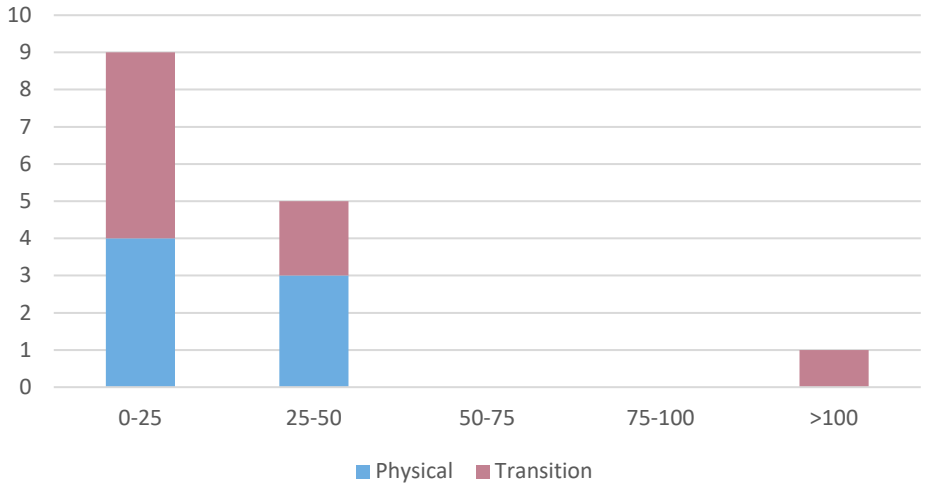


Source: authors' calculations, based on the review of 12 estimates provided by the academic literature, number of studies (vertical axis) providing an estimate of yield spreads of bank loans, in basis points (horizontal axis). Impact is usually measured as the response to a one standard deviation on climate change exposure. The articles displayed here are: Beyene et al. (2022); Chava (2014); Correa et al (2023); Degryse et al (2023); Delis et al. (2021); Do et al. (2021); Ehlers et al. (2022); Garbarino and Guin (2021); Huang et al (2021); Javadi and Masum (2021); Kleimeier and Viehs (2018); Nguyen et al. (2022). The studies investigating shocks in terms of physical risk are depicted in blue, transition risk in red. The reference above 100 bp is Huang et al. (2021).

Impact of climate change on bond spreads

15 studies

Figure 2



Source: authors' calculations, based on the review of 15 estimates provided in the academic literature, number of studies (vertical axis) providing an estimate of yield spreads on corporate or sovereign bonds, in basis points (horizontal axis). Acharya et al (2022) -2 entries; Auh et al. (2022); Baker et al (2018); Cevik and Tovar Jalles (2020); Goldsmith-Pinkham et al. (2021); Höck et al. (2020); Kim and Pouget (2023) -2 entries; Painter (2020) -2 entries; Pastor (2022); Seltzer et al (2022); Xia and Zulaica (2022); Zerbib (2019). The studies investigating shocks in terms of physical risk are depicted in blue, transition risk in red. The reference above 100 bp is Höck et al. (2020).

Delis et al. (2023) analyze in the corporate loan market the extent to which U.S. banks price firms' climate policy risk exposure to (stranded) fossil fuel reserves. In particular, they estimate whether banks charge a higher loan rate to fossil fuel firms. The authors find that (1) the effects of fossil fuel reserves held by the borrowing firms, on the loan rate is more pronounced for firms in countries with stringent policy, or with close costal proximity; (2) fossil fuel firms obtain larger loans compared to non-fossil fuel firms; and (3) higher loan pricing to fossil fuel firms by "green banks". Their results also support the view that the fossil fuel industry has lost some access to equity finance, leading to larger borrowing by these firms. Thus, part of the reason that these firms pay larger spreads could be related to greater loan demand. Consistent with this idea, Degryse et al. (2023), based on international syndicated loans, show that green firms borrow at a significantly lower spread, especially when the lender consortium can also be classified as green, especially after the Paris Agreements. Huang et al. (2021) investigate the impact of the Clean Air Action that the Chinese province of Jiangsu implemented in January 2014 as a quasi-natural experiment. Based on a sample of 1.3 billion loans they show that the lending spread to polluting firms significantly increased by 130 bp, which is equivalent to 5.5% of the mean lending spread.

Ehlers et al. (2022) investigate whether a higher carbon intensity drives the associated risk premium a company has to pay. Although the premium is rather small, the authors conclude that banks charge higher loan spreads only in case of higher emissions narrowly attributable to the firm's activity, and not to the broader carbon footprint of the firm (i.e. indirect emissions related to energy consumption and production inputs). In addition, while "green banks" may lend less to high carbon emitters than other banks, they do not appear to charge a higher carbon premium.

Kaza et al. (2014) find that mortgages on energy-efficient homes have significantly lower risks than those on less efficient homes. The risk of default is about one third lower compared to the control group. In addition, the more energy efficient, the lower the mortgage risk. An increase in the energy efficiency by 1 point decreases the probability of a default by 4% and decreases the chance of prepayment by 2%, measuring the higher performance of energy-efficient projects from the lenders' perspective. However, the authors do not consider the potential endogeneity of the results in the sense that more affluent (hence less risky) borrowers can more easily afford more efficient housing.

Guin et al. (2022) improve upon the previous methodologies and examine the relative riskiness of residential mortgages depending on the energy efficiency of the underlying real estate as well as borrowers' risk characteristics. For a data sample collected in the United Kingdom, the analysis concludes that the energy efficiency of residential real estates reduces the frequency of mortgage payment arrears. This finding is unaffected when controlling for other relevant determinants of mortgage default, like borrower income and loan-to-value (LTV).

However, Bell et al. (2023) on pre-2018 loans, so far find "no evidence of lenders charging higher rates on riskier mortgages against energy-inefficient properties".

b) Bond spreads

Several studies explore a carbon premium – the extra yield investors demand to buy bonds issued by firms with more greenhouse gas emissions – in the U.S. corporate bond market. Seltzer, Starks, and Zhu (2022) find that high emitters have lower credit ratings and higher yield spreads, particularly in states with stricter regulatory enforcement. Further, they find that the composition of bondholders changed after the Paris Agreement. Xia and Zulaica (2022) study two potential mechanisms behind the carbon premium in corporate bonds and find evidence consistent with both: One is the preference channel, under which the premium reflects investors' preference for firms that they perceive as being more environmentally responsible. The other channel is the risk channel, where investors perceive more carbon-intensive firms as more prone to default. Further, the authors find that the premium is larger for firms in more energy-intensive sectors. Kim and Pouget (2023) study the relation of carbon emissions and yield spreads both in the primary and secondary corporate bond market. They find that firms with higher emissions have larger yields than firms with low emissions on the primary market, implying a higher cost of capital of 4 bp.

However, the premium in the primary market accounts for less than 15% of the one prevailing on the secondary market and measured at 27.4 bp. Underpinned by a theoretical framework, the authors document support for both the uncertainty about future climate preferences of investors and limited competition among primary market dealers as drivers of this difference.

In addition, there is an abundant literature on green bonds (i.e., bonds for which issuance proceeds are required to be invested in green projects). Zerbib (2019) measures a small negative premium for the period from July 2013 to December 2017: the yield on a green bond is lower than that on a conventional bond. On average, the premium is -2 basis points both for the entire sample and euro and U.S. dollar bonds separately. Baker et al. (2018) study a sample of more than 2,000 municipal and corporate green bonds and find that green bonds trade at lower yields than bonds with similar characteristics but without a green label. Pastor et al. (2022) predict that similarly to the existence of a "greenium" for green bonds (i.e., lower interest rates on green than brown bonds), green stocks have lower expected returns, but show that ex post, based on realized returns, green stocks outperform brown due to positive surprises over the sample period. These market reactions provide further evidence that the effects of climate change are not fully anticipated. Nevertheless, the "greenium" is not very substantial overall. Further research would need to explain why green and brown bonds issued by the same company may have different ratings.

The study by Pastor et al. (2022) also highlights the overlap of concerns about climate-related risk and environmental, social and governance (ESG) performance. As borrower and lender ESG disclosures can contain relevant information for climate risk management, Box 1 considers research on ESG information and lending. The perspective of risk for equities is discussed in section 1.2.

Box 1: Bank lending and environmental sustainability

A growing literature investigates the impact of environmental, social and governance (ESG) performance and objectives on credit risk. As discussed by Bolton and Kacperczyk (2022), the increasing importance of such factors "may reflect the growing frustration with inadequate policies". We first discuss the research on the effect of ESG performance on borrowers. Subsequently, we summarize the literature on lenders' ESG scores and outcomes related to credit risk.

For borrowers, Höck et al. (2020) show that environmental sustainability reduces the credit risk premium measured in CDS spreads but only for companies with a good creditworthiness. Billio et al. (2022), as well as Carbone et al. (2022), find that sustainability also affects borrower ratings positively and leads to a decline in the credit spread for those corporates. In addition, some papers explicitly connect emissions, ESG ratings, and credit spreads. They document that both high emissions and low ESG ratings are connected to a higher probability of default and higher credit spreads (Kleimeier and Viehs (2018), Capasso et al. (2020), Ehlers et al. (2022)). Chava (2014) shows that lenders charge a significantly higher interest rate on the bank loans issued to firms with these environmental concerns Further, the paper documents that banks are also more reluctant to lend to these firms, as witnessed by the lower number of banks participating in their loan syndicate than for the firms without such environmental concerns. In line with this evidence, recent papers document a rise of sustainability-linked lending, in which lenders reward sustainable borrowers with lower lending rates (Kim et al., 2022, Carrizosa and Gosh, 2022).

From the perspective of **lenders**, Birindelli et al. (2022) show that banks' commitment to climate issues – meaning a medium to high attention to this topic – is connected to a lower risk of bank loans. Besides the management of financial and event risk, the studies allude to lowered reputational risk as a driver of banks' attention to non-financial characteristics of their borrowers.

Some studies indicate that the effects are concentrated in groups of lenders and borrowers with high similarity. For instance, Kim, Surroca, and Tribo (2014) study bank lending in 19 countries and find that banks offer better financing conditions to ethical borrowers as measured by sustainability scores. They document a substantial decrease in mean spreads by almost 25% for a one standard deviation increase in a measure of ethical behavior of the borrower. The reduction is even larger with 38% compared to the sample mean when lenders also rank high in ethical behavior. In line with this result, Hauptmann (2017) finds that borrowers with higher sustainability ratings pay lower loan spreads only when the lending bank exhibits strong sustainability performance as well. Chen et al. (2021) find that banks require higher loan spreads from borrowers with higher levels of chemical pollution. Similar to Kim et al. (2014) and Hauptmann (2017), they document that the effect is concentrated in lenders with higher social responsibility performance. Moreover, Degryse et al. (2023) show that green banks, measured by their membership in the UN Environment Program Finance and their reporting to the Carbon Disclosure Project, offer better loan conditions to green firms after the ratification of the Paris Agreement.

1.2 Market risk

In addition to credit risk, banks could be exposed to climate change through market risk from shocks associated with sudden changes in stock prices, interest rates, exchange rates, and commodity prices. In this section, we focus on equity markets, as bond markets are discussed in section 1.1. As Giglio et al. (2021a) stress, research on market risk is complicated by the fact that investors may have recently started to pay more attention to climate change-related risks.

As for credit risk, physical and transition risks have different implications for market risk and are discussed separately. Figure 3 summarizes the estimates in the empirical literature. The same caveats as for Figures 2 and 3 apply. Also note that the risk premium is not comparable to lending and bond spreads, as indicators for market risk measure the expected return differential from a brown versus a green portfolio.

1.2.1 Physical risk

For physical risk, Acharya et al. (2022) conclude that S&P 500 corporations with a one standard deviation higher heat stress exposure have a 45 bp higher (unlevered) expected return per annum, with the effect being observed robustly since 2013; Furukawa et al. (2020) show that security prices of corporate bonds and equities reflect the impact of climate change physical risk. However, investors tend to assess the impact of climate change-related risks based on "memorable" events rather than all available events. For example, Hong et al. (2019) demonstrate that drought risk is not priced in food companies' equity prices in regions/countries which have not suffered from severe damage of drought for 20–30 years, although drought risk indicators are globally available. Alok, Kumar, and Wermers (2019) document that professional money managers overreact to large climatic disasters that happen close to them, underweighting disaster-zone stocks to a much greater degree than distant mutual fund managers. They also document that this overreaction can be costly to fund investor performance. In contrast, Choi et al. (2020) find that in abnormally warm weather, stocks of carbon-intensive firms underperform those of low-emission firms. An increase of one standard deviation in abnormal temperature corresponds to a decrease of 16 bp in return. For firms in the United States, Addoum et al. (2023) show that firm profitability is influenced by extreme temperatures, but stock prices do not immediately respond to temperature shocks. For firms outside of the United States, Pankratz et al. (2023) reach similar conclusions. They find that heat reduces revenues and operating income. However, analysts and investors do not appear to fully anticipate these effects. Moreover, the deviation in analyst estimates from actual financial performance and the earnings announcement returns become more negative when firms' heat exposure increases. These findings indicate that investors do not fully anticipate the economic repercussions of heat as a first-order physical climate risk.

A possible explanation for this mixed evidence of pricing for climate risks is that it is challenging for investors to make decisions under deep uncertainty regarding climate change-related risks. Barnett,

Brock and Hansen (2020, 2022) document that even supervisory authorities and central banks suffer from shortages in information in policy decision making. Such uncertainty can lead to loss in economic welfare and biases in resource allocation (ACPR, 2021).

1.2.2 Transition risk

There are three hypotheses on potential transmission mechanisms of transition risk into market risk (Bolton and Kacperczyk, 2021a).

First, the profitability of firms with high emissions could decline due to a carbon tax, pricing and other regulatory interventions to limit emissions. Then, forward-looking investors would seek compensation for holding the stock of these firms ("carbon premium hypothesis").

Second, the prices of securities might not reflect climate transition risk properly and efficiently as climate change-related financial risks are unconventional. Consequently, conventional methodologies of market risk measurement (e.g., value-at-risk and expected shortfall) are not directly applicable to risk management and measurement of climate change-related risks under limited availability of historical data ("market inefficiency hypothesis" or "carbon alpha hypothesis").

Third, the number of institutional investors that commit to socially responsible investment could continue to increase. These investors pledge to request firms to commit to the reduction in their emissions and to reduce their investment in firms which are reluctant to reduce their emissions ("divestment hypothesis").

Regarding the carbon premium hypothesis, Bolton and Kacperczyk (2021a and 2021b) document a broad range of evidence that investors require a higher expected excess return for investing in the securities of firms with higher GHG emissions. This is true for the United States as well as from a cross-border perspective. They conclude that the pricing is uneven across countries, depending on the likelihood of transition policies, with little effect in Africa, Australia and South America. They also provide robust evidence (also confirmed by Bolton and Kacperczyk (2022)), that the level of emissions matters more than the intensity (emissions/value of sales), highlighting the importance of industry fixed effects. There is a carbon premium for firms within the same industry, which is growing with the size of firms, as bigger firms are more likely to be concerned with transition policies. They also stress that the premium of high emissions emerged after the Paris agreement in COP21 in 2015. This indicates that policy initiatives and international agreements on greenhouse gas emission reduction can send a signal of risk in transition to a low carbon society. However, it is also noteworthy that other studies find no significant differences in ex ante return of securities in terms of firms' GHG emissions (Dai, 2020). As trigger events of transition risk, the implementation of comprehensive carbon tax/pricing have materialized in only a limited number of jurisdictions, it is still challenging to identify the source of excess returns of high emission firms. In particular, Bolton and Kacperczyk (2022) do not uncover a carbon premium for banks.

Similarly, Hsu, Li, and Tsou (2023) find that highly polluting firms are more exposed to environmental regulation risk and command higher average returns of 4.42% for the United States in the period 1994–2017, measured by the return of a long-short portfolio from firms with high versus low toxic emission intensity within an industry. Emissions, not limited to GHGs, are measured by plant-level chemical pollutants data from the Toxic Release Inventory (TRI) database constructed and maintained by the U.S. Environmental Protection Agency (EPA).

Bua et al. (2022) investigate the climate risk premium on European equity markets. Using a low-minus-high transition (physical) climate beta portfolio, they identify positive excess returns, measuring a climate risk premium 7.05% and 6.14% on average per-year after 2015, for transition and physical risk, respectively.

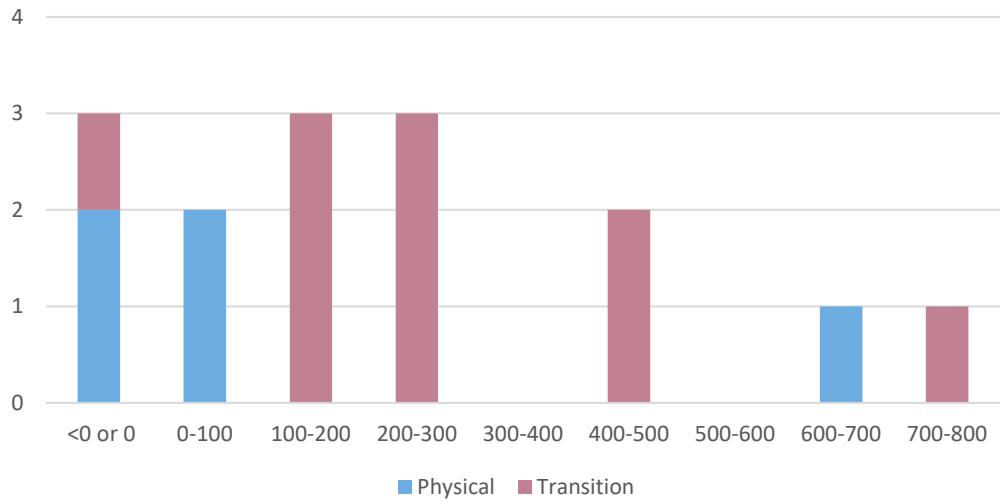
The quality of information on firms' carbon emissions is a common challenge for studies on transition risk. Aswani et al. (2021) find no statistically significant excess return from the data of firms'

actual disclosure while they find supporting evidence of excess returns from the dataset complemented by financial data vendors. This finding is consistent with the assessment of financial institutions' preparedness to conduct scenario analysis of climate change-related risks by European Central Bank (2022). The majority of banks participating in the exercise conduct their analysis based not on borrowers' disclosure of emission data but on the estimated emission data provided by third party data vendors. Similarly, Krueger et al. (2020) show that the majority of institutional investors expect that equity prices do not fully reflect climate related risks.

Impact of climate change on risk premium for stocks

15 studies

Figure 3



Source: authors' calculations, based on the review of 15 papers in the academic literature, number of studies (vertical axis) providing an estimate of risk premium on non-green, or carbon-intensive, or non-ESG stocks, in basis points (horizontal axis). Acharya et al. (2022); Addoum et al (2023); Bua et al (2022) -2 entries; Bolton et Kacperczyk (2021 a and b) – 6 entries; Choi et al. (2020); Hong et al. (2019); Hsu et al (2023); Giglio et al. (2023); Monasterolo and De Angelis (2020). The studies investigating shocks in terms of physical risk are depicted in blue, transition risk in red. Note that the risk premium is not comparable to lending and bond spread.

There are two additional strands of the literature that need to be mentioned: the impact of disclosures and ESG investments in financial market.

First, the disclosure of exposures also has an impact on the equity risk premium. As discussed by Bolton and Kacperczyk (2022), disclosures reduce uncertainty, leading to a lower premium. Krueger (2015) studies the effect of mandatory GHG emissions disclosure passed into law in 2013 in the United Kingdom. His research shows that firms most heavily affected by the regulation experience a significant increase in Tobin's Q, as compared to a matched sample of European firms, providing evidence of positive valuation gains. He further finds that investors value carbon transparency more in carbon intensive sectors: basic materials (mining) as well as oil and gas production. In an international context, Krueger, Sautner, Tang, and Zhong (2023) find that ESG disclosure mandates positively affect firm-level stock liquidity. The effects are stronger for binding mandates compared to comply-or-explain policies and increase under stringent enforcement. Using survey methods, Ilhan, Krueger, Sautner, and Starks (2023) show that investors value and demand climate risk disclosures. Further, the authors use the introduction of a law on the energy transition in France (Article 173) to show that climate-conscious institutional ownership drives better firm-level climate risk disclosure.

Bolton and Kacperczyk (2021c) report the asymmetric reaction of investors in transition risk pricing in a response to companies' new disclosure of GHG emissions. This indicates that firms' disclosure of their GHG emissions and exposure to climate change-related risks is helpful to reduce investors'

uncertainty both in terms of transition and physical risks. Panjwani et al. (2023) find that firms that disclose scope 3 emissions have a cost of borrowing that is 20 basis points lower, on average (scope 3 disclosure premium). At the same time, controlling for scope 1 and 2 emissions that lead to higher lending spreads, higher scope 3 emissions are not associated with a higher cost of borrowing.

Second, and more generally, the literature has also extensively studied the connection between ESG indicators and market risk, the conclusions of which matter for banks. On the one hand, banks report increasing attention by investors and a strong demand for ESG investments. On the other hand, the literature offers conflicting results on ESG performance at this stage. Friede et al. (2015) combine the findings of about 2200 individual studies and report that 90% of studies find a nonnegative ESG–Corporate Financial Performance (CFP) relation, and that most studies report positive findings. Further, the positive ESG impact on CFP appears stable over time, but rather more apparent for bonds than equities. However, recent papers continue to find heterogeneous effects. Some studies indicate that there is no ultimate consensus. For instance, Giglio et al. (2023a) find that the average retail investor anticipates negative excess returns on ESG. They document an average expected 10-year annualized return that is lower by 1.4% for ESG investments than the overall stock market. They also highlight the heterogeneity of investors' return expectations –additional evidence of an absence of definite conclusions – with 25% of investors having ethical motives, 22% with hedging objectives.

1.3 Lending standards

After lending prices, it is important to study lending volumes. Banks are in a position to adjust credit supply to changes in risks and expected rewards. Climate change-related factors could affect how banks perceive these risks and rewards.[6] Banks can in principle play a role in making investments in high polluting or other exposed sectors more expensive and can provide more (and/or cheaper) credit to potential green sectors. However, papers differ in terms of ability to effectively identify exposures to climate change-related risks at a granular level. Syndicated loans offer detailed information on the financing of large corporations, especially for large energy producing projects such as power plants. Loan registers provide detailed bank loan level data to assess transition risk for a broader set of exposures (Schubert, 2023), including SMEs. For assessing physical risk, where information is required at the granular plant level, bank level data are also used by some authors, but at the cost of a few identifying assumptions (Blickle et al., 2022). To address these issues, Pagliari (2023) focuses on so called territorial banks, which are more likely to lend to local firms. Territorial banks are considered less significant institutions,[7] but may be more concentrated and located in areas that are more prone to flooding and more susceptible to suffer from climate change-related shocks.

1.3.1 Banks' supply of credit / credit rationing to sectors affected by physical risk

In the area of physical risk, some papers concentrate on the effects of floods and natural disasters. No paper investigates the impact of drought and heat stress.

Meisenzahl (2023) uses supervisory data for the largest U.S. banks and finds that after 2015 banks significantly reduced lending to areas more impacted by floods and wildfires. A one standard deviation increase in climate risk reduces county-level balances in banks' portfolios by up to 4.7 percent in counties with large loan balances. However, the reductions are concentrated among borrowers and products with high credit risk, and low-risk borrowers received more funding even in heavily affected areas.

[6] Demand effects by corporates are discussed in section 2.2.

[7] Banks that are under indirect ECB supervision (i.e. supervised by national supervision authorities), which are smaller than the ones under direct ECB supervision.

Chavaz (2016) investigates the mortgage lending market's reaction to the 2005 hurricane season – the costliest natural disaster recorded in U.S. history, where together, Hurricanes Katrina, Rita, Wilma, and Dennis damaged 1.2 million housing units. The author studies changes in banks' mortgage lending in affected counties compared to elsewhere and before the shock – depending on their geographic diversification. It appears that the financial capacity channel (whereby local banks have a smaller financial capacity after the shock as they are less diversified) is dominated by the relative loan profitability channel (local banks have better technology or higher incentives to lend in affected areas). According to the paper, local banks increase the share of new mortgages and small business loans in affected areas, but, at the same time, sell more of the new mortgages in the secondary market.

A small part of the literature tries to link the effects of physical events to bank behavior. Gallagher and Hartley (2017) investigate the impact of flooding on household finance using Hurricane Katrina. Spikes in credit card borrowing and overall delinquency rates for the most flooded residents are modest in size and short-lived. Greater flooding results in larger reductions in total debt. Lower debt levels are driven by homeowners using flood insurance to repay their mortgages, instead of rebuilding. Mortgage reductions are larger in areas where reconstruction costs exceeded pre-Katrina home values and where mortgages were likely to be originated by nonlocal lenders.

Garbarino and Guin (2021) look at how lenders react after a flood event using U.K. data. As mentioned above in 1.1.1.2, they find that banks do not offset the change in valuation by adjusting interest rates or loan amounts.

One should stress, however, that extra lending post natural disasters may offset reluctance to lend to risky borrowers: Blickle et al. (2022) find that disasters increase the demand for loans; new loans after a natural disaster offset losses on loans on the books. Bos, Li, and Sanders (2022) examine how banks adjust their asset structure in response to changes in loan demand following natural disasters. The empirical analysis shows that U.S commercial banks increase real estate lending after disasters and sell government bonds to finance this credit surge driven by natural disasters.

1.3.2 Banks' supply of credit / credit rationing to energy-inefficient real estate or industries with high emissions (brown and black sectors)

Reghezza et al. (2022) find that, following the Paris Agreement, European banks reduced credit to polluting firms; the same is observed after the withdrawal of the United States from the Paris Agreement; lending by European banks to U.S. firms decreased. For U.S. banks, Jung, Santos and Seltzer (2023) document a downward trend in exposures to the riskiest industries, at least partially explained by a reduction in banks' funding to these industries. Using the estimated sectoral effects of climate transition policies from the general equilibrium models of Jorgenson et al. (2018), Chen, Goulder and Hafstead (2018), and NGFS (2022), the authors find that bank exposures appear overall manageable. The largest projected exposures of the average bank reach 9 percent under the NGFS disorderly transition scenario.

Takahashi and Shino (2023) argue that the levels of scope 1 and 3 emissions have a negative impact on lending for Japanese banks, but this was already visible before the Paris Agreement. They also show that banks with greater leverage and a lower return on assets are more likely to decrease loans to firms with high GHG emissions.

1.3.3 Banks supply of credit to green industries

Whereas only a few papers explicitly investigate the financing of green sectors, a slightly larger set of papers considers the issue of financing the transition to low-GHG emission economies, taking into account differences between advanced countries and developing countries.

1.3.3.1 Limited evidence on the financing of green sectors

Very few papers directly address the issue of financing green sectors.

As mentioned above in 1.1.2 for lending spreads, Chava (2014) provides seminal analysis about the impact of environmental concerns on loan availability in the syndicated loan market. Degryse et al. (2023) use international syndicated loans to investigate whether banks create obstacles to the transition given the legacy of brown loans. They actually show that it is not the case for green firms which receive a lower spread on loan volume when the lender consortium can also be classified as green, especially after the Paris Agreement.

Accetturo et al. (2022) measure the ability of banks to finance the green transition in Italy by estimating the likelihood of firms to start green projects conditional on bank lending. This leads eventually to a less risky bank portfolio. However, the approach raises the issue of the implications of such findings regarding the broader and more relevant issue of financing the transition.

1.3.3.2 Impact of commitment

The impact of bank commitments in favor of the transition is mixed.

Ehlers et al. (2022), writing on syndicated loans, conclude that self-identified green banks may lend less to high carbon emitters.

Kacperczyk and Peydró (2021) measure a cut in bank lending after banks' commitment to reduce GHGs, but no effect on brown firms' environmental score.

Mesonnier (2021) shows that lending to small and medium-sized enterprises across more or less carbon-intensive industries is unaffected by banks' commitment to green their portfolio.

1.3.3.4 Ability to finance the transition

Offering the proper funding for the energy and climate transition is a difficult issue to address empirically.

Mueller and Sfrappini (2022) show that European banks extend their exposure to "green" corporates after the Paris Agreement and this might turn out beneficial with a future environmental-friendly regulation. This is not the case for U.S. banks which appear to create an obstacle to the transition. Banks lend relatively more to firms that are likely to lose from future regulation. The authors find "no evidence that lending in the United States is directed to firms that have a higher likelihood of transition; moreover, low-capitalized banks exploit lending to this group of firms to boost profits". In contrast, for Europe, they conclude that "banks shift credit supply to European firms that consider themselves likely to benefit from future regulation; hence, banks' credit allocation seems to facilitate the transformation of the economy". Nevertheless, they also study the effect of banks' indirect exposure via their loan portfolios and find that "banks' exposure appears to be a hindering factor in Europe: larger exposures to brown sectors limit the transition".

Interestingly, Cohen et al. (2020) find that oil, gas, and energy firms are particularly important in the production of green assets, complicating questions about the funding of the low carbon economy.

1.3.3.5 Green washing or regulatory arbitrage

Regulatory arbitrage in response to climate change policy may take different forms.

Several studies point to the role of cross border lending and regulatory arbitrage in response to a tightening of the regulation: Benincasa, Kabas and Ongena (2021); Laeven and Popov (2023).

Captive banks belonging to car manufacturers may face wrong incentives in the face of a tightening of regulation on GHG emissions. Beyene et al. (2022) show that captive banks have stronger incentives to support the manufacturer's sales of high emission cars.

Gianetti et al. (2023), analyzing euro area banks, conclude that banks with extensive environmental disclosure lend more to brown borrowers. Furthermore, this is not offset by lending to green projects or financing the transition. However, banks are less likely to start new lending relationships

with brown companies. The divergence between green commitments and lending appears to be higher for low capitalized banks.

Box 2

Insurance markets and climate risk

A healthy insurance industry could play an important role in mitigating the impact of climate events on financial systems and economies globally; however, the natural response of insurers to growing physical risks from climate change is to reprice insurance coverage or reduce its availability, leading to larger insurance protection gaps. Financial sector supervisors are aware of this and have taken actions in at least two ways. One way is to help ensure that insurance companies manage climate risks well, to protect policy holders and support financial stability (see, for example, Cleary et al. (2019)). A second way is that insurance companies are sometimes included in the climate stress tests financial sector supervisors run to assess the impact of climate change-related risks on financial systems (see Box 3 on climate stress tests). One potentially important channel operating via insurance would be the increased risk of mortgages held by banks if residential and commercial properties, which serve as collateral, become less insurable against natural hazards. A second potentially important channel is the reduced availability of business continuity insurance. Growing insurance protection gaps in these two areas could threaten financial stability.

Insurance can mitigate the effect of climate related disasters

Climate physical risks can of course have a direct impact on economies and financial systems, and ECB (2023) argues that catastrophe insurance is a key tool to mitigate macroeconomic losses following extreme climate-related events, as it provides prompt funding for reconstruction and should incentivize risk reduction and adaptation. Rousová et al. (2023) suggest that if a large disaster of 1% of GDP hits a country, GDP growth declines by 0.24 percentage points in the quarter of impact. However, if 25% of the losses are insured, the GDP growth rate is estimated to only decline by around 0.15 percentage points. For unusually high shares of insured losses – e.g., a 75% insured share corresponding to the 90th percentile of the distribution – the empirical model even suggests an almost immediate (within quarter) rebound in GDP growth.

Climate change can make it more difficult to price insurance

Insurance only exists if the risks to be insured can be priced correctly and transferred to reinsurance companies and to the capital market. Charpentier (2007) argues that "[i]t is extremely difficult to insure in a changing environment". In his view, climate risk – and more specifically natural disasters – is a challenging issue for the insurance industry, since it involves the possibility of extremely large losses. He concludes that involving reinsurance markets and insurance linked securities seems one solution to avoid insolvency problems. But climate is changing fast, and if this uncertainty cannot be reduced, it might lead to challenges in the availability, pricing and affordability of insurance.

Some markets already see sharp increases in the price of home ownership insurance due to potential climate related hazards. Keys (2023) reports that while the average price of home insurance in the United States is $1,900, the price in New Orleans is $4,000 and the price in Miami $5,000 per year. If a price cannot be set, insurance coverage may be incomplete, possibly triggering non-linearities when the natural disasters go beyond initial basic coverage and governments do not step in. ECB (2023) documents a large insurance protection gap, especially in southern and Eastern Europe. Only about a quarter of climate-related catastrophe losses are currently insured in the European Union.

Oh et al. (2022) provide evidence that price regulation might cause a decoupling of insurance rates from the underlying risks. In the U.S. states where price regulations appear most restrictive, rates are least reflective of risks. In these high friction states, insurers are restricted in their ability to change rates in response to losses. As a result, rates have not adequately adjusted in response to growth in losses. To overcome these frictions, insurers cross-subsidize high friction states by raising rates in low friction states.

If climate change triggers an increase in the frequency of natural disasters, this can have significant impacts on insurance, potentially increasing the risk of insurance companies not being able to cover their liabilities. Gray (2021) argues that extreme weather has begun to diverge from historical records. Firms using models based on historical data have struggled to integrate new information about climate change and climate variability into their forecasts.

Hadzilacos et al. (2021) find that most insurance models assume events to be uncorrelated. If extreme events are correlated, expected maximum pay-outs might increase substantially. They find a positive correlation of 20–40%. Ntelekos et al. (2018) find that U.S. hurricanes tend to cluster. In a year when two or more Group 3 major hurricanes occur, they estimate that there is around a 50% chance that they will occur within two weeks of each other.

Insurance-linked securities provide a protection against natural disasters

Insurance-linked bonds are paid if an event occurs. Polacek (2018) discusses CAT bonds. Catastrophe (CAT) bonds have been provided since 1997. Unlike traditional insurance, CAT bonds are 100% collateralized. CAT bonds are also structured to eliminate counterparty risk. CAT bonds have an appeal to investors as their returns are largely uncorrelated with the returns of other financial market instruments. In the past, CAT bonds have provided strong returns. This has helped attract alternative sources of capital into insurance markets.

Insurance-linked bonds can also be used as protection against negative weather events. Such bonds will normally be index-based. A literature study by Kraehnert et al. (2021) finds that the CAT bond market has become a vital pillar of the risk management of insurers. Weather derivatives, on the other hand, still seem to be a niche product outside the United States. One challenge with insurance-linked securities is that there are economies of scale and therefore easier for larger companies to use these tools than for smaller ones. With risk-based premiums one needs to monitor the potential unaffordability of insurance. This will especially be the case if the less affluent tend to locate in high-risk areas.

Index-based insurance might be a solution for the agricultural sector, but so far uptake is low

Index-based insurance has been used to protect farmers against negative outcomes. With index-based insurance pay-outs depend on an index that strongly correlates with losses in income or assets. Kraehnert et al. (2021) argue that index insurance especially can welfare-enhancing effects in developing countries. However, uptake rates so far remain low despite the use of subsidies through vouchers or premium reductions. One reason for the low uptake might be low levels of trust in the insurance provider. Individuals might also have difficulties assessing the probability that a natural disaster will strike and therefore have problems understanding when the index-based insurance will be triggered.

Citino et al. (2021), looking at agricultural insurance in Italy, also document a low uptake of insurance. They find that adverse selection and choice frictions render price mechanisms like subsidies less effective. Instead, one should consider mandates to assure a greater insurance coverage.

Low uptake of flood insurance

Kraehnert et al. (2021) find that in markets with voluntary flood insurance uptake is low, typically below 50%. Low-probability, high-impact events are often underestimated by economic agents. Large-scale information campaigns on flood risks and insurance possibilities have been ineffective so far. Another issue is moral hazard, as individuals might expect government relief in response to a large amount of uninsured losses. This might help explain the finding of Kousky et al. (2020a) that most households are uninsured or underinsured against floods, despite flooding being the most frequent and costliest natural disaster in the United States. Of course, any expectation on the part of households that government agencies will provide sufficient post-flood assistance could be, in the event, incorrect.

In the Netherlands flood insurance is not even available, as the government is responsible for providing flood relief. Botzen and Van den Bergh (2008) examine existing risk-sharing arrangements and the possible role of private insurance in some detail. They argue that private insurance has a role in spreading risk and raising incentives to reduce economic losses.

Mandatory insurance coverage schemes

Public-private initiatives can be used to increase insurance coverage against natural disasters. European Central Bank (2023) suggests that public-private partnerships (PPPs) and ex ante public backstops can be suitable safeguards and give incentives to promote risk mitigation. This might be necessary to ensure broad insurance coverage. Gray (2021) points out that how to incorporate knowledge about climate impacts into routine economic processes, such as insurance pricing, can trigger broader political disputes about how these risks should be socially distributed.

There is a trade-off between actuarial fairness and social solidarity in public–private mixed insurance schemes. Mandatory schemes reflect the principle that natural disasters are hard to predict and therefore offer wide coverage for moderate premiums to all. Owen and Noy (2019) look at payments after an earthquake in New Zealand and find that payments from the system are highly regressive. They find that the poor are subsidizing the rich. They suggest a simple shift from effectively flat premiums to a set percentage of the total private sum insured. Charpentier et al. (2021) look at the French system for flood insurance. Historically, the system was meant to give protection to the worst off. However, experience accumulated over past decades now makes it possible to assess physical risks that previously were not well understood. Flood losses, long considered uninsurable, is one example. In the current situation well-off properties might be the main beneficiaries of the natural disaster compensation scheme.

Part 2: Sector-specific channels of transmission

2.1 Climate impact on the pricing of property

We now consider the issue of the impact of climate change on real estate prices. Property is the most important source of collateral in the banking system. Buildings are also a major source for energy use, and they are highly vulnerable to many of the consequences of climate change – like increased risk of flooding, rising sea levels and more frequent extreme weather events. Property exposed to climate risk can be a major contributor to volatility in the financial system. At the same time, many of the risks are to some extent foreseeable, and with proper risk assessment banks can reduce exposure to climate risk significantly.

The transmission to banks obviously depends on the nature of the loan contract (whether it is a recourse or a non-recourse loan), which depends on the jurisdiction, but to our knowledge this dimension has so far not been fully investigated. It also depends on the existence of insurance guarantees (see Box 2).

A large literature has evolved on how climate related effects might affect property. The literature looks at possible price effects, with implications for collateral values. It also looks at how credit quality is related to exposure to different climate related issues. We will first discuss the substantial literature on physical risk and then look at the smaller literature on transition risk, especially related to energy efficiency.

2.1.1 Effects of physical risks

Property is directly exposed to acute physical risk associated with climate change. A fall in collateral values can affect banks both directly through increased losses and indirectly through less market growth or higher financing costs due to lower collateral values.

Acute physical risks are hazards that can become more frequent with rising global temperatures. The most common examples are rising maximum tide levels due to sea level rise (SLR), higher probability of floods due to periods with extreme rainfall and higher exposure to forest fires due to periods with heat waves and drought. In addition, some regions might see a higher frequency of storms.

In OECD countries, many such risks tend to be well known and mapped by authorities. It is possible to identify if a building is in a risk zone or not. However, the awareness of this information has been slow to disseminate in some regions. So far, most papers have investigated the effect of flood risk and rising sea levels, as these are the risks best documented. Some event studies look at the effect of hurricanes and storms.

The countries most exposed to acute physical risks are probably outside the OECD. These countries tend to have less resources to prevent damage or to map potential risk zones. However, with a few exceptions the papers reviewed only cover industrialized countries.

2.1.1.1 Price effects of exposure to flood risk

A large literature has evolved on the question of price effects for property exposed to flood risk and SLR. Flood risk can either arise because the building is on a flood plain or at the coast and exposed to higher probability of water damage with rising sea levels. The results are summarized in Figure 4.

Many papers find that properties in potential flood areas sell at a discount. Baldauf et al. (2020) and Bernstein et al. (2019) find that "homes exposed to SLR sell for approximately 7% less than observably equivalent unexposed properties equidistant from the beach". Keys and Mulder (2020) find that for exposed properties in Florida transaction volumes declined 16–20% from 2018–2020 while prices declined 5%. Mirone and Poeschel (2021), looking at Demark, find that properties with expected future flood risk sell at a 3–4% discount. The discount for flood risk tends to increase after flooding events. Fuerst and Warren-Myers (2021) find a discount between 1 and 3% for properties and between 2 and 5% discount in land value in a flood risk area identified through the statutory authority planning overlays, looking at floodplains and SLR from Melbourne, Australia. Reeken and Phlippen (2022) find a more modest negative price effect of 2.5% in the Netherlands, but the paper notes a number of methodological issues identifying comparable properties. Giglio et al. (2021a) argue that flooded areas may indeed benefit from a premium, due to various amenities.

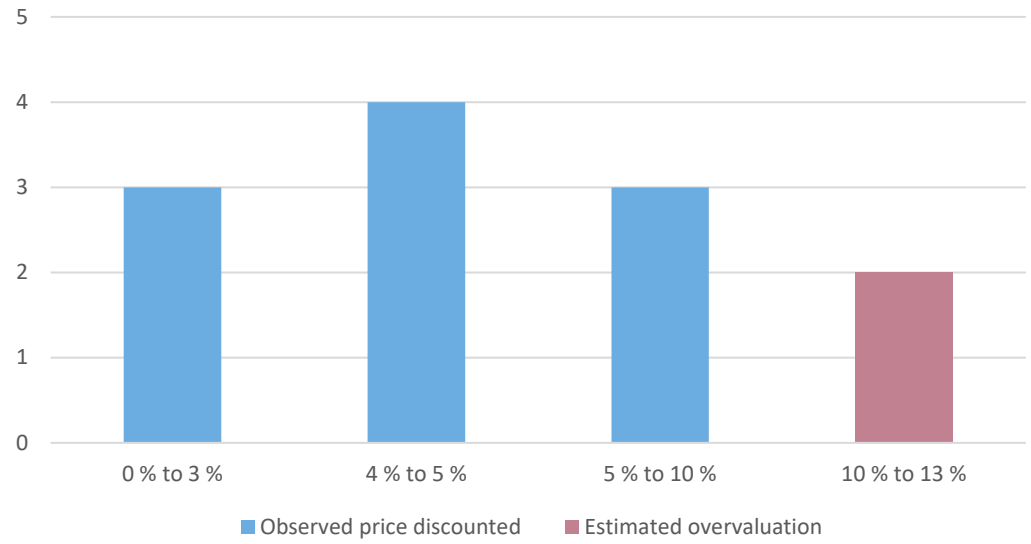
Beltrán et al. (2018), in a meta-analysis, find that "for inland flooding the price discount associated with location in the 100-year floodplain is -4.6% in the United States". Hino and Burke (2020) estimate that full pricing of presence in a floodplain in the United States should reduce property values by 5.1% to 10.7%. Garbarino and Guin (2021) look at how lenders react after a flood event, using U.K. data. Properties in flooded areas decrease in selling price between 2.6 and 4.2%.

It should be noted that some papers also find smaller effects. Murfin and Spiegel (2020) find no price effect. They put forward two plausible interpretations of this finding. One is that home buyers have a limited understanding of relative SLR risk. The other is that homebuyers have sophisticated expectations of relative SLR risk but believe mitigation efforts will be largely successful. Bakkensen and Barrage (2021) find that prices are not always adjusted for risk and argue that that coastal prices in Rhode Island exceed fundamentals by 6–13%.

Estimated discount or overvaluation of house prices in high flood risk area

12 studies

Figure 4



Source: authors' calculations, based on the review of 9 papers in the academic literature, number of studies (vertical axis) providing an estimate of the impact of exposure to flood risk for property valuation. Studies finding an observed price discount in blue, studies indicating an estimated overvaluation due to lack of valuation of flood risk in red. Studies included: Bakkensen and Barrage (2021), Baldauf et al. (2020), Beltrán et al. (2018), Bernstein et al. (2019), Fuerst and Warren-Myers (2021), Garbarino and Guin (2021), Giglio et al. (2021a), Hino and Burke (2020), Keys and Mulder (2020), Mirone and Poeschel (2021), Murfin and Spiegel (2020), Reeken and Phlippen (2022).

2.1.1.2 Perception and information is important for price impact

Many papers note that perceptions of risk can differ across locations, and that this can have a major impact on the price effect. Keys and Mulder (2020) find that sellers remain optimistic about the value of exposed property, while buyers are more and more suspicious. As a result, as is typical in case of adverse selection, volumes fall before prices begin to fall. Bakkensen and Barrage (2021) argue that belief heterogeneity can reconcile prior mixed evidence on flood risk capitalization. Bernstein et al. (2019) find that the discount has grown over time and is driven by sophisticated buyers and communities worried about global warming.

Information dissemination is also important. Baldauf et al. (2020), as well as Hino and Burke (2020), find that "the price penalty for flood risk is larger for commercial buyers and in states where sellers must disclose information about flood risk to potential buyers". This suggests that policies to improve risk communication could influence market outcomes.

Gourevich et al. (2023) present a broad study of flood risk across the United States. They argue that there is a "housing bubble by unpriced flood risk". Overpriced properties are concentrated along the coast, in areas with no flood risk disclosure laws and less concern about climate change. Overvaluation is especially widespread among low-income households. They estimate that U.S. residential properties are overvalued between USD 121–USD 237 billion, depending on the choice of discount rate (hence an average overvaluation of 0.5%, according to estimates based on data from the real estate company Zillow; total US residential value in 2021 was around USD 36.2 trillion).

2.1.1.3 Price effects of natural disasters

Another strand of the literature looks at how property prices are affected by natural disasters. While flood risk is a potentially recurring event, a natural disaster could be interpreted as a one off.

Often houses are built back better, making comparison of prices before and after difficult. Instead, the risk of future disasters might affect demography and housing supply. Zivin et al. (2020), using a detailed data set with housing characteristics from Florida, find that usually supply falls after a hurricane, but demand seems unaffected. This induces an increase in equilibrium prices and a decrease in transactions in affected areas, both lasting up to three years. The authors control for property characteristics, seasonality and differential economic growth across counties. As a result, incoming homebuyers during recovery have higher income, conditional on the characteristics of transacted homes, resulting in an enduring increase in the distribution of income.

Similarly, Apergis (2020), in a study that covers 117 countries from 2000–2018, finds floods cause an immediate fall in prices, but prices recover as repairs are completed. Only when floods occur very frequently do they find a permanent impact on prices, as there is no time to conduct full repairs. In a similar pattern, Kivedal (2023) uses payments from the Norwegian natural disaster insurance pool to identify exposed properties. The paper finds a positive effect in the short run for flood surges and damages related to extreme weather, indicating creative destruction in that homes are rebuilt with a higher quality than previously.

Clayton et al. (2021), survey the literature on effects on commercial real estate (CRE). The drop in prices after climate events has been modest and short-lived in locations that historically have been most exposed to extreme weather events like flooding and hurricanes. In such areas climate risk might already be capitalized into property values. However, some recent evidence finds that an increase in the frequency of climate related risks can lead to a long-lasting decline in CRE prices or reduce market liquidity. It can be reasonable to see this as a correction to previous under-acceptance or under-awareness of risk.

Rodríguez et al. (2023) look at a special case of ecological deterioration. A beach area in Spain located at a saltwater lagoon has since 2015 been struck by increased algal bloom. The authors find that in the 6 years after 2015 return on housing in the affected area was 43 percent lower than in similar neighborhoods outside the affected lagoon, indicating that environmental degradation can have large effect on housing value.

Non-climate related events can have a larger effect than climate-related events. Apergis (2020) highlights that geological disasters exert the strongest (negative) impact on house prices. Kivedal (2023) finds evidence of a negative effect on house prices from natural disasters at a longer horizon.

2.1.1.4 Investment in climate risk adaptation

The potential cost of future flooding raises the question of the social cost of adaptation. Hovekamp and Wagner (2023) look at the possibility of elevating houses as a private defense against flooding. Undertaking adaptation is socially optimal in the highest risk areas over a house's lifetime, but individual homeowners may underinvest in flood protection because the benefits do not accrue over their average tenure. The wedge between the perceived private benefits and the social value of adaptation is exacerbated by any undervaluation of flood protection while living on the coast, and the full benefits of adaptation also are not internalized by homeowners purchasing better than actuarially fair public flood insurance. The results underline the importance of public standards for new construction to ensure that minimum elevation standards are met in order to encourage efficient outcomes in areas at high risk of catastrophic flooding.

Benetton et al. (2022) look at the sea wall constructed around Venice to provide new evidence on the capitalization of infrastructure investment in climate change adaptation into housing values. They exploit the quasi-experimental temporal discontinuity in the exposure to sea floods from the first

activation of the sea wall. They find that the sea wall increased house prices by 3% for properties above the sea wall activation threshold and by an additional 7% for ground-floor properties. Overall, one year after its inception, the sea wall generated an estimated 4.5% increase in the value of the total residential housing stock in Venice, which is a lower bound of the total welfare gains potentially generated by this infrastructure.

Giglio et al. (2021a) look at the housing market to determine appropriate discount rates for valuing investments in climate change abatements. The paper seeks to identify a term structure of discount rates for real estate over a horizon of hundreds of years – the horizon most relevant for investments in climate change abatements. Looking at data from the U.S. East Coast, they identify climate risk by linking geo-code addresses to identify properties that will be flooded with a six feet increase in sea levels. They find that if real estate is affected by climate risk the real estates' term structure of discount rates is downward sloping and reaches 2.6% for payoffs beyond 100 years.

Clayton et al. (2021) find that good governance and public investments might abate negative price effects and help explain the modest and short-term nature of price reductions. On the other side, lack of governance or proactive investment may be harming prices. There is some evidence that investors put higher risk premiums on properties in areas exposed to negative climate events. This is regardless of whether their individual properties have been directly affected. This might even extend to areas with similar climate risk profiles, where events have yet to occur. On the other hand, there is so far little evidence that owners' investment in resilience improves financial performance or insurance pricing on the asset level.

2.1.2 Transition risk to property prices

Building accounts for about 40% of Europe's total energy consumption (Zancanella et al., 2018). Heating of homes made up over 60% of households' total energy use in the European Union in 2020 (Eurostat, 2022).[8] Median housing-related energy costs accounted for 7.2% of a household's weekly expenditure in Great Britain (Griffiths et al., 2015). Changing the sources of energy and making energy use in properties more efficient, will be a major factor in the transition to a low carbon society. Energy transition might increase energy prices. New requirements for energy efficiency will make it obligatory with investments today but can reduce expected energy costs in the long run.

With more volatile energy prices, energy costs can become a major risk factor for both households and commercial businesses. It is becoming increasingly clear that energy efficiency can reduce the risks associated with a property investment. This is motivating increasing action by financial regulators and governments to require banks to incorporate these factors into risk management and pricing decisions.

For banks and other financial institutions, energy efficiency might be an indicator of lower financial risk since the property has lower costs and a lower exposure to volatile energy prices. This should be reflected in lending requirements.

Beyond the effects identified above of lending spreads on transition sensitive real estate assets (see 1.1.2), energy-saving improvements have a direct price impact. Zancanella et al. (2018), doing a broad literature review, find that residential assets tend to increase by 3–8% in price because of energy efficiency improvements. For commercial buildings the premium seems higher, over 10% and in some studies even over 20%. Rental prices of commercial real estate tend to increase by 2–5%. On the other hand, Ferentinos et al. (2023) conclude that the implementation of the Minimum Energy Efficiency Standard (MEES) that fined landlords in England and Wales if their rented properties did not meet minimum efficiency standard, was rapidly incorporated into a lower price on affected houses and flats. However, the study suffers only

[8] See Eurostat: Energy consumption in households - Statistics Explained (europa.eu).

provides a lower bound of the effect so that it is not possible to know the full extent of the decline in house prices.

2.2 Climate impact on non-financial firms

Businesses face increasing regulatory and economic pressure to address their operational exposure to physical and transition risk. This demand and their responses could affect their financial health and quality as borrowers, their demand for credit, and their behavior as depositors. Therefore, the magnitude of potential repercussions of physical hazards and regulatory shocks for borrowing firms is important to understand from the perspective of banks and financial institutions.

2.2.1 Physical risk

When it comes to physical risks, many studies examine damages from the perspective of equity holders as residual claimants. A common challenge for this type of research is the requirement of granular information on firm locations. However, for competitive reasons and complicated production processes, firms face incentives to keep their information on establishment locations private. Further, it is difficult to measure indirect impacts on firms through their supplier networks in a world of limited supply-chain transparency. For these reasons, existing studies estimate the effects of climate change-related hazards across a subset of the universe of firm locations.

The literature on firms and physical risk is most developed related to temperatures. Somanathan et al. (2021) study the effect of heat on the productivity of Indian firms. They find a sizeable negative effect of heat on worker productivity as well as an increase in absenteeism. The estimates decrease with climate control availability. In support of the importance of the labor channel in explaining the destructive effects of heat, the authors find that that the estimates are large enough to explain observed cross-country output losses. Related to this study, Li et al. (2016) find that export quantities of firms in China decrease with heat, and Zhang et al. (2018) document that heat reduces the productivity of Chinese establishments. For firms in the Ivory Coast, Traore and Foltz (2017) also find a negative link between heat and measures of firm performance. In an international sample of over 90 firms, but excluding the United States, Pankratz et al. (2019) find that hot days reduce revenues and operating income, with a one-standard-deviation increase in the number of hot days decreasing operating income by 1.8% of the average quarterly value. In contrast, Addoum et al. (2020) find no effects of abnormally high or low temperatures on establishment sales in the United States, apart from a positive impact of low temperature on sales in the energy sector. Hong et al. (2019) study droughts and document decreases in the profitability of firms in the food sector. Apart from heat, Kruttli et al. (2021) study the effects of hurricanes and show that stock options on firms in the landfall region show increases in implied volatility of 5–10%. Floods and storms have been implicitly studied using aggregate data on natural disasters.

Despite the data limitations outlined above, a few papers investigate firms' indirect exposure to climate change-related hazards through supply chains. For example, Barrot and Sauvagnat (2016) find that natural disasters at supplier locations in the United States impose substantial output losses on their customers. The effects are pronounced when suppliers provide specific inputs. Pankratz and Schiller (2019) study how heat and floods affect firms' financial performance and operational risk management in global supply chains. They find that adverse weather at supplier locations reduced both the operating performance of the directly affected suppliers and their remotely located customers. In addition, they document that customers respond to increases in the exposure of their suppliers and are more likely to terminate existing supplier relationships when the realized number of heat or flood days exceeds ex ante expectations.

The documented effects on firms are economically relevant from the perspective of equity holders. Lenders and bondholders, in contrast, may be less concerned about residual changes in firm value due to their short investment horizon and liquidity preference. Potentially, shocks of moderate severity

could magnify and affect operations and creditworthiness if increasing frequencies limit companies' access to insurance. However, the evidence on the effect of physical risks on firms' probability of default so far is limited. As one exception, Xie (2017) finds that the exposure to heat may not only affect firm performance but also the survival probability of firms in Indonesia.

Besides default risk, decreases in productivity and increases in uncertainty could affect firms' demand for credit and volume of deposits. Related to the demand for bank credit, Ginglinger and Moreau (2019) find that firms decrease their leverage when they face increased physical risk, which may be a sign of lower loan demand.

When it comes to deposits, the existing evidence points in different directions. On the one hand, the repercussions for firm performance documented by the aforementioned studies could thin out firms' cash buffers and bank deposits. On the other hand, firms may respond to actual or perceived uncertainty by increasing cash. For instance, Dessaint and Matray (2017) show that corporate managers increase cash holdings when firms in neighboring countries are hit by hurricanes.

2.2.2 Transition risk

In addition to physical risk, regulatory pressure and transition risk could affect firms' financial health, demand for credit, and deposits. Recent studies examine the effects of climate policy on stock prices and returns. For instance, Meng (2017) studies the failed attempt to pass a cap-and-trade climate policy in the U.S. Senate and finds significant differences in the stock price reactions of affected and exempted firms. Bartram et al. (2022) use a diff-in-diff analysis to document that financially constraints firms shift emissions in other states following implementation of the Californian cap-and-trade system. Li et al. (2020) conduct a textual analysis and find that firms facing high transition risk are valued at a discount. Ramelli, Ossola, and Rancan (2021) document decreases in the stock prices of carbon-intensive firms around the first global climate strike of 2015. They argue that the strike marked a turning point in climate activism and find that the unanticipated success is also linked to analyst downgrades of firms' long-term earnings projections. Further, public attention to climate activism appears to be a plausible driving channel of these effects. Ramelli, Wagner, Zeckhauser, and Ziegler (2021) show that stock prices move with expectations related to climate policy around the U.S. 2016 and 2020 Presidential elections. Ochoa et al. (2022) study carbon taxes in Germany and find that the value of firms with low carbon emissions increases compared to high carbon counterfactuals. Whereas these studies point to the sensitivity of equity markets to transition risks, the potential consequences for default frequencies and losses given default are studied less frequently.

Related to questions about the demand for credit from corporate borrowers in response to climate policy and uncertainty, recent work suggests that affected borrowers may shift from public to private sources of financing. Beyene et al. (2021) find that bond markets price the risk in fossil fuel firms, whereas syndicated loan markets do not appear to respond. In line with this gap, they find evidence that fossil fuel firms increasingly rely on syndicated loans instead of bonds.

Like the effects of physical risks, the uncertainty created by transition risks could affect the preferences of non-financial firms for holding cash. While international evidence is scarce, two studies point in this direction in China: Wu, Shih, Wang and Zhong (2023) document that carbon-intensive firms increase cash holdings after the adoption of the Paris Agreement. Further, Yuan and Gao (2022) find that firms increase their cash holdings with the enforcement of green credit guidelines.

2.3 Climate impact on government bonds

Understanding the extent to which climate risk is priced into government bonds (including those issued by central governments and local governments) is important to assess banks' exposure to climate risk. This is because government bonds often account for a non-negligible share in banks' holdings of securities.

Climate risks, both physical and transition risks, can affect sovereign risk mainly through the following three channels (Volz et al., 2020; and Zenios, 2021).

Fiscal channel: climate risk is likely to increase governments' debt burden. For physical risk, natural disasters may damage government assets and public infrastructures, increasing public expenditure. Also, natural disasters are likely to disrupt economic activity, lowering tax income and other public revenues and increasing social transfer payments. As regards transition risk, adaptation and mitigation policies in response to the challenges that climate change poses require large government investments.[9] In addition governments may lose the tax revenues from oil consumption, if the economy decarbonizes.

Macroeconomic channel: climate risk, especially physical risk, is likely to adversely affect both supply and demand sides of the economy. Extreme weather events and global warming may reduce supply by damaging the capital stock and reducing investment and consumption by weakening balance sheets of corporates and households.[10]

Financial stability channel: climate risk would decrease financial stability. Both physical and transition risks would manifest as credit risk for banks, reduce insurers' margins due to higher insurance claims and trigger repricing of certain, especially "stranded", assets.

Several studies look into the pricing of climate risk in government bond yields. Their findings generally suggest that higher climate risk comes with more expensive borrowing costs for governments. A few papers focus on physical risks. Mallucci (2020) finds that extreme weather restricts a country's access to financial markets. While a clause that allows governments to suspend payments when extreme weather hits can allow governments to borrow more, spreads increase 40% to compensate investors for the risk that governments activate the disaster clause (based on Caribbean countries' data). Bowman et al. (2022) propose an approach to assess climate change's impact on sovereign bonds with outputs from climate models reviewed by the Intergovernmental Panel for Climate Change. Then, they consider their economic impacts from the literature and use those as overlays in a pricing model for sovereign bonds. Their estimates suggest that, under the RCP 4.5 mean scenario, the impact on G20 countries' sovereign spreads ranges from close to 0 to 20 basis points, with a bigger impact on poorer countries. Goldsmith-Pinkham (2021) and Acharya et al. (2022) examine how physical risks affect U.S. municipal bonds (see 1.1.1). Cevik and Jalles (2020)'s estimates suggest a 233 bp spread between the top and bottom quantile of countries ranked by climate vulnerability. The economic and statistical significance of these effects are much greater in developing countries with weaker capacity to adapt to, and mitigate the consequences of, climate change. Beirne et al. (2021) find that the premium on sovereign bond yields due to climate risk amounts to around 113 basis points for EMEs overall. In contrast, exposure to climate risk is not statistically significant for advanced economies overall.

Part 3: Aggregate and macro-economic effects

To assess the impact of climate related shocks on banks, it is also important to consider the overall effects on individual banks, the aggregate effect on the whole banking system, with possible spillovers across banks, as well as the macroeconomic environment, together with feedback effects (see also European Systemic Risk Board, 2021 and 2022).

[9] That said, a low-carbon transition can also have some positive impacts on fiscal space. For example, the transition could generate significant public savings from phasing out fossil fuel subsidies. For another example, governments could generate substantial revenue from carbon taxes.

[10] In the long run, gradual global warming and transition policies have important implications for growth potential by causing fundamental and enduring structural changes to the economy.

Note that the review does not cover the aggregate effect on banks in the case a climate event comes through the liquidity channel. Acharya et al. (2023), reviewing the literature, find some papers that document that climate events can cause deposit withdrawals as well as increased demand for loans. See in particular Brei et al. (2019). However, compared to other channels, they argue that the liquidity risk channel of climate risk has been relatively understudied. Further, they find no paper that has studied the effect of transition climate risk on banks through the liquidity risk channel.

3.1. Aggregate effect on banks

Beyond the effect of climate change on individual portfolios and specific risk, it is important to get a comprehensive view of the overall effect of these different channels on the situation of banks and notably on their profitability. From that perspective, Pagliari (2023) focuses on flood risks and exploits the peculiarities of business models for small European banks to proxy for the location of the banks' counterparties. She finds that "ROA has been on average lower at banks located in areas that have been historically subjected to severe flooding events". This is partially due to what she identifies as the "core lending channel of transmission", whereby flood risks can hinder banks' profitability via the decrease in lending to households and non-financial companies. Similarly, Schubert (2023) finds that, in the cross-section of stock returns, small banks with high exposure to flood risk underperform other banks, on average, by up to 8.7% per year. Blickle et al. (2022), on the other hand, find that FEMA disasters over the last twenty-five years had insignificant or small effects on U.S. banks' performance. They highlight that disasters increase loan demand, which offsets losses and boosts profits over the medium run at larger (multi-county) banks. This is consistent with Cortés and Strahan (2017) who show that banks reallocate credit from less exposed to more exposed areas.

3.2 Effects on the overall banking system, in particular through the lens of stress tests

The second dimension is the effect of climate change on the banking system as a whole, as opposed to individual banks, and how it interacts with macroeconomic developments.

Bottom-up stress tests provide information on the aggregate effects of climate change-related shocks. There is also limited evidence for non-linearities at the aggregate level. However, research is active to assess second-round effects.

3.2.1 Bottom-up stress tests

The results of climate change-related stress tests run by banks on the basis of scenarios provided by supervisors indicate that the risks are significant, but banks have the capabilities to withstand the shock. For the euro area, the European Central Bank (2022) conducted a constrained bottom-up climate risk stress test in 2022. Based on modified NGFS scenarios, banks assessed the impact of transition and physical risks on corporate exposures and exposures secured by real estate. The results showed that banks are to a varying degree exposed to the materialization of physical risks. Taking the impact of physical and transition risks together, the projections of 41 banks indicate a loss of around 70 bn EUR for the analyzed scenarios. These additional provisions correspond to around one third of the total exposure of participating banks and the amount is highly likely to underestimate the impact of climate risk due to numerous additional reasons, e.g., moderate scenarios compared to conventional stress scenarios and data and modeling techniques that are at a preliminary stage. (See Box 3 on climate stress tests for a discussion of some of the challenges facing climate stress tests and also some of the limitations of the exercises.)

3.2.2 There is limited evidence of non-linearities at the aggregate level

There is currently only limited information regarding possible non-linearities (as well as contagion effects discussed in the next section). But it is very likely that we underestimate the risk.

Danielsson (2020), looking at Swedish data, finds that the number of coastal homes below 2 meters above sea level is small. This can be interpreted as showing that the risk of flooding was considered when the housing was built. The low number of homes on these low levels may thus partly be due to the risk of flooding being high if a house is too close to sea level; it is safer to build houses at a higher point above sea level. The rapid increase in the number of owner-occupied and tenant-owned homes at 2–3 meters above sea level also means that, should the sea level rise much, even more housing will be exposed to the risk of flooding, as significantly more housing is situated 2.5–3 meters above present sea level than at levels of up to 2 meters.

Caloia and Jansen (2021) do a reverse stress test of how a flooding event in the Netherlands might affect Dutch banks. They find that the Dutch banking system is well capitalized to withstand floods in unprotected areas, with little real estate, as this will have a negligible effect on banks' capital. However, a major flooding event affecting densely populated areas might have a significant effect on bank capital. They estimate that a major flooding event might cause a 10% fall in GDP, and a possible impact of up to 700 basis points on bank capital. It should be noted that these scenarios are very much in the tail of the distribution. However, the study shows that the cost of not mitigating climate change in an effective manner can potentially be very costly.

In addition, the existence of "tipping points" with the breach of biophysical thresholds (like the loss of the Greenland ice sheet), with irreversible effects on climate change, would have considerable effects on the overall banking system. As described by Bolton et al. (2020), "green swan" events may trigger non-linearities and have far reaching consequences on banks, including profitability and charter value. A new emerging literature considers the increasing likelihood of the simultaneous breach of several tipping points.

3.2.3 Research is active to assess second-round effects of climate change-related shocks

There is a substantial literature on the existence of second-round effects of climate change-related shocks, in particular from the stress testing literature, as the financial system may amplify initial climate shocks, notably through uncertainty channels.

Battiston et al. (2017) show in their climate stress test for the 50 largest EU banks that second-round effects can be of comparable magnitude to first-round effects. In their analysis, second-round effects are in particular the consequences of fire sales, triggering a fall in asset prices, which affects the value of the portfolio of banks, leading to an even larger sell-off. De facto, some analyzed banks only experienced second-round losses and only marginal first-round losses.

Even if they do not focus on climate change, Ahnert and Georg (2018) find that, when banks are subject to common exposure, information contagion increases systemic risk. Aldasoro et al. (2017), studying a network model of the interbank market, show that contagion occurs through interbank interlinkages, fire sales and liquidity hoarding. Extending such analysis to climate change-related shocks is a relevant issue for future research.

Indeed, the exposure to common asset classes of different market participants, interdependencies among financial institutions, and potential fire-sale dynamics could amplify the impact of climate risks on banks.

For instance, Roncoroni et al. (2021a) study how the structure of a financial network and market conditions affect financial stability in the European banking system. They detect two channels of financial contagion: i) *direct interconnectedness*, via a network of interbank loans, bank loans to non-financial corporates and retail clients, and security holdings; and ii) *indirect interconnectedness*, via overlapping

exposures to common asset classes. They uncover a strongly *nonlinear* relationship between diversification of exposures (distinguishing whether it takes place vis-à-vis the real or the financial sector[11]), shock size, and losses due to interbank contagion. They also demonstrate the potential for contagion effects to amplify first-round stress test results due to interconnectedness.

Roncoroni et al. (2021b) analyze the effects on financial stability of the interplay between climate transition risk and market conditions. To this end, they extend in a novel way the framework of the climate stress test of the financial system by including an ex ante network valuation of financial assets (that accounts for asset price volatility as well as for endogenous recovery rate on interbank assets). Moreover, as in the previous paper, they consider the dynamics of indirect contagion of banks and investment funds, which are key players in the low carbon transition, via exposures to the same asset classes. More precisely, the methodology combines the estimation of losses arising both from interbank distress contagion, as well as from common asset exposures.

In other words, they identify conditions under which total losses of the financial system are large, even if the direct exposure to shocks is small. They also show that the combination of distress contagion and common exposure contagion gives rises to losses that are larger than the sum of individual contributions. This result naturally reminds us of the distinctive features of climate change risks. Indeed, physical and transition risks may trigger complex, non-linear chain-reaction effects with associated tipping points and irreversible impacts (see Bolton et al. (2020) for further details).

- Jourde and Moreau (2023) propose a market-based framework to study systemic climate risks in the financial sector. More precisely, they propose a test procedure to assess whether climate risks can exacerbate contagion effects among financial institutions, which is a key element to assess the level of systemic risk in the financial sector (e.g., Billio et al. (2012)). More precisely, the proposed procedure is based on the following steps:
- First, using a GARCH model, they estimate time-varying Value-at-Risk (VaR) from the stock returns of financial institutions of interest. Then, from the estimated correlation matrix of those individual measures of tail risk (relevant for financial stability), they extract the first principal component, namely an indicator of systemic tail risk dependence within the financial sector.
- Second, they construct climate risk factors, distinguishing between transition and physical risks, and they estimate associated VaR measures.
- Third, building upon the previous steps, they propose a two-pass regression procedure to assess whether climate risks can exacerbate tail risk dependence among financial institutions. First, they run a time-series regression to verify if an increase in climate risks is associated with a contemporaneous increase in downside risk within the financial sector. Then, they perform a cross-sectional regression to test if the financial institutions most exposed to climate risks have stronger tail dependence with the rest of the financial sector.
- Fourth, they investigate the characteristics of the financial institutions that correlate with individual climate risk exposure.

They apply their framework to large European financial institutions, observed between 2005 and 2022, and show that: i) exposure to transition risk has increased since 2015, mainly for banks and life and non-life insurance companies; and ii) unlike physical risk, transition risk can exacerbate tail dependence among financial institutions and, thus, significantly influence systemic risk.

In other words, there is a clear need to integrate the contributions of second-round effects of the initial climate change-like shock induced by the contagion channels characterizing a banking system. Belloni, Kuik, and Mingarelli (2022) assess the effects of changes in carbon prices on the European banking

[11] In their analysis, diversification within the financial sector is less likely to reduce systemic risk.

system by means of four contagion channels (real economy credit risk, interbank credit risk, liquidity risk, and market risk). They find that the European banking system may be facing substantial risks only in cases of high and abrupt changes in carbon prices, if emissions are unchanged. The paper also finds that large increases in carbon prices might still entail tail risks for the banking system if firms reduce emissions only slightly.

Box 3

Issues raised by evidence from stress tests

Financial sector supervisors are aware that there is the possibility that financial institutions will underestimate risks from climate change and that this poses a threat to financial stability. To date, the main response of financial sector supervisors has been the development of stress tests for climate change for macroprudential and microprudential purposes (see, e. g. Vermeulen et al, 2021, for a top-down transition stress test for the Netherlands). These exercises are different from traditional stress tests in a number of ways. Baudino and Svoronos (2021) discuss the main features of several early stress tests for climate change, which are also shared by more recent climate stress tests. It is recognized that climate stress tests are in a very early stage of development. Nevertheless, novel approaches to assess climate risk in stress tests are developed continuously. In particular, Jung, Engle and Berner (2023) compute banks' expected shortfall or CRISK, similar to Brownlees and Engle's (2017) SRISK. Such a market-based approach allows one to analyze large global banks' vulnerability, measuring the impact of disorderly stress scenarios, including a stranded asset factor (*). There is thus considerable uncertainty about the outcomes of these exercises, in part because of their early stage of development but also because of the inherent uncertainty of climate change risks and the long time horizons of the exercises. Because of this greater uncertainty, it is fairly common for climate stress tests to involve the running of more scenarios than traditional stress tests (see, for instance, Allen et al. (2020) and Emambakhsh et al. (2023)). The results for individual financial institutions also tend not to be disclosed, given that the exercises are in an early stage of development. Another key difference is that, to date, the quantitat3ive output of stress tests for climate change have not been used to determine capital requirements for climate risks, although qualitative results may sometimes have an impact on (bank-specific) Pillar 2 requirements (P2R in the European Single Supervisory Mechanism).

It is recognized that climate stress tests have general limitations, even if they are nevertheless viewed as useful risk management exercises. Indeed, there are general limitations to any quantification due to the lack of appropriate data. As mentioned in the main text, this creates the potential to underestimate the risks that climate change poses to financial institutions. This is true for a number of reasons. Firstly, climate physical and transition risks are mostly absent from past data, while most risk management techniques rely heavily on risk realizations in past data to measure future risks. Secondly, granular data is needed to properly assess risks from climate change, and financial institutions often do not have this data. Thirdly, it is also generally agreed that in times of economic stress correlations diverge from regular, non-stressed periods, although as observed by Forbes and Rigobon (1999) as well as Loretan and English (2000) care must be taken when measuring correlations during times of high volatility because there is a mechanical effect of rising volatility on measured correlations. Consequently, for climate-related risks with only scarce historic observations, measuring stressed correlations is almost impossible, which makes climate stress testing even more challenging.

Another general limitation is the high level of uncertainty surrounding the results arising from the fact that climate change-related risks play out over a time horizon much longer than for other, more common risks. These stress tests usually assume a static balance sheet; thus second-round effects are ignored. Second-round effects can amplify the stress of a climate scenario to individual banks and the banking system as a whole through, for example, effects within the interbank credit market, spillover effects to other financial institutions (e.g., insurance companies, see Box 2) and direct impacts on the real economy (e.g., credit supply reduction). The role of insurance companies is crucial because increased realizations of physical risks could lead to less insurance coverage and larger insurance protection gaps, leading to larger credit risks for banks if the collateral backing mortgages becomes uninsurable against natural hazards (see also Box 2). Given the long time horizon of climate stress tests, it is agreed that the static balance sheet assumption is problematic. It should arguable be relaxed, so that second-round effects can be incorporated into the analysis. Alogoskoufis et al. (2021) also show for the European economy that second-round effects amplify the impact of the stress, and it is crucial to analyze the effects of a climate risk scenario. The same reasoning applies to Acharya et al. (2023) who, in addition to noting the importance of second-round effects and feedback loops, argue that it is essential to account for "compound risk" scenarios which allows one to analyze the

co-occurrence of climate risks and conventional economic stress. This criticism notwithstanding, climate stress tests are viewed as useful risk management exercises mainly because of the potential for financial institutions, typically banks and insurers, and financial sector supervisors, to understand more fully the threats climate change poses to individual banks, the banking system and financial stability.

(*) This factor is developed by Litterman and the WWF and is constructed as an equity-based hedge portfolio that is long in global fossil energy index and short in S&P 500.

Conclusion and suggestions for future work

The survey acknowledges the great number of new research papers that have very recently been made available to understand better the various transmission channels by which climate change impacts banks. The richness of these studies helps provide a first assessment of the distribution of risk spreads for loans, bonds and equity, indicating that banks have started pricing these risk, while the issue remains of whether it is adequate. Based on this material, a few provisional conclusions may be drawn, which provide directions for future research, with a particular view to assess the robustness of these findings.

1. Apart from a few outliers, according to the overall distribution of impacts across academic studies, the microeconomic impacts of climate change on particular portfolios are relatively small, below 50 bp on loan and bond spreads. Stock markets appear to react more significantly and appear to have started pricing some, but maybe not all, of the risks. As a consequence, significant uncertainty remains regarding the magnitude of the effects of climate change.

2. There are various possible explanations for why banks may be able to manage risks from climate change at the macro level, although the situation might change over time, as climate change accelerates. Acharya et al. (2023) argue that the pricing of climate change-related credit or market risks only partly offsets the impacts of the realization of climate change-related shocks. Indeed, several authors conclude that realized returns on climate change-related risks are below expected return, providing evidence of an underestimation of risk.

3. New dimensions are uncovered, like the impact of ESG criteria as well as the reporting on exposures, which also help to partly reduce uncertainty.

4. Liquidity issues arising from climate change-related shocks are still insufficiently researched.

5. The overall impact of climate change, which becomes multifaceted and affects various portfolios at the same time and in a correlated fashion, may therefore be more significant. In particular, the difficulty to model possible non-linear effects related to climate change and to capture tipping points might lead to an underestimation of risks.

6. There are still data issues, notably in terms of granularity, as well as methodological issues, which prevent a definite assessment of the situation, both for physical risks (lack of exact location of the exposures in many instances) and transition risks (notably lack of evaluation for SMEs).

All in all, one may conclude that the overall balance is more in the direction of an underestimation of the risks from climate change from the perspective of banks, rather than a situation where risks are likely to be fully manageable by banks. The main channel is the materialization of unexpected risks insufficiently priced in lending or bond spreads.

Note that the review did not consider the policy implications in terms of optimal prudential regulation. Although we investigated to what extent the channels may interact with regulation, the review did not investigate how regulation could mitigate these effects from a financial stability point of view. Dafermos and Nikolaidi (2021) argue that capital requirements have the potential to reduce the pace of global warming if green supporting factors and brown penalizing factors are implemented simultaneously

and in tandem with fiscal policies. However, alone the effect of regulation is rather small. In contrast, Oehmke and Opp (2022) show that while banking regulation might reduce climate change-related financial risks, they might not necessarily reduce emissions. Acharya et al. (2023) note that any increase in capital requirements for high-emission firms to account for their more substantial transition risk exposure might raise the cost of capital for those firms and could thus itself constitute a source of transition risk. It is important to consider, among other things, whether green capital requirements will shift the funding of high-emission firms from the regulated banking sector to the unregulated, or less-regulated, shadow banking sector.

In addition, while it is not a central objective of financial regulation and maybe not an objective at all, we did not cover an assessment of schemes with a preferential treatment for banks involved in green lending.

References

Accetturo, A., G. Barboni, M. Cascarona, E. Garcia-Appendini, M. Tomasi (2022) "Credit supply and green investments", Available at SSRN 4093925

Acharya, V. V., Johnson, T., Sundaresan, S. and Tomunen, T. (2022). "Is physical climate risk priced? Evidence from regional variation in exposure to heat stress". NBER Working Paper no. 30445, National Bureau of Economic Research, September 2022.

Acharya, V. V., R Berner, R. F. Engle, H. Jung, J. Stroebel, X. Zeng, Y. Zhao (2023). "*Climate stress testing*". *NBER Working Paper* no. 31097, National Bureau of Economic Research, April 2023.

Addoum, J. M., D. T. Ng and A. Ortiz-Bobea (2020). "Temperature shocks and establishment sales." *The Review of Financial Studies, V*ol. 33, no. 3, pp. 1331–1366.

Addoum, J. M. and Ng, D. T. and Ortiz-Bobea, A. (2023). "Temperature Shocks and Industry Earnings News." *Journal of Financial Economics*, forthcoming.

Ahnert, T. and Co-Pierre Georg, Co-P. (2018), "Information contagion and systemic risk", vol. 35, issue C, 159-171.

Aldasoro, I., Delli Gatti, D. and E. Faia (2017). "Bank networks: Contagion, systemic risk and prudential policy", *Journal of Economic Behaviour & Organization*, Vol. 142, pp. 164–188.

Allen, T., Dees, S., Boissinot, J., Caicedo, C. M. Graciano, Chouard, V., Clerc, L., De Gaye, A., Devulder, A., Diot, S., Lisack, N., Pegoraro, F., Rabaté, M., Svartzmann R., and L. Vernet (2020). "Climate-Related Scenarios for Financial Stability Assessment: An Application to France", Banque de France Working Paper n. 774.

Alogoskoufis, S., Dunz, N., Emambakhsh, T., Hennig, T., Kaijser, M., Kouratzoglou, C., Salleo, C. (2021). "*ECB economy-wide climate stress test: Methodology and results*". *ECB Occasional Paper* No. 281.

Alok, S., Kumar, N. and Wermers, R. (2019) "Do Fund Managers Misestimate Climatic Disaster Risk?". *Review of Financial Studies*, Forthcoming, Indian School of Business, Available at SSRN.

Apergis, N. (2020). "Natural disasters and housing prices: Fresh evidence from a global country sample." *International Real Estate Review*, Vol. 23/2, pp. 815–836.

Aswani, J., Raghunandan, A., Rajgopal, S. (2021) « Are carbon emissions associated with stock returns?" *Review of Finance*, forthcoming

Auh, J. K., J. Choi, T. Deryugina and T. Park (2022). "Natural disasters and municipal bonds". SSRN Working Paper, July 2022, ssrn.com/abstract=3996208.

Autorité de Contrôle Prudentiel et de Résolution – ACPR (2021), "*The main results of the 2020 climate pilot exercise", Analysis and synthesis* no. 122, acpr.banque-france.fr/en/analysis-and-synthesis-no-122-main-results-2020-climate-pilot-exercise.

Baker, M., Bergstresser, D., Serafeim, G., Wurgler, J. (2018). "*Financing the response to climate change: the pricing and ownership of U.S. green bonds*". *NBER Working Paper* no 25194, October 2018.

Bakkensen, L. A. and L. Barrage (2021). "Going underwater? Flood risk belief heterogeneity and coastal home price dynamics." *The Review of Financial Studies,* Vol. 35, issue 8, pp. 3666–3709.

Baldauf, M. L. Garlappi and C. Yannelis (2020). "Does climate change affect real estate prices? Only if you believe in it." *The Review of Financial Studies,* Vol. 33 (3), pp. 1256–1295.

Bandt (de), O., Jacolin, L., Lemaire, T. (2021). "*Climate Change in Developing Countries: Global Warming Effects, Transmission Channels and Adaptation Policies*", *Banque de France Working Paper* No. 822.

Barnett, M., Brock, W. and Hansen, L.P. (2020) "Pricing uncertainties related to climate change" *The Review of Financial Studies*, Volume 33, Issue 3, March 2020, Pages 1024–1066

Barnett, M., Brock, W. and Hansen, L.P. (2022) "Climate Change Uncertainty Spillover in the Macroeconomy", *NBER Macroeconomics Annual*, volume 36, 2022.

Barrot, J.-N. and J. Sauvagnat (2016). "Input specificity and the propagation of idiosyncratic shocks in production networks", *The Quarterly Journal of Economics* vol 131, no 3, pp. 1543–1592.

Bartram, S. M., Hou, K. and Kim, S. (2022). "Real effects of climate policy: Financial constraints and spillovers." *Journal of Financial Economics, Vol. 143*(2), pp. 668–696.

Battiston, S., Mandel, A., Monasterolo, I., Schütze, F. and Visentin, G. (2017). "A climate stress-test of the financial system". *Nature Climate Change*, Vol. 7(4), pp. 283–288.

Baudino, Patrizia and Jean-Philippe Svoronos (2021). "*Stress-testing Banks for Climate Change – a Comparison of Practices*", *FSI Insights on Policy Implementation* No 34.

BCBS (2021a). "*Climate-related risk drivers and their transmission channels*", BIS, April.

BCBS (2021b). "*Climate-related financial risks – measurement methodologies*", BIS, April.

Bell, J., G. Battisti and B. Guin (2023). "*The greening of lending: mortgage pricing of energy transition risk*". *Staff working paper* (No. 1016), Bank of England.

Belloni, M., F. Kuik and L. Mingarelli (2022). "*Euro area bank's sensitivity to changes in carbon prices*". (No. 2654) *European Central Bank Working Paper Series*, March 2022.

Beltrán, A. and Maddison, D. and Elliott, R. J. R. (2018). "Is flood risk capitalised into property values?" *Ecological Economics,* Vol. 146, pp. 668–685.

Benetton, M., S. Emiliozzi, E. Guglielminetti, M. Loberto and A. Mistretta (2022): "*Do house prices 31eflect climate change adaption? Evidence from the city on the water*". *Banca d'Italia Occasional Papers* no. 735, November 2022.

Benincasa, E., Kabas, G. and Ongena, S. R. G., "There is No Planet B", But for Banks There are "Countries B to Z": Domestic Climate Policy and Cross-Border Bank Lending (October 1, 2021). CEPR Discussion Paper No. DP16665, Available at SSRN: https://ssrn.com/abstract=3960269

Bernstein, A., M. T. Gustafson and R. Lewis (2019). "Disaster on the horizon: the price effect of sea level rise." *Journal of Financial Economics,* Vol. 134 (2), pp. 253–272.

Beyene, W., K. De Greiff, M. D. Delis, and S. Ongena (2021). "*Too-big-to-strand? Bond versus bank financing in the transition to a low-carbon economy*". (No. 16692) CEPR Discussion Paper.

Beyene, W., Falagiarda, M., Ongena, S. R. G. and Scopelliti, A. (2022). "*Do Lenders Price the Brown Factor in Car Loans? Evidence from Diesel Cars*". *Swiss Finance Institute Research Paper* No. 22-76.

Billio, M., Getmansky, M., Lo, A. W., and L. Pelizzon (2012). "Econometric measures of connectedness and systemic risk in the finance and insurance sectors." *Journal of financial economics*, Vol. 104(3), pp. 535–559.

Billio, M., Costola, M., Hristova, I., Latino, C. and Pelizzon, L. (2022). "*Sustainable finance: A journey toward ESG and climate risk*". *SSRN Working Paper*, April 2022, papers.ssrn.com/sol3/ papers.cfm?abstract_id=4093838.

Beirne, J., Renzhi, N., and Volz, N. (2021). "Feeling the heat: Climate risks and the cost of sovereign borrowing", *International Review of Economics & Finance,* Vol. 76(C), pp. 920–936.

Bin, O., T. W. Crawford, J. B. Kruse, and C. E. Landry (2008a). "Viewscapes and flood hazard: Coastal housing market response to amenities and risk," *Land Economics,* Vol. 84, pp. 434–448.

Birindelli, G., Bonanno, G., Dell'Atti, S. and Iannuzzi, A. P. (2022). "Climate change commitment, credit risk and the country's environmental performance: Empirical evidence from a sample of international banks." *Business Strategy and the Environment*, Vol. 31(4), pp. 1641–1655.

Blickle, K. S., S. N. Hamerling and D. P. Morgan (2022). "*How bad are weather disasters for banks?*". (No. 990). *Federal Reserve Bank of New York Staff reports*, January 2022, www.newyorkfed.org/medialibrary/media/research/staff_reports/sr990.pdf.

Bolton, P., Despres, M., Pereira Da Silva, L.A., Samama, F., Svartzman, R. (2020). "*The green swan – central banking and financial stability in the age of climate change*". Banque de France and Bank for International settlements. *Technical report*.

Bolton, P., M. Kacperczyk., (2021a). "Do Investors Care about Carbon Risk?" *Journal of Financial Economics,* Vol. 142, Issue 2, November 2021, pp. 517–549.

Bolton, P., M. Kacperczyk., (2021b). "*Global pricing of carbon risk*", *NBER Working paper*, National Bureau for Economic Research, no. 28510, February.

Bolton, P., M. Kacperczyk., (2021c). "*Carbon Disclosure and the Cost of Capital"*. SSRN Working Paper, papers.ssrn.com/sol3/papers.cfm?abstract_id=3755613.

Bolton, P., M. Kacperczyk., (2022) "The Financial cost of Carbon". *Journal of Applied Corporate Finance*, Vol. 34 (2), Spring 2022, pp. 17–19.

Botzen, W J W and C J Van Den Bergh (2008): "Insurance against climate change and flooding in the Netherlands". Present, future, and comparison with other countries, *Risk Analysis*, Vol. 28, issue 2, pp. 413–426.

Bowman, L., D. Hu, M. Hu, A. Madaan and A. B. da Silva (2022). "Assessing Climate Change Impact on Sovereign Bonds". *The Journal of Portfolio Management*, Vol. 48(10), pp 98–118.

Brar, J., Kornprobst, A., Braun, W. J., Davison, M. and Hare, W. (2021). "A Case Study of the Impact of Climate Change on Agricultural Loan Credit Risk." *Mathematics,* Vol. 9(23), 3058.

Brei, M., Mohan, P. and Strobl, E. (2019). "The impact of natural disasters on the banking sector: Evidence from hurricane strikes in the Caribbean." *The Quarterly Review of Economics and Finance,* Vol. 72, pp. 232–239.

Brownlees, Christian T. and Robert F. Engle (2017). "SRISK: A Conditional Capital Shortfall Index for Systemic Risk Measurement," *Review of Financial Studies*, Vol. 30, issue1, pp. 48–79.

Bua, G., Kappa, D., Ramella, F., Rognone, L. (2022). "*Transition Versus Physical Climate Risk Pricing in European Financial Markets: A Text-Based Approach*". *ECB Working Paper*.

Caloia, F. and D.J. Jansen (2021). "*Flood risk and financial stability: Evidence from a stress test for the Netherlands*". (No. 730m) *Working Paper DNB*, November 2021.

Capasso, G., Gianfrate, G. and Spinelli, M. (2020). "Climate change and credit risk." *Journal of Cleaner Production,* Vol. 266, 121634.

Carbone, S., Giuzio, M., Kapadia, S., Krämer, J. S., Nyholm, K. and Vozian, K. (2022). "*The low-carbon transition, climate commitments and firm credit risk*". *SUERF Policy Brief* 309.

Carrizosa, R. and Ghosh, A. A. (2022). "*Sustainability-linked loan contracting*". Available at SSRN 4103883.

Cevik, S. and Jalles, J.T. (2020). "*This Changes Everything: Climate Shocks and Sovereign Bonds*". (No. 20/79) *IMF Working Papers*.

Charpentier, A. (2007). "Insurability of climate risks". *The Geneva Papers on Risk and Insurance – Issues and Practices*, Vol. 33, pp. 91–109.

Charpentier, A, L Barry and M James (2021): "Insurance against natural catastrophes: balancing actuarial fairness and social solidarity". *Geneva Papers on Risk and Insurance – Issues and Practices*, Vol. 47(2).

Chava, S. (2014). "Environmental Externalities and Cost of Capital", *Management Science*, Vol. 60, Issue 9, pp. 2223–2247.

Chavaz, M. (2016). "*Dis-integrating credit markets: diversification, securitization, and lending in a recovery*". (No. 617) *Bank of England Staff Working Paper*.

Chen, Y., Goulder, L. H., Hafstead, M. A. C. (2018) "The sensitivity of CO2 emission under a carbone tax to alternative baseline forecasts" *Climate Change Economics*, Vol. 09, No. 01.

Chen, I. J., Hasan, I., Lin, C. Y. and Nguyen, T. N. V. (2021). "Do banks value borrowers' environmental record? Evidence from financial contracts". *Journal of Business Ethics*, 174, pp. 687–713.

Choi, D., Gao, Z. and Jiang, W. (2020). "Attention to Global Warming." *Review of Financial* Studies, Vol. 33 (3), pp 1112–1145.

Citino, L., Palma, A. and Paradisi, M. (2021). "*Dance for the rain or pay for insurance? An empirical analysis of the Italian crop insurance market*", mimeo, December 2021, luca-citino.github.io/docs/CPP_dance_for_the_rain.pdf.

Clayton, J., Devaney, S., Sayce, S. and van de Wetering, J. (2021). "*Climate Risk & Commercial Property Values: A review and analysis of the literature*". UNEP FI Working Paper.

Cleary P., W. Harding, J. McDaniels, J.-P. Svoronos and J. Yong (2019): "*Turning up the heat – climate risk assessment in the insurance sector*", FSI Insights on policy implementation No 20.

Cohen, L., Gurun, U. G. and Nguyen, Q. H. (2020). "*The ESG-innovation disconnect: Evidence from green patenting*". *NBER working paper*, no. 27990, National Bureau of Economic Research.

Correa, R., A. He, C. Herpfer and U. Lel (2023). "*The rising tide lifts some interest rates: Climate change, natural disaters and loan pricing*". (No. 889/2023) *ECGI Working Papers in Finance*, March 2023.

Cortés, K. R. and Strahan, P. E. (2017). "Tracing out capital flows: How financially integrated banks respond to natural disasters". *Journal of Financial Economics*, Vol. 125(1), pp. 182–199.

Covas, Francisco (2020): "*Challenges in Stress Testing and Climate Change*", *Bank Policy Institute Research Paper*, 9 October.

Dafermos, Y. and M. Nikolaidi (2021). "How can green differentiated capital requirements affect climate risks? A dynamic macrofinancial analysis." *Journal of Financial stability,* Vol. 54, issue C.

Dai, W. (2020) "Greenhouse Gas Emissions and Expected Returns " Available at SSRN: http://dx.doi.org/10.2139/ssrn.3714874

Danielsson, M. (2020). "*Rising sea levels due to global warming will entail increased risks to housing*". Economic commentaries, Sveriges Riksbank.

Degryse, H., Goncharenko, R., Theunisz, C. and Vadasz, T. (2023). "When green meets green". Journal of Corporate Finance, Volume 78, February 2023,

Dessaint, O. and A. Matray (2017). "Do managers overreact to salient risks? Evidence from hurricane strikes". *Journal of Financial Economics*, Vol. 126 (1), pp. 97–121.

De Guindos, L. (2021). "*Shining a light on climate risks: the ECB's economy-wide climate stress test*". The ECB Blog, 18.

Delis, M., De Greiff, K., Iosifidi, M. S. Ongena, (2021). "*Being Stranded with Fossil Fuel Re-serves. Climate policy risk and the pricing of bank loans*". (No. 18-10) *Swiss Finance Institute Research Paper Series*.

Dessaint, O. and A. Matray (2017). "Do managers overreact to salient risks? Evidence from hurricane strikes", *Journal of Financial Economics,* Vol. 126, no 1, pp. 97–121.

Do, V., Nguyen, T. H., Truong, C. and Vu, T. (2021). "Is drought risk priced in private debt contracts?" *International Review of Finance,* Vol. 21(2), pp. 724–737.

Ehlers, T., Packer, F. and de Greiff, K. (2022). "The pricing of carbon risk in syndicated loans: Which risks are priced and why?" *Journal of Banking & Finance,* Vol. 136, 106180.

Emambakhsh, T., Fuchs, M., Kördel, S., Kouratzoglou, C., Lelli, C., Pizzeghello, R., Salleo, C. and Spaggiari, M. (2023). "*The Road to Paris: stress testing the transition towards a net-zero economy*", ECB Occasional Paper Series No. 328.

Eren, E, F Merten and N Verhoeven (2022). "*Pricing of climate risks in financial markets: a summary of the literature*". *BIS Papers* No 130.

European Central Bank (2022): "*2022 climate risk stress test*". July 2022,

European Central Bank (2023): "*Policy options to reduce the climate insurance protection gap*", Discussion Paper, April 2023.

European Systemic Risk Board (2021): "*Climate-related risk and financial stability*", July 2021.

European Systemic Risk Board (2022): "*The macroprudential challenge of climate change*", July 2022.

Ferentinos, K., A. Gibberd and B. Guin (2023). "Stranded houses? The price effect of a minimum energy efficiency standard". *Energy Economics*, Volume 120.

Forbes, K. and R. Rigobon (1999): "*No Contagion, Only Interdependence: Measuring stock market co-movements*", *NBER Working Paper* No. 7267, July. Published in *Journal of Finance*, Volume 57, Issue 5, October 2002, pp. 2223–2261.

Friede, G., Busch, T. and Bassen, A. (2015). "ESG and financial performance: aggregated evidence from more than 2000 empirical studies". *Journal of Sustainable Finance & Investment*, 5(4), pp. 210–233.

Fuerst, F. and G. Warren-Myers (2021). "Pricing climate risk: Are flooding and sea level rise risk capitalised in Australian residential property?". *Climate Risk Management.*

Furukawa. K., H. Ichiue, N. Shiraki (2020). "*How Does Climate Change Interact with the Financial System? A Survey*". *Bank of Japan staff working paper*.

Gallagher, J. and D. Hartley (2017). "Household finance after a natural disaster: The case of Hurricane Katrina." *American Economic Journal: Economic Policy,* Vol. 9, pp. 199–228.

Garbarino, N. and B. Guin (2021). "High water, no marks? Biased lending after extreme weather." *Journal of Financial Stability*, Vol. 54.

Giannetti, M., M. Jasova, M. Loumioti, C. Mendicino (2023) "*Glossy banks*". SSRN

Giglio, S., Kelly, B., Stroebel, J. (2021a) "Climate Finance", *Annual Review of Financial Economics*, 13, pp. 15–36.

Giglio, S., M. Maggiori, K. Rao, J. Stroebel and A. Weber (2021b). "Climate change and long-run discount rates: Evidence from real estate." *The Review of Financial Studies, Vol. 34*, pp. 3527–3571.

Giglio, S., Maggiori, M., Stroebel, J., Tan, Z, Utkus, S. and Xu, X. (2023). "*Four Facts About ESG Beliefs and Investor Portfolios*". NBER Working Paper no. 31114, National Bureau of Economic Research, April 2023.

Ginglinger, E. and Moreau, Q. (2019). "*Climate risk and capital structure*". (No. 327185) *Université Paris-Dauphine Research Paper*.

Goldsmith-Pinkham, P. S., Gustafson, M. Lewis, R. and Schwert, M. (2021). "*Sea Level Rise Exposure and Municipal Bond Yields*". *Jacobs Levy Equity Management Center for Quantitative Financial Research Paper*, October 2021

Gourevitch, J. D., C. Kousky, Y. Kiao, C. Nolte, A. B. Pollack, J. R. Porter and. J. A. Weill (2023). "Unpriced climate risk and the potential consequences of overvaluation in US housing markets", *Nature Climate Change*, no. 13, pp. 250–257

Gray, I. (2021). "Hazardous simulations: Pricing climate risk in U.S. coastal insurance markets." *Economy and Society*, Vol. 50, issue 2.

Griffiths, R., I. Hamilton and G. Huebner (2015). "*The role of energy bill modelling in mortgage affordability calculations*". UK Green Building Council, August 2015, ukgbc.s3.eu-west-2.amazonaws.com/wp-content/uploads/2017/09/05152811/The-role-of-energy-bill-modelling-in-mortgage-affordability-calculations.pdf.

Guin, B., P. Korhonen and S. Moktan (2022). "Risk differentials between green and brown assets?", *Economic Letters Vol. 213*(6).

Hadzilacos, G., R. Li, P. Harrington, S. Latchman, J. Hillier, R. Dixon, C. New, A. Alabaster and T. Tsapko (2021). "*It's windy when it's wet: why UK insurers may need to reassess their modelling assumptions*". Bank Undergound, April 2021.

Hauptmann, C. (2017). "*Corporate sustainability performance and bank loan pricing: It pays to be good, but only when banks are too*". *Saïd Business School WP*, 20.

Hino, M. and M. Burke (2020). "*Does information about climate risk affect property values?*" (No. 26807) *NBER Working Paper*.

Höck, A., Klein, C., Landau, A. and Zwergel, B. (2020). "The effect of environmental sustainability on credit risk." *Journal of Asset Management*, Vol. 21(2), pp. 85–93.

Hong, H., F. W. Li and J. Xu (2019). "Climate risks and market efficiency." *Journal of Econometrics, Vol 208*, no 1, pp. 265–281.

Hovekamp, W. P., K. R. H. Wagner (2023). "*Efficient adaption to flood risk*" (No. 10243) *CESifo Working Paper*.

Hsu, P.-H., Li, K. and Tsou, C.-Y. (2023). "*The Pollution Premium*", SSRN Working Paper.

Huang, B., Punzi, M. T. and Wu, Y. (2019). "*Do Banks price environmental risk? Evidence from a quasi natural experiment in the people's republic of China*". (No. 974) Asian Development Bank Institute, *Working Paper Series*, July 2019.

Huynh, T. D., Nguyen, T. H. and C. Truong (2020) "Climate risk: the price of drought". *Journal of Corporate Finance*, Vol. 65.

Ilhan, E., Krueger, P., Sautner, Z. and Starks, L. T. (2023). "Climate risk disclosure and institutional investors". *The Review of Financial Studies*, 36(7), pp. 2617–2650.

Ilhan, E., Sautner, Z. and Vilkov, G. (2021). "Carbon tail risk." *The Review of Financial Studies*, Vol. 34(3), 1540-1571.

IPCC (2023): "Summary for Policymakers". *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001

Javadi, S., Masum, A.-A. (2021) "The impact of climate change on the cost of bank loans", *Journal of Corporate Finance*, Volume 69, August 2021, 102019.

Jorgenson, D. W. (2018) « Econometric general equilibrium modelling" *Journal of Policy Modeling* Volume 38, Issue 3, May–June 2016, Pages 436-447

Jourde, T., and Q. Moreau (2023). "*Systemic Climate Risk*", SSRN working paper available at SSRN: ssrn.com/abstract=4300469.

Jung, H, R Engle and R Berner (2022): "*Climate stress testing*", Federal Reserve Bank of New York Staff Reports, no 977, June

Jung, H., Santos, J. A. and Seltzer, L. (2023). "*U.S. Banks' Exposures to Climate Transition Risks*". *FRB of New York Staff Report*, (1058).

Kacperczyk, M. and Peydro, J.-L. (2022), "Carbon Emissions and the Bank-Lending Channel", Available at SSRN: http://dx.doi.org/10.2139/ssrn.3915486

Kaza, N., R. G. Quercia and C. Y. Tian (2014). "Home energy efficiency and mortgage", *Community Development Innovation Review*, issue 01, pp. 63–69.

Keys, B. (2023). "Your homeowners' insurance bill is the canary in the coal mine", *New York Times*, Guest Essay, May 7, 2023.

Keys, B. J. and P. Mulder (2020). "*Neglected no more: housing markets, mortgage lending, and sea level rise*". *NBER Working Paper* no. 27930, National Bureau of Economic Research.

Kim, S., Kumar, N., Lee, J. and Oh, J. (2022). "'*ESG*' *lending*". In Proceedings of Paris December 2021 Finance Meeting EUROFIDAI-ESSEC, European Corporate Governance Institute–Finance Working Paper (No. 817)

Kim, D. and Pouget, S. (2023). "*Who benefits from the bond greenium?*". Available at SSRN.

Kim, M., Surroca, J. and Tribó, J. A. (2014). "Impact of ethical behavior on syndicated loan rates". *Journal of Banking & Finance*, Vol. 38, pp. 122–144.

Kivedal, B. K. (2023). "*Natural disasters, insurance claims and regional housing markets*". (No. 2023/1) Housing Lab Working Paper Series.

Kleimeier, S. and Viehs, M. (2018) "Carbon Disclosure, Emission Levels, and the Cost of Debt", Available at SSRN: http://dx.doi.org/10.2139/ssrn.2719665

Kousky, C., H. Kunreuther and M. LaCour-Little and S. Wachter (2020a). "Flood risk and the U.S. housing market." *Journal of Housing Research,* Vol. 29, issue sup. 1.

Kousky, C., M. Palim and Y. Pan (2020b). "Flood damage and mortgage credit risk: a case study of hurricane Harvey." *Journal of Housing Research,* Vol. 29, sup1.

Kraehnert, K., D Osberghaus, C. Holt, L. T. Habtemariam, F. Wätzold, L. P. Hecker and S. Fluhrer (2021): "Insurance against extreme weather events: An overview". *Review of Economics*, Vol. 72/2.

Kraemer and Negrilla (2014). "*Climate Change Is A Global Mega-Trend For Sovereign Risk*". S&P Ratings Services.

Kruttli, M. S., B. Roth Tran and S. W. Watugala (2021). "*Pricing Poseidon: Extreme weather uncertainty and firm return dynamics*". Working Paper, Board of Governors of the Federal Reserve System.

Krueger, P. (2015). "*Climate Change and Firm Valuation: Evidence from a Quasi-Natural Experiment*". Swiss Finance Institute Research Paper no. 15-40.

Krueger, P., Z. Sautner, L. T. Starks (2020). "The Importance of Climate Risks for Institutional Investors" *The Review of Financial Studies,* Vol. 33, Issue 3, pp. 1067–1111.

Krueger, P., Sautner, Z., Tang, D. Y. and Zhong, R. (2023). "*The effects of mandatory ESG disclosure around the world*". European Corporate Governance Institute–Finance Working Paper, (754), pp. 21–44.

Laeven, L., Popov, A. (2023) Carbon taxes and the geography of fossil lending, *Journal of International Economics*, Volume 144, September 2023,

Lenton, T. M., Rockström, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W., and Schellnhuber, H. J. (2019). "Climate tipping points—too risky to bet against." *Nature*, Vol. 575(7784), pp. 592–595.

Li, C., J. Cong, H. Gu and X. Xiang (2016). "*Extreme heat and exports: Evidence from Chinese exporters*". Working Paper, Jinan University.

Li, Q., H. Shan, Y. Tang, and V. Yao (2020). "*Corporate climate risk: Measurements and responses*". (No. 3508497) SSRN Working Paper.

Loretan, Mico and William B English (2000): "Evaluating Changes in Correlations during Periods of High Market Volatility", *BIS Quarterly Review*, June.

Mallucci, E.(2020). "*Natural Disasters, Climate Change, and Sovereign Risk*". (No.1291) *International Finance Discussion Papers*, Board of Governors of the Federal Reserve System.

Meisenzahl, R. (2023). "*How Climate Change Shapes Bank Lending: Evidence from Portfolio Reallocation*". *Working Paper Series* WP 2023-12, Federal Reserve Bank of Chicago.

Meng, K. C. (2017). "Using a free permit rule to forecast the marginal abatement cost of proposed climate policy." *American Economic* Review, Vol. 107, no. 3, pp. 748–784.

Mésonnier, J.-S. (2021). "Banks' climate commitments and credit to carbon-intensive industries: new evidence for France." *Climate Policy*, forthcoming.

Mirone, G. and J. Poeschl (2021). "*Flood risk discounts in the Danish housing market*". (No. 7/2021) Economic memo, Danmarks Nationalbank.

Monasterolo, I. de Angelis, L. (2020) "Blind to carbon risk? An analysis of stock market reaction to the Paris Agreement, *Ecological Economics*, Volume 170, April 2020,

Mueller, I. and Sfrappini, E. (2022). "Climate change-related regulatory risks and bank lending.", *Economic Letters*, Vol. 220, November 2022.

Murfin, J. and M. Spiegel (2020). "Is the risk of sea level rise capitalized in residential real estate?". *Review of Financial Studies,* Vol. 33, no 3.

NGFS (2022). "Network Greening the Financial Sytsem: Running the NGFS scenarios in G-cubed: A tale of two modelling frameworks." NGFS Occasional Papers. Running the NGFS Scenarios in G-Cubed: A Tale of Two Modelling Frameworks | Banque de France

NGFS (2023), "*NGFS Survey on Climate Scenarios: Key findings*", June 2023, Network Greening the Financial System, June 2023.

Nguyen, D. D., Ongena, S., Qi, S. and Sila, V. (2022). "Climate change risk and the cost of mortgage credit." *Review of Finance, Vol. 26*(6), pp. 1509–1549.

Ntelekos, A., D. Papachristou and J. Duan (2018). "*U.S. Hurricane Clustering: A New Reality?*". Bank Undergound May 2018.

Ochoa, M., Paustian, M. O. and Wilcox, L. (2022). "*Do Sustainable Investment Strategies Hedge Climate Change Risks? Evidence from Germany's Carbon Tax*". SSRN Working Paper.

Oehmke, M. and M. M. Opp (2022). "*Green capital requirements*". (No. 22-16) Swedish House of Finance Research Papers, February 2022.

Oh, S. S., I. Sen, and A.-M. Tenekedjieva (2022). "*Pricing of Climate Risk Insurance: Regulation and Cross-Subsidies*", *FED Working Paper*, November 2022.

Owen, S. and I. Noy (2019): "Regressivity in Public Natural Hazards Insurance: a quantitative analysis of the New Zealand case". *Economics of Disasters and Climate Change*, volume 3, pp. 235–255.

Pagliari, M. S. (2023). "LSIs' exposures to climate change related risks: an approach to assess physical risks." *International Journal of Central Banking*, March 2023.

Painter (2020) An inconvenient cost: The effects of climate change on municipal bonds, *Journal of Financial Economics*, Volume 135, Issue 2, February 2020, Pages 468-482

Panjwani, A., Melin, L., Mercereau, B. (2023). "*Do Scope 3 Carbon Emissions Impact Firms' Cost of Debt?*". SSRN Working Paper.

Pankratz, N., R. Bauer and J. Derwall (2019). "Climate change, firm performance, and investor surprises." *Management Science* (2023).

Pankratz, N. M. and C. M. Schiller (2019). "*Climate change and adaptation in global supply-chain networks*", *Working Paper*, Board of Governors of the Federal Reserve System.

Pastor, L., Stambaugh, R., Taylor, L. A. (2022). "*Dissecting Green Returns*", SSRN Working Paper.

Pindyck, R. S. (2020). "*What we know and don't know about climate change, and implications for policy*". *NBER Working Paper* no. 27304, National Bureau of Economic Research.

Polacek, A (2018): "*Catastrophe bonds: A primer and retrospective*", *Chicago Fed Letter*, No. 405, Federal Reserve Board of Chicago.

Ramelli, S., E. Ossola, and M. Rancan (2021). "Stock price effects of climate activism: Evidence from the first Global Climate Strike." *Journal of Corporate Finance*, Vol. 69.

Ramelli, S., A. F. Wagner, R. J. Zeckhauser, and A. Ziegler (2021). "Investor rewards to climate responsibility: Stock-price responses to the opposite shocks of the 2016 and 2020 U.S. elections." *The Review of Corporate Finance Studies,* Vol. 10, no. 4, pp. 748–787.

Reeken, J. van, S. Phlippen (2022). "*Is flood risk already affecting house prices?*". ABN-AMBO memo

Reghezza, A., Altunbas, Y., Marques-Ibanez, D., Rodriguez d'Acri, C., Spaggiari, M. (2022). "Do banks fuel climate change?" Journal of Financial Stability, Volume 62, October 2022.

Rodríguez, M. L., M. L. Garcia Lorenzo, M. Medina Magro and G. Perez Quiros (2023). "Impact of climate risk materialization and ecological deterioration on house prices in Mar Menon, Spain". *Scientific Reports*, no. 13, article no. 11772.

Roncoroni, A., Battiston, S., D'Errico, M., Hałaj, G., and C. Kok (2021a). "Interconnected banks and systemically important exposures." *Journal of Economic Dynamics and Control,* Vol. 133, 104266.

Roncoroni, A., Battiston, S., Escobar-Farfán, L. O., and S. Martinez-Jaramillo (2021b). "Climate risk and financial stability in the network of banks and investment funds." *Journal of Financial Stability*, Vol. 54, 100870.

Rousova, L. F., Giuzio, L. M., Kapadia, S., Kumar, H., Mazzotta, L., Parker, M., Zafeiris, D. (2023): "*The macroeconomic effects of the insurance climate protection gap*", mimeo, ECB/EIOPA. www.suomenpankki.fi/globalassets/en/financial-stability/events/sra-2023/papers/margherita-giuzio---the-macroeconomic-effects-of-the-climate-insurance-protection-gap.pdf

Schubert, V. (2022). "*Is flood risk priced in bank returns?*". mimeo, Stockholm School of Economics.

Seltzer, L. H., Starks, L. and Zhu, Q. (2022). "*Climate regulatory risk and corporate bonds*". *NBER working paper* no. 29994, National Bureau of Economic Research.

Somanathan, E., R. Somanathan, A. Sudarshan and M. Tewari (2021). "The impact of temperature on productivity and labor supply: Evidence from Indian manufacturing." *Journal of Political Economy,* Vol. 129*,* no. 6.

Stern, N. and Stern, N. H. (2007). "*The economics of climate change: the Stern review*". Cambridge University press.

Stern, N. (2013). "The structure of economic modelling of the potential impacts of climate change: grafting gross underestimation of risk onto already narrow science models". *Journal of Economic Literature,* Vol. 51(3), pp. 838–859.

Takahashi, K. and Shino, J. (2023). "*Greenhouse gas emissions and bank lending*". (No. 1078) *BIS Working Papers*, March 2023.

Traore, N. and J. Foltz (2017). "*Temperatures, productivity, and firm competitiveness in developing countries: Evidence from Africa*". *Working Paper*, University of Wisconsin-Madison.

Vermeulen, R., Schets, E., Lohuis, M., Kölbl, B., Jansen, D. J. and Heeringa, W. (2021). "The heat is on: A framework for measuring financial stress under disruptive energy transition scenarios." *Ecological Economics,* Vol. 190.

Volz, U., Beirne, J., Preudhomme, N. A., Fenton, A., Mazzacurati, E., Renzhi, N. and Stampe, J. (2020). "*Climate Change and Sovereign Risk*". (No. 3) FSA Occasional Paper.

Wu, Z., Y.-C. Shih, Y. Wang, and R. Zhong (2023). "*Carbon Risk and Corporate Cash Holdings*". (No. 4316705) SSRN Working Paper.

Xia, D and O Zulaica (2022). "*The term structure of carbon premia*". *BIS Working Papers* No 1045.

Xie, V. (2017). "*Heterogeneous firms under regional temperature shocks: exit and reallocation, with evidence from Indonesia*". *Working Paper*, University of California San Diego.

Yuan, N., and Y. Gao(2022). "Does green credit policy impact corporate cash holdings?". *Pacific-Basin Finance Journal,* Vol. 75.

Zancanella, P., P. Bertoldi and B. Boza-Kiss (2018). "*Energy efficiency, the value of buildings and the payment default risk*", JRC Science for Policy Report, European Commission.

Zenios, S. A. (2021). "The risks from climate change to sovereign debt in Europe". *Policy Contribution Issue,* no 16/21, July 2021

Zerbib, O. D. (2019). "The Effect of Pro-Environmental Preferences on Bond Prices: Evidence from Green Bonds." *Journal of Banking & Finance,* Vol. 98, pp. 39–60.

Zhang, P., O. Deschenes, K. Meng and J. Zhang (2018). "Temperature effects on productivity and factor reallocation: Evidence from a half million Chinese manufacturing plants", *Journal of Environmental Economics and Management,* vol. 88, pp. 1–17.

Zivin, J. S. G., Y. Liao and Y. Panassie (2020). "*How hurricanes sweep up housing markets: Evidence from Florida*". *NBER Working Paper* no. 27542, National Bureau of Economic Research.

Annex 508

Report of the independent expert on the effects of foreign debt and other related international financial obligations of States on the full enjoyment of all human rights, particularly economic, social and cultural rights, A/HRC/14/21, 29 April 2010

United Nations A/HRC/14/21

General Assembly

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Human Rights Council
Fourteenth session
Agenda item 3
Promotion and protection of all human rights, civil, political, economic, social and cultural rights, including the right to development

Report of the independent expert on the effects of foreign debt and other related international financial obligations of States on the full enjoyment of all human rights, particularly economic, social and cultural rights, Cephas Lumina*

Summary

Despite their limitations, international debt relief efforts have helped reduce the external debt burden of heavily indebted poor countries (HIPCs) and contributed to the creation of fiscal space for resources to be channelled to poverty-reducing expenditures and economic development in these countries. Evidence also suggests that the additional fiscal space has allowed some HIPCs to increase their public spending on essential, human rights-related social services, such as health care and education, thereby contributing to the realization of human rights, particularly economic, social and cultural rights, in these countries.

Nevertheless, the voluntary nature of these debt relief measures has created opportunities for some commercial creditors to eschew such efforts and then attempt to recover the full value of their debt through litigation. These creditors — termed "vulture funds" — purchase the defaulted debt at significant discounts, hold out for other creditors to cancel their debts and then aggressively pursue repayments that are vastly in excess of the amount that they paid for the debt. These activities not only dilute the impact of debt relief by reducing the resources available to the targeted debtor countries to finance development and reduce poverty, they also diminish the capacity of indebted poor countries to create the conditions necessary for the realization of human rights, particularly economic, social and cultural rights.

The present report, which is submitted in accordance with Human Rights Council resolution 11/5, is intended to draw global attention to the adverse impacts of vulture fund activities on debt relief and on the capacity of poor countries to fulfil their human rights

* Late submission.

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obligations and attain their development goals. It also includes a call for definitive international and national action to combat vulture fund activity.

The report has five sections. In section I, the independent expert introduces the report. In section II, the activities that the independent expert has undertaken since his last report to the Council (A/HRC/11/10) are outlined. In section III, the independent expert briefly discusses what vulture funds are and provides some illustrations of vulture fund litigation against HIPCs. He also outlines the impact of vulture fund activities on debt relief and their implications for the realization of human rights in the countries targeted by these predatory creditors. In section IV, the independent expert sketches official initiatives that have been undertaken or are being considered to combat vulture funds. In section V, he offers some recommendations on measures to address the negative effects of vulture fund activities.

Contents

I. Introduction

1. The present report is submitted in accordance with Human Rights Council resolution 11/5, in which the Council requested the independent expert on the effects of foreign debt and other related international financial obligations of States on the full enjoyment of all human rights, particularly economic, social and cultural rights, to submit analytical reports to the Council and the General Assembly on the implementation of that resolution.

2. In his report to the Council at its eleventh session (A/HRC/11/10), the independent expert outlined a preliminary conceptual framework for understanding the link between foreign debt and human rights, based on international legal standards. In his report to the General Assembly (A/64/289), he highlighted the relevance of the concept of illegitimate debt to international efforts to find a fair and sustainable solution to the debt crisis, and argued that human rights considerations must inform the formulation of the concept in precise terms. The present report is intended to achieve three objectives: (a) to draw global attention to the negative impacts of "vulture fund" activities on international debt relief efforts and on the capacity of indebted poor countries that have benefitted from debt relief to create the necessary conditions for the realization of human rights and attainment of their development goals; (b) to examine the measures and proposals designed to combat these speculative investors; and (c) to make recommendations concerning these initiatives.

II. Activities undertaken

3. Since he submitted his first report to the Council (A/HRC/11/10) in June 2009, the independent expert has engaged in a broad range of activities. The activities that he undertook during the period March to July 2009 are outlined in his report to the General Assembly (A/64/289).

4. From 31 August to 2 September 2009, the independent expert participated in the Social Forum of the Council in Geneva, at which he spoke on the impact of the global economic and financial crises on efforts to combat poverty. On 12 November, he participated in the inaugural meeting of the expert working group established by the United Nations Conference on Trade and Development (UNCTAD), under its project on promoting responsible sovereign lending and borrowing, to provide technical and policy analysis to inform the discussions concerning principles that could promote responsible sovereign lending and borrowing. On 17 December, he issued a press statement in which he expressed regret at the decision of the British High Court that Liberia must pay a debt dating to 1978 to two vulture funds. This event and other initiatives detailed in this report informed the decision of the independent expert to focus the present report on vulture funds.

5. From 11 to 13 January 2010, the independent expert participated in a colloquium in Geneva on human rights in the global economy, which was organized by the International Council on Human Rights Policy in collaboration with Realizing Rights: The Ethical Globalization Initiative. On 21 January, he participated in a panel discussion on Millennium Development Goal 8, Targets B and D on debt relief, held by the High-Level Task Force on the Implementation of the Right to Development during its sixth session (14–22 January) in Geneva. During this event, the independent expert delivered a statement in which he critically assessed the achievements and limitations of the multilateral debt relief initiatives in response to statements by representatives of the World Bank and the International Monetary Fund (IMF).

6. In addition, the independent expert undertook his first country missions to Norway (28–30 April 2009) and Ecuador (2–8 May 2009) at the invitation of the Governments of these countries. The main objective of the missions was to examine the unique roles of the two countries in the debate concerning illegitimate debt and to consider the effect, on the enjoyment of human rights, of the decisions by both countries concerning public debt, from the creditor and debtor perspectives. The official report on these missions is contained in the addendum to this report (A/HRC/14/21/Add.1).

7. For ease of reference, all United Nations documents related to the work of the independent expert, including reports to the General Assembly and the Council, interventions on foreign debt and human rights, and press statements, are available on the website of the Office of the High Commissioner for Human Rights at www2.ohchr.org/english/issues/development/debt/index.htm.

III. Vulture funds

A. What are "vulture funds"?

8. The term "vulture funds" is used to describe private commercial entities that acquire, either by purchase, assignment or some other form of transaction, defaulted or distressed debts, and sometimes actual court judgements, with the aim of achieving a high return. In the sovereign debt context, vulture funds (or "distressed debt funds", as they often describe themselves) usually acquire the defaulted sovereign debt of poor countries (many of which are heavily indebted poor countries (HIPCs)) on the secondary market at a price far less than its face value and then attempt, through litigation, seizure of assets or political pressure, to seek repayment of the full face value of the debt together with interest, penalties and legal fees.[1] According to the African Development Bank (AfDB), vulture funds have averaged recovery rates of approximately 3 to 20 times their investment, equivalent to returns of 300 to 2,000 per cent.[2] AfDB describes these recovery rates as "probably the highest in the distressed debt market".[3] At present, there are neither laws that limit the amount of interest or profit such funds can collect through litigation, nor regulatory frameworks that require disclosure of the amount such funds paid to purchase the debt.

9. It is difficult to state with precision how many lawsuits have been instituted by vulture funds. However, it is estimated that there have been over 50 lawsuits by commercial creditors against HIPCs and many of these are still outstanding.[4] According to the World Bank and IMF, 54 court cases were instituted against 12 HIPCs between 1998 and 2008.[5]

[1] See African Development Bank (AfDB), "Vulture funds in the sovereign debt context". Available from www.afdb.org/en/topics-sectors/initiatives-partnerships/african-legal-support-facility/vulture-funds-in-the-sovereign-debt-context/.

[2] Ibid.

[3] Ibid.

[4] Examples include Greylock Global Opportunity registered in the British Virgin Islands and owned by Greylock Capital Management, which sued Nicaragua and was awarded US$ 50.9 million; FG Hemisphere registered in the United States, which sued the Congo and the Democratic Republic of the Congo and was awarded US$ 151.9 million and $81.7 million, respectively; Kensington International, registered in the Cayman Islands and owned by Elliott Management, which sued the Congo and was awarded US$ 118.6 million; and Donegal International registered in the British Virgin Islands (ownership unclear), which sued Zambia and was awarded US$ 15.4 million.

[5] International Development Association (IDA) and IMF, "Heavily Indebted Poor Countries (HIPC) Initiative and Multilateral Debt Relief Initiative (MDRI) – status of implementation" (2008), para. 38.

Of those, 33 had not been settled as of September 2008. In the majority of cases a court judgement had been granted, for an estimated total of $1.2 billion (excluding awards extinguished through Debt Reduction Facility buy-backs). The potential impact of court awards varied from less than 0.5 per cent of the debtor country's gross domestic product (GDP) to 49 per cent in the case of Liberia.[6]

10. The 2009 report on the status of implementation of the HIPC Initiative and Multilateral Debt Relief Initiative indicates that litigation by commercial creditors appeared to be "less of a problem" in 2009 as compared to the previous year and that the number of cases still pending declined from 33 in 2008 to 14 in 2009.[7] However, the same report warns that "the threat of new litigation remains" and states that new lawsuits were initiated in 2008 against the Democratic Republic of the Congo, Sierra Leone, the Sudan and Zambia.[8]

11. Commercial creditor litigation is not confined to HIPCs. According to a study by the Trade Association for the Emerging Markets (EMTA), at least nine non-HIPC countries have been the subject of such litigation.[9] In a number of these cases, the litigating creditor was awarded what EMTA has described as "a substantial amount" relative to what was paid for the debt obligation in the secondary market, or to what other creditors who voluntarily exchanged their debt in the restructuring received.[10]

12. Vulture fund lawsuits tend to be instituted in the courts of the developed countries. This may be where the vulture fund is registered or it may be the jurisdiction specified in the loan agreement. Most lawsuits are filed in courts in the United States of America, the United Kingdom of Great Britain and Northern Ireland and France, which are perceived as "creditor-friendly" jurisdictions. A small number of lawsuits have been filed in the courts of HIPCs.

13. It is notable that vulture funds are often secretive, both in terms of their ownership and operations, and many of them are incorporated in offshore financial centres and banking secrecy jurisdictions, commonly referred to as tax havens.[11] Some are owned by large financial institutions such as hedge funds (often based in the United States) and in other cases their ownership is obscure. Often, companies are established to pursue a single debt. For example, Donegal International Limited, which sued Zambia in 2006 (see below), was incorporated in the British Virgin Islands on 18 December 1997 by Debt Advisory International LLC, a company based in the United States and owned by Michael Sheehan,

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It should be noted, however, that IMF only tracks private creditor lawsuits for HIPC Initiative eligible countries that have reached the decision or completion point.

[6] Ibid., para. 38.

[7] IDA and IMF, "Heavily Indebted Poor Countries (HIPC) Initiative and Multilateral Debt Relief Initiative (MDRI) – status of implementation" (2009), para. 24. According to IDA and IMF, the drop in the number of active cases is attributable to Debt Reduction Facility operations in Nicaragua and Liberia, out-of-court settlements by Cameroon, the Republic of the Congo, Sierra Leone and Zambia, and the discontinuation, by five creditors, of lawsuits against Nicaragua (para. 24).

[8] Ibid., para. 25.

[9] These are Argentina, Brazil, Bulgaria, Costa Rica, Ecuador, Panama, Paraguay, Peru and Poland. However, EMTA states that it is "unable to confirm that this is a complete list of cases brought against non-HIPC sovereigns in the restructuring context". (EMTA, "Creditor litigation in the non-HIPC sovereign debt restructuring context: EMTA case summaries", discussion draft (2009), p. 1).

[10] EMTA, "Preliminary analysis of creditor litigation in the non-HIPC sovereign debt restructuring context", discussion draft (2009), p. 3.

[11] Many tax havens are located in Europe, or are dependencies or overseas territories of European countries. See European Network on Debt and Development (Eurodad) and others, "Addressing development's black hole: regulating capital flight" (May 2008), p. 9.

with the sole aim of pursuing a debt owed by Zambia to Romania. As at the time of its litigation against Zambia, Donegal was owned by Select Capital Limited, a company registered in the British Virgin Islands on 27 June 1997. In the *Donegal International* case, the court found that the "ultimate ownership of Select Capital (was) rather obscure" and in his testimony before the court, Mr. Sheehan said that Select Capital had been set up offshore because "many of the investors were European and did not want to be subject to US tax".[12]

14. The independent expert supports the view that tax havens facilitate the secretive manner in which vulture funds operate as well as the flight of much-needed capital from developing countries.[13] Consequently, he considers that a key priority for the international community should be to end this secrecy and lack of transparency. In his estimation, tackling tax havens would also help address money laundering, tax evasion and capital flight.

B. Case studies

Liberia

15. In 1978 Liberia borrowed US$ 6.5 million from Chemical Bank, a company based in the United States.[14] The bank sold the debt to FH International Financial Services Inc. and Sifida Investment Company S.A., which later brought an action for its recovery before a court in New York. On 19 June 2002, the court entered a default judgement against Liberia for approximately US$ 18.4 million. Following the judgement, the debt was assigned several times by FH International Financial Services and Sifida to third parties and back to the two judgement creditors. The debt was subsequently assigned to Hamsah Investments Ltd. (registered in the British Virgin Islands) and Wall Capital Ltd. (registered in the Cayman Islands).

16. In June 2008, Hamsah Investments and Wall Capital commenced proceedings in the High Court in London to register, as an English judgement, the judgement of the New York court.[15] On 26 November 2009, the High Court ordered Liberia to pay the claimants more than US$ 20 million including interest. While it accepted that Liberia was "short of money" and that the judgement debt was "a substantial sum", the court stated that Liberia "must do the best they can".[16] The court rejected the submission of Liberia that it had been unable to respond to the claim before the New York court because of the financial difficulties which it faced, particularly during the period of the country's civil war.[17] The court also held that

[12] *Donegal International Ltd. v. Republic of Zambia & Another* [2007] EWHC 197 (Comm.), para. 27.

[13] See Jubilee Debt Campaign, "Time to stop the debt vultures" (June 2009). The flow of financial resources from developing to developed countries is estimated at US$ 500 billion – US$ 800 billion each year (Eurodad, "Addressing development's black hole", p. 4). See also L. Ndikumana and J.K. Boyce, "New estimates of capital flight from sub-Saharan Africa: linkages with external borrowing and policy options", Working Paper No. 166 (Political Economy Research Institute, University of Massachusetts, April 2008).

[14] See H. Stewart, "Vulture funds sue Liberia for £12m in high court", 25 November 2009. Available from www.guardian.co.uk/business/2009/nov/25/vulture-funds-sue-liberia.

[15] See *Hamsah Investments Ltd. & Anor v. The Republic of Liberia*, Case No. 2008/587 (High Court of Justice, London), judgement of 26 November 2009.

[16] Ibid., para. 29.

[17] Ibid., paras. 4 and 17.

the debt rescheduling agreements Liberia had reached with its Paris Club creditors did not affect the obligations of the State to the private companies.[18]

17. Liberia, an HIPC with a GDP of US$ 870 million, ranks 169th out of 182 countries in the Human Development Index.[19] Over 94 per cent of the country's population of more than 4 million lives on less than US$ 2 per day, while the unemployment rate is as high as 85 per cent. Life expectancy is less than 50 years and only slightly more than a third of the population is literate. The estimated adult HIV prevalence rate is 1.7 per cent.[20] The country is attempting to recover from the effects of a devastating civil war that include badly damaged infrastructure as well as limited or no access to safe water and sanitation or electricity for the majority of the population. The judgement debt of US$ 20 million payable by Liberia is equivalent to about 5 per cent of the budget of the Government of Liberia this year, the country's entire education budget and 150 per cent of its health budget in 2008.[21] Plainly, Liberia cannot service its debt without jeopardizing its poverty-reduction and economic development prospects, let alone pay an amount that the British High Court accepted was "a substantial sum".

Democratic Republic of the Congo

18. In 1980 and 1986 the Democratic Republic of the Congo (formerly Zaire) and its national electricity company (Société Nationale d'Électricité) entered into credit agreements with Energoinvest, a Yugoslav company, to provide electrical infrastructure. The Government guaranteed the amount but by the late 1980s both the electricity company and the Government had defaulted on the debts. In 2003, the International Chamber of Commerce made two arbitral awards in favour of Energoinvest for US$ 18.43 million and US$ 11.725 million plus 9 per cent interest and the cost of arbitration. In 2004 the United States District Court for the District of Columbia confirmed the US$ 11.725 million arbitral award and in 2005 confirmed the US$ 18.43 million arbitral award.

19. Energoinvest then sold its interests in the arbitral awards and judgements to a company called FG Hemisphere (now FG Capital Management) which specializes in uncovering, investigating and managing alternative investment opportunities and special situations within the emerging markets.[22] Subsequently, FG Hemisphere attempted to seize assets of the Democratic Republic of the Congo in the Bahamas, Europe, South Africa, the United States and in Hong Kong, Special Administrative Region of China. In 2005, the company obtained a court order compelling the State to furnish detailed information about all its assets throughout the world. The State failed to comply with the order, arguing that it imposed a virtually impossible burden. In May 2008, FG Hemisphere filed a motion in the United States District Court for the District of Columbia to hold the Democratic Republic of the Congo in contempt.[23] In March 2009, the court fined the State the sum of US$ 5,000

[18] Ibid.

[19] United Nations Development Programme (UNDP), *Human Development Report 2009* (New York, 2009), p. 145; World Bank, *World Development Indicators* (October 2009), available from http://data.worldbank.org/indicator/NY.GDP.MKTP.CD.

[20] Joint United Nations Programme on HIV/AIDS (UNAIDS), *2008 Report on the Global AIDS Epidemic* (2008), p. 215.

[21] Jubilee USA Network, "UK judge awards funds $20 million, more than Liberia's total spending on education last year". Available from www.jubileeusa.org/press/press-item/article/advocacy-groups-decry-profiteering-by-vulture-funds-in-liberia.html?tx_ttnews%5BbackPid%5D=170&cHash=924f4678be.

[22] H. Stewart and A. Seager, "Vulture fund swoops on Congo over $100m debt", *Observer*, 9 August 2009. Available from www.guardian.co.uk/world/2009/aug/09/congo.

[23] See M. Stulman, "Indebted nations fight off vulture funds", *Asia Times* Online, 8 July 2009.

per week and rising every four weeks to a maximum of US$ 80,000 per week, for failing to comply with the order.[24]

20. The Democratic Republic of the Congo, which has a GDP of US$ 11.6 billion and a Human Development Index ranking of 176, remains embroiled in a civil war.[25] Approximately 79.5 per cent of its nearly 66 million population lives on less than US$ 2 per day. Government expenditure on health is estimated at 7.2 per cent of GDP.[26] With a debt burden deemed unsustainable by the World Bank and IMF, the Democratic Republic of the Congo cannot service its external debt obligations without harming its poverty-reduction and economic development prospects. It is currently going through the HIPC process; the court awards mentioned above threaten the country's potential gains from international debt relief efforts and its capacity to create the conditions for fulfilling its human rights obligations.

Zambia[27]

21. In 1979 Romania lent Zambia US$ 15 million, which the latter used to purchase tractors and other agricultural machinery from the former. It appears that some of this equipment arrived in an unusable condition. This situation was compounded by the fact that European subsidies rendered it difficult for Zambia to compete in the global marketplace. Unable to raise enough revenue from its exports to service the loan, Zambia defaulted.

22. In early 1997 Debt Advisory International (which later incorporated Donegal International to pursue the debt Zambia owed to Romania) started putting forward proposals to acquire the Zambian debt from Romania. In an obvious attempt to persuade Romania to accept its proposal to acquire the debt, Debt Advisory International sent a memorandum to Romania in May in which it stated:

> We understand that Zambia is currently not servicing its debt to Romania and has not made any serious attempts to reschedule these claims in many years. Furthermore, Zambia is not likely to resume servicing its obligations to Romania in the near term. Zambia's economic situation remains dire, and the country's unsustainable external debt burden makes it one of the countries likely to benefit from the Heavily Indebted Poor Countries (HIPC) Initiative … Under the HIPC initiative, Zambia will receive additional debt reduction from its bilateral creditors … In particular, bilateral creditors may need to write off up to 90 per cent of their Zambian claims and reschedule the remaining 10 per cent over 23 years or more. It is the practice of the Paris Club to require African Governments to agree a minute to the effect that they will not afford any other sovereign creditor better rescheduling terms than they have afforded the Paris Club. Consequently, we believe that there is very little chance that Romania can expect to obtain more in net present value terms that we are presently offering.[28]

23. In 1998, Romania agreed to sell the debt to Donegal International for US$ 3.2 million subject to the fulfilment of certain conditions by Donegal. The company failed to meet one of these conditions, namely, meeting a deadline of 31 December 1998 for the completion of the assignment. In December 1998, the two countries commenced negotiations to liquidate the debt for US$ 3,281,780 and subsequently signed a

Available from www.atimes.com/atimes/Global_Economy/KG08Dj02.html.

[24] Ibid.

[25] UNDP, *Human Development Report 2009*, p. 145 and World Bank, *World Development Indicators*.

[26] UNDP, *Human Development Report 2009*, pp. 178 and 201.

[27] See *Donegal International v. Zambia* (see footnote 12).

[28] Ibid., para. 75.

memorandum of understanding to the effect that Zambia would have until 31 January 1999 to confirm its offer to purchase the debt at its slightly higher offer of US$ 3.5 million. Just 12 days before this deadline and, without prior notice to Zambia, Romania sold the debt to Donegal International for US$ 3.2 million. At the time, the debt had a face value of approximately US$ 30 million.

24. In September 2002, after unsuccessfully attempting to swap the debt for investments in Zambia, Donegal International commenced litigation in the British Virgin Islands for approximately US$ 43 million. In April 2003, in controversial circumstances involving allegations of corruption and bribing of public officials, Zambia signed a settlement agreement with Donegal International in which it agreed to waive sovereign immunity from litigation and pay around US$ 15 million of the then US$ 44 million face value. It also agreed to penal rates of interest in the event of default and to have any disputes determined under English law. Zambia paid a total of US$ 3.4 million in three instalments and thereafter stopped paying, arguing that the agreement was tainted with corruption and had been signed without the requisite authority.

25. In 2006, months before Zambia was due to receive debt cancellation under the HIPC Initiative, Donegal International instituted legal action against the country for US$ 55 million – an amount that was nearly 17 times the amount the company paid for the debt. In February 2007, the British High Court ruled in favour of Donegal International. Despite having found that the owner of the company, Mr. Sheehan, was "deliberately evasive and even dishonest", that he had "deliberately" given "false evidence", that the company had "deliberately" withheld documents "because they contradicted the case that they were seeking to advance" and that "the evidence from the witnesses called by Donegal (was) vague and inconsistent",[29] the court held that Donegal International had a case in law. However, it subsequently ruled that Zambia had a real prospect of establishing that certain provisions of the settlement agreement were penal and therefore unlawful. It ordered Zambia to pay US$ 15.4 million (an amount equivalent to 65 per cent of the country's savings in debt relief in 2006)[30] to Donegal International. Under HIPC Initiative terms, Zambia could have expected 88 per cent cancellation of its debt.

26. This case underscores the need for debtor countries to fully comprehend the implications of formally recognizing claims arising out of sovereign debts sold on the secondary market.

C. Vulture funds, debt relief and human rights

27. There are two main international debt relief schemes: the Heavily Indebted Poor Countries (HIPC) Initiative and the Multilateral Debt Relief Initiative (MDRI). The HIPC Initiative was created in 1996 with the aim of reducing the debt burden of the world's poorest countries to "sustainable levels".[31] A comprehensive review in 1999 resulted in the

[29] Ibid., paras. 51 (iii), 64, 90 and 127. See also paras. 132, 136, 150, 151, 156 (ii), 159, 167, 181, 188, 273, 344, 544.

[30] See Jubilee USA Network, "Vulture funds and poor country debt: recent developments and policy responses", Briefing Note 4, April 2008, citing IDA and IMF, "Heavily Indebted Poor Countries (HIPC) Initiative and Multilateral Debt Relief Initiative (MDRI) – status of implementation" (2006), p. 65.

[31] In order to qualify for debt relief under the HIPC Initiative, a country must: (a) have an unsustainable debt burden (i.e. a net present value of debt-to-exports ratio, after traditional debt relief, of more than 150 per cent); (b) establish a track record of policies and reforms through IMF- and IDA-supported programmes; and (c) have prepared a poverty reduction strategy paper through "a broad-based participatory process".

Enhanced HIPC Initiative to ensure faster, deeper and broader debt relief with the core objective of poverty reduction. In 2005, the HIPC Initiative was supplemented by MDRI to help accelerate countries' progress towards the Millennium Development Goals. MDRI ostensibly provides countries that complete the HIPC Initiative with full debt cancellation from four main multilateral institutions: IMF, the International Development Association (IDA), African Development Fund (administered by AfDB) and the Inter-American Development Bank.[32]

28. As of end-July 2009, 26 of the 40 eligible countries had completed the HIPC Initiative and qualified for irrevocable debt relief, while a further 9 had reached the decision point and qualified for interim debt relief. In September 2009, the World Bank and IMF reported that the total debt relief committed to the 35 post-decision-point HIPCs under the initiatives was US$ 124 billion (in nominal terms), representing on average about 40 per cent of the 2008 GDP of these countries.[33] Commercial creditors account for 6 per cent of the total cost of debt relief to be provided to the 35 post-decision-point HIPCs, but only around a third of this has been provided.

29. According to the World Bank and IMF, the two international debt relief initiatives have helped significantly reduce the external debt burden of HIPCs and contributed to creating the fiscal space necessary for poverty-reducing expenditure and economic development in these countries. Countries that have benefitted from debt relief have increased average spending on health and education and now spend on average six times more on these basic services than they do on debt service. The 2009 HIPC and MDRI status of implementation report indicates that between 2001 and 2008, poverty-reducing spending in the 35 post-decision-point HIPCs increased by 2 percentage points of GDP on average, while debt service obligations declined concomitantly.

30. There is a dearth of empirical studies on the impact of HIPC and MDRI debt relief on economic and human development. Nevertheless, a few studies show a positive correlation between the reduction in debt service and the increase in poverty-reducing expenditure. For example, a study by Crespo Cuaresma and Vincellette shows that average educational expenditures are about 18.5 per cent of total government expenditures in post-completion-point HIPCs, which is 2 to 3 percentage points higher than in pre-decision-point countries.[34]

31. From a human rights perspective, reduced debt burdens and increased fiscal capacity have contributed to the creation of the conditions necessary for the realization of human rights, particularly economic, social and cultural rights, in HIPCs. Some of the human rights impacts of debt cancellation include the abolition of primary school fees in Ghana, Malawi, Uganda, the United Republic of Tanzania and Zambia, resulting in increased school enrolments in these countries; abolition of user fees for health care in Zambia, thereby making basic health care available to millions of Zambians living in rural areas; and improvement of health care in Mauritania and the Plurinational State of Bolivia.[35]

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[32] The initiative covers all post-completion point HIPCs. Debt relief covers all debt due to IMF, the African Development Fund, and Inter-American Development Bank (IDB) by end-December 2004 and all debt due to IDA by end-December 2003 and still outstanding at the time of qualifying (i.e. after HIPC Initiative debt relief). See www.imf.org/external/np/exr/facts/mdri.htm.

[33] IDA and IMF, "HIPC Initiative" (2009) (see footnote 7), para. 4.

[34] J. Crespo Cuaresma and G.A. Vincelette, "Debt relief and education in heavily indebted poor countries" in C.A. Primo Braga and D. Domeland (eds.), *Debt Relief and Beyond: Lessons Learned and Challenges Ahead* (Washington DC, World Bank, 2009), pp. 40–41.

[35] See Jubilee Debt Campaign, *Unfinished Business: Ten Years of Dropping the Debt* (London, Jubilee Debt Campaign, 2008), pp. 25–26.

32. Nevertheless, the voluntary nature of the two international debt relief schemes discussed above creates opportunities for individual creditors to refuse to participate and then attempt to recover — through litigation, seizure of assets or political pressure — the full value of their debt.[36] In particular, this has enabled vulture funds to purchase defaulted debts and to litigate for the full face value at the expense of the debtor country and of other creditors.

33. Vulture fund litigation prevents heavily indebted poor countries from using resources freed up by debt relief for their development and poverty reduction programmes, and therefore diminishes the capacity of these countries to create the conditions necessary for the realization of human rights for their people. Money that is earmarked for poverty reduction and basic social services, such as health and education, is diverted to settling the substantial claims of vulture funds. In short, vulture funds erode the gains from debt relief for poor countries and jeopardize the fulfilment of these countries' human rights obligations.

34. It has been estimated that the average potential impact of vulture fund litigation against HIPCs amounts to 18 per cent of spending on health care and education, 59 per cent of debt repayments, and 5 per cent of budget revenue. A 2007 study by Debt Relief International found that lawsuit costs amount to 52 per cent of health and education in the Niger and 98 per cent of revenue in Cameroon. In 2008, the World Bank and IMF estimated that the potential impact of court awards varied from less than 0.5 per cent of the debtor country's GDP to 49 per cent in the case of Liberia.[37]

35. Vulture fund litigation can also be lengthy and costly for HIPC countries, thereby diverting much needed resources and attention from pressing development, social and human rights issues. According to AfDB, vulture funds "grind down poor countries in cycles of litigation" and many lawsuits typically take 3 to 10 years to settle.[38]

36. It is noteworthy that the World Bank and IMF have recognized that litigation by commercial creditors has been "an impediment to the delivery of full debt relief to HIPCs".[39] Similarly, the European Commission has acknowledged that cases of aggressive litigation by commercial creditors have diluted some of the benefits of debt relief initiatives. In 2007, the Paris Club acknowledged that litigation against HIPCs "is a cause of concern for the international community".[40]

IV. Official initiatives to tackle vulture funds

37. A number of initiatives have been adopted or are being considered at the international and national levels to tackle vulture funds. In this section, the independent expert sketches these initiatives and briefly addresses some of the key concerns raised in relation to the potential adverse consequences of proposed national legislative measures on the development prospects of the intended beneficiaries – HIPCs.

[36] Thus, even when a country reaches the completion point, creditors retain their legal rights to enforce claims against the country concerned.

[37] IDA and IMF, "HIPC Initiative" (2008) (see footnote 5), para. 38.

[38] AfDB, "Vulture funds" (see footnote 1).

[39] IDA and IMF, "HIPC Initiative" (2009) (see sect. III, footnote 7), para. 24.

[40] See www.clubdeparis.org/sections/types-traitement/reechelonnement/initiative-ppte/sujets-relatifs-aux/sujets-relatifs-aux.

A. Multilateral initiatives

38. The IDA Debt Reduction Facility, established in 1989, provides grants to heavily indebted IDA-only countries to enable them buy back, at a significant discount, commercially held external sovereign debt.[41] The facility provides grants for both the preparation and the implementation of commercial debt-reduction operations. In order to be eligible for support from the Debt Reduction Facility, countries must meet certain conditions, including the demonstration of "satisfactory performance under a medium term adjustment program" and implementation of a "satisfactory strategy for debt management that seeks comprehensively to address commercial debt, provides substantial relief from official bilateral creditors, and enhances the country's growth and development prospects".[42] Since its inception, the facility has helped extinguish approximately US$ 10 billion of external commercial debt.

39. In April 2008, changes were made to the policies and procedures of the Debt Reduction Facility to improve its effectiveness at assisting eligible countries to reduce their burden of sovereign commercial external debt and reducing the opportunities for commercial creditors to profit from litigation against HIPC countries. In terms of the modifications, formerly bilateral debts sold to commercial creditors and domestic debts sold to external creditors after the HIPC decision-point reference date are no longer considered eligible for buy-back. These changes aim to prevent distressed debt funds (i.e., vulture funds) from making a profit by buying claims at a deep discount and tendering them for a buy-back under the facility and to discourage the sale of debt from official to commercial creditors.[43]

40 Despite these successes and enhancements, the Debt Reduction Facility has a major limitation: participation by commercial creditors is entirely voluntary. In other words, the facility does not prevent a creditor from holding out and then suing to recover the full face value of its debt instrument. The case of Liberia illustrates this problem. In April 2009, commercial creditors provided debt relief to Liberia under a debt buy-back operation under the facility and contributions from bilateral donors, which extinguished US$ 1.2 billion of commercial debt at a deep discount of 97 per cent of face value. Despite this buy-back, the non-participating creditors continued to hold claims against Liberia worth 85 per cent of the cost of the facility buy-backs. In November, the British High Court ordered Liberia to pay more than US$ 20 million to two vulture funds (see para. 16 above). Thus, as the Government of the United Kingdom has acknowledged, the Debt Reduction Facility "cannot address the problem posed by creditors determined to pursue a higher payout than that given by HIPC Initiative terms".[44]

41. In September 2006, the Commonwealth Secretariat established a Legal Debt Clinic to provide legal advice to both Commonwealth and non-Commonwealth HIPCs facing or likely to face litigation by commercial creditors. The clinic also aims to hold regional seminars to raise awareness about the legal aspects of debt management, legal soundness of loan agreements, debt restructuring and how to deal with litigation threats.[45]

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[41] See http://go.worldbank.org/DB88PB5XA0. See also B. Gamarra, M. Pollock and C.A. Primo Braga, "Debt relief to low-income countries: a retrospective", in C.A. Primo Braga and D. Domeland (eds.), *Debt Relief and Beyond* (see footnote 13), pp. 24–25.

[42] See http://go.worldbank.org/2W4HSIN5I0.

[43] IDA and IMF, "HIPC Initiative" (2008) (see sect. III, footnote 5), p. 32, box 3.

[44] United Kingdom, *Ensuring Effective Debt Relief for Poor Countries: A Consultation on Legislation* (HM Treasury, 2009), p. 22.

[45] See www.thecommonwealth.org/Internal/39284/157583/legal_debt_clinic/.

42. The Paris Club creditors have collectively committed not to sell claims on HIPC countries to creditors who do not intend to provide debt relief, and called upon other creditors to make the same commitment.[46]

43. In 2008, Commonwealth Finance Ministers issued a communiqué in which they "recognized the importance of Commonwealth creditors leading by example by providing full HIPC relief and not selling claims on to other creditors".[47]

44. In May 2008, European Union countries pledged to take action to "deter aggressive litigation by distressed-debt funds" and agreed not to sell claims on HIPCs to creditors who are not willing to provide debt relief.[48] They further agreed to support: (a) dialogue with other creditors (bilateral, multilateral and commercial) and with borrowing countries; and (b) technical assistance to strengthen the debt management capacities of low-income countries and assist efficient debt negotiations; and (c) commercial debt buy-backs complementary to HIPC debt relief operations.[49]

45. In June 2009, AfDB launched the African Legal Support Facility with the goal of maximizing resources available for economic development and social progress for its member countries by enhancing their access to technical legal advice in dealing with lawsuits and other claims brought by vulture funds, in addition to other ancillary areas.[50] The facility is designed to, among other things: (a) provide members of the facility involved in creditor litigation with legal advice and services; and (b) provide members of the facility with technical legal assistance to enhance their legal expertise and negotiating capacity in matters related to debt management; natural resources and extractive industries management and contracting; investment agreements; and related commercial and business transactions.

46. The independent expert welcomes the foregoing multilateral initiatives against vulture funds. However, he is of the view that they are insufficient to prevent vulture fund activity. All of these initiatives depend on voluntary commitments not to sell debt obligations on to speculative investors or they provide funds or technical legal support to heavily indebted poor countries. Further, as the European Network on Debt and Development has argued, multilateral initiatives to discourage vulture fund activity appear to have ignored the fact that "it is entirely legal for vulture funds to pursue their claims in court".[51] Significantly, these measures do not prevent speculative commercial creditor litigation against poor countries. Indeed, the potential for profit remains a strong incentive for vulture funds to continue their activities.[52] The problem is aptly summed up in the

[46] Paris Club, press release on the threats posed by some litigating creditors to heavily indebted poor countries, 22 May 2007. Available from www.clubdeparis.org/sections/communication/archives-2007/communique-presse-du/switchLanguage/en.

[47] See www.thecommonwealth.org/document/184212/commonwealth_finance_ministers_meeting_communiqu.htm.

[48] Council of Europe, "Council conclusions: speeding up progress towards the Millennium Development Goals (MDGs)", 2870th External Relations Council Meeting, Brussels, 26 and 27 May 2008, para. 41. Available from www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/gena/100688.pdf.

[49] Ibid.

[50] See www.afdb.org/en/topics-sectors/initiatives-partnerships/african-legal-support-facility/goals-and-objectives/. See also IDA and IMF, "HIPC Initiative" (2009) (see sect. III, footnote 7), para. 25.

[51] Eurodad, "Taming the vultures: are new measures enough to protect debt relief gains?" (Brussels, 2008), p. 11.

[52] The Government of the United Kingdom acknowledges the problem as follows: "These methods cannot prevent creditors intent on pursuing their claims through the courts from doing so. So long as it remains possible and potentially profitable (depending on the price paid for the debt) to litigate for

words of Michael Sheehan of Donegal International: "Our experience and that of others in this business is that you always eventually recover. You have a legal claim. Eventually if you litigate and work hard enough, you will always recover a sufficient amount to cover your costs."[53] The independent expert therefore calls upon all countries — creditor and debtor alike — to urgently consider enacting legislation that would make vulture fund profiteering illegal within their respective jurisdictions.

47. The following section briefly reviews the legislative measures that have been taken or are being considered by individual countries to tackle the vulture fund problem.

B. Initiatives at the national level

48. At the national level, legislative proposals are being considered or have been adopted in the United States and the United Kingdom to limit vulture fund litigation against HIPCs. In Belgium, the Senate approved a Law in May 2008 which prohibited vulture fund litigation in that country.[54] The law stresses that official development assistance funds are "untouchable and non-transferable". The Senate also adopted a non-binding resolution which, inter alia, called upon the Government of Belgium to urge the World Bank and IMF to develop the necessary legal instruments to ensure that debt relief initiatives are binding on all creditors.[55]

49. In July 2009, Representative Maxine Waters introduced the Stop Very Unscrupulous Loan Transfers from Underprivileged Countries to Rich, Exploitive Funds Act, or the Stop VULTURE Funds Act (H.R.2932), in the United States House of Representatives. This legislation is designed to protect low-income developing countries from the predatory practices of vulture funds by preventing "speculation and profiteering in the defaulted debt of certain poor countries". The proposed legislation (which is limited to countries that are eligible to borrow from IDA, the concessional loan facility of the World Bank) would make it illegal for any private creditor holding defaulted sovereign debt to use litigation in a United States court, or the threat of such litigation, to secure payment of more than the total amount they paid for the debt obligation plus 6 per cent simple interest from the date the debt was acquired from an eligible poor country. Companies or individuals that act in contravention of this law would be subject to fines in amounts equal to the sum they sought to claim through litigation. The legislation also seeks to promote transparency by requiring full disclosure from any private creditor seeking to litigate against poor countries in United States courts.

50. It is notable that the United States draft legislation recognizes that profiteering in defaulted sovereign debt is facilitated by the lack of insolvency protections for sovereign debtors that are available to private debtors. Insolvency laws generally protect private debtors by, among other things, stays of execution pending restructuring of debt, suspension of accrual of interest and the ability to discharge debts and obligations as part of a debt restructuring process.

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payment of the full value once other creditors have provided relief, some creditors are likely to take this route." United Kingdom, "*Ensuring Effective Debt Relief*" (see footnote 23), p. 19.

[53] *Donegal International v. Zambia* (see sect. III, footnote 12), para. 76.

[54] See http://reflex.raadvst-consetat.be/reflex/pdf/Mbbs/2008/05/16/109374.pdf.

[55] P. Vandevoort (11.11.11 Belgium), "Belgian Senate unanimously approves 'vulture fund' legislation", 1 February 2008. Available from http://jubileeusa.typepad.com/blog_the_debt/2008/02/belgian-senate.html. See also IDA and IMF, "HIPC Initiative" (2009) (see sect. III, footnote 7), para. 26.

51. In July 2009, the Government of the United Kingdom launched a public consultation on possible legislation that would limit the extent to which vulture funds could recover debt already contracted by a HIPC under British law.[56] In February 2010, the Government published a response to the consultation as well as an impact assessment in support of the Debt Relief (Developing Countries) Bill, a Private Member's Bill introduced in the House of Commons in December 2009 by Andrew Gwynne MP.[57] On 8 April, the Bill was passed into law as the Debt Relief (Developing Countries) Act (c. 22) and it received the Royal Assent on the same date. The Act, which has a duration of one year from the date of commencement (although it may be extended for a further period or made permanent), is designed to limit the ability of vulture funds to use courts in the United Kingdom to recover debts owed by HIPCs.

52. The initiatives that have been undertaken or are being undertaken in Belgium, the United States and the United Kingdom to curb vulture fund activity are commendable. The independent expert urges all countries, particularly those that are preferred jurisdictions for vulture funds, to urgently consider enacting legislation to curtail vulture fund activity. Such a course of action would be consonant with the commitment, made in the Monterrey Consensus of the International Conference on Financing for Development, by all countries to share responsibility for preventing and resolving unsustainable debt situations as well as with the recognition in the Monterrey Consensus of the role of comprehensive strategies in reducing the vulnerability of debtor countries.[58]

53. The independent expert believes that such legislative frameworks should include measures to promote transparency in the secondary debt market and to tackle tax havens. In addition, as the Jubilee Debt Campaign has suggested in relation to the legislative proposals in the United Kingdom, the legislation should not be limited to HIPCs but should extend to all developing countries, with HIPC terms applied to HIPCs and a profiteering cap applied to all other developing countries.[59]

C. Concerns over proposed legislative controls on vulture funds

54. There has been some opposition to legislative proposals to curb vulture fund activity based on the concerns that, among other things, the proposed legislative controls offer minimal benefits to the beneficiary countries, they have adverse consequences for the secondary debt market and may limit access to credit for the intended beneficiary countries.[60] Due to space limitations, these concerns are addressed briefly.

55. In its submission in response to the consultation of the Government of the United Kingdom on proposed vulture fund legislation, EMTA — an organization which describes

[56] United Kingdom, *Ensuring Effective Debt Relief* (see footnote 44).

[57] United Kingdom, "Impact assessment of measures to address non-participation in debt relief", (HM Treasury, 2010), available from www.hm-treasury.gov.uk/consult_debt_relief.htm.

[58] *Report of the International Conference on Financing for Development, Monterrey, Mexico, 18–22 March 2002* (United Nations publication, Sales No. E.02.II.A.7), chap. I, resolution 1, annex, para. 47.

[59] See Jubilee Debt Campaign, "The business case for prohibiting 'vulture' actions in UK courts". Available from www.jubileedebtcampaign.org.uk/download.php?id=859.

[60] See, for instance, the submissions of (a) EMTA and (b) Africa Fighting Malaria, International Policy Network, Free Market Foundation of Southern Africa and Imani Ghana, in United Kingdom, *Ensuring Effective Debt Relief for Poor Countries: Consultation Responses Received* (2010). See also Free Market Foundation of Southern Africa, *The UK Debt Relief (Developing Countries) Bill: A Threat to Growth and Prosperity in Africa*. Available from www.freemarketfoundation.com/DynamicData/Event_18.pdf.

itself as "the principal industry trade association for the financial institutions worldwide that buy, sell and hold debt instruments issued by Emerging Markets countries and obligors located therein" and claims that it is "dedicated to promoting the orderly development of fair, efficient and transparent trading markets for Emerging Market instruments … and to helping to integrate the Emerging Markets more fully" into the international financial system[61] — contends that the proposed legislation "while intended to provide a very limited 'benefit' to certain highly indebted poor countries (HIPCs), would in fact negatively affect market access of all HIPCs, and therefore, limit their long-term prospects for development and economic growth, and jeopardize their further integration into the international financial system".[62] It further claims that the implications of the proposed legislation to the broader market include: "(i) a dramatic reduction of liquidity and price in the secondary market for defaulted claims, (ii) a corresponding reduction in the supply of credit and/or increased cost of financing for HIPC borrowers …, and (iii) potential increased cost of financing across the wider Emerging Markets, as creditors interpret this Legislative Proposal as hostile to creditor rights".[63] However, the submission fails to offer any cogent evidence to support the EMTA claims.

56. Contrary to the claims of the EMTA, legislation designed to protect debt relief gains from the predatory activities of vulture funds would not curtail the secondary debt market. Rather, it would enable the secondary debt market to function in a more transparent and efficient manner. The British legislation does not preclude creditors from obtaining recompense through the legal system for debts owing to them. It only prevents them from obtaining extortionate payments on sovereign debt at the expense of other creditors in much the same way that insolvency law does in relation to private debtors.

57. Vulture fund activity not only dilutes the gains from debt relief, it also complicates the debt relief process and undermines other creditors by forcing debtor countries to grant vulture funds preferential treatment at the expense of responsible creditors who may be involved in debt restructuring with the debtor countries. Unlike vulture funds, responsible secondary debt participants do not acquire sovereign debt for the sole purpose of enforcing payment of usurious interest rates from impoverished countries. Responsible and ethical creditors therefore have nothing to fear from the proposed legislation.

58. Further, vulture fund litigation and freezing of the assets of debtor countries in the course of such litigation jeopardizes the servicing of debt obligations by the affected countries. It also inhibits trade and investment relations with developing countries.[64] Illustratively, in 2001, the vulture funds FG Hemisphere Associates LLC and Af-Cap sued CMS Nomeco, an oil and gas company in Texas, in a bid to garnish payments that CMS Nomeco owed to the Republic of the Congo.[65] In 2008, FG Hemisphere Associates approached the High Court of Hong Kong, Special Administrative Region of China to try to force the China Railway Group to hand over part of its infrastructure investment in the Democratic Republic of the Congo. Such actions provide a disincentive for companies to trade with or invest in countries targeted by vulture funds and therefore harm the development prospects of these countries.[66]

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[61] Letter from Michael Chamberlin, Executive Director of EMTA to the Judicial Appeal Committee, House of Lords, 23 June 2007. See also EMTA, "Submission" (see footnote 60 above), p. 1.

[62] EMTA, "Submission", p. 1.

[63] Ibid., p. 13.

[64] Jubilee Debt Campaign, "The business case".

[65] See *FG Hemisphere Associates v. République du Congo*, 455 F.3d 575 (5th Circ. 2006) and *Af-Cap Inc v. The Republic of Congo*, 462 F.3d 417 (5th Cir. 2006).

[66] For a discussion of the difficulties faced by companies doing business with poor countries being targeted by vulture funds, see A.B. Derman and A. Melsheimer, "Recent developments in foreign

59. According to a joint World Bank and IMF report, pending litigation and outstanding court awards may also prevent HIPCs from regularizing financial relationships with the international banking community.[67]

60. EMTA also claims that "the process of commercial creditor debt renegotiation and debt relief within the HIPC Initiative framework is already functioning effectively without legislative intervention".[68] To buttress its claims, it relies on the example of the Liberia Debt Reduction Facility buy-back operation in April 2009 which saw US$ 1.2 billion of commercial debt extinguished at 97 per cent of face value. However, EMTA expediently omits to mention that participation in Debt Reduction Facility buy-back operations is voluntary and the facility does not prevent hold-outs by creditors, as the case of *Hamsah Investments Ltd v. Liberia*,[69] discussed in section III above, clearly demonstrates.

61. In its consultation paper on vulture fund legislation, the Government of the United Kingdom acknowledges the successful Liberian buy-back operation but cautions that "the non-participating creditors continue to hold claims against Liberia worth 85% of the cost of the Debt Reduction Facility buybacks".[70] Further, the World Bank and IMF have repeatedly emphasized that while the HIPC Initiative has helped reduce the external debt burdens of HIPCs, a number of challenges remain, including ensuring that HIPCs get full debt relief from all creditors, including private creditors.[71] This underscores the pressing need for legislative measures to combat predatory creditor activity.

62. In the estimation of the independent expert, the EMTA submission and similar concerns by other proponents of vulture funds appear to be based on the erroneous assumption that markets have efficient, self-correcting mechanisms. As the recent financial crisis has amply demonstrated, this assumption is fundamentally mistaken. It is precisely the lack of State regulation that facilitated the abuses that manifested themselves in the financial crisis.[72] In the Outcome of the Conference on the World Financial and Economic Crisis and Its Impact on Development, Governments recognized that the crisis was caused by "regulatory failures, compounded by over-reliance on market self-regulation, overall lack of transparency, financial integrity and irresponsible behaviour …".[73] Vulture funds are part of this flawed international financial system. Consequently, measures to reform the global financial system must include measures to curb profiteering by unethical commercial creditors. In this regard, it is worth recalling that the Monterrey Consensus recognizes that the orderly development of capital markets aimed at addressing development financing needs and nurturing productive investments requires "a sound system of financial intermediation, transparent regulatory frameworks and effective supervisory mechanisms" (para. 17).

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sovereign immunity and Texas garnishment law: a new threat facing U.S. oil and gas companies", *Houston Journal of International Law*, vol. 29 (winter, 2007), p. 277.

67 IMF and IDA, "Heavily Indebted Poor Countries (HIPC) Initiative – status of implementation" (2003), para. 54.

68 EMTA, "Submission" (see footnote 60), p. 4.

69 High Court of Justice, Case No. 2008/587, 26 November 2009.

70 United Kingdom, *Ensuring Effective Debt Relief* (see footnote 44), p. 17.

71 IDA and IMF, "HIPC Initiative" (2009), p. 5 (see sect. III, footnote 7).

72 The financial crisis started as the "sub-prime mortgage crisis" in the United States in August 2007 and then erupted into a global credit crisis in September 2008. It was caused by a combination of factors, including loose monetary policy, deregulation, excessive risk taking by banks and the explosion of credit/debt between 2002 and 2007. See UNCTAD, *The Global Economic Crisis: Systemic Failures and Multilateral Remedies* (United Nations publication, Sales No. E.09.II.D.4).

73 General Assembly resolution 63/303, annex, para. 9.

63. A further claim in the EMTA submission is that the British legislative proposal would appear to put the United Kingdom in contravention of international treaties that guarantee actionable property rights, such as the European Convention on Human Rights.[74] This submission appears to be based on the misguided notion that the right to property is an absolute right. Human rights supervisory bodies have made clear that a State is entitled to limit or control the use of property (including contractual rights with an economic value) in accordance with the general interest by enforcing such laws as it deems necessary for the aim pursued.[75] The limitation imposed by the Debt Relief (Developing Countries) Act is a "control of use" rather than a deprivation since there is no practical or legal extinction of the rights of ownership. Significantly, the Act does not preclude creditors from seeking reasonable recompense but merely seeks to prevent them from profiteering at the expense of indebted poor countries as well as the taxpayers who have contributed to international debt relief efforts. There are also compelling public interest grounds for reducing the recoverability of debts and judgements by vulture funds, namely, that the Act promotes fairness among creditors and that it promotes the development of HIPCs.

64. It is noteworthy that EMTA includes among its members a number of vulture funds (such as Elliott Associates, Debt Advisory International and Greylock Capital), as well as law firms such as Allen & Overy (which represented Donegal International in its lawsuit against Zambia) and Dechert LLP (which represented the two vulture funds, Hamsah Investments and Wall Capital, in their lawsuit against Liberia). It may therefore be asserted that the EMTA opposition to legislative measures to curtail vulture fund activity is actuated more by self-interest than a real concern for the development prospects of poor countries.

65. Governments have a responsibility to intervene "when markets fail to create the conditions in which all people, including the poorest and most marginalized, can exercise the full range of their human rights".[76] Although the consultation paper does not explicitly state so, it can be argued that the British legislation is ultimately intended to help HIPCs create the necessary conditions for the realization of the basic rights of their citizens and the right to development. This would be in keeping with the spirit of international assistance and cooperation recognized in the Charter of the United Nations and binding international human rights instruments such as the International Covenant on Economic, Social and Cultural Rights which the United Kingdom has ratified.[77]

66. It is clear that existing laws in the "creditor-friendly" jurisdictions cannot effectively protect poor countries from predatory creditor activity. The case of *Donegal International Ltd v. Republic of Zambia & Another*[78]provides a good illustration of the problem. In that case, the British High Court, while accepting that Zambia "is a poor country", stressed that it was concerned with the "legal questions" raised by the applications before it and "not with questions of morality or humanity".[79] This underlines the need for Governments to

[74] EMTA, "Submission" (see footnote 60), p. 16. See also submission of Dechert LLP, in United Kingdom, *Ensuring Effective Debt Relief for Poor Countries: Consultation responses received* (2010).

[75] Case of *Sporrong and Lonnroth*, judgement of 23 September 1982, Publications of the European Court of Human Rights, Series A, No. 52, para. 61.

[76] Centre for Economic and Social Rights, "Human rights and the global economic crisis: consequences, causes and responses" (2009), p. 5.

[77] "The Government believes it is in the interests of the UK and the world to tackle the many challenges of world poverty. In an increasingly interdependent world, international development is vital to global common interests that will profoundly affect the quality of life for all …." (United Kingdom, *Ensuring Effective Debt Relief* (see footnote 44), p. 11).

[78] See sect. III, footnote 12.

[79] Ibid., para. 2.

implement legislative measures (which the courts would be bound to apply) to protect vulnerable countries from vulture fund activity.

V. Conclusions and recommendations

67. **Despite their limitations, international debt relief initiatives have helped reduce the debt burdens of heavily indebted poor countries (HIPCs) and create fiscal space for poverty-reducing expenditures in these countries. There is some evidence that reduced debt burdens and improved fiscal space has led to increased investment in essential social services related to human rights, such as health and education, in these countries.**

68. **Nevertheless, the voluntary nature of international debt relief schemes has created opportunities for vulture funds to acquire defaulted sovereign debt at vastly reduced prices and then seek repayment of the full value of the debt through litigation, seizure of assets or political pressure. While the debts held by vulture funds do not represent the bulk of poor countries' debt, awards in vulture fund lawsuits represent a considerable burden on the budgets of these countries. Further, vulture fund activities complicate sovereign debt restructuring by causing inequitable burden sharing among creditors, and undermine trade and investment relations of the countries that they target. They may also hamper efforts by HIPCs to normalize their financial relationships with the international banking community.**

69. **By forcing HIPCs, through litigation and other means, to divert financial resources saved from debt cancellation, vulture funds diminish the impact of, or dilute the potential gains from, debt relief for these countries, thereby undermining the core objectives of internationally agreed debt relief measures. Vulture funds profiteer at the expense of both the citizens of HIPCs and the taxpayers of countries that have supported international debt relief efforts.**

70. **From a human rights perspective, the settlement of excessive vulture fund claims by poor countries with unsustainable debt levels has a direct negative effect on the capacity of the Governments of these countries to fulfil their human rights obligations, especially with regard to economic, social and cultural rights, such as the rights to water and sanitation, food, health, adequate housing and education.**

71. **The various initiatives (including the creation of legal support funds, voluntary codes and provision of legal advice) that have been undertaken at the international level to address vulture fund activity have all contributed towards addressing the negative effects of vulture fund activity on debt relief. However, these initiatives are insufficient. Given that the success rate of past litigation may generate more lawsuits against HIPCs, more concrete, legally enforceable measures are urgently required to curb predatory creditor activity and preserve the gains from international debt relief efforts.**

72. **Consideration should be given to making international debt relief schemes legally binding on all creditors (including commercial creditors). This would help prevent the exploitation of the proceeds of debt cancellation by unscrupulous creditors.**

73. **The absence of an international insolvency procedure concerning defaulted sovereign debt creates opportunities for vulture funds to profiteer at the expense of HIPCs and other creditors. Consequently, urgent consideration should be given to the establishment of a fair and transparent debt resolution mechanism at the international level. As the independent expert intimated in his report to the General**

Assembly (A/64/289, para. 52), an independent and impartial international debt resolution mechanism based on the principles of equity, transparency, inclusion and participation would help resolve sovereign debt repayment difficulties and disputes fairly and efficiently.[80]

74. **The international community should adopt legally binding standards on responsible sovereign lending and borrowing which should contain provisions restricting the right of creditors to unilaterally assign debt obligations to third parties without the prior informed consent of the debtor. In this regard, the independent expert calls upon all countries to support the United Nations Conference on Trade and Development project on promoting responsible sovereign lending and borrowing. In addition, it may be necessary to consider whether a secondary market for sovereign debt is appropriate, while remaining aware of the importance of the secondary market for other types of debt.**

75. **The independent expert welcomes the initiatives undertaken or under consideration in Belgium, the United Kingdom and the United States to combat vulture fund activity. In particular, he commends the United Kingdom for passing legislation to protect poor countries against vulture fund lawsuits and to safeguard the gains from international debt relief efforts. He urges the United Kingdom to make the Debt Relief (Developing Countries) Act permanent upon expiry of its initial period of validity with such enhancements as may be appropriate. He also urges all other countries, particularly the major creditor countries, to urgently consider implementing legal frameworks to curtail predatory vulture fund activities within their jurisdictions. These measures would be consistent with the principle of the shared responsibility of creditors and debtors for resolving unsustainable debt situations which is enshrined in the Monterrey Consensus.**[81]

76. **Such legislation should not be limited to HIPCs but should cover a wider group of poor countries (particularly those eligible for International Development Association lending) and should, in view of the negative effects of the global recession on the budgets of many developing countries, cover post-HIPC debts, original debts (some of which may be of questionable legitimacy) and court judgements which have already been obtained.**[82] **Additionally, the legislation should promote transparency in the secondary debt market by compelling full disclosure (to the courts and other appropriate national authorities), by creditors seeking to sue developing countries for recovery of debt, of information concerning loan amounts, procurement documentation and details of the creditors.**

77. **The independent expert calls upon creditor countries to support the African Legal Support Facility and the Legal Debt Clinic of the Commonwealth Secretariat both politically and financially. He also urges debtor countries to avail themselves of the assistance proffered under these initiatives and, in particular, to enhance their own national legal expertise over time.**

78. **Borrower countries should also consider implementing legislative measures to assure transparency, participation and accountability in the negotiation, contraction, restructuring and settlement of public loans, and to provide for oversight of loan**

[80] See also Eurodad, "Taming the vultures" (see sect. IV, footnote 51), p. 16.

[81] *Report of the International Conference on Financing* (see sect. IV, footnote 58).

[82] This is a call that has also been made by debt relief campaigners. See for example the submission of the Catholic Agency for Overseas Development (CAFOD) in United Kingdom, *Ensuring Effective Debt Relief* (see sect. IV, footnote 44).

contraction, loan use and debt management by parliaments and civil society organizations.

79. **Tax havens aid vulture fund activity by assuring secrecy and lack of transparency in the operation of these funds. Consequently, there is a pressing need for international action to address tax havens. In this regard, the independent expert supports the Eurodad proposals concerning the imposition of financial levies on transactions with tax havens and sanctions on tax havens that do not cooperate as regards disclosure of information.**[83]

80. **The activities of vulture funds highlight some of the problems in the global financial system and are indicative of the unjust nature of the current system. Measures to combat vulture funds should therefore be part and parcel of reforms of the international financial system.**

[83] Eurodad, "Taming the vultures" (see sect. IV, footnote 51), p. 4.

Annex 509

"Climate Change and Labour: Impacts of Heat in the Workplace, United Nations Development Programme", *United Nations Development Programme*, 28 April 2016

Empowered lives.
Resilient nations.

CLIMATE CHANGE AND LABOUR: IMPACTS OF HEAT IN THE WORKPLACE

CLIMATE CHANGE, WORKPLACE ENVIRONMENTAL CONDITIONS, OCCUPATIONAL HEALTH RISKS, AND PRODUCTIVITY – AN EMERGING GLOBAL CHALLENGE TO DECENT WORK, SUSTAINABLE DEVELOPMENT AND SOCIAL EQUITY

International Labour Organization

65 YEARS

actalliance

The Global Voice of Business

UNI global union

ITUC CSI IGB

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This Issue Paper was prepared by academic and institutional experts as well as experts from the CVF country members to inform policy formulation. The information contained in this document is not necessarily intended for use in other contexts such as UN resolutions or UNFCCC negotiations and interested groups are encouraged to take contact with initiative partners for follow-up.

CONTENT

KEY FINDINGS[1]

- Excessive workplace heat is a well-known occupational health and productivity danger: high body temperature or dehydration causes heat exhaustion, heat stroke and in extreme cases, death. A worker's natural protection is to slow down work or limit working hours, which reduces productivity, economic output, pay and family income.
- A range of key international and national labour standards informed by decades of ergonomic and occupational health and safety research are designed to protect workers from adverse thermal conditions (high heat levels).
- Levels of heat in many tropical locations are already very high with respect to thermal tolerances even for acclimatised populations. Hot days and hot hours affect virtually all workers operating outdoors or in non-climate controlled conditions across several world regions. The continued changes to the climate with growing heat worsen the situation.
- Highly exposed zones, with effects experienced on a macro-scale, include the Southern United States, Central America and the Caribbean, Northern South America, North and West Africa, South and South East Asia.
- By the mid-1990s, heavily exposed countries, such as Bangladesh, have been estimated to have lost approximately 1 to 3% of the entirety of available daylight work hours due to heat extremes, underscoring the current nature of the problem with workers and employers needing protection now.
- Future climate change will increase losses. Even if the current commitments of the world governments to combat climate change are realized, losses by the end of this century to most vulnerable economies of all available daylight work hours will double or triple.
- The IPCC's 5th Assessment Report confirmed that labour productivity impacts could result in output reductions in affected sectors exceeding 20% during the second half of the century–the global economic cost of reduced productivity may be more than 2 trillion USD by 2030.
- The lowest income-bracket work – heavy labour and low-skill agricultural and manufacturing jobs – are among the most susceptible to climate change.
- Through this and other challenges altered thermal conditions also undermine development and present multi-faceted hurdles for the achievement of the Sustainable Development Goals (SDGs) related to poverty (SDG1) and hunger (2), health (3), education (4), gender (5) and income inequalities (10), good jobs and growth (8), and sustainable cities and communities (11), as well as climate change (13).
- Heat extremes also affect the very habitability of regions, especially in the long term, and may already constitute an important driver of migration internally and internationally.
- Since November 2015, the ILO adopted Guidelines for governments and other labour organizations to address the health and safety ramifications of climate change. But no international organization has established a programme to assist countries vulnerable to the challenges of climate change for the workplace.
- Limiting warming to 1.5 Celsius degrees as enshrined in the UNFCCC Paris Agreement would still result in a substantial escalation of risks but increases the viability of adaptation measures and contains the worst impacts in health, economic and social terms.
- Actions are needed to protect workers and employers now and in the future, including low cost measures such as assured access to drinking water in workplaces, frequent rest breaks, and management of output targets, carried out with protection of income and other conditions of Decent Work.
- Further analysis of the health and economic impacts of climate change in the workplace is needed to understand the full impacts of current and future climate. This should be linked to application of specific heat protection methods based on sustainable energy systems and conditions of Decent Work. Current and emerging analysis results should be the basis for effective national adaptation and mitigation policies.

[1] See the full list of references at the end of this document.

FIGURE 1.

Typical workplaces with excessive heat exposures during several months each year.

Sugar cane cutting by hand in Nicaragua, 2003.

This work and other heavy labour agricultural activities in many tropical areas have to be carried out during the hottest season each year. Solar heat radiation adds substantially to the ambient air heat.
Heat stress and heavy work create injuries, clinical health risks and daily productivity losses. Many of these workers are paid by production output, so heat causes longer workdays or reduced daily income.

T.Kjellstrom photos

Shoe manufacture in Haiphong, Viet Nam, 2002.

Factories in low and middle income countries that produce consumer goods, many of which are destined for consumption by high income countries, seldom have air conditioning or other effective cooling and ventilation systems. Heat stress and the same daily production targets in all parts of the year means that the workers have to work longer each day in the hot season than in cool seasons; but the salaries typically remain the same.

T.Kjellstrom photos

OVERVIEW

Excessive heat while working, generally at temperatures above 35° Celsius, creates occupational health risks and reduces work capacity and labour productivity (Parsons, 2014). Maintaining a core body temperature close to 37°C is essential for health and human performance, and large amounts of sweating as a result of high heat exposure while working creates a risk of dehydration. Excessive body temperature and/or dehydration causes "heat exhaustion", slower work, more mistakes while working, clinical heat effects (heat exhaustion, heat stroke, and even death; Bouchama and Knochel, 2002) and increased risk of accidental injuries (Schulte and Chun, 2009). These health effects lessen labour productivity, whether the worker is in paid work in a range of industries, in traditional subsistence agriculture or farming, or in other daily life activities (examples in Figure 1). Daily family activities, such as caring for children or the elderly, are equally affected.

The rapid increase of heat levels due to climate change is making such risks more severe for large shares of the global working population (Kjellstrom et al., 2009a). In January 2016, the World Meteorological Organization confirmed the likelihood that the average global temperature change had already reached 1 degree Celsius (or 1.8° Fahrenheit) (WMO, 2015). In West Africa, for

instance, the number of very hot days per year doubled since the 1960s, with an increase of approximately 10 additional hot days with each decade (McSweeney et al., 2010). Heat waves that are more prevalent as a result of climate change bring punctual spells of intense heat that are particularly dangerous for exposed workers. However, global warming is also altering the average climate experienced throughout the year (WMO, 2015).

This rising heat in the workplace is a significant concern to any person working out-of-doors or in indoor conditions without climate control or with ineffective control of ambient temperatures. Primary sectors of the economy, especially agriculture, are worst affected. It also presents challenges for the manufacturing sector, including construction and industrial work wherever heat is poorly controlled. Certain service sector professions are also affected, such as sports, tourism and transport. Work that involves high levels of physical exertion, such as heavy lifting and manual labour, are particularly affected since individuals tire faster and metabolise heat less effectively under exertion. However, even basic office and desk tasks are compromised at high levels of heat as exhaustion sets in. Physiological acclimatization provides some protection, but it has limits and requires 1-2 weeks of heat exposure to fully develop. During the hot season in hot countries workers have usually reached their acclimatization limit, and increased heat still creates the risks referred to in this paper.

As a challenge to Decent Work, this issue needs more attention. The workplace heat concern was first mentioned in the fourth (2005-07) assessment report of the Intergovernmental Panel on Climate Change (IPCC) and given a much stronger focus in the fifth (2013-15) IPCC assessment. Effective understanding of the issue required combining long-standing research into physiological responses to heat with the emerging science of climate change. Late recognition in science has delayed policy responses. No major international organization has established a programme of response to the challenges it presents. Trade Union materials on occupational health usually refer to heat as a hazard, but the link to climate change impact has not been pursued.

Because of the scale of the challenge, its impact is likely to be a major economic effect of climate change. Economic losses occur at worker and family level, enterprise level and community level. For heavily exposed economies, effects are meaningful enough to alter national output, affecting in turn the global outlook. The economic, social and health effects are a challenge for efforts to tackle poverty and promote human development including the global Sustainable Development Goals (SDGs) where it could undermine progress towards SDGs 1 (poverty), 2 (food), 3 (health), 4 (education), 5 (women), 8 (economy), 10 (inequality), 11 (cities) and 13 (climate). The shifting of the thermal conditions of many of the world's workplaces is leading to breaches of international

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ISO standards and International Labour Organization (ILO) Codes of Practice on hot workplace environments. It is also likely to amplify current migration patterns for the most vulnerable workers.

The impact analysis of different possible global temperature increases this century show that lost working hours have already been substantial and expand rapidly even for a 1.5° Celsius increase of global temperature (see analysis later in this paper). Impacts worsen much more considerably for 2 ºC and for the 2.7ºC level of warming implied by governments' existing commitments under the new UN Framework Convention on Climate Change (UNFCCC) Paris Agreement. Business-as-usual warming (4ºC) could yield output reductions for some sectors in excess of 20% during the second half of the twentieth century.

Climate change is also among the root causes of migration, which was recognized by the UNFCCC Paris Agreement with the formal inclusion of "migrants" in the Preamble and 2015 UNFCCC Paris decision on Loss and Damage. Climate change and climate change-related environmental degradation is driving environmental migration with a potential to change labour migration patterns. Migrant workers are often among the most harshly affected by climate-related risks in a world where the importance of migrants in the global economy continues to grow. Migrant workers frequently find themselves–at origin, transit and destination–engaged in occupations that are highly exposed to rising heat, such as in the construction or agricultural sectors. Migration also represents a viable adaptation strategy to climate change with practical examples of temporary and circular labour migration.

The economic, health and social ramifications of rising heat in the workplace requires an urgent response to protect workers, families, businesses, and vulnerable economies through investment in appropriate climate change adaptation measures. A number of adaptation responses have been identified, including establishing or reinforcing worker rehydration regimes, shade, insulation and air conditioning. An immediate opportunity also exists with implementation of the 2015 ILO Guidelines for a just transition towards environmentally sustainable economies and societies for all, which include a focus on climate change and health, safety and social protection in the context of climate change. Nevertheless, the ability to manage the impact of climate change on labour diminishes at higher heat levels, while unavoidable losses and damage are an additional reason to pursue more ambitious emission control responses to mitigate climate change.

This Issue Paper explains the underlying mechanisms of the impact of climate change through altered thermal conditions in the workplace, shows examples of the current and likely future impacts and provides indications of policy response options to these challenges.

BASIC MECHANISMS FOR HOW HEAT IN THE WORKPLACE AFFECTS PRODUCTIVITY, HEALTH AND SAFETY

The conflict between health and productivity that workplace heat creates

It is well known that physical work creates heat inside the body and that this affects occupational health and performance when combined with excessive workplace heat (Parsons, 2014). The physiological mechanisms have been known for more than 100 years, and during the last 50 years hundreds of laboratory and field studies have documented heat risks and injury causing heat exhaustion and heat stroke (Bouchama and Knochel, 2002), and even deaths (MMWR, 2008). When heat exposed workers slow down or take more rest to avoid the health effects of heat, their hourly work output and productivity goes down (Kjellstrom et al., 2009a). This is the conflict between health and productivity that workers and employers face.

Climate change has and will continue to exacerbate workplace heat as highlighted in the latest IPCC assessment (Smith et al., 2014). For many middle and lower income countries, more than half of the work force is currently exposed to this type of hazard (DARA and the CVF, 2012). Figure 1 shows examples of agricultural and factory work that can be affected in locations with long hot seasons and expectations of high productivity.

The occupational and ergonomic sciences have long examined the effects of heat extremes on the safety, health and productivity of workers. Occupational guidelines for heat have existed in Europe and the United States since the 1980s (NIOSH, 2015). International ISO standards have also been in place since the 1980s (ISO, 1989a, b), complemented additionally now by ILO codes of practice (ILO 2001) among other guidelines. In particular, ISO 7243 (1989a) specifies the health based limits (body temperature) for heat stress on workers, and ISO 7933 (1989b), specifies a method for the analytical evaluation and interpretation of the thermal stress experienced by a subject (excessive sweating) in a hot environment. Moreover, the ILO Code of Practice on "Ambient Factors in the Workplace" deals with both heat and cold, including prevention and control measures in hot environments. Growing heat extremes for working people also undermine Decent Work as promoted by the International Labour Organization (ILO, 2013; UN, 2015).

Considerable industry-focused analysis exists, explaining, for example, how the climate conditioning of call centres can promote optimal worker productivity (Niemelä et al. 2002). Furthermore, many of today's military combat operations in regions with thermal extremes are guided by the latest knowledge of this field, such as the United States defence force (USDAAF 2003).

From the perspective of climate change, the most predictable and highest confidence outcome of global warming is the increase of local heat levels in most of the world, as demonstrated by the IPCC (Collins et al., 2013). This makes predicting the impacts of changing thermal conditions in the workplace more reliable than for estimates of changing storm patterns, rainfall regimes, wind and other aspects of the consequences of climate change.

"CLIMATE CHANGE HAS AND WILL CONTINUE TO EXACERBATE WORKPLACE HEAT"

The physiological foundation of the work-heat challenges

The core body temperature of every human needs to be kept close to 37°C in order to avoid serious health risks (Parsons, 2014). When the external temperature is higher than 37°C, the only way for the body to stay at a healthy temperature is through loss of heat via sweat evaporation. However, high external air humidity, and the clothes worn in some jobs, limit sweat evaporation and core body temperature goes up. In many situations the only way to avoid clinical "heat stroke" is to reduce the work rate, take more rest, and drink water frequently (Parsons, 2014). As mentioned earlier, acclimatization to heat reduces the health risks, but the limit is reached within a week or two, and field studies in hot locations usually already account for acclimatized workers in their analysis.

Epidemiological studies show the quantitative impacts of high workplace heat (Wyndham, 1969; Sahu et al., 2013), and recent interview studies of workers in hot countries highlight these hazards in various sectors and occupations (Zander et al., 2015; Venugopal et al., 2016a, b). One detailed review (de Blois et al., 2015) highlights the considerable public health risks that environmental heat exposure effects on the heart and vascular system will create.

To quantify the workplace heat exposures and estimate associated health and economic risks, it is essential to find formulas that combine the four elements that contribute to the relevant external heat levels: temperature, humidity, air movement (wind speed) and heat radiation (outdoors mainly from solar radiation). During the last century more than 160 different heat indices were developed (De Freitas and Grigorieva, 2015). Several indices are described in a recent heat wave guidance document (WMO and WHO, 2015), and the applications and interpretations of the resulting data varies. Only one of the indices has achieved widespread global use in occupational health, namely the Wet Bulb Globe Temperature (WBGT), which is an important proxy measure for how people experience heat (Parsons, 2014). WBGT combines temperature, humidity, wind speed and heat radiation into one number. It was developed long ago for the US Army (Yaglou and Minard, 1957) to protect

soldiers from heat stress and serious clinical effects, and it can be calculated from routine weather station data (Lemke and Kjellstrom, 2012).

Actual heat stress on a working person is also affected by the intensity of work (metabolic rate) and the clothing used, so the interpretation of a WBGT value, or any other heat estimate, needs to take these factors into account. When heat stress and core body temperature becomes too high the working person may suffer exhaustion or fainting and in serious cases more severe heat stroke with effects on the brain and heart (Bouchama and Knochel, 2002). If the person has sweated profusely, and not been able to replace the lost body liquid with drinking water, dehydration may occur contributing to exhaustion and possibly leading to chronic kidney disease as has happened in sugar cane farms in Central America (Wesseling et al., 2013).

More than 100 studies in the last decade have documented the health risks and labour productivity loss experienced by workers in hot locations. The most recent report (Venugopal et al., 2016a) of perceived heat impacts in 18 workplaces with both male and female workers concluded that 87% of workers experience health problems during the hottest 3 months and 48% reported lost productivity. Another report (Venugopal et al., 2016b) highlighted the problems for women workers, in particular, pregnancy creates additional problems with heat stress. Another vulnerable group is migrant workers.

FIGURE 2.
Heat exposed workplaces with many women workers.

Construction work in India, 2008.

Millions of women earn small daily cash income in labouring jobs, carrying material on to roofs where male workers perform the tradesmen tasks.

T.Kjellstrom photos

Shoe manufacture in Haiphong, Viet Nam, 2002.

These factories employ mainly women and exposure to hazardous chemicals is common. Glues used to join different parts of a shoe contain volatile solvents that can damage the brain, injure the foetus of a pregnant woman and cause other health effects. Some solvents, such as benzene, are potential cancer causing agents. The solvents evaporate faster in hotter environments, so climate change will increase the health risks.

T.Kjellstrom photos

Occupational health impacts of climate change other than direct heat effects

This Issue Paper is focused on the effects of changing thermal conditions in workplaces and the related economic, health and social repercussions. However, climate change is also responsible for a range of other occupational health and productivity threats (Bennett and McMichael, 2010; Schulte and Chun, 2009; NIOSH, 2015).

Climate change entails, for instance, more extreme weather events and these create injury risks for affected populations as well as for the emergency workers trying to help the other victims. Violent storms, floods and resulting landslides, as well as forest fires due to drought, are all creating occupational health and safety hazards for outdoor and indoor workers, as well as for the relief workers (Brearley et al., 2013; Smith et al., 2014). There are mental health effects (Smith et al., 2014) including suicides among farmers whose harvests fail due to climate change.

Secondly, in assessments of climate change health impacts, the changing patterns of vector-borne diseases are routinely highlighted (Smith et al., 2014). One aspect of such health risks that is likely to be a health hazard for workers, particularly agricultural workers (Figure 1), is the probability that daily work has to be shifted to cooler dawn and dusk periods as the middle of the day is too hot to work (Bennett and McMichael, 2010). Disease spreading vectors such as mosquitoes are more likely to bite people during these cooler hours, and so the risk of malaria and other diseases may increase.

Another indirect effect of increasing heat is a likely increase of exposures to hazardous chemicals (Figure 2). At higher temperatures chemicals in workplaces evaporate more quickly and the chemical amounts that the workers inhale from the workplace air will increase (Bennett and McMichael, 2010) creating an increased risk of poisoning.

"ANOTHER INDIRECT EFFECT OF INCREASING HEAT IS A LIKELY INCREASE OF EXPOSURES TO HAZARDOUS CHEMICALS"

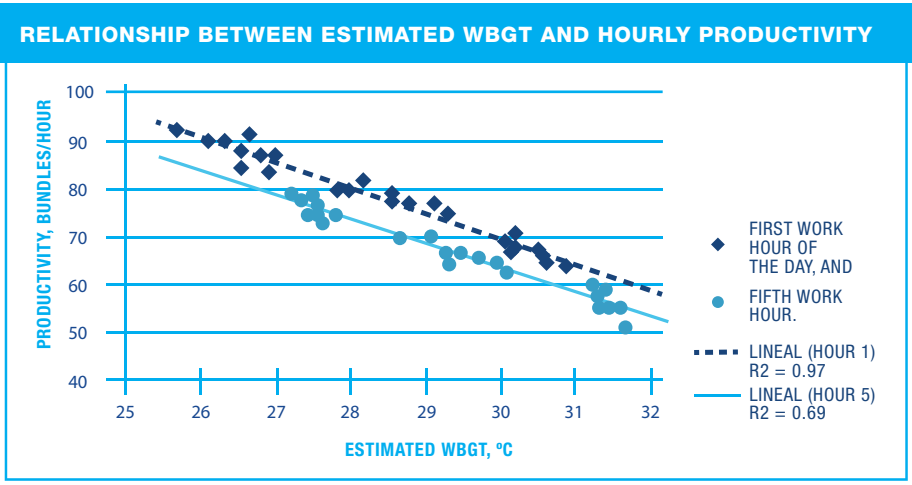
Estimated work capacity loss in different settings

The clinical ill health effects mentioned above will contribute to work capacity and labour productivity loss, and in addition there are the effects of the amount of rest and breaks that the worker takes to avoid clinical effects ("self-pacing"). Figure 3 shows data from the only recent epidemiological study (Sahu et al., 2013) which indicates the loss of approximately one third of the hourly labour productivity when hourly heat increases from 26° C to 31° C (measured by WBGT). Similar results for South African gold mine workers were reported more than 50 years ago (Wyndham, 1969), and other studies are now emerging. The ISO international standard (Nr 7243, 1989a) recommends that regular rest periods are taken when heat is above 26° C (WBGT) in the context of heavy physical work if clinical health effects are to be avoided.

FIGURE 3.

Reduced labour productivity due to heat.

Bundles of rice harvested per hour (productivity) at different environmental heat levels (WBGT). Regression lines and equations and correlation coefficients shown. (Each point is a group average of 10-18 workers); (Sahu et al., 2013).



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It should be pointed out that in South-East Asia, for example, the heat stress level is approximately 2-3°C (WBGT) higher in the sun during the afternoon than it is in full shade or in indoor workplaces without cooling systems (Kjellstrom et al., 2013). This is why it is essential for the interpretation of workplace heat stress issues to consider whether outdoor workers are protected by shade, workplace cooling systems, special clothing, or other parameters.

Analyses of the annual losses of daylight work hours due to excessive heat exposure (Kjellstrom et al., 2009b, 2014) show substantial losses in many regions of the world. The losses in the 1980-2009 period are already up to 5-7% for several regions. Estimates for 2030 showed that the worst affected regions would be South Asia and West Africa, and ten regions in Asia, Africa and Latin America have more than 2% of work hours lost by this date.

The underlying physiological and ergonomical science for these calculations of health risks and productivity loss are very robust and well established. The key question is whether to focus on the increased clinical health effect risks as workers keep their work activity going at usual speeds, or on the labour productivity loss risks as workers slow down to avoid health effects. Many health professionals and scientists appear to consider the productivity loss as a "non-health effect" and therefore not worth including in health impact analysis. But this oversight undermines efforts to achieve Decent Work, which includes both health protection and fair income protection.

SCALE AND IMPORTANCE OF EFFECTS IN REGIONS, COUNTRIES, SECTORS AND POPULATION GROUPS

Extent of current climate threats to labour

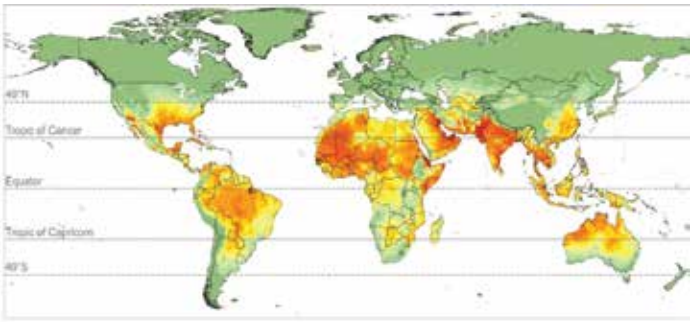
It is now well recognized and established in science that the global climate is already changing towards higher temperatures (Collins et al., 2013). Much of the analysis by climatologists and in public debate focus on the average global temperature change, which increased by 0.74° C per century (or 0.074° C per decade) in the period 1906-2005. More recently, the World Meteorological Organization (WMO) announced the likelihood that the planet has already warmed by 1° C since the pre-industrial era (WMO, 2015). The bulk of that warming occurred in recent decades in an accelerating trend whereby all but one of the ten hottest years since records began have occurred since the year 2000, the warmest yet being 2015 (WMO, 2015).

These changes are not the same everywhere in the world and according to routine recordings at weather stations in Asia and Africa (US NOAA and Hothaps-Soft; see Resources later on), the increase of annual mean temperature from 1980 to 2012 is often 0.2-0.8° C per decade (and even > 1° C per decade), much faster than the global average from 1906 to 2005. Using existing climate data for 67,000 geographic sections over land around the world (0.5 x 0.5 degree sections, data from ISI-MIP at Potsdam Institute, Warshawski et al., 2014), analysis can show the levels of different heat stress indexes. Figure 4 shows the current heat situation in the hottest months in each part of the world (employing the WBGT measure). All the areas in other colours than green will experience workplace heat challenges, and often for several months (WBGT levels higher than 25° C as stipulated by ISO, 1989a).

The future modelling of climate change impacts is based on the analysis carried out for IPCC by a large number of scientists (Collins et al., 2013). This Issue Paper uses two well tested models (HadGEM2-es and GFDL-esm2m). Estimates can therefore be considered robust and can be used as indications of how climate change will affect labour conditions and productivity. This report does not include the details of methods used, which are available in published references.

FIGURE 4.

Geographic distribution of heat exposure around the planet.



The ***hottest month*** average level of the heat stress index WBGT in each part of the world, afternoon values in shade or indoors, 30-year averages 1980-2009. The colour scale shows the heat levels.

HEAT EXPOSURE WBGT °C

<26 27 28 29 30 31 32 33 34 35 36 37 38+

LOW RISK MODERATE RISK HIGH RISK

The increasing heat trend can be demonstrated at many locations. For instance, it can be shown that for each decade in Kolkata, India (Figure 5) there are 12 additional days where WBGT levels in the shade are at or above 29° C. The tropical and sub-tropical parts of the world, where very hot seasons are already commonplace, are also where most of the world population lives and works, or approximately 4 billion people (see Figure 6). A recent analysis comparing the daily distributions of high heat level days during the 20th century and the most recent period, concluded that most of the days with extremely high temperature or humidity (linked to precipitation) are caused by human induced climate change (Fischer and Knutti, 2015). The trends in Kolkata can then be considered a symptom of the climate change that emissions of greenhouse gases can cause.

FIGURE 5.

Increasing heat in Kolkata, India.

Annual number of days when WBGT indoors or in full shade in the afternoons (=WBGTmax) exceeded 29 oC at the airport in Kolkata, a level that reduces work capacity (greater than 30 more days in 2012 than in 1980). Source: Hothaps-Soft with data from US NOAA website (Sahu et al., 2013).

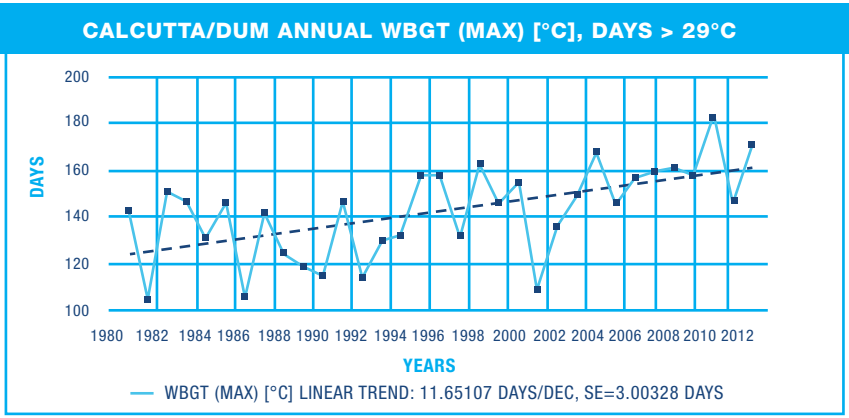
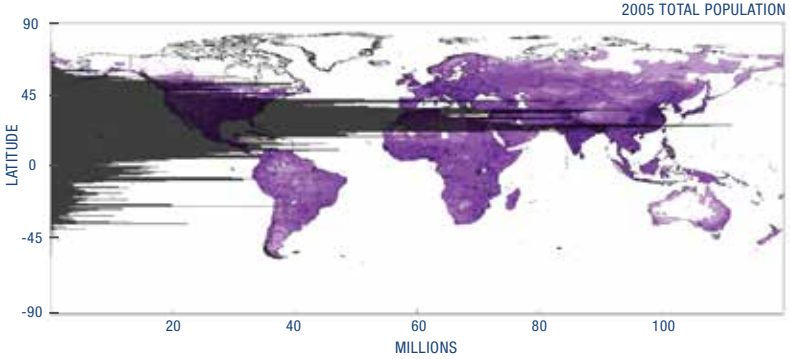


FIGURE 6.

Global population distribution by latitude in 2005.

Number of people in each 0.5 degree latitude band is shown; most people live in the tropical and sub-tropical range.



Future trends of heat impacts

Heat impacts in terms of health and productivity loss start occurring at approximately 26ºC (WBGT) for heavy physical labour impacts as indicated by ISO standards (ISO, 1989a). The trends can be put into the context of the agreements reached at the UN Climate Change Conference at Paris in December 2015 (UNFCCC COP21). Modelling by IPCC scientists now employs four scenarios (or representative pathways, RCPs) for emissions and the warming it generates. These RCPs are used to study potential future trends of the global climate (Collins et al., 2013). The "business as usual" pathway (RCP8.5) with very limited mitigation actions results in global warming of 4ºC in the last decades of this century. A pathway based on some extent of mitigation (RCP6.0) results in warming of 2.7ºC, which compares with the combined commitments for mitigation action by the world's governments in the context of the UN Paris Agreement in 2015 (UNFCCC COP21). Stricter mitigation actions (RCP4.5) would be needed to limit warming to 2.4 ºC. But only the IPCC's most ambitious scenario (RCP2.6) shows consistency with the "well below 2ºC" with "efforts to limit" warming to 1.5ºC as stipulated in Article 2 of the UNFCCC Paris Agreement.

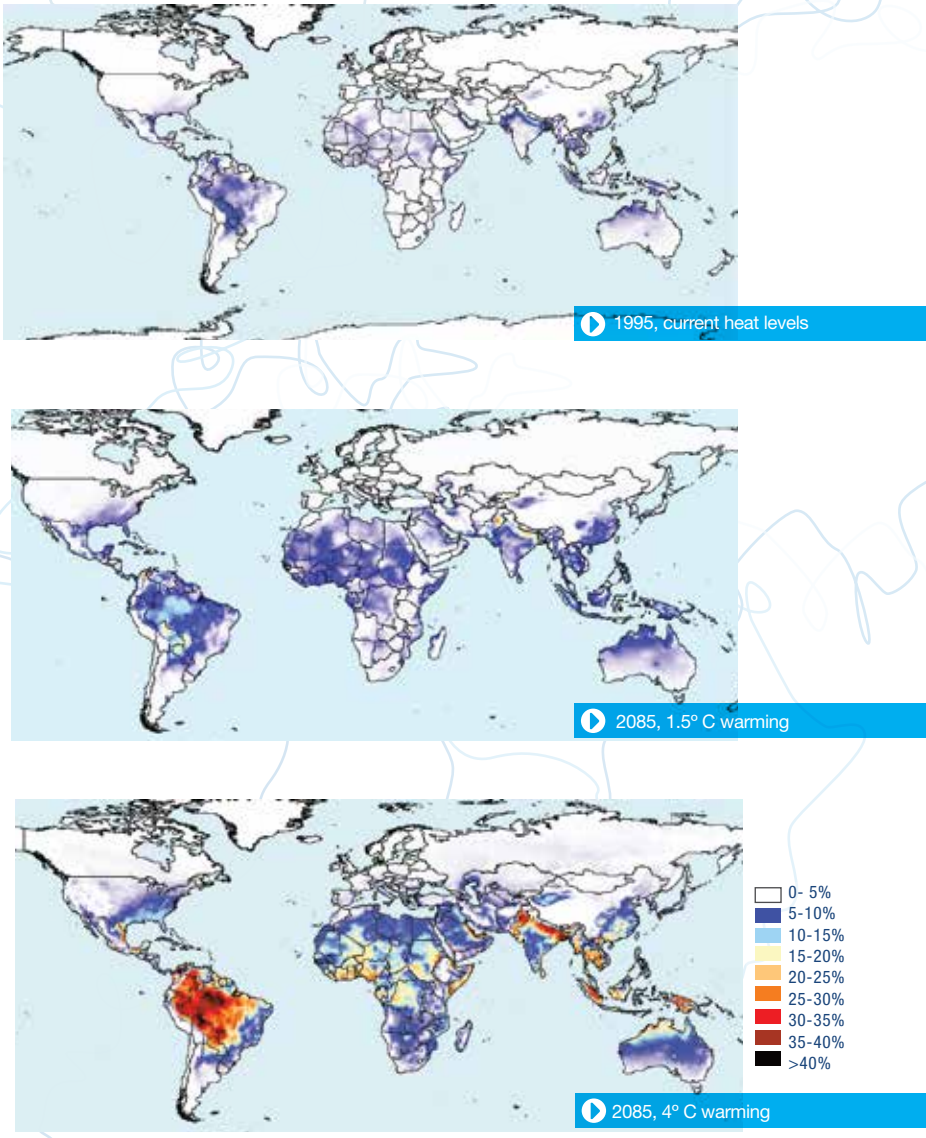
Figure 7 shows estimated losses of work capacity for 30-year periods around 1995 and 2085 at different global warming levels between 1.5 ºC (RCP2.6) and 4 ºC (RCP8.5). Lost work hours are calculated based on the geographic distribution of adult (working age) population numbers for the year 2000, and expressed as the annual percent of daylight hours lost due to heat (as indicated by the data in Figure 3). Already now, up to 10-15% of annual daylight hours are so hot that productivity is lost. By the end of the century this will increase in the hottest areas even if global temperatures are held at 1.5 ºC (RCP2.6), but the increase is much higher for the business-as-usual scenario of 4 ºC (RCP8.5), reaching more than 30% (Figure 7). The details of the calculation methods are described in the Appendix.

"ALREADY NOW, UP TO 10-15% OF ANNUAL DAYLIGHT HOURS ARE SO HOT THAT PRODUCTIVITY IS LOST"

FIGURE 7.

Workplace heat health risks and loss of labour productivity due to heat.

The percentages refer to potential annual daylight hours when health and productivity problems due to heat start occurring for moderate work and labour productivity falls as workers slow down or take more rest (Kjellstrom et al., to be published)



Impacts by region and country

Using a limited mitigation scenario (RCP6.0) we calculated the losses in different countries at different times (Table 1). This table currently includes a select range of countries from different regions, to illustrate the breadth of the concern and its varying repercussions across locations and geographic characteristics. More detailed results for all individual Member States and other countries are expected to be produced as the Hothaps project, an ongoing research initiative mapping changing thermal conditions for exposed populations around the world.

Table 1 shows that for a range of countries, increases in lost work hours between current situation and 2.7 ºC of warming is often considerable and can be as high as 10% by 2075.

Already in the current situation (2015) several percent of working hours can be lost in highly exposed regions. There is a 10-times or more increase of work hours lost from 2015 to 2085 for a number of countries. The worst impacts are estimated for Asia and the Pacific region with similar impacts also in West Africa. Latin America and the Caribbean have lower impacts and in Europe some impacts occur in the South, but it is much less than in the worst affected countries in Asia and Africa.

TABLE 1.

Regional and country level losses of labour productivity.

These are preliminary and indicative results for a selection of countries based on model data by IPCC analysis. Updated analysis will be produced in 2016. The 2015 numbers in the table range from a linear extrapolation of trends since 1980, and interpolation point between 1995 and 2025. Each year point is a 30-year average estimate around that year. The data apply to work in the shade at moderate work intensity (300W). The RCP6.0 model outputs fit well with the national mitigation policies presented at COP21.

COUNTRY	WORKING AGE POPULATION	POTENTIAL ANNUAL DAYLIGHT WORK HOURS LOST FOR WORK AT 300W, %; BASED ON A BUSINESS AS USUAL SCENARIO (RCP8.5, AVERAGE OF HADGEM2 AND GFDL MODELS) CURRENT (1995) AND UP TO 2085				
ASIA AND THE PACIFIC	2015, MILLIONS	1995	2015	2025	2055	2085
Bangladesh	98.65	1.06	1.4 - 2.0	2.53	4.61	8.56
Cambodia	9.51	1.82	2.2 - 3.4	4.24	6.54	10.93
China	892.11	0.32	0.33 - 0.56	0.68	1.12	2.12
India	817.16	2.04	2.6 - 3.1	3.61	5.22	7.98
Indonesia	164.23	0.33	0.42 - 0.93	1.23	2.56	5.45
Kiribati	0.06	0.59	0.75 - 1.5	1.95	4.31	8.66
Maldives	0.12	0.42	0.59 - 1.4	1.90	4.52	9.17
Nepal	19.7	0.61	0.88 - 1.1	1.27	1.98	3.38
Pakistan	109.88	3.73	4.1 - 4.7	5.22	7.00	9.97
Philippines	61.92	0.32	0.33 - 0.79	1.03	2.07	4.41
Vietnam	60.55	0.80	0.78 - 1.7	2.08	3.44	6.31

COUNTRY	WORKING AGE POPULATION	POTENTIAL ANNUAL DAYLIGHT WORK HOURS LOST FOR WORK AT 300W, %; BASED ON A BUSINESS AS USUAL SCENARIO (RCP8.5, AVERAGE OF HADGEM2 AND GFDL MODELS) CURRENT (1995) AND UP TO 2085				
AFRICA	2015, MILLIONS	1995	2015	2025	2055	2085
Burkina Faso	10.25	1.90	2.8 - 3.0	3.56	5.59	9.17
Ethiopia	51.55	0.14	0.19 - 0.24	0.28	0.43	0.72
Ghana	17.34	0.64	1.1 - 1.4	1.71	3.49	6.75
Kenya	29.57	0.05	0.09 - 0.13	0.17	0.32	0.63
Morocco	21.02	0.01	0.03 - 0.03	0.04	0.08	0.22
Nigeria	109.4	0.96	1.6 - 1.8	2.18	3.86	6.69
Tanzania	33.57	0.04	0.08 - 0.11	0.15	0.35	0.83
Tunisia	6.89	0.29	0.65 - 0.56	0.69	1.14	2.15
AMERICAS						
Barbados	0.18	0.05	0.13 - 0.25	0.34	0.78	2.96
Colombia	30.48	0.21	0.32 - 0.49	0.63	1.22	2.41
Costa Rica	3.14	0.28	0.33 - 0.53	0.65	1.19	2.23
Honduras	5.3	0.07	0.11 - 0.24	0.32	0.67	1.51
Mexico	74.94	0.33	0.50 - 0.57	0.69	1.15	2.03
USA	208.12	0.15	0.26 - 0.34	0.43	0.73	1.38
EUROPE						
France	40.56	0.00	0.00 - 0.00	0.00	0.01	0.04
Germany	52.17	0.00	0.00 - 0.00	0.00	0.00	0.02
Greece	7.38	0.00	0.02 - 0.02	0.02	0.06	0.24
Spain	30.69	0.01	0.03 - 0.03	0.04	0.08	0.25
Switzerland	3.56	0.00	0.00 - 0.00	0.00	0.00	0.01

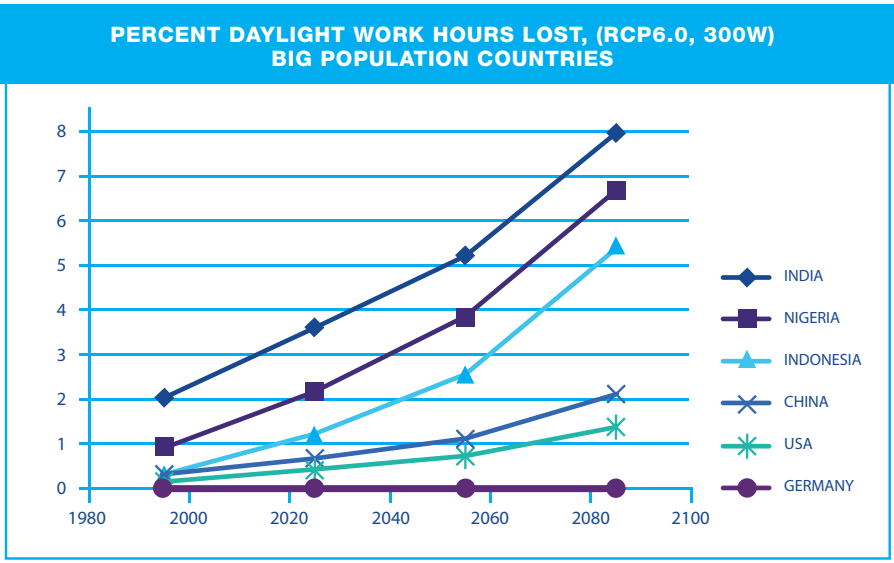
A level of working intensity (metabolic rate) of 300W is a reasonable mid-point level for a variety of jobs in agriculture, industry and construction. The share work capacity losses at very intense physical work (at a metabolic rate of 400W) would be up to twice as high as the numbers in Table 1. The results in that table are also based on work in the shade or indoors without effective cooling. Work in the sun adds to the heat exposure and creates higher hourly losses. Estimates of country based overall work capacity loss need to take into account the percentage of the working population carrying out work at different levels including indoors as well as outdoors. This Issue Paper used an approach in a report for the World Health Organization (WHO) (Kjellstrom et al., 2014), but it can be modified at country level. Continued analysis work should compare different approaches and validate these through comparison with actual country data.

Detailed analysis also shows that the percentage work hours lost due to heat in 2085 for a 2.7° C warming level (using the RCP6.0 data), similar to the UNFCCC COP21 Paris meeting country commitments, may be approximately half of the levels shown in Table 1. Greater emissions control would further limit negative effects.

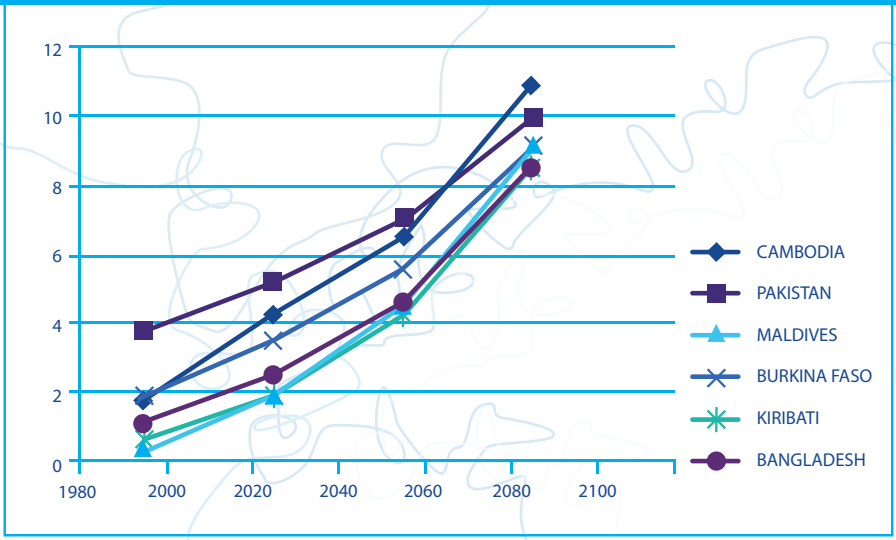
Figure 8 shows the time trends for selected countries. These indicative estimates show substantial differences in the health and productivity impacts between estimates for a global temperature change at 1.5 °C and at 2 °C. This needs to be considered further in global and national climate change policy development.

"WORK IN THE SUN ADDS TO THE HEAT EXPOSURE AND CREATES HIGHER HOURLY LOSSES"

FIGURE 8.
Time trends of work hours lost due to heat.



PERCENT DAYLIGHT WORK HOURS LOST, (RCP6.0, 300W)
WORST AFFECTED COUNTRIES



Additional calculations of labour productivity loss

It can be seen in Figure 9 that for countries with the highest climate change impacts there is a major difference in the workplace heat impact between a GTC at 1.5 ºC and GTC at 2.0 ºC. In India the increased impact goes from approximately 4% work hour loss to 6% loss, and in the Philippines it goes form approximately 1% loss to more than 2% loss.

TABLE 2.

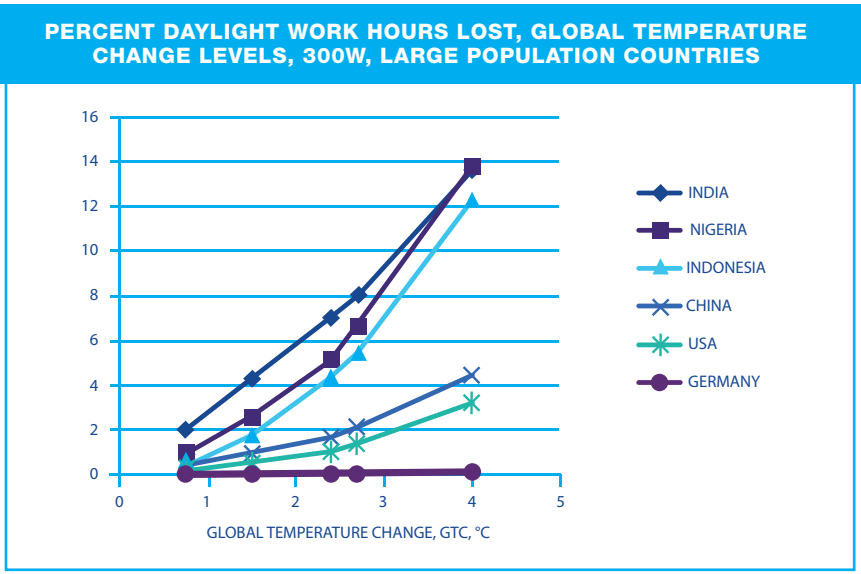
Regional and country level losses of labour productivity.

These are preliminary results based on model data by IPCC analysis. Updated analysis will be produced in 2016. The work capacity loss (300W metabolic rate work) due to heat in 2085 is related to the four RCPs and the associated GTCs.

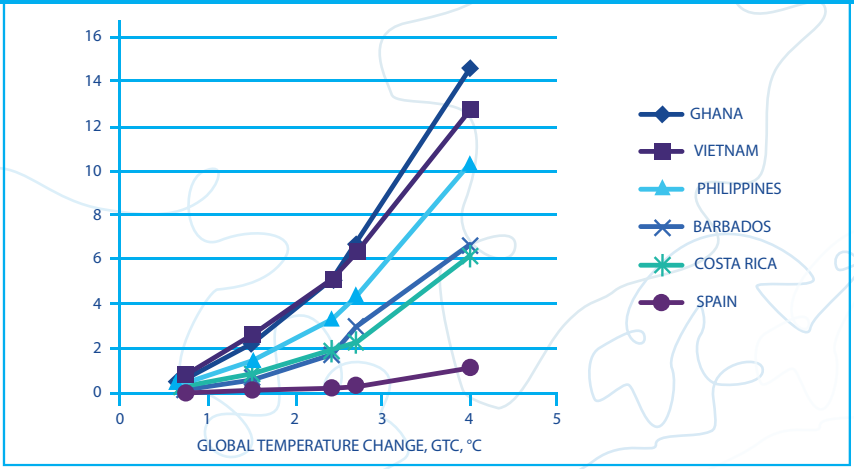
COUNTRY	WORKING AGE POPULATION	POTENTIAL ANNUAL DAYLIGHT WORK HOURS LOST (%) FOR WORK (AT 300W; BASED ON AVERAGE OF HADGEM2 AND GFDL MODELS)				
GLOBAL TEMPERATURE CHANGE, °C (APPROXIMATE)		0.74	1.5	2.4	2.7	4
ASIA AND THE PACIFIC	2015, MILLIONS	1995	2085	2085	2085	2085
Bangladesh	98.65	1.06	3.43	7.57	8.56	14.92
Cambodia	9.51	1.82	5.09	8.94	10.93	18.97
China	892.11	0.32	0.95	1.63	2.12	4.44
India	817.16	2.04	4.31	7.03	7.98	13.60
Indonesia	164.23	0.33	1.75	4.35	5.45	12.28
Kiribati	0.06	0.59	2.46	6.19	8.66	18.50
Maldives	0.12	0.42	2.73	7.16	9.17	18.22
Nepal	19.7	0.61	1.63	2.86	3.38	6.19
Pakistan	109.88	3.73	6.04	8.63	9.97	15.27
Philippines	61.92	0.32	1.37	3.27	4.41	10.32
Vietnam	60.55	0.80	2.58	5.09	6.31	12.72
AFRICA						
Burkina Faso	10.25	1.90	4.11	7.02	9.17	17.11
Ethiopia	51.55	0.14	0.33	0.58	0.72	1.57
Ghana	17.34	0.64	2.18	5.10	6.75	14.62
Kenya	29.57	0.05	0.22	0.47	0.63	1.57
Morocco	21.02	0.01	0.06	0.12	0.22	1.04
Nigeria	109.4	0.96	2.61	5.17	6.69	13.79
Tanzania	33.57	0.04	0.17	0.57	0.83	2.72
Tunisia	6.89	0.29	0.92	1.75	2.15	4.66

COUNTRY	WORKING AGE POPULATION	POTENTIAL ANNUAL DAYLIGHT WORK HOURS LOST (%) FOR WORK (AT 300W; BASED ON AVERAGE OF HADGEM2 AND GFDL MODELS)				
GLOBAL TEMPERATURE CHANGE, °C (APPROXIMATE)		0.74	1.5	2.4	2.7	4
AMERICAS	2015, MILLIONS	1995	2085	2085	2085	2085
Barbados	0.18	0.05	0.52	1.67	2.96	6.65
Colombia	30.48	0.21	0.80	1.83	2.41	5.20
Costa Rica	3.14	0.28	0.80	1.80	2.23	6.14
Honduras	5.3	0.07	0.43	1.22	1.51	4.37
Mexico	74.94	0.33	0.87	1.61	2.03	4.01
USA	208.12	0.15	0.49	1.03	1.38	3.20
EUROPE						
France	40.56	0.00	0.01	0.02	0.04	0.29
Germany	52.17	0.00	0.00	0.01	0.02	0.12
Greece	7.38	0.00	0.04	0.17	0.24	1.15
Spain	30.69	0.01	0.06	0.15	0.25	1.07
Switzerland	3.56	0.00	0.00	0.01	0.01	0.13

FIGURE 9.
Trends of work capacity loss as a function of Global Temperature Change.



PERCENT DAYLIGHT WORK HOURS LOST, GLOBAL TEMPERATURE CHANGE LEVELS, 300W, OTHER COUNTRIES



Economic consequences and poverty risks

Climate change and heat will affect the large share of the global workforce that operates outdoors and in non-climate controlled conditions in populous affected regions, implying significant economic costs. Effects are felt at a range of levels. For instance, the worker faces income loss when less is achieved within the same period of time, or a loss of leisure/family time if more work is required. Employers and businesses experience losses when their workers fail to deliver the same daily outputs as before due to hotter conditions. Injury rates also increase with extreme heat entailing health and economic consequences for workers and employers. Where workers receive less income due to diminished productivity, family incomes are also affected. Child health, women's health and elderly health risks increase when family incomes are reduced. Effects for small-scale and subsistence farmers are further compounded in many situations by the inability to displace working hours into the evening because of the importance of terrain sight and the need to operate during daylight hours. This is an important development challenge since loss of working hours for subsistence farmers would directly affect family food security and hold back progress on eradicating extreme forms of rural poverty. As an adaptation strategy to climate change, people might decide to migrate to leave extreme climatic conditions, in particular areas affected by extreme heat due to consequences for work, income, food security and health, and/or to diversify their livelihood.

At industry level, economic consequences are concentrated on sectors that have high proportions of the labour force out-of-doors, engaged in moderate to heavy work tasks, or who operate in non-climate controlled conditions in offices, factories or health, education and other facilities. Economic effects are most severe for the primary sector, in particular, agriculture. Other industries, however, such as mining and construction, are also exposed to heat risks. While the bulk of manufacturing and service sector workers operate indoors, the extent to which indoor conditions are effectively controlled through air conditioning, insulation or other measures, varies considerably between high, middle and lower-income countries (Kjellstrom, 2009; Dahl, 2013). Faced with growing heat extremes, many secondary and tertiary sector workers in emerging economies and Least Developed Countries are therefore experiencing heightened risks, and poverty is an underlying risk factor. Slum workshops and basic industries will be directly affected by ambient climate and heat conditions (examples, Figure 10).

FIGURE 10.
Basic manufacturing work situations where preventive actions are urgently needed.

Climate change will bring increasing heat problems in such workplaces.

Slum workshops like this one in Tanzania, expose the workers to increasingly severe ambient heat levels and associated hazards.

T.Kjellstrom photos

This factory for recycling car batteries in Vietnam have few opportunities to provide cooling systems at the workplace.

T.Kjellstrom photos

At a macro level, a number of studies have examined the potential economic impact of climate change on labour productivity. One study for the USA (Kopp et al., 2014) estimated a several billion US$ loss in 2030 for the American economy. With different methods and similar results for the USA in 2030, another study estimated US$300 billion in losses globally and rising to $2.5 trillion by 2030 (DARA and the CVF, 2012). Vulnerability was assessed as highest among emerging economies and Least Developed Countries, with the greatest overall losses in China, India, Mexico and Indonesia (DARA and the CVF, 2012).

Another macro-economic study and application of the World Bank's ENVISAGE model (Mensbrugghe and Roson, 2010) estimated the impact of climate change on labour to be the single most costly effect of climate change.

The IPCC's 5th Assessment Report also recognized the effects of changing thermal conditions in the workplace and the links between productivity and output. The IPCC has considered the translation of labour productivity losses into economic losses at an output elasticity of labour of 0.8, meaning labour productivity impacts would be felt as economic losses at 80% of their scale (and not as a 1:1 equivalent). It recognized that labour productivity impacts for affected sectors could entail 8–22% reductions in output during the second half of the century (Kjellstrom et al., 2009b). 2100 impacts for severely affected regions, such as India and Sub-Saharan Africa, have been estimated by another study to result in adverse deviations of more than 6% of GDP (Mensbrugghe and Roson, 2010).

Analysis of work capacity and labour productivity loss can calculate likely economic impacts and consider potential impacts on future GDP due to heat-related labour productivity losses. For instance, a situation can be considered whereby at the middle of this century the loss in moderate intensity work (300W) is 10% and 50% of the working age population is engaged in work at least at 300W, and half of the labour productivity loss is creating GDP loss (as some workplaces can reduce the impact of heat via cooling systems), and an output elasticity of labour of 0.8 is assumed. In such a situation, the annual GDP loss would be approximately 2% due to the loss heat levels. Further analysis of the economic impacts based on detailed estimates of work force distribution and occupational practices is urgently needed to integrate this issue into climate change policy and the study of response actions.

SOCIAL AND DEVELOPMENT IMPACTS AND RELATIONSHIP TO SDGs

The social settings of work and the impacts of climate change

Work is an essential part of social and economic development at all levels: the family, the local community, the country, the region and the whole planet. Global development objectives provide an opportunity to analyse and explore the links between work and other development challenges via policies and actions in families, communities and enterprises. The 2005-2015 Millennium Development Goals (MDGs), for instance, included labour productivity as an indicator of progress for extreme poverty (MDG1). Assessment of the MDG1 labour productivity indicator demonstrated very marginal progress in the chief poverty lag regions, which also correspond with the regions severely affected by the impact of climate change on labour (Kjellstrom et al., 2009b).

"ASSESSMENT OF THE MDG 1 LABOUR PRODUCTIVITY INDICATOR DEMONSTRATED VERY MARGINAL PROGRESS IN THE CHIEF POVERTY LAG REGIONS"

The UN's 17 new Sustainable Development Goals (SDGs) now constitute the international community's primary development objectives.

The effect of rising heat in the workplace will continue to present multi-faceted challenges for many of the new global SDG goals, in particular the eight goals related directly to incomes, family health and nutrition, inequalities and jobs, community sustainability and climate change. Key challenges for each of these goals are highlighted in Table 2.

TABLE 2.
Climate change impacts on work and Sustainable Development Goals.

GOAL	FOCUS	CLIMATE CHANGE RISING WORKPLACE HEAT IMPACT
1	No Poverty	The lowest-income groups, in particular agricultural sector workers and small-scale and subsistence farmers, in tropical and sub-tropical developing countries are worst affected.
2	No Hunger	Impacts for small-scale and subsistence farmers curtailing available work hours and outputs are likely to affect household food security.
4	Quality education and Learning	Heat-exposed students and teachers are less likely to access and provide quality education and learning.
3	Good Health	Large-scale exposure to heat injury and health risks such as heat stroke, exhaustion and even death will frustrate efforts to improve health. Migrants can be especially vulnerable to health risks as they may not have access to health care and occupational safety and health services in their destination country.
5	Gender Equality	Many heat-exposed occupational functions involve women, especially in developing countries, and pregnancy adds to the heat exposure risks. Men and boys are at risk as they often perform the heaviest loaded outdoor work in industries like agriculture and construction.
8	Good Jobs and Economic Growth	New heat extremes make it more difficult for international standards and guidelines for occupational health and safety of workers to be respected, and economic consequences are large in scale.
10	Reduced Inequalities	High income temperate regions are much less affected than tropical and sub-tropical developing regions which counteracts efforts to achieve improved globally.
11	Sustainable Cities and Communities	Heat extremes will challenge the built environment (houses and workplaces) and its sustainability, while heat waves are most intense in urban areas.
13	Climate Action	The impact of climate change on labour presents a large-scale challenge to climate resilience that has yet to be effectively recognized or addressed by international and national measures.

OPTIONS TO REDUCE SOCIAL, ECONOMIC AND HEALTH IMPACTS FOR WORKING PEOPLE

The impacts of increasing heat on working people is a key feature of climate change and can undermine efforts to reduce poverty and to achieve the SDGs. Preventive policies and actions are therefore sorely needed at local, national, regional and global level. The first preventive approach includes those that reduce climate change itself through greenhouse gas emission control measures, or climate change mitigation. As described earlier, the difference in heat impacts between policies that limit warming to below 2º C and the heat impacts associated with a 3 or 4º C world are major. Thus, much of the negative health and physiological effects of climate change on labour can be prevented by stricter greenhouse gas policies. This was highlighted in previous assessments (e.g. Costello et al., 2009; DARA, 2012; Watts et al., 2015) but the connection of mitigation to the impact of rising heat on the workforce could be better integrated into policy.

A second approach to prevention is what termed adaptation, or finding healthy and productive ways to live and work in the hotter environment. This can involve any way of reducing the actual workplace heat exposure or finding ways to avoid the heat stress caused by a changing climate. It has been pursued with national adaptation policy development in a number of countries, as it is clear that some impacts of climate change cannot be avoided by mitigation, as the climate is already changing (Collins et al., 2013). Guidance on how to protect communities from increasing heat have been produced by WMO and WHO (2015) and this has been followed up with national guidelines in a number of countries.

Another dimension approach to prevention focuses on resilience strengthening, such as through strengthened poverty reduction efforts and measures to improve population health status aimed at enhancing the ability of communities to withstand adverse changes.

It is important to consider the geographic scale of policies and actions to reduce climate change impacts on labour. The global and regional scale is important for setting targets for future greenhouse gas emissions and warming limits, as was done in Paris in December 2015 (UNFCCC COP21). At national and local scale various methods to achieve stronger resilience and effective adaptation are available. Finally, actions at individual scale are also of great importance, especially as the exposure to potentially damaging climate conditions can be acted on by the individual worker.

In terms of policies building on the ILO Decent Work framework and considering the impacts on individuals, we can highlight the following. First of all, working people who need to carry out continuous heavy or moderate labour in very hot work environments should be provided with basic occupational health programs and actions as outlined in ILO documents (ILO 2016). The protection would involve sufficient access to drinking water at hot work sites, so that sweat loss of liquid can be replaced. A person in this type of work may sweat 1-1.5 litre/hour.

Rest breaks in cool locations should also be made available, but as pointed out earlier, this will reduce hourly productivity and could reduce the working persons income. Therefore, some people have an incentive to not take rest, as their hourly income will then be higher, and they may risk their health and even their life by not slowing down when their bodies are overheated.

Possible heat protection measures

Direct: engineering solutions, such as cooling and air conditioning, building insulation, shade and worker rehydration stations, and protective clothing; administrative controls, education and awareness campaigns and worker practice and monitoring programs (e.g. rest, scheduling and acclimatization regimes, bio-physical monitoring and other related measures); strengthening labour institutions, guidelines, regulations, protection programs, and policies.

Indirect: fiscal and regulatory intervention to speed structural shifts of economies towards industries involving non-outdoor work (especially in the service and industrial sectors); compensating for productivity losses via other means, such as expanding the use of information and communications technologies or modernized agricultural technologies.

Creating cooler work environments with air conditioning consumes energy and costs money. It is often not possible to use this solution in small workshops and in outdoor work. In addition, the provision of sustainable energy sources need to be considered. For instance, solar panel driven air conditioning systems are already available and should be assessed as a part of national policies.

However, it is important to consider mitigation as the key feature of labour protection, and energy policies and programs that broaden the use particularly of renewable energy for electricity production is of high priority. This is because effectively adapting to climate change that is already expected to occur will require a significant increase in air conditioning in hot regions of the world. Under the current energy mix for such regions, those measures – vital for protecting workers from heat extremes – would generate significant additional emissions, counteracting efforts to cap further warming in a vicious cycle.

"IT IS IMPORTANT TO CONSIDER MITIGATION AS THE KEY FEATURE OF LABOUR PROTECTION"

CONCLUSION: SUMMARY OF KEY FINDINGS AND POLICY RECOMMENDATIONS

- When it is too hot, people work less effectively out-of-doors, in factories, the office or on the move due to diminished ability for physical exertion and for completing mental tasks.
- Heat extremes also increase accident risk and expose people to serious heat-related health risks including heat stroke, severe dehydration and exhaustion, while a body temperature above 40.6° Celsius is life-threatening.
- That is why governments and international organizations have long put in place standards on thermal conditions in the workplace. But climate change has already altered thermal conditions in the work place, and additional warming is a serious challenge for any worker or employer reliant on outdoor or non-air conditioned work.
- The challenge is that workers are required to work longer hours to achieve a targeted output, or more workers are needed for the job; this creates costs due to a lower hourly productivity of labour.
- The world's warmest regions – tropics and sub-tropics – are worst affected due to pre-existing heat extremes and because of high concentrations of exposed sectors (agriculture and manufacturing).
- More than one billion workers already grapple with dozens of additional extremely hot days in a year due to climate change alone. While every decade brings a similar amount of additional hot days for exposed regions with warming set to continue for decades no matter what degree of emissions control is realized.
- Unmanaged, the impact of climate change results in lost work hours that can be substantial at a macro-economic level, with losses for most vulnerable countries already exceeding 2% of all available work time.
- Rising heat in the workplace will undermine progress towards the Sustainable Development Goals (SDGs), the UNFCCC's Global Adaptation Goal, and makes Decent Work and respecting international Labour standards on thermal environments of workers a serious challenge.
- An emerging concern, most national climate or employment policies do not address the impact of climate change on health and productivity in the workplace, but new ILO Guidelines address occupational health and safety and social protection linked to climate change and provide a starting point for a more substantial response.
- Workers and employers need protection now and measures to manage risks to health, income and output do exist, but often entail costs and may compound challenges as in the case of air conditioning, a costly and energy and emissions intensive response.
- Risks become increasingly less manageable and costly to deal with at higher levels of warming as even 1.5 °C of warming entails substantial increased heat and workplace impacts that is a strong incentive for ambitious action to reduce emissions and limit warming in-line with the new UN Paris Agreement on climate change.
- More detailed research and analysis of this issue is urgently required.

Policy recommendations

- The most relevant international organizations have yet to establish any major programmes to address the major challenges of rising heat in the workplace. In November 2015, however, the ILO Governing adopted the "Guidelines for a just transition towards environmentally sustainable economies and societies for all", which include occupational safety and health and social protection policies within the context of climate change.
- These guidelines recognize the need for enterprises, workplaces and communities to adapt to climate change to avoid loss of assets and livelihoods and involuntary migration.
- Under the Occupational Safety and Health (OSH) item, these guidelines call on social partners, to conduct assessments of increased or new OSH risks resulting from climate change; improve, adapt or develop and create awareness of OSH standards for technologies and work processes related to the transition; and review policies concerning the protection of workers.
- The Social Protection Policies item mentions the promotion of innovative social protection mechanisms that contribute to offsetting the impacts of climate change and tripartite mechanisms to identify and understand challenges posed by climate change.
- The guidelines will be revised within the next two years and the adaptation angle could be reinforced in this process.
- These guidelines will be implemented in two or three pilot countries; special attention needs to be paid to the climate change impacts on labour during the implementation phase.
- There are also a range of options that can be explored to further develop research and advocacy initiatives, review labour standards, and implement practical preventive measures in the workplace in the context of climate change adaptation.
- Swift efforts by all countries to live up to the UN Paris Agreement objective of well below 2 degrees of warming with efforts to limit temperatures to not more than 1.5 degrees will also constitute the most significant preventative measure against a tremendous escalation of workplace heat risks this century.

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ONLINE RESOURCES

Hothaps Program and Hothaps-soft are described in the website: http://www.ClimateCHIP.org

ILO guidelines for a just transition towards environmentally sustainable economies and societies for all (2015):http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_432859.pdf

ILO Standards and other instruments on occupational safety and health (2016): http://www.ilo.org/safework/info/standards-and-instruments/lang--en/index.htm

Hothaps Program and Hothaps-soft: http://www.ClimateCHIP.org

ILO guidelines for a just transition towards environmentally sustainable economies and societies for all (2015): http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_432859.pdf

ILO Standards and other instruments on occupational safety and health (2016): http://www.ilo.org/safework/info/standards-and-instruments/lang--en/index.htm

WHO Heat Stress session on the ATLAS of Health and Climate http://www.who.int/globalchange/publications/atlas/report/en/

WHO Country Profiles: http://www.who.int/globalchange/resources/countries/en/

WHO "Heatwaves and health: guidance on warning-system development": http://www.who.int/globalchange/publications/heatwaves-health-guidance/en/

WHO guidance to protect health from climate change through health adaptation planning: http://www.who.int/globalchange/publications/guidance-health-adaptation-planning/en/

WHO Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s: http://www.who.int/globalchange/publications/quantitative-risk-assessment/en/

REFERENCES

Bennet C, McMichael T (2010). Non-heat related impacts of climate change on working populations. Global Health Action, Dec 17;3. doi: 10.3402/gha.v3i0.5640.

Bouchama A, Knochel JP. Heat Stroke. N Engl J Med 2002; 346: 1978-1988

Brearley M et al (2013) Physiological responses of utilities crews working in the Northern Territory. SIA seminar. http://www.thermalhyperformance.com.au/images/2013_SIA_OHS_Presentation_Final.pdf

Collins, M., R. Knutti, J. Arblaster, J.-L. Dufresne, T. Fichefet, P. Friedlingstein, X. Gao, W.J. Gutowski, T. Johns, G. Krinner, M. Shongwe, C. Tebaldi, A.J. Weaver and M. Wehner, 2013: Long-term Climate Change: Projections, Com¬mitments and Irreversibility. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.(IPCC AR5 WG1Ch 12)

Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, Freil S et al. (Lancet-University College London Institute for Global Health Commission). Managing the health effects of climate change. The Lancet 2009; 373: 1693-733.

Dahl R (2013) Cooling concepts. Alternatives to air conditioning for a warm world. Environ Health Persp, 121, A18-A25.

DARA (2012) Climate vulnerability monitor 2012. A guide to the cold calculus of a hot planets. Barcelona: Fundacion DARA Internacional. 250 pp.

De Blois J, Kjellstrom T, Agewall S, et al. The effects of climate change on cardiac health. Cardiology. 2015;131:209-217.

De Freitas CR, Grigorieva EA (2015) A comprehensive catalogue and classification of human thermal climate indices. Int J Biometeorology 59: 109-120.

Dunne JP, Stouffer RJ, John JG (2013) Reductions in labour capacity from heat stress under climate warming. Nature Climate Change. DOI: 10.1038/NCLIMATE1827.

Fischer EM, Knutti R (2015) Anthropogenic contribution to global occurrence of heavy-precipitation and high-temperature extremes. Nature Clim Change 5, 560-565.

Haines A, McMichael AJ, Smith KR, et al. Public health benefits of strategies to reduce greenhouse-gas emissions: overview and implications for policy makers. The Lancet 2009;374:2104-14.

ILO (2013) Sustainable development, Decent work and green jobs. Geneva, International Labour Office, http://www.ilo.org/wcmsp5/groups/public/@ed_norm/@relconf/documents/meetingdocument/wcms_207370.pdf

IOM (2011) Climate Change, Environmental Degradation and Migration. Geneva, International Organization. Available: http://www.iom.int/jahia/webdav/shared/shared/mainsite/microsites/IDM/workshops/climate-change-2011/Report-EN.pdf.

IOM (2014) IOM Outlook on Migration, Environment and Climate Change. Geneva, International Organization for Migration. Available: http://dx.doi.org/10.18356/9ba951ac-en

Ionesco, D.,Chazalnoël M.T. (2015) Migration as an Adaptation Strategy to Climate Change. WebBlog. International Organization for Migration. Available: http://weblog.iom.int/migration-adaptation-strategy-climate-change.

Ionesco, D., Mokhnacheva D., Gemenne F. (2016) Atlas des Migrations Environnementales. Presses de Sciences Po. Paris, France.

IPCC (2013) Climate Change 2013: Contribution of working group 1 to the fifth assessment report. Geneva: The Intergovernmental Panel on Climate Change. (http://ipcc-wg1.gov/AR5/)

IPCC (2014) Climate Change 2013: Contribution of working group 2 to the fifth assessment report. Geneva: The Intergovernmental Panel on Climate Change. (http://ipcc-wg2.gov/AR5/)

Kjellstrom T. Climate change, direct heat exposure, health and well-being in low and middle income countries. Global Health Action 2009a; 2: 1-4. DOI 10.3402/gha.v2i0.1958. (on the web at:http://www.globalhealthaction.net/index.php/gha/article/view/1958/2183).

KjellstromT, Holmer I, Lemke B. (2009a) Workplace heat stress, health and productivity – an increasing challenge for low and middle income countries during climate change. Global Health Action 2009(on website: www.globalhealthaction.net). DOI 10.3402/gha.v210.2047.

Kjellstrom T, Kovats S, Lloyd SJ, Holt T, Tol RSJ. (2009b) The direct impact of climate change on regional labour productivity. Int Archives of Environmental & Occupational Health, 2009, 64, 217-227

Kjellstrom T, Lemke B, Otto M (2013) Mapping occupational heat exposure and effects in South-East Asia: Ongoing time trends 1980-2009 and future estimates to 2050. Indust Health 51: 56-67.

Kjellstrom T, Lemke B, Otto M, Dear K (2014) Global assessment of the health impacts of climate change: Occupational heat stress. Report for a WHO project. Technical Report 2014:4 on www.ClimateCHIP.org.

Kopp R, Hsiang S, Muir-Wood R, et al. American Climate Prospectus. Economic risks in the United States. New York: Rhodium Group, 2014 (accessed on July 18, 2014 at http://rhg.com/wp-content/uploads/2014/06/RHG_AmericanClimateProspectus_June2014_LowRes1.pdf)

Lemke B, Kjellstrom T (2012). Calculating workplace WBGT from meteorological data. Industrial Health, 2012, 50, 267-278.

McSweeney, C., New, M., Lizcano, G. & Lu, X. (2010) The UNDP Climate Change Country Profiles Improving the Accessibility of Observed and Projected Climate Information for Studies of Climate Change in Developing Countries. Bulletin of the American Meteorological Society, 91, 157-166 at http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/

McSweeney et al (2015) Selecting CMIP5 GCMs for downscaling over multiple regions. Clim Dyn, 44, 3237-3260.

Mensbrugghe D and Roson R (2010) Climate, Trade and Development. Working paper for a conference. Geneva, World Trade Organization. https://www.wto.org/english/res_e/reser_e/climate_jun10_e/background_paper1_e.pdf

MMWR. Heat-related deaths among crop workers – United States, 1992-2006. JAMA, 2008, 300, 1017-1018. (MMWR, 2008, 57, 649-653).

Niemelä R, Hannula M, Rautio S, Reijula K, Railio J. 2002. The effect of indoor air temperature on labour productivity in call centres – a case study. Energy and Buildings. 34: 759-764.

NIOSH (2015) New US heat standard recommendations.

Parsons K. (2014) Human thermal environment. The effects of hot, moderate and cold temperatures on human health, comfort and performance. 3rd edition. New York: CRC Press.

Sahu S, Sett M, Kjellstrom T . Heat Exposure, Cardiovascular Stress and Work Productivity in Rice Harvesters in India: Implications for a Climate Change Future. Ind Health, 2013;51,424-431.

Schulte PA, Chun HK (2009) Climate change and occupational safety and health: establishing a preliminary framework. J Occup Environ Hyg, 6, 542-554.

Smith, K.R., A. Woodward, D. Campbell-Lendrum, D.D. Chadee, Y. Honda, Q. Liu, J.M. Olwoch, B. Revich, and R. Sauerborn, 2014: Human health: impacts, adaptation, and co-benefits. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 709-754.(IPCC AR5 WG2 Ch 11)

UN (2015) Sustainable Development, Knowledge Platform, SDG 8. New York, United Nations. https://sustainabledevelopment.un.org/sdg8

USDAAF (2003). Heat stress control and heat casualty management. Technical Bulletin TB MED 507/AFPAM 48-152 (I). Washington DC: US Department of the Army and Air Force.

Venugopal V, Chinnadurai JS, Lucas RAI, Kjellstrom T (2016a) Occupational heat stress profiles in selected workplaces in India. Int J Environ Res Publ Health 13, 89-101.

Venugopal V, Chinnadurai J, Lucas R, Wishwanathan V, Rajiva A, Kjellstrom T (2016b) The social implications of occupational heat stress on migrant workers engaged in public construction: a case study from southern India. Int J Constructed Environ 2, 25-36.

Warszawski L, Frieler K, Huber V, Piontek F, Serdeczny O, Scewe J. 2014. The Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP): Project framework. PNAS 111:3228-32
Watts N, Costello A, and 43 other authors (2015) Health and climate change: policy responses to protect public health. The Lancet, 386, 1861-1914.

Wesseling, C., et al., (2013) Report from the First International Research Workshop on MeN. 2013, Costa Rica: Program on Work, Environment and Health in Central America (SALTRA) and CentralAmerican Institute for Studies on Toxic Substances (IRET) Universidad Nacional (UNA), Costa Rica. 239.

WMO (2015) Provisional statement on the status of global climate 2011-2015. Geneva, World Meteorological Organization.
https://www.wmo.int/pages/meetings/documents/WMO2011-2015.final_-1.pdf

WMO and WHO (2015) Heatwaves and Health: Guidance on Warning-system development. Geneva, World Meteorological Organization, and World Health Organization.

Yaglou, C.P., Minard (1957), D. Control of Heat Casualties at Military Training Centers, A.M.A. Arch. Ind. Hlth16:. 302-316.

Wyndham CH (1969). Adaptation to heat and cold. Env Res 2, 442-469.

Zander KK, Botzen WJW, Oppermann E, Kjellstrom T, Garnett ST (2015) Heat stress causes substantial labour productivity loss in Australia. Nature Climate Change 5, 647-651.

APPENDIX: CALCULATION METHODS

Calculation of occupational heat stress and impacts on health and productivity

The climate data for recent years (30-year period around 1995) are from the detailed analysis of 67,000 grid cells by the Climate Research Unit (CRU), University of East Anglia, Norwich, United Kingdom.

Modelling towards the end of this century uses the HadGEM2 and GFDL models, developed for the IPCC assessments (Collins et al., 2013). These two models produce Global Temperature Change estimates by 2085 (30-year average) for RCP8.5 at 2.5-percentile (GFDL) and 97.5-percentile (HadGEM2) of the 25 models calculated by IPCC. That means that their range covers most of the different model outputs for the whole planet.

The heat effects are calculated based on HadGEM2 and GFDL separately. Then the average of these models is calculated as an estimate for the average of different models. A comparison of the average of all models and the average of the two models shows very similar results.

Using the monthly averages of daily maximum temperature, daily average temperature, and daily absolute humidity (water vapour pressure) the monthly averages of daily values for average WBGT (Wet Bulb Globe Temperature) and maximum WBGT are then calculated using methods described by Lemke and Kjellstrom, 2012). This produces heat levels in the shade or indoors without cooling.

The daily variability within each calendar month, and the hourly variability within a typical monthly day is estimated from available daily modelling data. These variability estimates are then used to calculate the number of hours each month when WBGT values are at specific 1-degree levels. If the number of hours at a certain WBGT level is less than 0.5 hours, we truncate the heat exposure calculation at that level. Any higher WBGT level fractional hour exposures are not included.

For each hour the exposure-response function for heat impact on health and productivity based on the Sahu et al. (2013) paper (Figure 3) and the similar results Wyndham (1969) paper. The loss of productivity in % of each heat exposure hour is calculated for each of the 67,000 grid cells, and then weighted by the grid cell working age population to be added up for each country into a weighted loss (%) of potential daylight work hours for each country at different times and using different RCPs.

The resulting work hours lost due to heat are shown in the Tables and Figures, and the counteraction between occupational health risk due to heat and the loss of work hour productivity means that the resulting numbers can be interpreted for both effects. If X % of the potential daylight work hours are "lost" due to heat if the workers slow down and take more rest, as is the natural prevention method, then also X % of the hours are high risk hours for clinical health effects if the workers try to keep their work pace up to normal.

The conceptual structure of the analysis fits with the description in the reference Kjellstrom et al., (2014), but the current Issues Paper uses the latest climate modelling data is grid cell based (67,000 grid cells) for country specific estimates rather than just regional estimates based on cruder climate data.

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The Climate Vulnerable Forum (CVF) represents 43 countries:

- **Afghanistan**
- **Bangladesh**
- **Barbados**
- **Bhutan**
- **Burkina Faso**
- **Cambodia**
- **Comoros**
- **Costa Rica**
- **Democratic Republic of the Congo**
- **Dominican Republic**
- **Ethiopia**
- **Fiji**
- **Ghana**
- **Grenada**
- **Guatemala**
- **Haïti**
- **Honduras**
- **Kenya**
- **Kiribati**
- **Madagascar**
- **Malawi**
- **Maldives**
- **Marshall Islands**
- **Mongolia**
- **Morocco**
- **Nepal**
- **Niger**
- **Palau**
- **Papua New Guinea**
- **Philippines**
- **Rwanda**
- **Saint Lucia**
- **Senegal**
- **South Sudan**
- **Sri Lanka**
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- **Timor-Leste**
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- **Vanuatu**
- **Viet Nam**
- **Yemen**

www.theCVF.org *www.ilo.org* *www.iom.int* *www.who.int* *www.uniglobalunion.org* *www.ioe-emp.org* *www.ituc-csi.org* *www.actalliance.org*

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Annex 510

"Climate Change and the Cost of Capital in Developing Countries: Assessing the Impact of Climate Risks on Sovereign Borrowing Costs", *United Nations Environment Programme,* May 2018

Climate Change and the Cost of Capital in Developing Countries

Assessing the impact of climate risks on sovereign borrowing costs

UN environment

Imperial College Business School | Centre for Climate Finance & Investment

SOAS University of London

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Acronyms

ADRF	African Disaster Risk Financing Initiative
COP	Conference of the Parties
CPI	Consumer Price Inflation
CVF	Climate Vulnerable Forum
EbA	Ecosystem-based adaptation
ESG	Environmental, Social and Governance
FAO	The Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
IADB	Inter-American Development Bank
IFC	International Finance Corporation
IMF	International Monetary Fund
IPCC	Intergovernmental Panel Climate Change
ND-GAIN	Notre Dame Global Adaptation Index
NGOs	Non-Governmental Organizations
OECD	Organization for Economic Co-operation and Development
PPP	Purchasing power parity
S&P	Standard & Poor's
UN	United Nations
UN-REDD	United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme (also referred to as UN Environment)
USAID	The United States Agency for International Development
USD	United States (of America) Dollars
V20	Vulnerable 20

Executive summary

This report represents the first systematic effort to assess the relationship between climate vulnerability, sovereign credit profiles, and the cost of capital in developing countries. Climate risks are multi-dimensional, covering a range of geophysical, social, and economic issues. The intensification of these risks and the degree to which they are accurately priced by financial markets are of increasing concern to global economic stability.

Key messages:

– Integrating climate risks into financial decision-making is crucial to long-term economic and financial stability as these risks affect return on investment. Broader recognition of these risks will be necessary for sustainable development.

– For every USD 10 paid in interest by developing countries, an additional dollar will be spent due to climate vulnerability. This financial burden exacerbates the present-day economic challenges of poorer countries. The magnitude of this burden will at least double over the next decade.

– The climate consequences on poorer countries' cost of capital and overall fiscal health need to be addressed. A range of existing policy and market responses can build climate resilience in vulnerable countries and deliver demonstrable financial benefits.

– Investments that enhance the resilience of climate vulnerable countries are crucial to not only helping vulnerable countries deal with the consequences of climate risks, but also bring down their cost of borrowing.

Core research findings:

– Our econometric modeling suggests that climate vulnerability has already raised the average cost of debt in a sample of developing countries by 117 basis points. In absolute terms, this translates into USD 40 billion in additional interest payments over the past 10 years on government debt alone.

– Incorporating higher sovereign borrowing rates into the cost of private external debt, we estimate that climate vulnerability has cost these countries USD 62 billion in higher interest payments across the public and private sectors. We expect the additional interest payments attributable to climate vulnerability to increase to between USD 146 – 168 billion over the next decade.

– Investments in social preparedness can partially mitigate the impacts of climate vulnerability on sovereign borrowing rates by increasing the social and economic resilience of countries.

– Cooperative efforts to measure, monitor, and transfer climate risks provide an opportunity to prevent a deterioration of sovereign borrowing capacity in affected countries. Monitoring the financial indicators used by the major rating agencies is a crucial tool for anticipating impacts on sovereign credit profiles.

Contents

Introduction

This study investigates whether climate change is impacting on the rate at which countries can borrow from international debt capital markets. We focus on physical climate risks that have the potential to undermine a country's sovereign credit profile. Our analysis considers countries that are members of the Climate Vulnerable Forum (CVF).

The CVF was established in 2009 as an 'international partnership of countries highly vulnerable to a warming planet'.[1] The concept of Vulnerable 20 countries (V20) arose from the Climate Vulnerable Forum's Costa Rica Action Plan in 2015. By March 2018, member nations of the CVF and V20 had risen to total of 48 countries.[2]

V20 countries (as of March 2018)

Afghanistan	Fiji	Maldives	Samoa
Bangladesh	The Gambia	Marshall Islands	Senegal
Barbados	Ghana	Mongolia	South Sudan
Bhutan	Grenada	Morocco	Sri Lanka
Burkina Faso	Guatemala	Nepal	Sudan
Cambodia	Haiti	Niger	Tanzania
Colombia	Honduras	Palau	Timor-Leste
Comoros	Kenya	Palestine	Tunisia
Costa Rica	Kiribati	Papua New Guinea	Tuvalu
Democratic Republic of the Congo	Lebanon	Philippines	Vanuatu
Dominican Republic	Madagascar	Rwanda	Vietnam
Ethiopia	Malawi	Saint Lucia	Yemen

Figure 1. V20 countries

The key aims of the research are:

– First, to analyze the impact of climate change on the cost of debt capital for climate-vulnerable countries, through the analysis of potential impacts on sovereign credit ratings.

– Second, to quantify any change in cost of capital in climate-vulnerable countries and forecast such changes into the future.

– Third, to discuss policy interventions at the national and international scale that could mitigate potential fiscal impacts.

Our study investigates whether physical climate risks currently are incorporated in country-level credit ratings and sovereign bond yields of V20 countries. We employ a mix of quantitative and qualitative methods to explore the mechanisms by which physical climate impacts may impair fiscal health. Our work concludes with a set of case studies that identify the mechanisms by climate change impacts that manifest themselves as financial risks. We consider three physical impacts in five countries:

Flooding – Vietnam and Bangladesh

Drought – Guatemala and Kenya

Severe weather events – Barbados

While there is a substantial body of research on the economic impacts of climate change on developing countries, there has been very little work to date on translating estimates of economic loss into fiscal measures. Our analysis seeks to isolate how climate change may impact the rate of interest demanded by investors on government-issued debt.

Our analysis focuses exclusively on the physical impacts of climate change, such as extreme weather shocks and severe climatic trends, which have the potential to impair country-level credit ratings and increase sovereign bond yields. We do not address broader impacts of climate change, such as carbon pricing, technological disruption, and shifts in consumer demand. While these 'transition risks' will likely have equal, and in some cases greater, impact on the fiscal health of developing countries, the methodologies for quantifying these impacts are only now emerging for country-level analysis. A study by HSBC[3] is a notable example of recent work in this area.

This report discusses three closely related topics. They are climate impacts, climate vulnerability, and climate risks. We define **climate impacts** as the physical manifestations of man-made climate change. They include rising sea levels, increased coastal flooding, and increased incidence of drought. Climate impacts generate economic costs. Climate vulnerability is an aggregate measure of a country's propensity to be affected by climate change. **Climate vulnerability** encompasses the level of sensitivity (as determined by geographic, demographic and economic factors) as well as the capacity to cope and adapt.

Finally, **climate risks** are negative financial outcomes that are attributable to man-made climate change. While it has become commonplace to speak of 'climate risk' as a catch-all phrase in financial markets, the use of the singular term is, in fact, a gross simplification. Climate risks are highly heterogeneous and affect economic sectors in different ways. For example, the loss of oil revenues from a shift to electric vehicles (a transition risk) bears little resemblance to loss of fisheries revenues from ocean acidification (a physical risk). Quantifying climate change as a priced risk factor in financial markets therefore requires specification of unique variables.

In this study, we define climate risk as the marginal increase in the rate of interest on sovereign debt that is attributable to national climate vulnerability.

In the sections that follow, we address the following questions regarding this climate risk in developing countries:

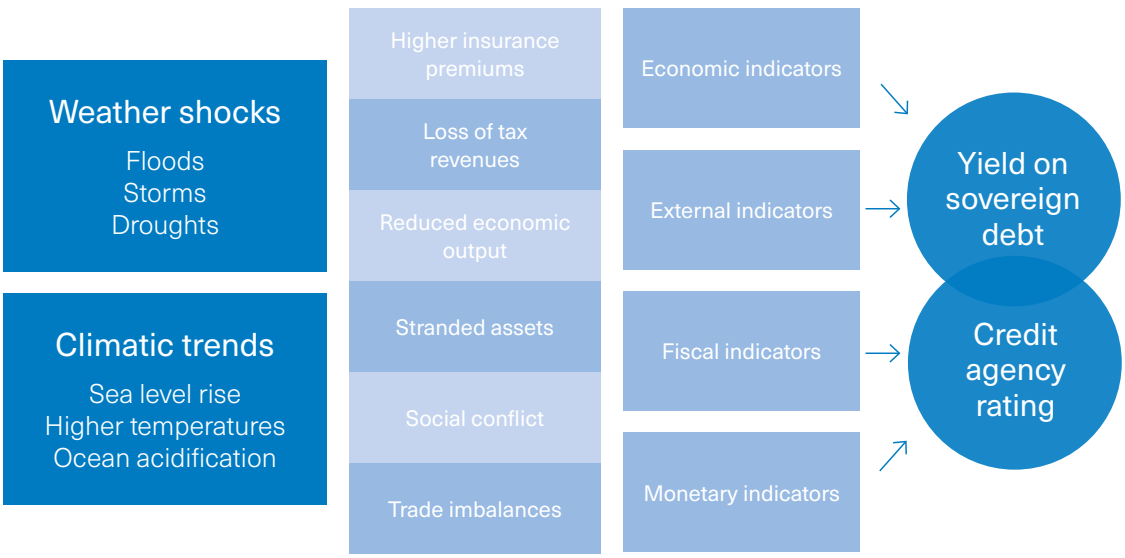
Do credit rating agencies perceive a relationship between climate change and a country's cost of sovereign borrowing?

Can the cost of climate vulnerability be quantified within sovereign borrowing rates?

What policies might alleviate the impact of climate change on the cost of borrowing?

Figure 2. below, provides a simplified schematic of the relationship between physical climate impacts and country-level financial indicators, as explored in this report.

Figure 2. Relationship between physical climate impacts and country-level financial indicators



2. Climate change and sovereign credit ratings

In summary

To date, no downgrade by a major credit rating agency has been attributed to climate risks. As the major rating agencies do not generally itemize climate risks in their published country assessments, sovereign credit ratings are likely to be incorporating these risks in their assessments, but capturing them in other areas. At the sovereign level, climate change is an asymmetrical, downside risk. If climate-related rating actions are taken in the future, as the agencies themselves have indicated is likely, these actions will almost certainly be negative.

Credit ratings are an assessment of the credit risk of a borrower. There is a strong relationship between sovereign credit ratings and the market rate of interest. Understanding how ratings agencies measure (or might measure) climate impacts is vital for understanding real or potential climate change vulnerability in financial markets.

Rating agencies have recently begun to take note of climate change and its potential role in credit assessment. Rating agency comments have suggested that a range of sovereign issuers, particularly emerging market sovereign issuers, are potentially vulnerable to negative rating actions as a result of climate impacts. Rating agencies have also noted that mitigating factors potentially could offset these negative climate trends.

Moody's has neatly summarized the types of climate impacts likely to be felt by countries:

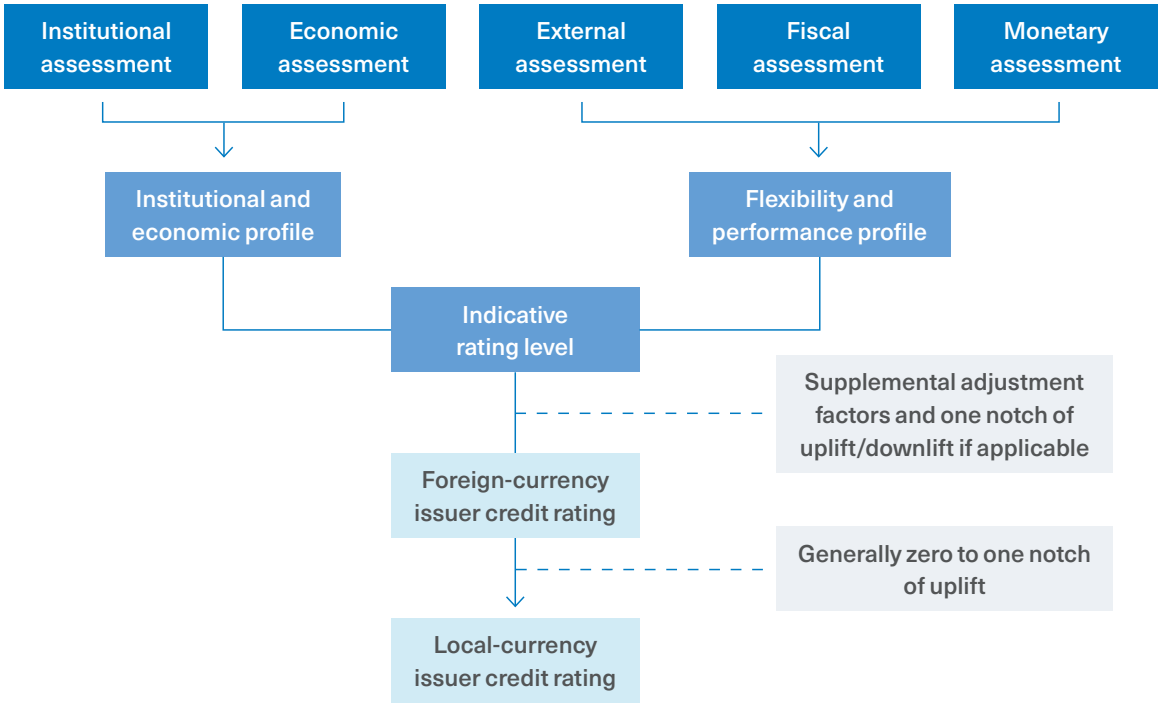
"The physical effects of climate change can be broadly grouped into two categories: climate shocks and climate trends. Climate shocks, in the form of storms, floods, droughts, and other climate-related disasters, are acute, costly and more conspicuous than trends. While climate trends including higher global temperatures and rising sea levels are multi-decade phenomena and less visible from one year to the next, one of the manifestations of climate trends is a higher frequency of shocks."[4]

Rating agencies such as S&P Global Ratings (S&P) and Moody's, whose role in capital markets is to assess the relative likelihood of the ability of borrowers to repay debt obligations, are aware of the potential risks posed by climate change. S&P has noted in a recent report that "climate change, in particular, could have significant implications for sovereign ratings in the decades to come".[5] In addition, both agencies have published occasional research pieces on particular climate topics. For example, Moody's recently published a report on climate risks potentially affecting small island nations.[6] Nonetheless, climate risks have not yet been specifically indicated in Sovereign Ratings Methodologies, the formal criteria published by rating agencies that delineate the factors relevant to credit rating assessment, although S&P includes vulnerability to 'constant natural disasters or adverse weather conditions,' areas where some climate impacts will manifest themselves, in its recently updated methodologies.[7]

More specifically, both Moody's and S&P have published several reports on the potential credit impacts of natural catastrophes,[8] although we note that natural catastrophes and climate impacts are not interchangeable terms. Changes in climate affect both average temperatures and extreme temperatures, and climate change is increasing the risk of natural catastrophes such as extreme weather events, including droughts, flooding and heat waves.[9] However, natural catastrophes such as earthquakes and the incidence of tsunamis are unaffected by climate impacts.

In its studies focused specifically on the impact of climate change on sovereign credit ratings, S&P has indicated that climate change could become a factor in credit profiles at the sovereign level, especially for lower-rated emerging market countries. S&P also noted that the ratings pressure created by climate change factors would be negative.[10] **However, the agency noted that this was not likely to be a near-term event within the current five-year horizon of sovereign credit ratings.** Moody's has made similar comments about the increased vulnerability of lower-rated countries, noting that "In general, sovereign issuers with smaller, less diversified economies and geographies, lower incomes and quality of infrastructure, and lower fiscal flexibility are more susceptible to the credit implications of climate change".[11]

Figure 3. Sovereign issuer credit rating framework
Five key areas to determine a sovereign's creditworthiness



Source: S&P Global Ratings, *Sovereign Rating Methodology,* 18 December 2017

In a recent report, Moody's itemized those areas relevant to sovereign credit profiles where climate impacts might be expected to materialize:

We identify four primary channels by which the effects of physical climate change are transmitted to sovereigns' credit profiles. These are: 1) the potential economic impact (for example, weaker activity due to a loss of agricultural production); 2) damage to infrastructure assets as a direct result of the physical destruction incurred from climate shocks; 3) rising social costs brought about, for example, by a health crisis or food security concerns; and 4) population shifts due to forced displacements resulting from climate change.[12]

Even more recently, Moody's has expanded its list of climate-vulnerable countries, and notes, "A common characteristic among the most susceptible sovereigns is their economic reliance on the agricultural sector, which is typically not irrigated and is thus rain-fed. In addition, undiversified economies are disproportionately affected by the increasing frequency and/or severity of natural disasters impacting growth and causing lasting damage to infrastructure".[13]
As we demonstrate in our case studies, agriculture is particularly vulnerable to climate risks and a corresponding loss of economic resilience, and as a result may also provide the best indicators of evolving climate risks in some countries.

In practice, climate risks are rarely discussed in individual country reports, or in rating actions, although these risks are the subject of numerous general commentaries. When they are, these are almost always situation-specific. For example, Moody's has recently commented that Cape Town's credit profile could come under stress in the event the ongoing drought in South Africa persists.[14] An ongoing Brazilian drought was discussed by S&P in a comment on Brazil's electricity distribution system, in 2016.[15] Bangalore's water issues have been well documented;[16] and, in fact, Moody's discussed India's water and drought issues in general in 2015.[17]

In a joint report from the UN Environment Finance Initiative and the Global Footprint Network in 2012 on integrating ESG issues into sovereign credit analysis,[18] the authors note the paucity of comments from ratings agencies at the time. A second report in 2016 noted that while rating agencies had issued some reports on potential impacts of climate change on credit quality, "Research on the broader economic impacts of long-term environmental degradation is, however, still rare".[19] However, it is now clear that both S&P and Moody's are becoming increasingly vigilant about climate impacts and their possible fiscal and economic consequences.

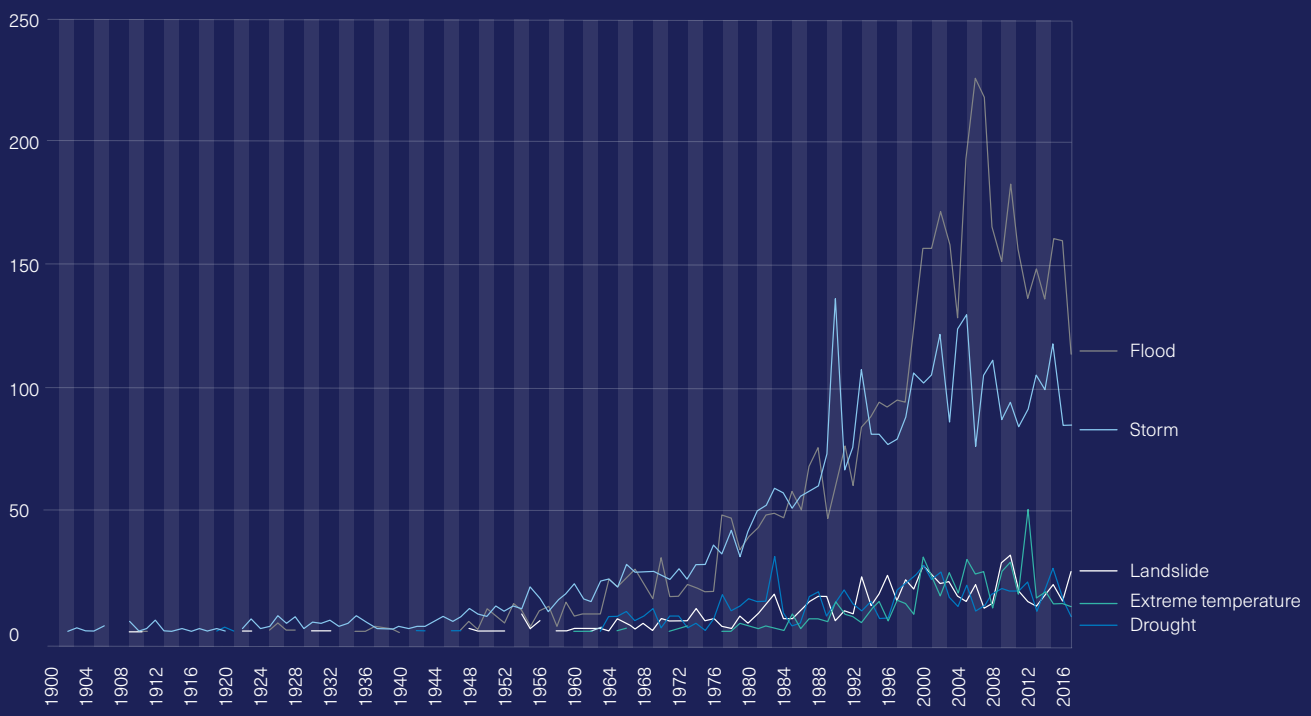
3. Climate vulnerability and the cost of sovereign borrowing

In summary

Our analysis confirms that countries with higher vulnerability to climate change risk bear an incremental cost on government-issued debt. These costs are above and beyond the rates attributable to macroeconomic and fiscal fundamentals. This incremental debt yield carries over into the cost of private debt. Greater social preparedness mitigates this source of risk to developing countries, but only partially. Our findings distinguish between the economic losses V20 countries suffer from climate change, and the fiscal burdens they carry due to their exposure to climate vulnerability. Recognizing climate vulnerability in investment decision-making will help direct financial resources more effectively. Further strengthening of national adaption capacity and resilience is an appropriate response to climate-related fiscal impacts.

The frequency of natural catastrophes has increased significantly over the past 50 years. While the causes of these hazards are complex, there is widespread consensus in the scientific community that anthropogenic climate change has led to an increase in temperatures of oceans and the atmosphere, which have contributed to an increase in the frequency and severity of extreme weather events.[20] Figure 4 shows a pronounced increase in droughts, extreme temperatures, floods, landslides and storms since the 1970s.

Figure 4. Number of weather-related catastrophes, 1900–2017

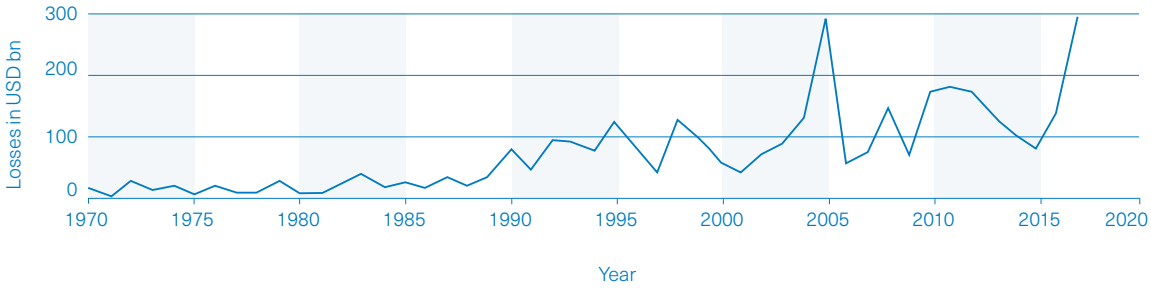


Source: Compiled with data from EM-DAT: The Emergency Events Database – Université Catholique de Louvain (UCL) –CRED, D. Guha-Sapir – www.emdat.be, Brussels, Belgium, 2018.

Note: The count includes events that meet at least one of the following criteria: (i) 10 or more people reported as dead, (ii) 100 people reported as affected, (iii) a declaration of a state of emergency, or (iv) a call for international assistance.

Figure 5 shows the increase in economic losses due to major weather-related events over the last five decades, which also displays a clear trend.[21] As documented in a range of economic studies, future increase in climate-related natural disasters could have large negative effects on economic growth.[22] While natural disasters do not always negatively impact GDP growth, when they do, the negative impacts are larger for developing countries.[23]

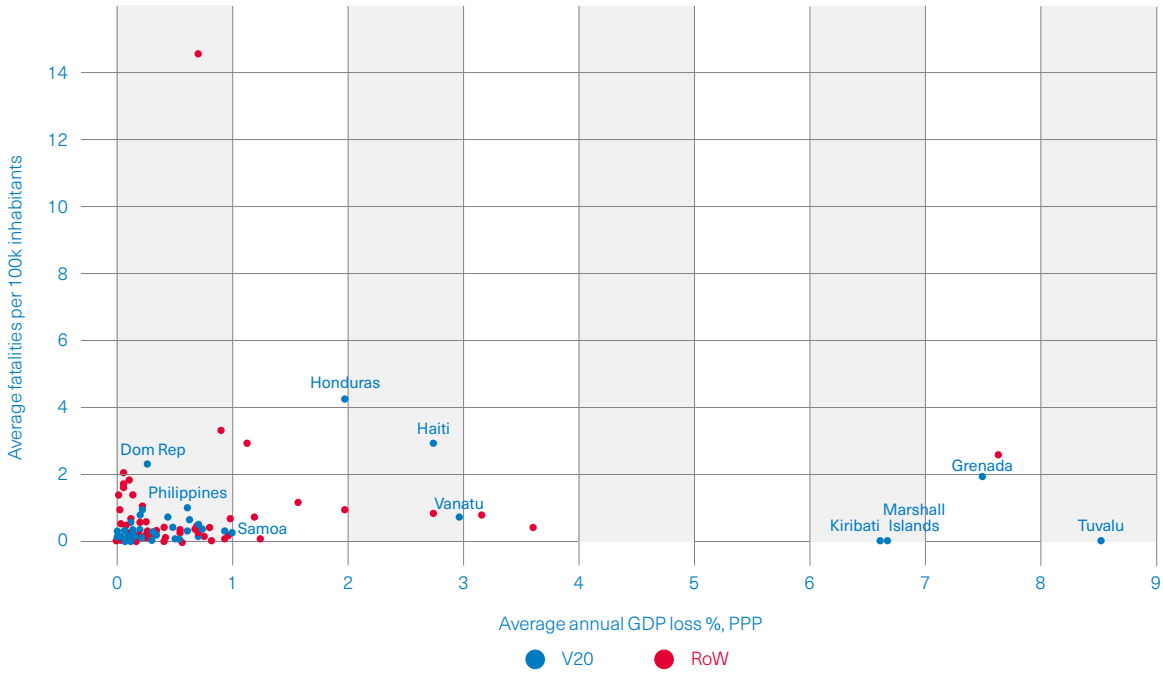
Figure 5. Total economic losses due to major weather-related events (insured and uninsured), USD inflation adjusted, 1970–2017



Source: Compiled with data from Swiss Re.

V20 countries are particularly exposed to the effects of climate change. Between 1997 and 2016, major weather events negatively impacted the national incomes of Tuvalu, Grenada, the Marshall Islands and Kiribati by over 6% a year.[24] Although there are large differences between the highly diverse members, this is not just a matter of economic statistics. Extreme weather events also entail substantial human fatalities. Figure 6 and Table 1 illustrate the burden to selected V20 countries from extreme weather events over the last 20 years.

Figure 6. 20-year average fatalities per 100,000 inhabitants and percentage GDP losses due to major weather events, 1997–2016



Source: Compiled with data from Germanwatch's Global Climate Risk Index database.
Note: V20 countries selected on the basis of available data in 2016.

Table 1. V20 average annual weather-related human fatalities and economic losses, 1997–2016

Country	CRI	Deaths		Deaths per 100k		Losses in USD mil		GDP loss %	
	Score	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank
Honduras	12.2	302	14	4.3	2	561.1	31	2.0	12
Haiti	13.5	280	15	3.0	5	418.8	36	2.7	10
Philippines	20.2	860	7	1.0	18	2,893.4	8	0.6	35
Bangladesh	26.5	642	9	0.4	38	2,311.1	10	0.7	32
Vietnam	31.8	313	13	0.4	44	2,029.8	14	0.6	38
Dominican Republic	34.0	211	19	2.3	7	243.5	53	0.3	59
Guatemala	34.3	98	30	0.7	26	402.9	40	0.4	42
Madagascar	37.8	79	36	0.4	39	196.4	61	0.7	26
Fiji	37.8	8	90	1.0	19	119.5	77	2.0	11
Cambodia	38.0	54	44	0.4	41	242.7	54	0.8	24
Grenada	41.0	2	132	1.9	9	78.5	90	7.5	3
Afghanistan	44.2	280	15	1.0	16	100.3	84	0.2	67
Nepal	45.8	228	18	0.9	20	108.6	81	0.2	68
Vanuatu	55.5	2	137	0.7	24	15.9	132	3.0	8
Kenya	56.0	57	40	0.2	76	354.7	44	0.4	50
Sri Lanka	59.3	49	46	0.3	61	315.6	46	0.2	71
Colombia	59.5	107	27	0.3	63	609.1	30	0.1	87
Saint Lucia	61.0	1	144	0.7	28	17.8	130	1.0	18
Mongolia	66.8	8	93	0.3	57	80.2	88	0.3	53
Papua New Guinea	67.7	24	66	0.4	42	36.8	110	0.2	73
Ethiopia	69.7	91	31	0.1	92	180.6	65	0.2	69
The Gambia	75.5	5	105	0.3	49	7.3	146	0.3	52
Samoa	76.3	0	156	0.3	62	8.6	144	1.0	17
Yemen	77.0	41	52	0.2	73	114.0	78	0.1	93
Niger	77.2	15	72	0.1	97	47.0	101	0.4	48
Malawi	78.8	11	76	0.1	111	61.8	95	0.5	40
Sudan	94.0	47	48	0.1	85	82.8	86	0.1	130
Costa Rica	95.0	6	96	0.1	82	50.4	98	0.1	106
Bhutan	95.5	2	137	0.3	60	5.0	154	0.2	81
Burkina Faso	98.0	8	92	0.1	125	40.2	106	0.2	70
Morocco	98.0	17	70	0.1	124	172.1	66	0.1	102
Ghana	103.0	30	62	0.1	84	32.1	114	0.1	137
Tanzania	104.2	25	65	0.1	116	61.7	96	0.1	116
Kiribati	112.0	0	174	0.0	174	10.6	140	6.6	5
Marshall Islands	112.2	0	174	0.0	174	9.0	143	6.7	4
South Sudan	113.5	11	80	0.1	102	16.6	131	0.1	133
Tuvalu	114.2	0	174	0.0	174	2.6	161	8.5	1
Rwanda	118.5	11	78	0.1	91	3.3	157	0.0	147
Comoros	119.3	1	147	0.2	78	0.7	171	0.1	121
Tunisia	122.5	4	115	0.0	145	64.2	94	0.1	118
Senegal	126.7	5	103	0.0	138	15.4	133	0.1	124
Lebanon	127.0	2	129	0.1	122	27.3	117	0.1	136
Congo, Dem. Rep. of	131.0	33	58	0.1	130	5.7	150	0.0	159
Barbados	142.7	0	173	0.0	161	3.7	155	0.1	103
Palau	167.2	0	174	0.0	174	0.1	181	0.0	150
Maldives	169.2	0	174	0.0	174	0.6	173	0.0	160
Timor-Leste	171.5	0	171	0.0	170	0.3	176	0.0	171

Source: Compiled with data from Germanwatch's Global Climate Risk Index (CRI) database.
Note: Countries are ranked out of 182. Losses in USD purchasing power parity.
The lower the CRI score, the higher a country's level of exposure and vulnerability to extreme events.

While a growing literature has investigated the impact of climate change on economic growth and estimated the economic losses associated with extreme weather events,[25] there is a dearth of research that investigates the effect of climate vulnerability on the cost of sovereign debt. The cost at which governments can access finance does not only affect their ability to invest in climate mitigation and adaptation, but also has a range of negative spillover effects. A high cost of capital in the public sector constrains social investments in areas such as infrastructure, education and public health. The governmental cost of borrowing also acts as a proxy for the country risk premium, which has direct ramifications on investments undertaken by the private sector. Empirical evidence has shown that the most critical variable affecting the Weighted Average Cost of Capital – which is a crucial variable for investment appraisal – is the sovereign risk assigned to each country.[26] Understanding the extent to which climate vulnerability impacts the sovereign cost of borrowing is not just vital for helping to develop appropriate policies at the sovereign level, but also to develop appropriate policies and mechanisms for unlocking private finance.

Methodology

To formally investigate the relationship between climate vulnerability, adaption capacity and the cost of sovereign debt, we calculated bond yields for 46 countries. The sample is made up of a selection of V20 countries, the Group of Seven (G7) and a group of middle-to-low income countries not in the V20. Among the V20 countries, our sample includes 17 countries with openly traded debt.[27] It also includes an additional eight V20 member countries whose yields can be tracked using multilateral concessionary bond yield observations from the International Monetary Fund (IMF). The complete group of countries is shown in Table 8. Estimation and testing is conducted within the sample period 1996-2016.

We developed a linear econometric model with a series of macroeconomic control variables, including per capita income (on a purchasing power parity basis), gross government debt to GDP, government revenue as share of GDP, government expenditure as share of GDP, the government's primary balance as share of GDP, consumer price inflation, and foreign direct investment as share of GDP, to gauge the effects of climate vulnerability on sovereign bond yields.[28] Our model employs the Notre Dame Global Adaptation Index (ND-GAIN) to generate our variables for climate vulnerability and social preparedness.[29] It is currently the most comprehensive and granular database for these purposes.

ND-GAIN has three sub-components of interest for this study – they are the Sensitivity index, the Capacity index and the Social Readiness index. The ND-GAIN sensitivity index, which acts as our proxy for climate vulnerability, is based on 12 measures.[30] We combine this statistically with the ND-GAIN capacity index, which is based on a further 12 measures, using principal component analysis.[31] The ND-GAIN Social Readiness index acts as our proxy for country-level climate preparedness. It comprises variables including social inequality, information and communications technology infrastructure, education, and economic innovation. The data for the indices are drawn from the United Nations, the Food and Agriculture Organization, the World Health Organization, the World Bank, and peer-reviewed academic research.[32]

Further details on the methodology and the data are presented in Appendix 1, along with the main estimation results. A technical paper with details of this analysis and a detailed description of all variables used is available online **https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3198093** [33]

Table 2. Empirical model sample countries

Country	Type of debt cost observation		V20 member	Outstanding debt 2016 (V20 only), in USD billions		
	Marketable	Multilateral		External total	Public & guaranteed	Multilateral
Argentina	✓					
Bangladesh	✓		✓	41.1	28.6	26.5
Brazil	✓					
Burkina Faso	✓		✓	2.8	2.5	2.5
Canada	✓					
China	✓					
Colombia	✓		✓	120.3	70.9	6.8
Costa Rica	✓		✓	25.6	11.1	1.2
Dominican Republic	✓		✓	28.0	17.2	1.8
Egypt	✓					
Ethiopia		✓	✓	23.1	21.8	15.8
Fiji		✓	✓	0.9	0.7	0.3
France	✓					
Germany	✓					
Ghana	✓		✓	21.4	17.0	8.7
Guatemala	✓		✓	21.2	8.1	1.3
Honduras		✓	✓	7.6	6.0	3.4
India	✓					
Indonesia	✓					
Italy	✓					
Jamaica	✓					
Japan	✓					
Kenya	✓		✓	22.3	18.3	12.7
Lebanon	✓		✓	32.0	27.2	0.8
Malawi		✓	✓	1.8	1.5	1.5
Maldives		✓	✓	1.2	0.9	0.7
Mexico	✓					
Mongolia	✓		✓	23.9	4.5	2.1
Morocco	✓		✓	46.3	30.1	9.0
Nepal		✓	✓	4.3	3.6	3.6
Nigeria	✓					
Pakistan	✓					
Peru	✓					
Philippines	✓		✓	77.3	33.4	8.4
Papua New Guinea		✓	✓	19.7	1.9	1.2
Rwanda	✓		✓	2.8	2.4	1.9
Senegal	✓		✓	6.6	6.1	4.9
South Africa	✓					
Tanzania	✓		✓	16.5	11.2	9.1
Thailand	✓					
Tunisia	✓		✓	28.1	18.3	5.5
United Kingdom	✓					
United States	✓					
Vanuatu		✓	✓	0.2	0.1	0.1
Venezuela	✓					
Vietnam	✓		✓	87.0	48.0	35.0
Total				661.9	391.7	164.8

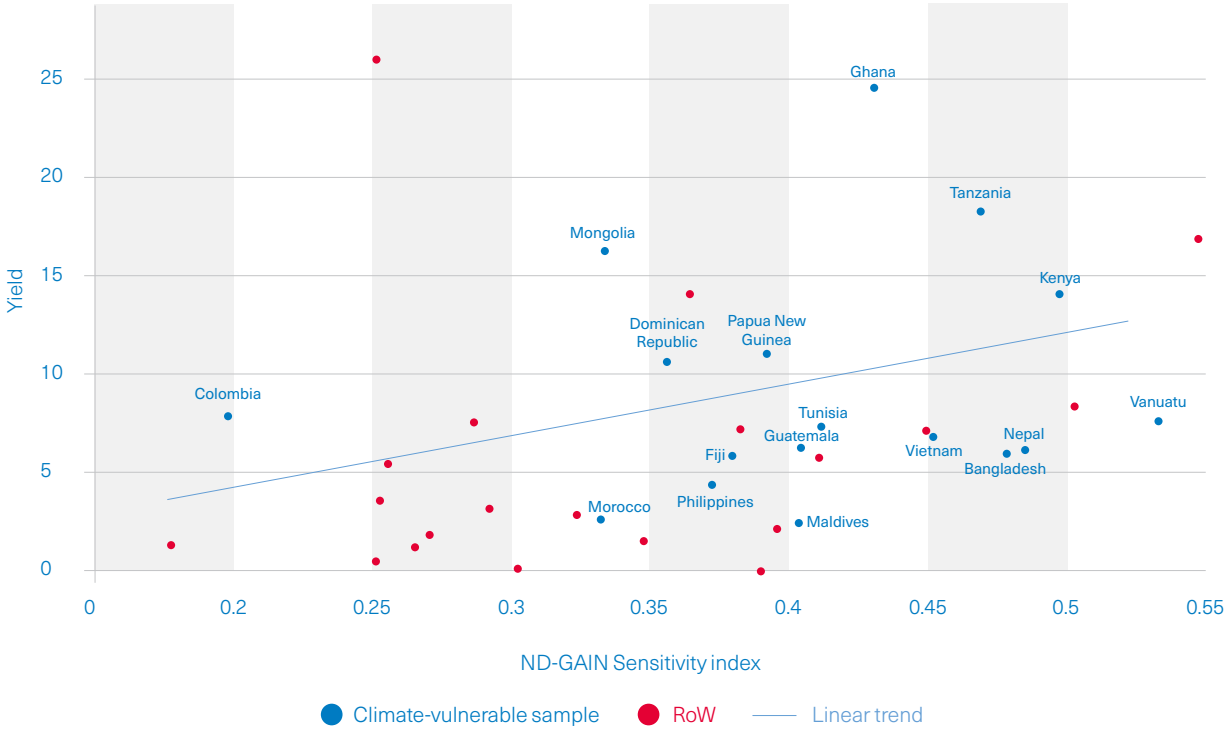
Source: Compiled with data on outstanding debt in 2016 from the World Bank Development Indicators.
Note: External total debt is the sum of public, publicly guaranteed, private non-guaranteed, use of IMF credit and short term debt – that is owed to non-residents.

Results

Our econometric analysis provides evidence regarding the impact of climate vulnerability on the cost of sovereign debt. We estimate a linear model to explain sovereign bond yields using a set of control variables. We link measures of climate vulnerability and social preparedness with cost of debt. Our primary conclusion is that countries with higher degrees of climate vulnerability face higher sovereign borrowing costs. Our econometric analysis finds that climate vulnerability, after controlling for a range of potentially confounding variables, has a positive and significant impact on sovereign yields. We also find that measures of social preparedness have a negative and significant effect on bond yields.

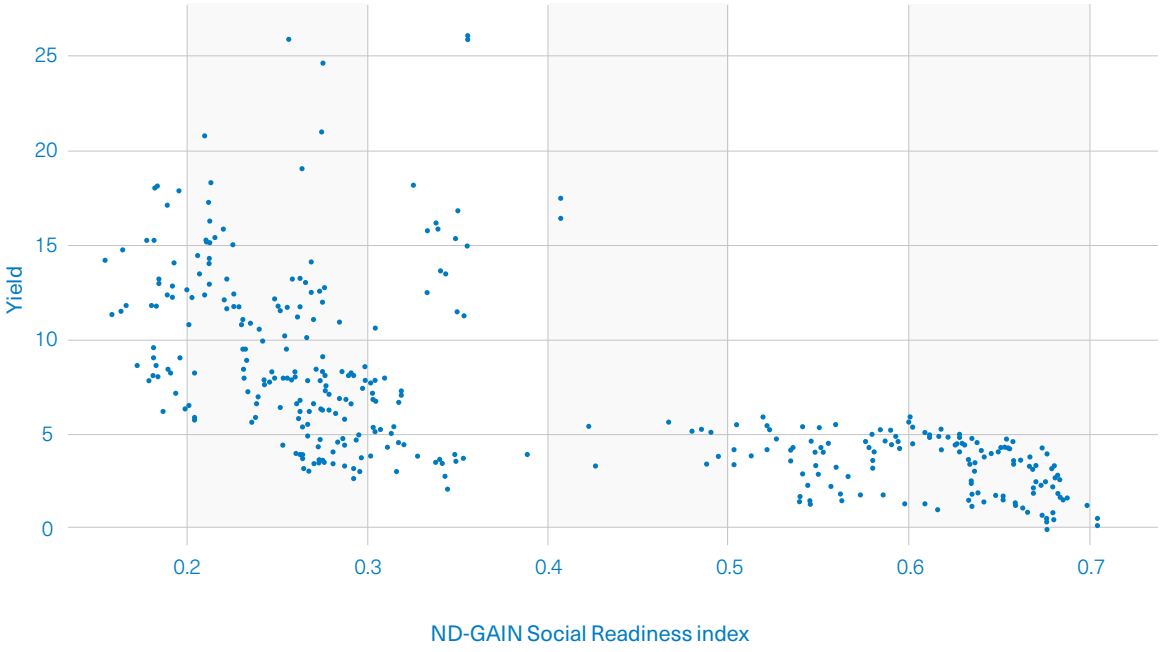
The main findings are illustrated in Figures 7 and 8. Figure 7 shows that countries with greater sensitivity to climate impacts tend to have higher sovereign borrowing costs. Figure 8 shows that countries that are well prepared to deal with the risks of climate change enjoy low borrowing costs; less well-prepared countries are often encumbered by high cost of debt.

Figure 7. Cost of debt and ND-GAIN Sensitivity index, 2016



Source: Compiled with data from Bloomberg and ND-Gain.

Figure 8. Cost of debt and ND-GAIN Social Readiness index, 1996–2016

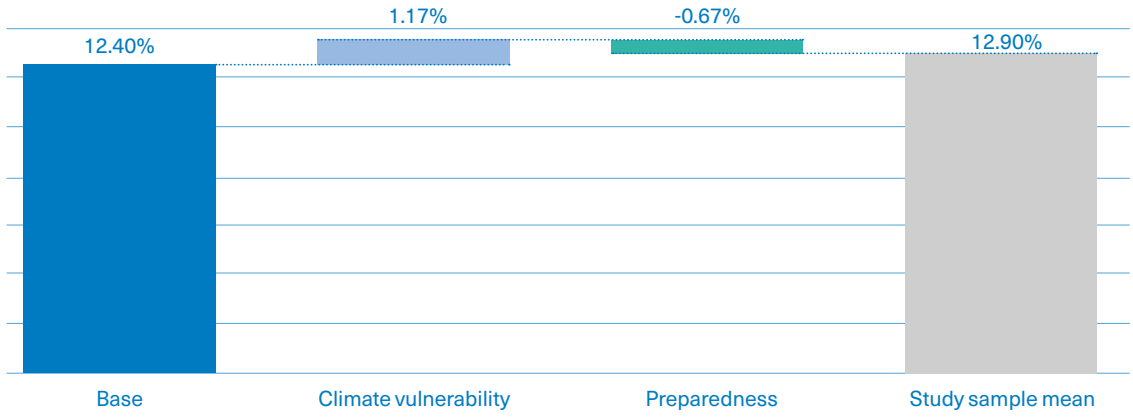


Source: Compiled with data from Bloomberg and ND-GAIN.
Note: Excludes multilateral debt.

Figure 9 shows our base estimate of the expected cost of sovereign debt based on macroeconomic control variables for V20 countries. On average the model predicts a base cost of debt of 12.40%. Climate vulnerability increases the cost of debt, on average, by 117 basis points.[34]

This increase is considerable, representing an uplift of nearly 10% on overall interest costs. Our modeling suggests that investing in social preparedness reduces the cost of debt by 67 basis points, on average.

Figure 9. Estimated impact on cost of debt



Source: Authors' own work, based on own estimations with data compiled from Bloomberg, ND-GAIN, IMF and the UN.

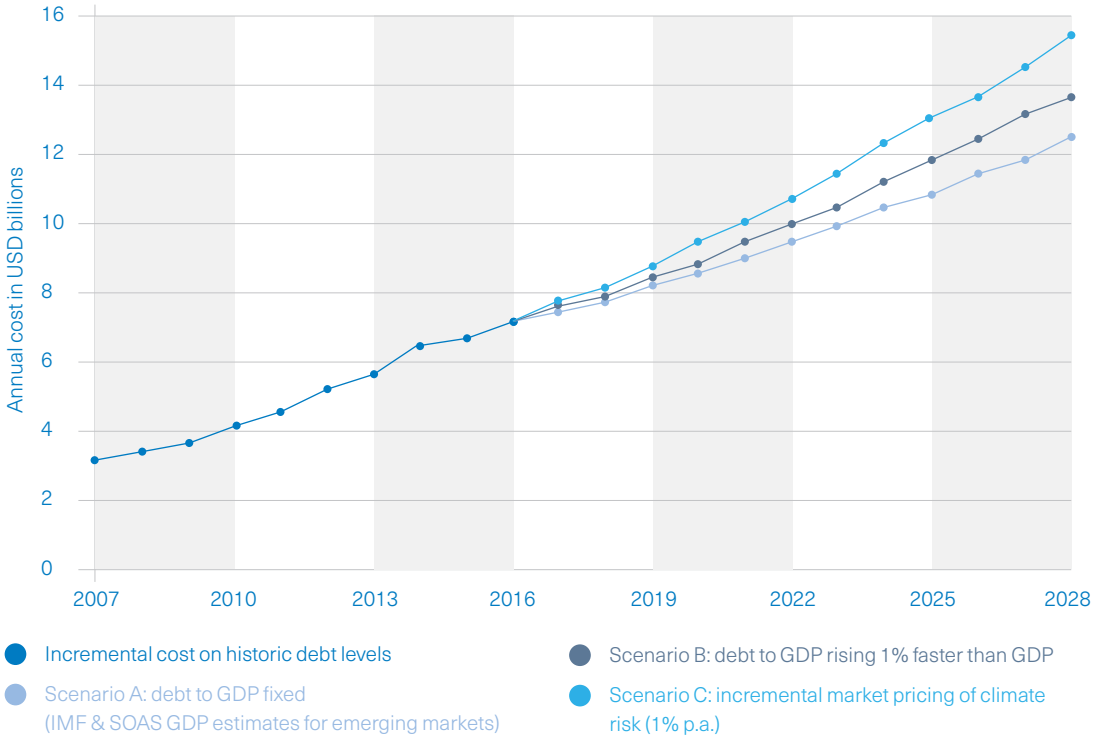
Based on our empirical analysis, we estimate that over the last 10 years, climate vulnerability has cost the V20 countries over USD 62 billion in higher external interest payments. This figure includes more than USD 40 billion in additional interest payments over the past 10 years on government debt alone. Our model estimates this incremental debt cost for the V20 countries was almost USD 9 billion in 2016 alone.

Our estimate of total additional interest payments is gained by multiplying the marginal cost of debt to the stock of external debt outstanding amongst V20 countries. We use the stock of outstanding external public, publicly guaranteed and private debt as reported by the World Bank's World Development Indicators database over the 10-year period 2007 to 2016.[35] Our estimate is a lower bound as many V20 countries face financial exclusion.[36] Moreover, indirect effects of climate on macroeconomic variables are not considered, only direct impact. Furthermore, we use historic debt levels understating current levels of debt, given that we are estimating the cumulative effect over the last 10 years. The 25 V20 countries sampled in our empirical model reflect 86% of the external debt reported by the World Bank for the 48 countries of the V20.

In Figure 10, we chart the historical increase in the cost of debt associated with climate risk as well as three scenarios for how it might develop over the next decade.

The low case Scenario A employs the central forecast for emerging market GDP growth in the IMF's most recent World Economic Outlook. The IMF estimate of GDP growth extends to 2022, after which we have applied a slight deceleration to 2028. We apply a constant marginal cost of debt associated with climate vulnerability (1.17%) and a stable debt to GDP ratio. Scenario B allows total indebtedness to grow 1% faster than GDP. Scenario C assumes that the interest rate premium associated with climate vulnerability grows by 1% each year, thereby increasing in absolute terms by 1.7 basis points per annum. This would be consistent with the rising frequency and severity of catastrophes, and higher volatility in fiscal revenues and expenditures as countries attempt to absorb and address changes in climate. Scenario A implies a 10-year incremental climate risk debt costs of USD 146 billion for the period 2019-2028. The forecast estimates are USD 156 billion for Scenario B and USD 168 billion for Scenario C, respectively.

Figure 10. Forecasted increases in annual interest costs due to climate vulnerability, 2007–2028



Source: Authors' own work, based on own estimations with data compiled from Bloomberg, ND-GAIN, IMF, the UN and the World Bank's World Development Indicators.

The use of macroeconomic and fiscal controls, such as GDP per capita and government primary balance, means that we have adjusted for differences in both wealth and fiscal policies. To test the robustness of the results, we re-ran the analysis using the US Treasury bond yield as a control for the risk-free rate and made a maturity adjustment to examine the impact of variations in bond maturities. The statistical results were largely unchanged. We also used the share of agricultural value added as a percentage of GDP as an alternative measure of climate vulnerability, with the results being very similar. Such a measure is correlated with the development of countries over time as well as the fact that the agricultural sector is particularly vulnerable to climate change. Our findings from the technical analysis are robust to alternative econometric approaches.

4. Country case studies

With a better understanding of the overall financial impact of climate vulnerability on developing countries, we also need to assess how the risks will manifest themselves for individual countries, particularly in terms of not only the physical risks themselves, but also in terms of the financial and economic impacts that may affect sovereign governments' ability to address these risks. This is a necessary condition for determining how these countries will develop policies and programmes, perhaps with international assistance, to reduce the impacts of these risks.

While all countries have some measure of climate vulnerability, some countries' situations are particularly acute. These differences reflect factors such as the country's physical size and population, its overall wealth, its existing infrastructure, and the relative effectiveness of its government. For highly vulnerable countries, there is a clear need to monitor the climate risks that impact upon national credit assessment and market responses by the bond markets. The purpose of this section is to identify specific physical climate risks that have the potential to lead to actions by ratings agencies such as Moody's and S&P, and to suggest potential mitigating actions that may reduce the likelihood of such actions. While rating agencies factor climate risks only generally in their approach to sovereign ratings, we believe they also will factor any positive impacts of adaptation or mitigation activity on relevant economic or fiscal indicators into their credit assessments.

For each country considered in these case studies, we highlight one particular physical climate risk and its potential impacts. We consider economic indicators that can be monitored to evaluate the impact of each risk over time. We take as our model the notion of a 'keystone species' discussed by ecologists in ecosystem analysis: the particular species that either dominates, or exemplifies the health and resilience of, a particular ecosystem. For each of our case studies, we propose a climate impact and a physical indicator that will exemplify that impact, either fiscally or economically. We propose that the relative health of that physical variable can be taken to represent the relative degree of physical resilience underlying a country's social and economic resilience.

Our basic model is shown in Figure 11. While we recognize that most countries face a number of climate risks, we believe this simplified approach to assessing the potential credit impacts of climate risks could prove useful for affected countries. We note that assessing a broader range of risks, a process that would more realistically capture the range of impacts that countries are experiencing, would involve more complex analysis. However, we believe that any such analysis will embody the approach taken here.

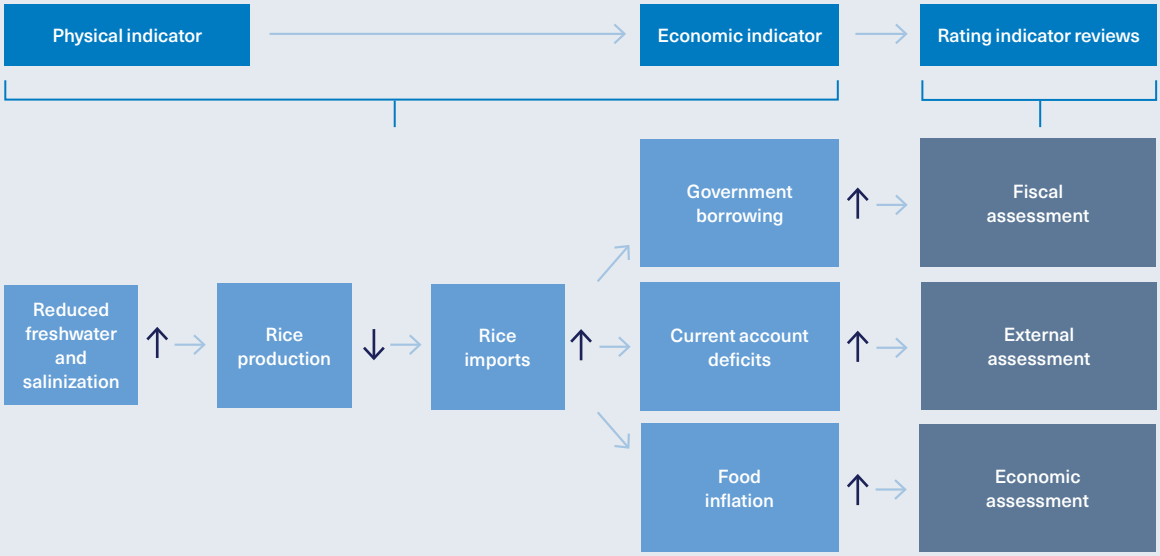
For each country considered in these case studies, we highlight one particular climate risk and its potential impacts. We consider economic indicators that can be monitored to evaluate the impact of each risk over time. Our basic model is shown in Figure 11.

Figure 11

4.1 Bangladesh

In summary

Bangladesh's credit rating is likely to come under pressure in the event of sustained rice production declines from climate change – either from salinization or from increased freshwater flooding. The impact of such declines would negatively affect critical measures of focus for rating agencies, including possible increased government borrowing, increased domestic food inflation, and deteriorating external trade balances. More aggressive efforts to limit rice production declines consequently are crucial to the long-term stability of Bangladesh's credit profile, and its ability to borrow internationally.



Current S&P Ratings assessment: BB- (Foreign long-term rating)/BB- (Domestic long-term ratings)

Climate risk assessed: River flooding

Key near-term indicators:

Rice production levels and yields

River salinization

Food inflation

Longer-term climate issues:

Sea level rise

Increased frequency and severity of tropical storms

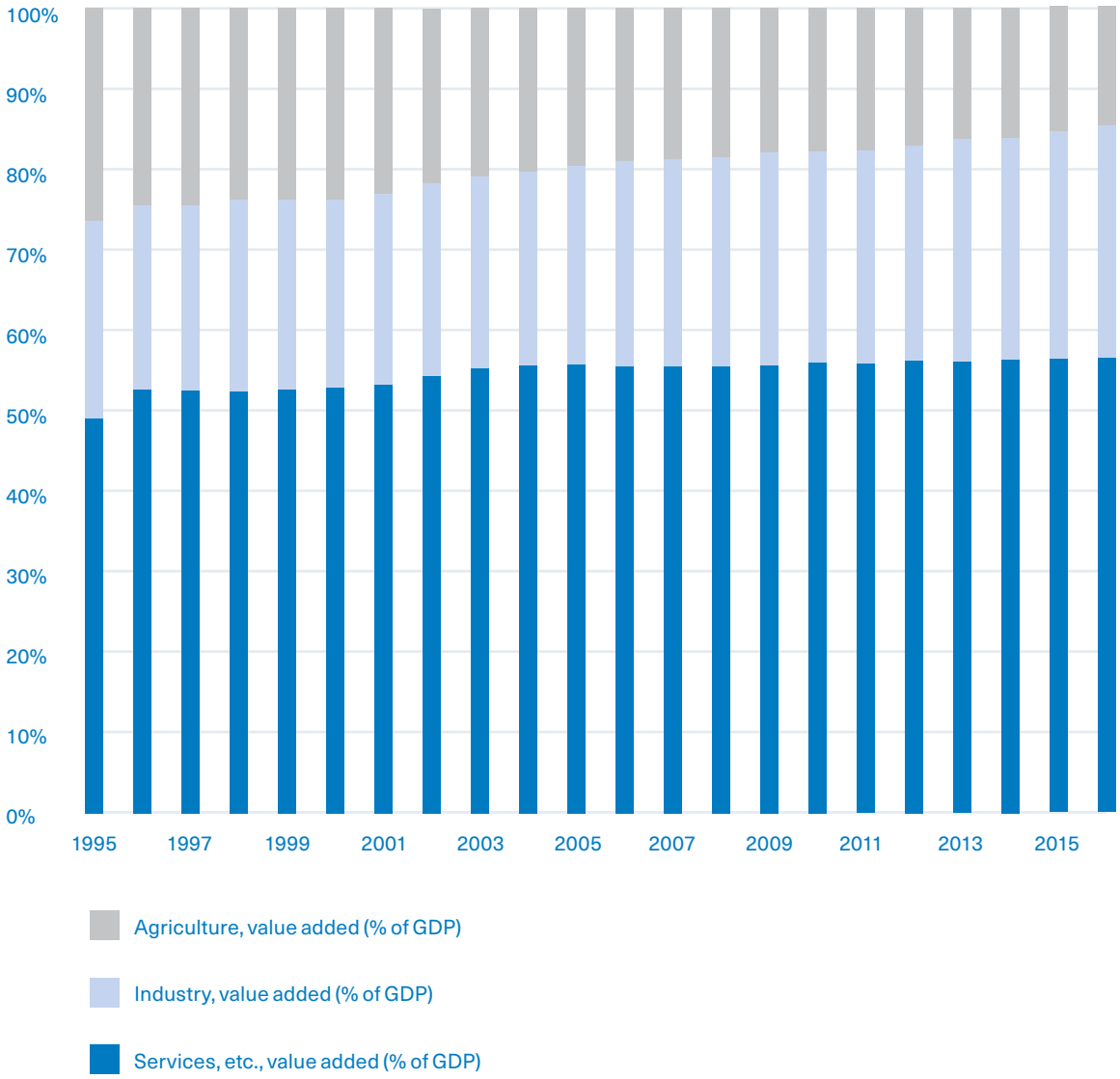
Storm surge severity

Economic vulnerabilities

Bangladesh's economy is beginning to diversify thanks to growth in its service and manufacturing sectors. The garments industry accounted for nearly 85% of total goods exports in US dollar terms in 2016.[37] Agriculture generates 15% of GDP, but its relevance to daily life in Bangladesh is far greater as it provides employment to 42% of the population.[38]

Bangladesh is the world's fourth largest producer of rice at 30 million tons/year, but almost all of it goes on domestic consumption. The country still needs to import rice, alongside other staples such as wheat.[39] The national food staple accounts for 75% of all cropping areas. Similarly, Bangladesh's fisheries sector currently contributes around 4% to GDP, while providing 55% of animal protein intake in Bangladesh.[41]

Figure 12. contribution to GDP by sector in Bangladesh, 1995-2016



Source: Compiled with data from the World Bank.

Government debt to GDP has been steadily declining over the past decade, reducing from 37% in 2008 to about 27% in 2016, suggesting some room for additional debt issuance. However, government interest payments on debt still account for nearly 20% of revenues per year.[42] Bangladesh runs a trade deficit of about 5% of GDP. Any major disruption to agriculture has the potential to create significant social pressures requiring increases in government spending. Domestic inflation remains a concern as well, particularly relating to food prices. Overall inflation hit a high in 2011 of 16%. Food price inflation, which reached over 9% in 2014, has more recently settled at around 7%.

Climate vulnerabilities

Flooding causes considerable economic dislocation, with concomitant impacts on government spending. Bangladesh ranks 160 out of 181 countries in the ND-GAIN Country index,[43] with very low rankings on both vulnerability and readiness. At a rank of 167 for the ND Readiness index, it is the 25th least ready country, and the 37th most vulnerable with a rank of 159 for the ND Vulnerability index. The ND-GAIN ranking has remained unchanged over the past two decades, with a mild improvement in Vulnerability being offset by a decline in readiness, particularly economic readiness, derived from a World Bank indicator measuring openness to external investment. As the World Bank has noted, climate-related risks are likely to depress agricultural activity by about 3% annually through 2050.[44] River flooding is a significant climate risk, largely because Bangladesh contains the second largest river basin in the world. 80% of the country is on floodplains. Equally problematic is the fact that about one third of the land is exposed to tidal incursions, which refers to the mixing of saline and fresh water, and which is expected to expand as tidal zones spread inland from sea level rise.

Overall, climate change could decrease agricultural GDP by 3.1 % each year during 2005–50.[45] That's a cumulative USD 36 billion in lost value-added. According to the World Bank, salinization issues in Bangladesh will most likely lead to significant shortages of drinking water and irrigation problems by 2050 and may result in a decline in rice yield by 15.6 %.[46] A separate analysis suggests Bangladesh may incur a financial impact of about USD 3.2 billion on average annually due to cyclones and floods, about 2.2 % of GDP.[47]

Increased intensity of storms and the potential for greater saltwater intrusion in rivers are likely to disrupt the normal annual salinization cycle. In addition, inland monsoon flooding is likely to become an even greater risk: a 1998 storm inundated[48] over two thirds of Bangladesh and cost 4.8% of GDP.[49] Climate change places an additional 4% of land area at risk from the inundations caused by monsoon flooding.[50]

Adaptation and resilience

In the case of Bangladesh, there are many climate impacts that have the potential to cause economic damage and widespread human suffering. From the narrower perspective of fiscal health, the impact of freshwater flooding on rice production stands out as a key economic indicator. Bangladesh imports rice for domestic consumption to make up for any domestic production shortfalls, even in a normal agricultural year. In the event of significant domestic shortfalls, imports will need to increase, negatively affecting the country's trade deficits. In addition, material increases in food inflation remain a concern.

Based on historical data, natural hazard events in Bangladesh cost more than USD 10 billion in economic losses from 2000 to 2013, but the total funding available, for relief, rehabilitation, and reconstruction for the same period was only USD 2 billion.[51] Many of the initiatives to date are preliminary, such as some of the measures being taken to combat rising salinity levels, and some involve external financing – in February 2018, a total of USD 80 million was approved for climate change adaptation initiatives in Bangladesh, Georgia, and Zambia through the Green Climate Fund, led by UNDP.[52]

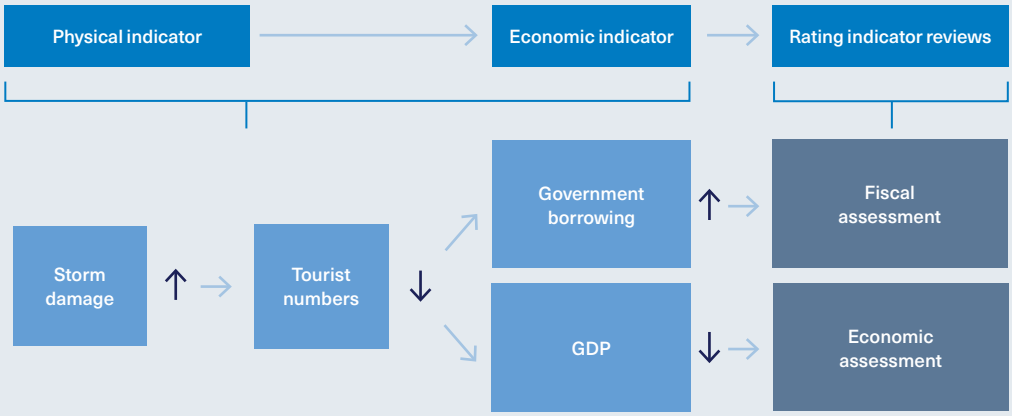
Some of these efforts could be further buttressed by greater utilization of existing natural capital resources to rebuild the natural infrastructure. There is currently a program underway to mitigate some of the current threats to mangrove forests,[53] which range from upstream agricultural practices to industrial development at the periphery of these areas. More broadly, there is now increasing interest in assessing the potential for natural capital factors to contribute to adaptation and mitigation efforts.[54] Work is being done to improve the effectiveness of salt-tolerant rice grains[55] and devise projects to build solar-powered desalination plants.[56]

Currently, three disaster risk finance solutions are considered effective in Bangladesh: sovereign disaster risk contingent credit, parametric sovereign risk insurance, and disaster risk microfinance portfolio insurance. Bangladesh is currently piloting a flood insurance program, with the support of several external agencies and insurers, under the direction of the Swiss Agency for Development and Cooperation.[57]

4.2 Barbados

In summary

Barbados represents a good example of the long-term impacts, and negative rating implications, that a significant one-time economic event can generate. Significant storm damage on the order of that generated by Hurricanes Harvey and Maria elsewhere in the Caribbean in 2017 would have a comparable effect. Developing natural capital approaches to minimizing physical impacts, and broader participation in risk-transfer partnerships, could help ensure more rapid recoveries, which would produce lower impacts on the country's credit profile.



Current S&P Ratings assessment: CCC+ (Negative) (Foreign long-term rating)/CCC (Domestic long-term rating)

Climate risk being assessed: Severe weather events

Key near-term indicators:

Tourist numbers

Major storm damage

Longer-term climate issues:

Increased frequency and severity of tropical storm events

Sea level rise reducing beach area

Economic vulnerabilities

As Moody's discussed in its report on small island nations[58], as well as its separate report on climate risks for Fiji, small island nations are expected to suffer a range of impacts from climate change. In aggregate, these impacts could reduce small islands' GDP by 4% by 2030. In 2016, the value of disaster effects arising from Tropical Cyclone Winston in Fiji, was estimated to amount to F$2 billion (USD 0.9 billion), which is more than 20% of Fiji's current GDP.[59]

Unlike Fiji, Barbados does not have significant natural resources. Rather, Barbados has significant exposure to two industries – tourism and financial services. Following the unfolding of the 2007-2008 financial crisis, GDP growth in 2009 was -4.1%, compared to an average of 2.8% over the period 2002-2007 (5.7% GDP growth rate in 2007.) Barbados has yet to fully recover from the impact of this event. GDP growth was 0% for several years following the crisis, and only in the past two years has GDP growth reached, or raised above, 1%. During this period, Barbados's S&P rating declined from A- in 2008 to CCC (Negative Watch) today. This ratings decline occurred without the physical damage that affected Fiji, or Puerto Rico, the Dominican Republic and other, more northerly Caribbean islands, in 2017. Government debt currently stands at about 154% of GDP, and the country's new government has indicated 'urgent action' is required to deal with the debt problem.[60] Barbados currently is limited in its ability to issue new debt without external assistance.

Climate vulnerabilities

Barbados ranks 54 out of 181 countries in the ND-GAIN Country index of climate vulnerability and its readiness to improve resilience, with relatively modest vulnerability and strong readiness measures.[61] However, this ranking has declined over the past decade, almost entirely due to the weakening economy and declining governance measures, offsetting a mild improvement in vulnerability measures. Barbados benefits from having a relatively low percentage of land within five meters of sea level – about 15%. Still, Moody's assesses Barbados's vulnerability to climate risks as relatively high, although not as high as some other Caribbean nations. However, as the Fifth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) has pointed out, 60% of resort properties in the Caribbean would be damaged by a one-meter rise in sea level.[62] Insured losses in Barbados over the past several decades have been substantially lower than elsewhere in the Caribbean. But the likelihood of comparable damage will increase as the likelihood of severe storms increases.

Adaptation and resilience

Barbados has undertaken a number of adaptation and mitigation measures to anticipate the impacts of climate change. These include some measures of coastal defense, and a recent initiative to pilot solar and wind power on the island. Given the island's current dependence on imported oil to generate the island's electricity, reducing such dependence would improve Barbados' external balances by removing the potential volatility associated with oil imports. Broader economic and ecological resilience measures may be harder to achieve, given the difficulties in diversifying a small island economy.

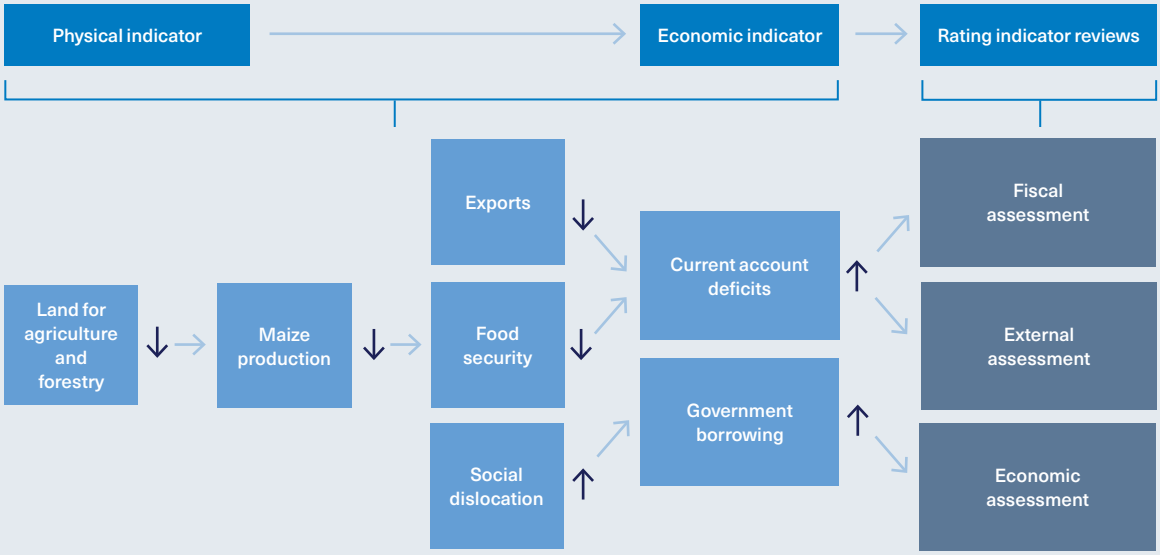
The government's recent initiative to assess the natural capital of Barbados, particularly its marine ecosystems, appears a welcome development. For example, a project being funded by the Inter-American Development Bank (Enhancing Capacity for Coastal Management with Ecosystem Services in Barbados) in conjunction with a number of scientific organizations and NGOs will assess coastal zone management from a natural capital perspective, including the potential for natural infrastructure development. Further initiatives along these lines for the island's full range of ecosystems would facilitate decision-making regarding keeping tourism central to the Barbadian economy and providing some degree of resilience to the island's economy in the event of severe events.

Barbados participates in the Caribbean Catastrophe Risk Insurance Facility. However, as noted earlier, insured and uninsured losses have been low relative to other Caribbean nations.

4.3 Guatemala

In summary

Guatemala's drought exposure has the potential to generate sufficient economic costs that would lead to increased government borrowings and a negative impact on agricultural exports; either event could weaken the country's credit profile and increase borrowing costs. More critically, negative impacts on maize production would result in higher government borrowing for measures to address social dislocation impacts. Minimizing drought impacts through aggressive reforestation efforts should remain a priority for helping to retain credit stability.



Current S&P Ratings aessessment: BB- (Foreign long-term rating)/BB (Domestic long-term rating)

Climate risk being assessed: Drought

Key near-term indicators:

Deforestation rates

Maize production yields

Changes in agricultural and arable land

Longer-term climate issues:

Increased drought frequency and severity, increasing social dislocation and social costs

More severe and frequent droughts, with increased government borrowings to deal with impacts of increased social dislocation

Economic vulnerabilities

Guatemala's GDP growth has been relatively strong in recent years. Much of this growth has been driven by exports of agricultural products (with bananas and sugar cane the leading crop exports) and light manufactured goods. In the latter category, Guatemala competes with other emerging market countries for developed country manufacturing facilities.

Nonetheless, the Guatemalan economy demonstrates some significant vulnerabilities, which have contributed to GDP per capita being about half the Latin American average. The country suffers from significant income inequality and a critical need for infrastructure expansion. The IMF noted in 2017, "At less than 1% of GDP, public infrastructure investment in Guatemala is among the lowest in Latin America and emerging markets. The resulting infrastructure gap constrains Guatemala's future growth and living standards"[63] Sovereign debt to GDP currently stands at about 24%, and has remained relatively constant over the past decade, suggesting some room for additional borrowings.

Climate vulnerabilities

Guatemala ranks 112 out of 181 countries in the ND-GAIN Country index. Despite this ranking improving over the past two decades, it is still the 70th most vulnerable country and the 64th least ready country. It has both a great need for investment and innovations to improve readiness and a great urgency for action[64]. Vulnerability remains high in a number of areas, including exposure to warm periods and natural capital depletion. Situated in the 'dry corridor' of Central America, Guatemala regularly suffers from multi-year droughts. Droughts in this region have a direct impact on agricultural production, which employed over 29% of the country's population in 2016 and into 2017.[65] Droughts can destroy up to 50-90% of the harvest in some areas in the dry corridor and may contribute to growing inequalities between the most vulnerable groups who are hardest hit.[66] Over the past decade, losses in Guatemala linked to all climate-related events amounted to USD 5 billion, according to the official statement made by Guatemala at the UN Disaster Reduction meeting during the COP event in Mexico in May 2017.[67]

Critically, agriculture still represents close to 30% of exports[68], thus constituting an important source of foreign earnings and access to foreign capital. Key indicators of the potential economic impacts of climate-related drought risks will come from this economic sector. An impact of recurring droughts has been increased rates of deforestation. Guatemala has lost more than a quarter of its forests since 1990, with forest cover representing only 33% of total land area in 2015, down from over 44% in 1990.[69] Over the longer term, forest loss is a significant contributor to topsoil loss, so total land productivity tends to trend downwards.

Second, while maize production is not necessarily critical to agricultural exports, it is critical to subsistence farming for much of the population. While production of bananas and sugar cane, each representing USD 1 billion in annual exports, have almost doubled over the last decade, other smaller staples like maize have stagnated relatively, with an 8% decrease in overall yield over this period. Negative impacts on maize production and yields are likely to drive up social dislocation costs.

Third, the total amount of land devoted to agriculture, for both domestic consumption and subsistence and for export, is likely to be negatively affected by increasing drought severity and frequency. While there has been an increase in permanent cropland since 2005, there has also been an overall loss of agricultural and arable land during this same period – from 56% of total land area in 2005 to 43% in 2015.

Adaptation and resilience

Guatemala has a national climate change fund to finance adaptation and mitigation projects, and some 80% of the fund will be mandated to fund risk and vulnerability management issues and adaptation projects.

While some efforts have been ongoing for the past 25 years to replant trees, educating the population to the benefits of keeping forest cover has been one of the biggest challenges, along with lack of funding.[70] This makes reforestation a means to both mitigate and adapt to the effects climate change. This is one of the objectives of the recent National Adaptation Plan,[71] part of an adaptation capacity-building program funded through the Global Environment Fund and implemented by UNDP.[72]

Guatemala has invested over USD 270 million over the past 16 years in reforestation, benefiting an estimated 900,000 people whose livelihoods depend directly on forests.[73] There are also ongoing programs with both multilateral agencies and NGOs to expand these efforts. For instance, Guatemala is one of the first countries to implement the Forest Investment Plan[74], backed directly by international institutions including the World Bank, IADB, and the UN-REDD program. NGOs like the Alliance for International Reforestation have also been present for decades to implement programs that increase the resilience among local populations by finding sustainable alternatives to the illegal forest clearing they often depend on.

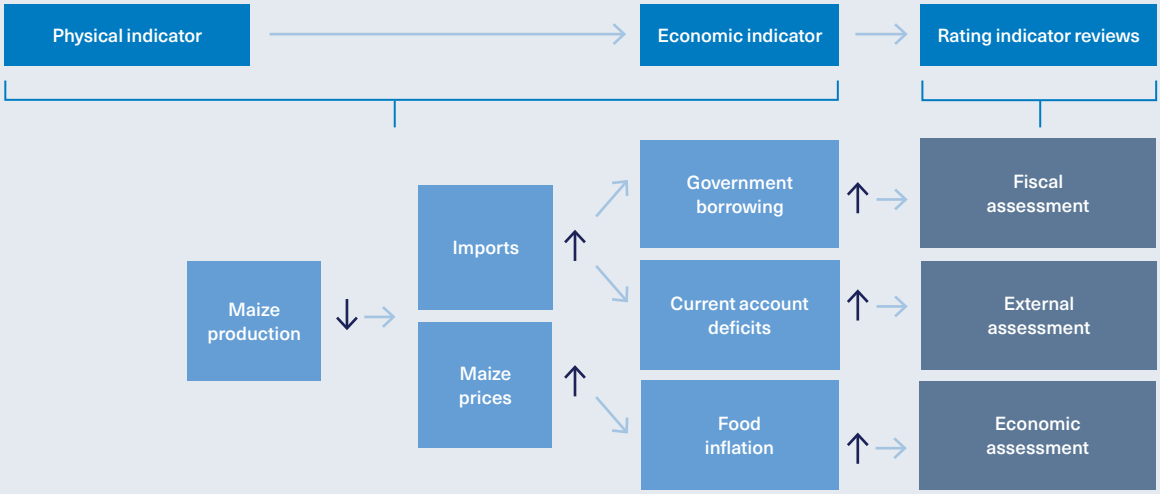
Much of Guatemala's efforts have been devoted to a broader range of climate shocks, not just drought. However, we believe that such an indicator as forest cover and its rate of change may be a useful indicator not only of climate impacts, but also of potential resilience to economic shocks. Guatemala has one of the more advanced efforts at natural capital assessment. Since 2014, the government has been working in conjunction with the World Bank's WAVES program (Wealth Accounting and the Valuation of Ecosystem Services) to update the 2006 Natural Capital assessment.

Guatemala has developed a comprehensive National Strategy for Disaster Risk Reduction, now in its second iteration. In addition, since 2016 microinsurance has been piloted by the Microinsurance Catastrophe Risk Organization (MiCRO), incorporating detailed risk analysis as the basis of payouts to rural farmers in the event of natural catastrophes. This program is similar to a program introduced in Kenya with some success.[75]

4.4 Kenya

In summary

Kenya's vulnerability to drought impacts, particularly in terms of potential food inflation and social dislocation costs, represent a potential risk to Kenya's credit stability through impacts on government borrowing levels, external debt, overall trade balances, and overall inflation. Programs to reduce the impact of drought on these fiscal and economic measures, in part through further risk-transfer programs, will help to prevent ratings deterioration.



Current S&P Ratings assessment: B+ (Foreign long-term rating/B+ (Domestic long-term rating)

Climate risk being assessed: Drought

Key near-term indicators:

Maize production

Maize imports and prices

Longer-term climate issues:

Persistent drought resulting in substantial food shortages

Increased coastal flooding risk, with resultant economic damage

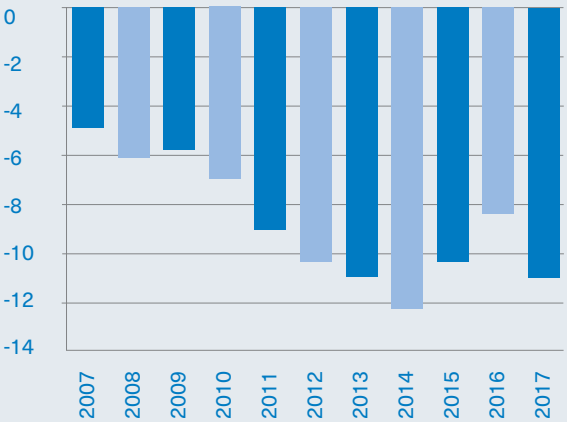
Rising sea levels

Economic vulnerabilities

Kenya has a large rural population (76% as of 2016, according to the World Bank) with 49% of the country's land devoted to agriculture. Agriculture employs about 62% of the population, despite Kenya having a relatively low average level of precipitation.[76]

Kenya also has the largest trade deficit of the countries profiled in our case studies. The average trade deficit was 5.9% of GDP in 2017,[77] reaching as high as 6.2% in February 2018. This increase was driven by a doubling of food imports and higher machinery imports. In addition, exports of agricultural goods were affected by drought. As a result, foreign reserves have been declining.

Figure 13. Kenya's trade deficit



Source: Compiled with data from the World Bank.

However, foreign exchange reserves of USD 7.1 billion (4.7 months of import cover), coupled with arrangements with the IMF of USD 1.5 billion, are seen as some degree of protection against short-term trade deficits. Nonetheless, Kenya remains vulnerable to foreign exchange volatility. Foreign debt continues to rise. S&P has cautioned the country on this issue. Government debt currently stands at about 57%.

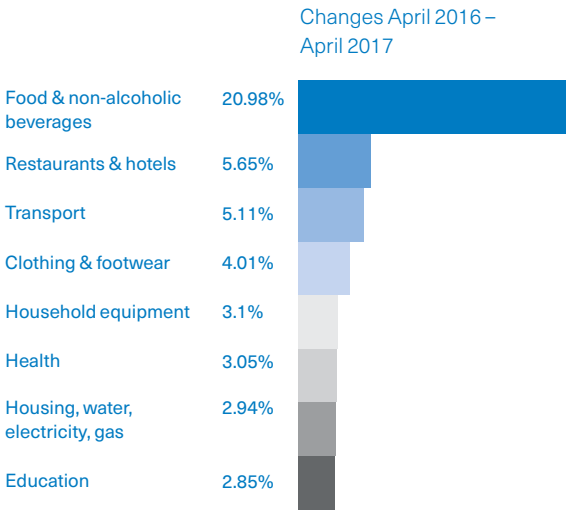
While Kenya's economy has remained a strong performer, with 2017 GDP growth at 4.7%, and CPI down to a manageable 4.5%, millions of vulnerable communities suffered from much higher food inflation during the year that was directly attributable to the persistent drought.

Climate vulnerabilities

Kenya ranks 151 out of 181 countries in the ND-GAIN Country index (in the bottom 20%), a modest decline over the past two decades. While most readiness measures have improved, overall it has a low readiness score and needs to prioritize investment in innovation and education. Kenya's vulnerability measures have deteriorated, particularly those associated with food and ecosystem services[78]. According to the Stockholm Environment Institute, Kenya is exposed to a potential loss of 2.6% of GDP annually through 2030 as a result of the impacts of climate events and trends.[79]

The government declared a drought emergency in February 2017. Climate vulnerability manifests itself in food prices during periods of drought. As the UN Environment ERISC Phase II report suggested, Kenya stands to suffer a 4.4% loss of GDP in the case of a doubling of food prices from drought events. The price of maize and beans (often consumed together) are the most indicative of any drought situation.[80] As shown in Figure 14, Kenya had 21% food price inflation between April 2016 and April 2017.[81]

Figure 14. Soaring food costs pushed inflation rates higher in Kenya



Spikes in food inflation have significant implications for vulnerable populations. Internal migration tends to increase during drought periods, bringing attendant social costs. Drought also is a significant contributor to food insecurity and malnutrition costs, which put a strain on government finances.

Maize imports are a critical measure of drought risk impacts, with higher levels of imports associated with extended periods of drought. Maize prices thus prove to be a key indicator of the impact of drought risk on several credit metrics, particularly food inflation and import requirements. If sufficiently large, these may affect external balances. Outbreaks of fall armyworm, associated with drought, have made a significant impact on yields on maize and wheat. Climate-related pest infestations clearly have an impact on food price inflation.

The impacts of drought are of concern to rating agencies as it impacts government borrowing levels, external debt, overall external balances, and overall inflation. Programs to reduce the impact of drought on these fiscal and economic measures will help to prevent ratings deterioration, with a resulting increase in interest costs. To date, none of these factors has been sufficient to change Kenya's credit profile.

Adaptation and resilience

The Kenyan government has undertaken a number of programs to deal with adaptation issues. USAID is funding a variety of adaptation efforts designed to address river vulnerability issues and natural resource management concerns. Dealing with drought, however, involves multiple levels of resilience preparation. Many of these involve adoption and implementation of the Sustainable Development Goals.

Kenya, unlike Guatemala, is not heavily forested, but deforestation nonetheless has been a trend for a number of years. However, its utility as a drought indicator is more limited because of the low level of forestation in the first place. Still, there are a number of forest preservation programs in place. The International Finance Corporation (IFC) has issued 'forest bonds,' where the proceeds are intended for use for forest conservation in Kenya. In this case, interest is being paid in the form of cash or carbon credits. Even here, though, there was a need for additional external support from BHP, a large mining company, which pays the cash interest. The principal will be paid upon maturity by the IFC.

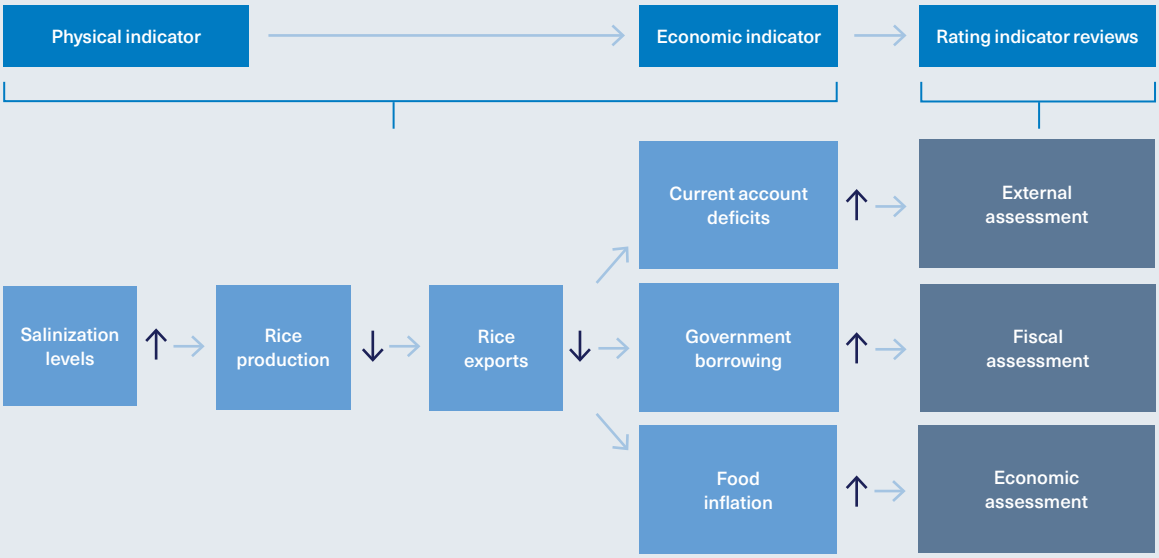
The Kenyan government is involved in several national or pan-East African initiatives to ensure better management of drought emergencies. While these initiatives will have no impact on drought incidence, the government is moving towards a more systematic set of efforts to manage drought emergencies. Other efforts are more targeted, relating to the most recent UN FAO Flash Appeal, which has among its objectives the strengthening of the resilience of drought-affected communities and mitigating the humanitarian impacts of drought emergencies. The overall goal is to reduce 'drought aid dependency'.[82]

There is now a concerted effort to develop local insurance markets, particularly for agriculture. Kenya's Livestock Insurance program[83] currently provides insurance for about 24,000 farmers, but the government plans on expanding the program to include 100,000 farmers by 2020. More financial options are being developed. The FAO's African Disaster Risk Financing Initiative (ADRF) is a notable example.[84]

4.5 Vietnam

In summary

Vietnam's economic profile is likely to be negatively affected by coastal flooding impacts, which will negatively impact rice production, and generate significant social dislocation effects. Current programs in coastal management and salinity infusion need to be aggressively expanded to minimize these economic impacts, which would likely result in credit profile deterioration and increased borrowing costs.



Current S&P Global Ratings assessment: BB- (Foreign long-term rating) /BB- (Domestic long-term rating)

Climate risk being assessed: Coastal flooding

Key near-term indicators:

Increased river salinization from coastal flooding and sea level rise

Rice yields

Loss of land area devoted to agriculture

Longer-term climate and economic concerns:

Changes in agricultural production in response to increased salinization, or reduced land devoted to agriculture

Food price inflation resulting from shortfall in domestic rice production

Increased government borrowing to fund population dislocations

Economic vulnerabilities

Vietnam's GDP has doubled over the past eight years.[85] The country has developed an export markets and implemented government reforms that are creating a transition from a centrally planned economy. A key plank of government reforms were incentives for rice production that would not just meet the needs of the population but create a major export product. Vietnam has been generating trade surpluses since 2012.

Vietnam is now a significant rice exporter to other Asian countries. Rice accounts for 90% of total domestic cereal production. It is the staple food for 95% of the population and an important source of income for 60 million people. Rice farms are generally small in size: only 2% rice farms throughout the country cover more than two hectares land and 47% of farms are smaller than 0.2 hectares.[86] One of the most vital components of Vietnam's economy is based on hundreds of small-scale farms, owned by individual land owners/farmers. The majority of these farms are located in land areas very exposed to coastal flooding and sea level rise risks.

In June 2017 Vietnam was disqualified from further development funding from the World Bank, although it is remains a 'blended borrower' from the Asian Development Bank. However, as rating agency comments have indicated, any increase in external borrowings at present could be problematic for maintaining the country's current ratings. Sovereign debt to GDP currently stands at about 61%, a level that has nearly doubled over the past decade.[87]

Climate vulnerabilities

Vietnam ranks 96 out of 181 countries in the ND-GAIN Country index[88], a ranking that has been improving over the past two decades from an increase in readiness and a decline in vulnerability measures. Nonetheless, two crucial vulnerability measures, projected change in sea level rise impacts, and projected change of flood hazard, remain very high. Investment in dam capacity is required. Despite its recent economic gains, it faces significant vulnerabilities from rising seas, river flooding and the resulting salinization and groundwater issues. Over 15% of all of Vietnam's land is below five meters above sea level. In total, 37% of Vietnam's population – or about 34 million people – live in this area. Coastal flooding risks are expected to increase with the severity of tropical storms, and this may have direct population impacts. Moreover, increased coastal flooding may well affect access to fresh water, with significant impacts on both local populations and local economies.

As with Bangladesh, salinization of rivers and other freshwater sources is significant concern for Vietnam. Salinization has multiple negative impacts for freshwater ecosystems, including the availability of groundwater, its effect on rice yields, and the amount of water available for both human and animal consumption and for irrigation.[89] More than half of Vietnam's rice crop is grown in the Mekong Delta. Forecasts up to 2050 suggest that not only could rice yields decline by an estimated 10-15% as a result of climate trends, but rice prices could increase by as much as one third in that event.[90]

Adaptation and resilience

The Vietnamese government has been monitoring salinity infusion in various river deltas since 1991, and there has been considerable modeling of the extent, and potential effects, of this process. In response, the government has created a Government National Climate Change Committee, to oversee the various National Climate Change Strategies passed by the government over the past 10 years, including a whole range of programs designed for adaptation and mitigation. Many of these programs receive external support from NGPs and foreign government agencies such as USAID. These include coastal zone management programs ranging from full protection; involving strengthening and elevating embankments to withdrawal from potentially affected areas. Given the length of Vietnam's coastline (3,440 kilometres), this is an ambitious program. We note that in conjunction to various agriculture measures described below, the government has introduced various measures directed at reforestation, including mangrove restoration.

In addition, the government has put forward various measures to protect agricultural production, including soil preservation measures, as well as accelerating a shift to more climate-appropriate crops. The government has also begun to implement a variety of water sustainability measures, including upgrading water infrastructure, and adding new infrastructure as appropriate. New for 2018, is a more inclusive approach: ecosystem-based adaptation (EbA)[91]. Traditional flood management structures, such as dikes, which vulnerable communities depend on, can have negative impacts on the environment. Two EbA measures will be implemented in Thua Thien Hue Province jointly with the Disaster Management Centre, the Women's Union and local communities.[92]

All of these measures require financing. The government, in conjunction with the World Bank, has issued a report outlining the various means at its disposal for financing these projects[93], with the majority of expenditures directed at food and water security. We note that development partners have provided about 30% of the funding required for these proposals to date, although whether this level of support will be maintained remains unclear.

Vietnam has begun to undertake broader risk transfer programs. Every year, natural disasters and epidemics have caused significant losses for the Vietnamese agricultural sector and farmers, accounting for 1.5% of the national GDP. Agricultural insurance has become an urgent need. After a pilot during the years 2013-2016, in which 300,000 households gained agriculture insurance worth USD 340m, the state is expected to subsidize insurance fees of up to 20% for farmers and 90% of poor households this year.

5. Conclusions

Vulnerable countries face not just economic losses from climate impacts, but also an increasing fiscal burden. The major credit rating agencies have discussed climate risks as being potentially material to sovereign ratings. Our work indicates that interest rates on V20 government debt are already higher than they would otherwise be, due to climate vulnerability. This effect has a broad impact on national measures of the cost of capital.

We estimate that exposure to climate risks has increased the cost of debt for V20 countries by 117 basis points, on average. In absolute terms, that translated into more than USD 40 billion in additional interest payments over the past 10 years on government debt alone. Incorporating higher sovereign borrowing rates into the cost of private external debt reveals that climate risks have cost debt-issuing V20 countries over USD 62 billion in higher interest payments across the public and private sectors. As we noted in Section 3, these additional costs are projected to balloon to between USD 146 – 168 billion over the next decade.

Vulnerable countries face the unenviable task of managing the financial costs of climate change increase as the physical impacts of climate risks themselves accelerate. National governments need to develop programs that will preserve physical and economic resilience to minimize these costs. Governments wishing to borrow internationally critically need to monitor the fiscal factors that could affect a country's sovereign credit profile. This is particularly true for the large number of climate-vulnerable countries that are not in a position to issue international sovereign debt because they lack an investment grade credit rating or are limited in further issuance by current debt levels.

Improved resilience will not only help safeguard sovereign credit profiles, but also has the potential to increase the rate of return for investment. Overall, we see broad economic, fiscal and social benefits from building greater economic and social resilience to climate change. Our research suggests that investing in social preparedness reduces cost of debt by 67 basis points, on average. In addition to traditional fiscal policies, programs that address social inequality, ICT infrastructure, education and innovation are crucial to strengthening national adaption capacity.

The process of identifying critical indicators that are of interest to rating agencies and bond market participants can be a useful tool for managing climate risks at the country level. In our case studies, we assessed one specific climate impact for each country. In many cases, changes in output in the agriculture sector were identified as having the greatest potential to ultimately lead to actions by rating agencies. In practice, national governments will need to track a much broader range of economic indicators. We hope this report serves as good guide for how that can be done on a bottom-up basis.

Our findings are consistent with other studies that have demonstrated a financial burden to developing countries from climate change.[94] As noted in this report, there are several market and policy initiatives that can play a role in reducing this burden. From a financial perspective, effective climate adaptation initiatives must accomplish at least one of the following three goals: reduce economic costs, improve economic recoveries, and/or transfer financial risks. These goals are not meant to be mutually exclusive. Given that countries will likely face increased costs as climate impacts become more severe, policy responses must be scalable to meet the growing sense of urgency.

Reducing economic losses

In our case studies, we highlighted adaptation programs designed to reduce economic loses from climate events. From a financial perspective, there appears to be a business case for restoring natural capital that acts as climate-resilient infrastructure. While the lag times associated with these investments make cost-benefit analysis difficult, there is a growing opportunity for 'natural climate solutions.'[95] For example, a recent report on flood protection through natural infrastructure noted that the "largest opportunities for funding are in the redirection of post-disaster recovery funds to pre-disaster investments in risk reduction".[96] The authors point to the European Investment Bank's Natural Capital Financing Facility as a model. Investments in adaptation will over the long-term be a more efficient use of expenditures than insurance, which allows for improved speed of economic recoveries but does not act to prevent the occurrence of event-related costs.

As rating agencies repeatedly have commented, the lack of a well-developed physical infrastructure in V20 countries needs to be addressed, not only for greater resilience in dealing with climate impacts, but more generally for reasons of economic development. We note in Section 3 that infrastructure development plays an important role in reducing climate vulnerability. Given the frequent limitations on the ability to borrow, other mechanisms for improving infrastructure need to be considered. In particular, public-private partnerships in areas such as transportation infrastructure may need to be expanded in situations where public borrowing options are limited. In addition to facilitating infrastructure development that reduces economic losses, the inclusion of the private sector may help transfer some of the associated economic risks.

'Green bonds' have been put forward as a possible option to fund not just infrastructure upgrades, but also a wide range of adaptation and mitigation investments. Green bonds are indeed an attractive option for those countries that actually are able to issue international debt. Fiji and Kenya both issued sovereign green bonds in 2017. The majority of countries in the Climate Vulnerable Forum, however, do not have sovereign credit ratings. These countries generally are not able to issue international debt, or, if rated, may be constrained from issuing further amounts. For these countries, such issuance would require external support for the costs incurred through such debt issuance, such as those mentioned below. The International Finance Corporation's 'forest bonds,' discussed previously, could serve as a model for financing structures that employ partial guarantees from higher-credit quality issuers such as multilateral lenders and large corporates.

Improving the speed of economic recoveries

Many initiatives in the V20 countries seek to create the conditions for more rapid recoveries from extreme weather shocks and long-term climatic trends. The development of more sophisticated domestic debt capital markets would help diversify sources of funding and build financial resilience to these external shocks. The recent growth in the number of local currency bond markets in developing countries is an encouraging trend in this direction.[97] However, this option is not available to all V20 countries in the short term. Likewise, GDP-indexed bonds may be useful for V20 countries, but only those that already have access to international capital markets.[98]

Developing markets for local insurance is a necessity for more rapid recoveries from climate shocks and trends. In most V20 countries, insurance is not a realistic option for a broad section of the population. This is a critical issue in countries that regularly experience catastrophic weather events, endure economic losses that are mostly uninsured, and are expecting further increases in the severity/frequency of extreme weather events. In some cases, national governments do provide selected insurance options. Kenya's drought insurance program is one example. Such programs are not widely available across the V20.

Sovereign catastrophe risk pools would enable climate-vulnerable countries to protect public budgets in a disaster situation and to access more rapid financing for disaster response. Catastrophe risk pools allow countries to pool risks in a diversified portfolio; retain some risk through joint reserves/capital; and transfer excess risk to the reinsurance and capital markets.[99] Examples of existing regional risk pools include the aforementioned Caribbean Catastrophe Risk Insurance Facility, the Pacific Disaster Risk Financing and Insurance Program, and the African Risk Capacity.[100] A recent international effort to address this problem is the InsuResilience Global Partnership for Climate and Disaster Risk Finance and Insurance Solutions,[101] which may provide a useful framework for designing risk finance and insurance solutions for V20 countries.

Transferring financial risks

The relatively weak economic situation of V20 countries may require that the costs of climate risks be absorbed more widely. Financial protection can be accomplished most immediately via sovereign risk transfer solutions. Since the 1990s, a number of different mechanisms of sovereign risk transfer have been developed. Insurance-linked securities such as catastrophe bonds, for example, are debt instruments that transfer a specific set of risks (usually natural disaster risks) from an issuer to investors. A recent report from the World Bank reviewed a variety of risk-pooling models of potential use by V20 countries.[102] It is worth noting that these risk-pooling measures do not necessarily reduce economic costs associated with climate shocks, but they do have the potential to transfer a significant amount of the financial costs to other parties.

There is considerable scope for expanding existing risk-transfer solutions. National efforts to preserve sovereign credit profiles will be necessary going forward, given the potential for increased climate-related costs and the need to finance these. Whether these will be sufficient will in part depend on the willingness of the international community to absorb some of the costs of these risks. It may be that the most effective way for the international community to support such initiatives is through measures designed to stabilize and support sovereign credit profiles.

Appendix

Econometric approach

As a baseline specification, a panel ordinary least squares (POLS) model is estimated:

$$Y_t = a + bx_t + yz_t + e_t$$

where the dependent variable y_t denotes country bond yields, b is a $k \times 1$ coefficient vector, x_t is a $k \times 1$ vector of climate-related variables, y is a $p \times 1$ coefficient vector, z_{it} is a $p \times 1$ vector of controls. Although a is a $k \times 1$ vector, all the intercepts are assumed to be identical within this framework. Subscript t is the year. We conduct multiple regressions to test the significance of the set of climate variables and controls.

The model is a linear regression model and hence all the standard assumptions apply (OLS assumptions: linearity, spherical error terms, exogeneity). To obtain the predictions, conditional expected values of the dependent variable are taken considering an average V20 country. Hence, the average of the V20 sub-sample of explanatory variables is used to derive linear predictions of base cost of debt for the average V20 country, climate risk and social preparedness. Mechanically this multiplies the coefficients estimated by the model with the variables themselves. We can then observe the mean, median and standard deviation for members of the V20 group of climate-vulnerable countries. The base effect is the predicted cost of debt minus the partial climate risk and social preparedness effects.

We assume that parameters are constant, i.e. the partial impact of climate risk on cost of debt does not change over time. Furthermore, our model only identifies the direct effect of climate risk on cost of debt; indirect effects through macroeconomic variables are not modeled. This also includes interventions such as IMF support, which is assumed to be exogenous, i.e. independent from climate risk. The results are presented in Table 3.

Table 3. Determinants of yields

	A	B	C	D
SCORE climate risk measure based on ND-GAIN sensitivity and capacity indices	0.146*** (-3.88)	0.176*** (-4.59)	0.135*** (-3.63)	0.081* (-2.07)
ND-GAIN social readiness index	-1.557*** (-5.37)	-1.764*** (-6.06)	-1.541*** (-5.31)	-2.410*** (-6.38)
Per capita gross domestic product	0.000** (-3.3)	0.000*** (-3.74)	0.000** (-3.14)	0.000 (-1.96)
Gross government debt to GDP	-0.010*** (-12.78)	-0.010*** (-12.80)	-0.010*** (-12.83)	-0.010*** (-14.35)
Government revenues to GDP	-0.185*** (-11.34)	-0.171*** (-9.91)	-0.178*** (-10.61)	-0.168*** (-10.21)
Government expenditures to GDP	0.182*** (-12.22)	0.172*** (-11.04)	0.178*** (-11.75)	0.160*** (-10.44)
Primary balance to GDP	0.150*** (-10.88)	0.140*** (-9.77)	0.145*** (-10.40)	0.112*** (-7.22)
Annual change in consumer price	0.006*** (-3.62)	0.006*** (-3.60)	0.006*** (-3.52)	0.006** (-3.02)
Foreign direct investment to GDP	0.024* (-2.20)	0.026* (-2.51)	0.018 (-1.75)	0.019 (-1.90)
IMF multilateral debt dummy		-0.227** (-2.65)	-0.271** (-3.15)	-0.300*** (-3.81)
V20 climate vulnerable forum member dummy			0.197*** (-3.62)	0.162** (-3.12)
G7 advanced economy group member dummy				0.974*** (-5.18)
aic	361.649	357.925	350.024	322.297
bic	400.593	400.763	396.757	372.925
Adjusted R^2	0.739	0.742	0.748	0.767
N	363	363	363	363

Note: Statistics in parentheses. All models refer to POLS using the Huber-White sandwich estimator. * p<0.05, ** p<0.01, *** p<0.001.

Endnotes

[1] Climate Vulnerable Forum. (2018). *About Us | Climate Vulnerable Forum.* [online] Available at: https://thecvf.org/about/

[2] In March 2018, five new signatories joined the CVF: Colombia, The Gambia, Lebanon, Palestine, and Samoa.

[3] Paun, A., Acton, L. and Chan, W. (2018). *Fragile Planet, scoring climate risks around the world*. HSBC Global Research.

[4] Moody's Investors Service, *How Moody's Assesses the Physical Effects of Climate Change on Sovereign Issuers,* 7 November 2016.

[5] S&P Global Ratings, *Sovereign Postcard: ESG And Sovereign Ratings*, 7 February 2018.

[6] Moody's Investors Service, *Small island credit profiles resilient to near term climate shocks, but climate trends pose longer-term risks,* 5 December 2017.

[7] S&P Global Ratings, *Sovereign Rating Methodology*, 18 December 2017.

[8] Moody's Investors Service, *Understanding the Impact of Natural Disasters: Exposure to Direct Damages Across Countries, 28 November 2016; S&P Global Ratings, The Heat Is On: How Climate Change Can Impact Sovereign Ratings,* 25 November 2015.

[9] Energy & Climate Intelligence Unit (2017), Heavy Weather: Tracking the fingerprints of climate change, two years after the Paris summit. December 2017. Available at: http://eciu.net/assets/Reports/ECIU_Climate_Attribution-report-Dec-2017.pdf

[10] S&P Global Ratings, *Climate Change Is A Global Mega-Trend for Sovereign Risk,* 2014.

[11] Moody's Investors Service, *How Moody's Assesses the Physical Effects of Climate Change on Sovereign Issuers*, 7 November 2016.

[12] Moody's Investors Service, *How Moody's Assesses the Physical Effects of Climate Change on Sovereign Issuers,* 7 November 2016.

[13] Moody's Investors Service, *Credit profiles of small, agriculture-reliant sovereigns most susceptible to climate change risk,* 15 May 2018.

[14] Moody's Investors Service, *Issuer In-Depth: City of Cape Town: Spending and borrowing set to increase as city battles water crisis, introduces new initiatives to bolster supply,* 12 March 2018.

[15] *For Brazil's Electricity Distributors, Credit Concerns Shift from Drought to Recession*, Moody's Investors Service, 28 March 2016.

[16] Wired magazine, *India's Silicon Valley is Dying of Thirst: Your City* May Be Next, 2 May 2017.

[17] *India, Government of: Vulnerability to Drought Poses Credit Challenges*, Moody's Investors Service, 11 August 2015.

[18] UN Environment Finance Initiative and Global Footprint Network, *A New Angle on Sovereign Credit Risk*, 2012.

[19] UN Environment Finance Initiative and Global Footprint Network, *ERISC PHASE II: How Food Prices Link Environmental Constraints to Sovereign Credit Risk,* 2016.

[20] E.g., ECIU, Heavy weather: Tracking the Fingerprints of Climate Change, Two Years after the Paris Summit, Technical report, London: Energy and Climate Intelligence Unit, 2017; IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)], IPCC, Geneva, 2014; Erich Markus Fischer and Reto Knutti, 'Anthropogenic Contribution to Global Occurrence of Heavy-precipitation and High-temperature Extremes,' Nature Climate Change 5, 560–564, 2015.

[21] The OECD highlights that data on the economic impact of disasters are sparse, even for advanced economies. Where estimates are available, they often include only disaster damages, i.e. direct economic impacts, while the cost of indirect economic impacts are not accounted for. See OECD, *Assessing the Real Cost of Disasters: The Need for Better Evidence*, OECD Reviews of Risk Management Policies, Paris: Organization for Economic Cooperation and Development, 2018.

[22] Wei Mei, Shang-Ping Xie, Francois Primeau, James McWilliams, and Clauia Pasquero, 'Northwestern Pacific Typhoon Intensity Controlled by Changes in Ocean Temperatures,' Science Advances, 20151 (4), e1500014; Robert Mendelsohn, Kerry Emanuel, Shun Chonabayashi and Laura Bakkensen, 'The Impact of Climate Change on Global Tropical Cyclone Damage,' *Nature Climate Change,* 2012, 2: 205–209; Gabriel Felbermayr and Jasmin Gröschl, 'Naturally Negative: The Growth Effects of Natural Disasters,' *Journal of Development Economics*, 2014, 111: 92–106; Emmanuel Alano and Minsoo Lee, 'Natural Disaster Shocks and Macroeconomic Growth in Asia: Evidence for Typhoons and Droughts,' ADB Economics Working Paper No.503, Manila: Asian Development Bank, 2016.

[23] Susana Ferreira and Berna Karali, 'Do Earthquakes Shake Stock Markets?' *PLoS ONE* 10(7), e0133319, 2015.

[24] Germanwatch, Global Climate Risk Index database.

[25] Norman Loayza, Eduardo Olaberria, Jamele Rigolini and Luc Christiaensen, 'Natural Disasters and Growth – Going beyond the Averages,' *World Development* 40 (7), 1317–1336, 2012; Felbermayr and Gröschl, op. cit.; Ezequiel Cabezon, Leni Hunter, Patrizia Tumbarello, Kazuaki Washimi and Yiqun Wu, 'Enhancing Macroeconomic Resilience to Natural Disasters and Climate Change in the Small States of the Pacific,' IMF Working Paper No. 15/125, Washington, DC: International Monetary Fund, 2015; Alano and Lee, op. cit.; Kerstin Gerling, 'The Macro-fiscal Aftermath of Weather-related Disasters: Do Loss Dimensions Matter?,' IMF Working Paper No. 17/235, Washington, DC: International Monetary Fund, 2017.

[26] Nadia Ameli, Andrea Biancardi, Paul Drummond, Paroussos Leonidas, Michael Grubb, Zoi Vrontisi, Fragkiadakis Kostas, Fragkos Panagiotis and Antoine Mandel, 'Stylised Models of Relative Rates of Return, Technology Co-benefit/Spillover Effects, Multiplier and Leverage Effects for Key Sectors,' mimeo, London: University College London, 2017.

[27] Bloomberg, bonds yield data, various frequencies and maturities, January 2018.

[28] Our control data is sourced from databases of the IMF and the United Nations Conference on Trade and Development.

[29] ND-GAIN Country Index, Notre Dame Global Adaptation Initiative, South Bend, IN: University of Notre Dame, https://gain.nd.edu/our-work/country-index/

[30] The 12 measures, all equally weighted, are as follows: food import dependency; rural population; fresh water withdrawal rate; water dependency ratio; slum population; dependency on external resource for health services; dependency on natural capital; ecological footprint; urban concentration; age dependency ratio; dependency on imported energy; population living under 5m above sea level.

[31] The 12 measures, all equally weighted, are as follows: agriculture capacity (e.g. fertilizer use); child malnutrition; access to reliable drinking water; dam capacity; medical staffs, access to improved sanitation facilities; protected biomes; engagement in international environmental conventions; trade and transport related infrastructure; paved roads; electricity access; disaster preparedness.

[32] We considered using other indices such as the World Risk Index and Germanwatch's Global Climate Risk Index for our analysis, but these indices are available only for relatively short time spans. We also considered but decided against using purely physical climate indices because they show little variation over time, which means they cannot explain observed variation in our dependent variable. Using actual weather events (as captured, for instance, in the EM-DAT Emergency Events Database) is also problematic because it is the losses that count. Put simply, weather events in areas with little economic activity cannot be expected to have much impact on the economy and hence bond yields. Including country-level data on economic losses of climate-related weather events in our econometric analysis would have been desirable but was not possible due to data limitations.

[33] Gerhard Kling, Yuen Lo, Victor Murinde and Ulrich Volz, 'Climate Vulnerability and the Cost of Debt,' mimeo, London: SOAS University of London, 2018. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3198093

[34] 117 basis points is the mean of the marginal effect. The median is slightly higher at 121 basis points, with a standard deviation of 0.198%.

[35] Data availability for internal debt of the V20 countries is limited, even with the IMF's new Global Debt Database published in 2018.

[36] Our analysis shows a clear pattern that V20 countries exhibit a high risk of exclusion, and climate risk makes access to international capital markets even more of a challenge. For details see the technical paper accompanying this report.

[37] Moody's report Moody's Affirms Bangladesh's Ba3 Rating; Maintains Stable Outlook Global Credit Research, 17 Apr 2017.

[38] Data.worldbank.org (2016) online. Available at: https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=BD

[39] Asia, S. and Reuters, D. (2018). *Bangladesh to import 600,000 tonnes of rice.* [online] The Daily Star. Available at: http://www.thedailystar.net/world/south-asia/bangladesh/bangladesh-government-import-rice-food-staple-price-production-agricultural-1403068

[40] Aquastat Survey (2011). *Irrigation in Southern and Eastern Asia in figures* [ebook] FAO. Available at: http://www.fao.org/nr/water/aquastat/countries_regions/BGD/BGD-CP_eng.pdf

[41] Fao.org. (2018). *FAO Fisheries & Aquaculture – Country Profile.* [online] Available at: http://www.fao.org/fishery/facp/BGD/en#CountrySector-SectorSocioEcoContribution

[42] Tradingeconomics.com. (2018). *Bangladesh Government Debt to GDP | 1995-2018 | Data | Chart | Calendar.* [online] Available at: https://tradingeconomics.com/bangladesh/government-debt-to-gdp

[43] Gain-new.crc.nd.edu. (2018). *Bangladesh | ND-GAIN Index.* [online] Available at: https://gain-new.crc.nd.edu/country/bangladesh

[44] Bangladesh: Economics of Adaptation to Climate Change. (2010). [ebook]. World Bank.

[45] Sdwebx.worldbank.org. (2017). *Climate Change Knowledge Portal.* [online] Available at: http://sdwebx.worldbank.org/climateportalb/home.cfm?page=country_profile&CCode=BGD&ThisTab=Overview

[46] Norwegian Institute of Bioeconomy Research, *Food security threatened by sea-level rise,* January 18, 2017.

[47] ADB South Asia Working Paper Series, No 46, '*Disaster Risk Financing in Bangladesh'* Sep 2016.

[48] Inundation refers to increased monsoon precipitation, higher transboundary water flows and rising sea levels resulting from climate change.

[49] Economics of Adaptation to Climate Change (2010) *Bangladesh*. World Bank [ebook] Available at: http://documents.worldbank.org/curated/en/841911468331803769/Main-report

[50] Impacts of climate change are measured by comparing inundation levels predicted by simulations using MIROC 3.2 Global Circulation Models under A2 emission scenario with inundation levels in the 1998 floods. conomics of Adaptation to Climate Change (2010) *Bangladesh*. World Bank [ebook] Available at: http://documents.worldbank.org/curated/en/841911468331803769/Main-report

Endnotes

[51] Disaster-related economic impact totaled, USD: $10.8m. Disaster-related total funding: USD $2.67m. Funding broken down: USD $897m for 55 recovery and rehabilitation projects – 29 were supported by international donors and agencies. 61% from internationally financed, 39% domestically financed; USD $697 from humanitarian aid; USD $1.1b from foreign aid. ADB South Asia Working Paper Series, No 46, '*Disaster Risk Financing in Bangladesh*' Sep 2016 (page 15).

[52] UNDP. (2017). *Over USD $80 million approved for climate initiatives in three countries | UNDP.* [online] Available at: http://www.undp.org/content/undp/en/home/news-centre/news/2018/over--80-million-approved-for-climate-initiatives-in-bangladesh-.html

[53] Fair Planet (2017). *How the loss of mangrove forests increase Bangladesh's vulnerability to climate change* [online] Available at: https://www.fairplanet.org/dossier/climate-change/how-the-loss-of-mangrove-forests-increase-bangladeshs-vulnerability-to-climate-change/

[54] Natural Capital Coalition, *Integrating Ecosystem Services Supply Potential from Future Land-Use Scenarios in Protected Area Management: A Bangladesh Case Study,* 31 August 2017.

[55] World Bank. (2016). *Bangladesh: Building Resilience to Climate Change.* [online] Available at: http://www.worldbank.org/en/results/2016/10/07/bangladesh-building-resilience-to-climate-change

[56] Kazi Meharajul, K. *A Solar Powered Desalination System for Remote Region in Bangladesh*, 2017.

[57] ADB South Asia Working Paper Series, No 46, '*Disaster Risk Financing in Bangladesh*', Sep 2016.

[58] Moody's Investor Service, 2017. *Small island credit profiles resilient to near- term climate shocks, but climate trends pose longer-term risks.*

[59] Mansur, A., Doyle, J., & Ivaschenko, O. (2017, February). *Social Protection and Humanitarian Assistance Nexus for Disaster Response: Lessons Learnt from Fiji's Tropical Cyclone Winston*(Working paper No. 1701). Retrieved from http://documents.worldbank.org/curated/en/143591490296944528/pdf/113710-NWP-PUBLIC-P159592-1701.pdf

[60] Telesur, Barbados: Prime Minister Mottley Announces 'Emergency Plan' to Tackle Massive Debt, Meeting With IMF, 2 June 2018.

[61] Gain-new.crc.nd.edu. (2018). Barbados | *ND-GAIN Index*. [online] Available at: https://gain-new.crc.nd.edu/country/barbados

[62] Nurse, L.A., R.F. McLean, J. Agard, L.P. Briguglio, V. Duvat-Magnan, N. Pelesikoti, E. Tompkins, and A.Webb, 2014: Small islands. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1613-1654.

[63] International Monetary Fund, *More and Better Infrastructure in Guatemala,* 17 February, 2017.

[64] Gain-new.crc.nd.edu. (2018). Guatemala | *ND-GAIN Index.* [online] Available at: https://gain-new.crc.nd.edu/country/guatemala

[65] Data.worldbank.org (2016) Online. Available at: https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=GT

[66] Dry Corridor Central America. (2016). [ebook] Food and Agriculture Organization of the United Nations. Available at: https://reliefweb.int/report/guatemala/central-america-dry-corridor-situation-report-june-2016

[67] PreventionWeb (2017). *Guatemala: Statement made at the Global Platform for Disaster Risk Reduction.* [video] Available at: https://www.preventionweb.net/english/policies/v.php?id=53812&cid=70

[68] Adaptation-undp.org. (2017). *Guatemala | UNDP's Climate Change Adaptation Portal.* [online] Available at: http://www.adaptation-undp.org/explore/guatemala

[69] Data.worldbank.org (2015) Online. Available at: https://data.worldbank.org/indicator/AG.LND.FRST.ZS?locations=GT

[70] "The Alliance for International Reforestation (AIR) has been working in Guatemala since 1993", see https://www.theguardian.com/journalismcompetition/deforestation-guatemala

[71] Fao.org. (2017). N*AP-Agriculture presented in Guatemala | Integrating Agriculture in National Adaptation Plans (NAPs) | Food and Agriculture Organization of the United Nations.* [online] Available at: http://www.fao.org/in-action/naps/news-events/detail/en/c/1071925/

[72] Adaptation-undp.org. (2017). *Guatemala | UNDP's Climate Change Adaptation Portal.* [online] Available at: http://www.adaptation-undp.org/explore/guatemala

[73] Anon, (2017). [online] Available at: https://www.climateinvestmentfunds.org/country/guatemala

[74] Forest Investment Plan Guatemala, April 2017, English version accessible here: https://www.climateinvestmentfunds.org/sites/default/files/meeting-documents/inb_-_plan_inversio_n_forestal_final_18-05-17_def.pdf

[75] WIRE, B. (2016). *MiCRO Expands Microinsurance Market in Central America.* [online] Businesswire.com. Available at: https://www.businesswire.com/news/home/20161115006784/en/MiCRO-Expands-Microinsurance-Market-Central-America

[76] World Bank Climate Change Knowledge portal, historical rainfall data 1901-2015,

[77] Tradingeconomics.com. (2018). *Country List Current Account to GDP | Africa.* [online] Available at: https://tradingeconomics.com/country-list/current-account-to-gdp?continent=africa

[78] Gain-new.crc.nd.edu. (2018). *Kenya | ND-GAIN Index.* [online] Available at: https://gain-new.crc.nd.edu/country/kenya

[79] Stockholm Environment Institute. (2009). *The Economics of Climate Change in Kenya.* [ebook].

[80] ReliefWeb. (2018). *Kenya Price Bulletin, January 2018.* [online] Available at: https://reliefweb.int/report/kenya/kenya-price-bulletin-january-2018

[81] Dahir, A. (2017). *A biting drought and rising inflation are hampering Kenya's economic growth.* [online] Quartz. Available at: https://qz.com/980255/drought-in-kenya-is-causing-inflation-to-soar-and-could-undermine-the-economy/

[82] Flash Appeal September – December (2017). [ebook] ReliefWeb. Available at: https://reliefweb.int/sites/reliefweb.int/files/resources/Kenya%20Flash%20Appeal%20Revision%20Sep2017.pdf

[83] the Guardian. (2017). *Satellite images trigger payouts for Kenyan farmers in grip of drought.* [online] Available at: https://www.theguardian.com/global-development/2017/apr/25/satellite-images-trigger-payouts-for-kenya-farmers-in-grip-of-drought

[84] ADRF, "Building Disaster Resilience in Sub-Saharan Africa Program", 2016-2017 progress report (2018)

[85] World Bank. (2017). *Vietnam's Economy Shows Fundamental Strength, with Stable and Positive Medium-Term Outlook.* [online] Available at: http://www.worldbank.org/en/news/press-release/2017/07/13/vietnam-economy-shows-fundamental-strength-with-stable-and-positive-medium-term-outlook

[86] Gavagnin, C., Zolin, M. B., & Pastore, A. (2017). Vietnams Rice Price at the Intersection of Globalisation and Climate Variability. *The Copenhagen Journal of Asian Studies,*34(2), 33-34.

[87] Tradingeconomics.com. (2018). *Vietnam government debt to GDP | Vietnam.* [online] Available at: https://tradingeconomics.com/vietnam/government-debt-to-gdp

[88] Gain-new.crc.nd.edu. (2018). Vietnam | *ND-GAIN Index.* [online] Available at: https://gain-new.crc.nd.edu/country/vietnam

[89] NIBIO Norwegian Institute of Bioeconomy Research (2017). *Food security threatened by sea-level rise* [online] Available at: https://phys.org/news/2017-01-food-threatened-sea-level.html

[90] IRRI. (n.d.). *IRRI – Rice and climate change.* [online] Available at: http://irri.org/news/hot-topics/rice-and-climate-change

[91] These measures also seem promising to help achieve Sustainable Development Goals (SDGs) 5 (Gender equality), 10 (Reduced inequalities) and 13 (Climate Action).

[92] weADAPT (2018). *Ecosystem-based adaptation as a tool to increase flood resilience* (ebook) Available at: https://www.weadapt.org/sites/weadapt.org/files/policy_brief_eba_1.pdf

[93] Vietnam Ministry of Finance and Investment, *Financing Vietnam's Response to Climate Change: Building a Sustainable Future Key Findings and Recommendations of the Climate Public Expenditures and Investment Review*, 2015.

[94] See, for example, World Bank, Sovereign Climate and Disaster Risk Pooling, World Bank Technical Contribution to the G20, Washington, DC: The World Bank, 2017; Maryam Golnaraghi, Ian Branagan, Stuart Fraser, Jonathon Gascoigne and Marie Gordon, *Guidelines for Risk Assessment to Support Sovereign Risk Financing and Risk Transfer – A Joint Publication of The Geneva Association and Insurance Development Forum,* Zurich: The Geneva Association, 2017; Kamleshan Pillay, Stine Aakre and Asbjørn Torvanger, *Mobilizing Adaptation Finance in Developing Countries,* Oslo: Center for International Climate Research, 2017.

[95] PNAS, Natural Climate Solutions, June 2018. [ebook] Available at: http://www.pnas.org/content/early/2017/10/11/1710465114/tab-article-info

[96] Colgan, C. S., M. W. Beck, S. Narayan. *Financing Natural Infrastructure for Coastal Flood Damage Reduction.* Lloyd's Tercentenary Research Foundation, London, 2017.

[97] See, for instance, Kathrin Berensmann, Florence Dafe and Ulrich Volz, 'Developing Local Currency Bond Markets for Long-term Development Financing in Sub-Saharan Africa,' *Oxford Review of Economic Policy,* 2015 (31) 3-4, pp 350-378; Florence Dafe, Dennis Essers and Ulrich Volz, 'Localising Sovereign Debt: The Rise of Local Currency Bond Markets in Sub-Saharan Africa,' *The World Economy*, 2018 (41) 2, 1-28.

[98] James Benford, Jonathan D. Ostry and Robert Shiller, *Sovereign GDP-Linked Bonds: Rationale and Design*, A VoxEU.org eBook, London: Centre for Economic Policy Research, 2018.

[99] World Bank, *Sovereign Climate and Disaster Risk Pooling*, World Bank Technical Contribution to the G20, Washington, DC: The World Bank, 2017

[100] Insurance Development Forum and the Geneva Association, *Guidelines for Risk Assessment to Support Sovereign Risk Financing and Risk Transfer,* June 2017.

[101] InsuResilience Global Partnership, *Launch of InsuResilience Global Partnership to enhance financial protection against climate risks,* 14 November 2017.

[102] World Bank Group, *Sovereign Climate and Disaster Risk Pooling:* World Bank Technical Contribution to the G20, 2017.

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Annex 511

Activities of vulture funds and their impact on human rights: Final report of the Human Rights Council Advisory Committee, A/HRC/41/51, 7 May 2019

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Activities of vulture funds and their impact on human rights

Final report of the Human Rights Council Advisory Committee

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I. Introduction

1. The present report is submitted in accordance with Human Rights Council resolution 27/30, by which the Council requested the Human Rights Council Advisory Committee to prepare a research-based report on the activities of vulture funds and their impact on human rights.

2. In the resolution, the Council reaffirmed that the activities of vulture funds highlighted some of the problems in the global financial system and were indicative of the unjust nature of the current system, which directly affected the enjoyment of human rights in debtor States. It called upon States to consider implementing legal frameworks to curtail the activities of predatory funds within their jurisdictions.

3. In preparing the present report, the Advisory Committee sought the views and inputs of Member States, United Nations agencies, relevant international and regional organizations, the Office of the United Nations High Commissioner for Human Rights (OHCHR) and relevant special procedures mandate holders, including the Independent Expert on the effects of foreign debt and other related international financial obligations of States on the full enjoyment of all human rights, particularly economic, social and cultural rights, as well as national human rights institutions, non-governmental organizations and eminent academics. The report was prepared by the Rapporteur of the drafting group on the activities of vulture funds and the impact on human rights, Jean Ziegler.[1]

4. The Advisory Committee would like to thank, in particular, the Governments of Argentina, Cuba, El Salvador, Kuwait, Mauritius, the Philippines and the Bolivarian Republic of Venezuela, the Ombudsman of Portugal, the National Commission for Human Rights of Greece, the Centre for Legal and Social Studies, the Centre Europe-Tiers Monde, the Committee for the Abolition of Illegitimate Debt and the Permanent Assembly for Human Rights (Asamblea Permanente por los Derechos Humanos) for the information provided in response to the questionnaires sent in March 2015 and February 2018.

5. In the report, the growing concerns raised by the strategies deployed by vulture funds are highlighted. It also includes an analysis of some of the most striking examples of the activities of vulture funds and national and international initiatives and efforts undertaken to face and mitigate the negative impact stemming from those activities on the enjoyment of economic, social and cultural rights and the right to development.

II. What are vulture funds?

6. There is no international legal regime governing cases of State insolvency or bankruptcy. When a State defaults on its sovereign debt, it must initiate a process for restructuring the debt in order to obtain a reduction in the debt or an extension of the repayment terms. That implies undertaking complex and protracted negotiations with a very diverse range of creditors.[2] Participation in such restructuring processes is voluntary and therefore even a small percentage of creditors may well decide to hold out with a view to obtaining a higher level of repayment in future. It is at this point that vulture funds come into play.

7. According to the former Independent Expert on foreign debt, vulture funds are “private commercial entities that acquire, either by purchase, assignment or some other form of transaction, defaulted or distressed debts, and sometimes actual court judgments, with the aim of achieving a high return. In the sovereign debt context, vulture funds (or ‘distressed debt funds’, as they often describe themselves) usually acquire the defaulted sovereign debt of poor countries (many of which are heavily indebted poor countries

[1] The Rapporteur would like to thank Milena Costas Trascasas for her support in the elaboration of the present report.

[2] They might be international financial institutions, bilateral or multilateral lenders, private financial institutions or bondholders.

(HIPCs), on the secondary market at a price far less than its face value and then attempt, through litigation, seizure of assets or political pressure, to seek repayment of the full face value of the debt together with interest, penalties and legal fees" (A/HRC/14/21, para. 8).

8. These commercial entities are not lenders, but private hedge funds that purchase on the secondary market (or collect from other bondholders) distressed debt at discounted prices and then sue the debtor for a much higher amount. They are popularly called "vultures" because of their modus operandi, whereby they:

(a) Target States with distressed economies and a weak capacity for legal defence. According to the African Development Bank, 20 of the 36 poorest developing countries have been threatened or targeted by aggressive litigation by vulture funds since 1999. The World Bank estimates that more than one third of the countries that qualified for its debt relief initiative have been targeted by lawsuits by at least 38 litigating creditors, with judgments totalling $1 billion in 26 of those cases;[3]

(b) Operate and take advantage of the lack of regulation of the secondary market. To obtain significant discounts, vulture funds acquire sovereign bonds when the indebted country is either close to default or has already defaulted on its debt. In the secondary market, they can operate with great secrecy in terms of both ownership and operations. Sovereign bonds are thus traded between investors without the debtor State concerned necessarily being aware or informed of such operations;[4]

(c) Refuse systematically to participate in orderly debt restructuring processes. Once the State starts negotiations with private bondholders to restructure the sovereign debt, vulture funds exercise their "right" to hold out and/or start collecting and purchasing sovereign distressed bonds; they then wait until the country's financial situation has improved to start negotiations for a better deal. In addition to difficulties in gaining access to the international capital markets again, the debtor State is under the threat of being subjected to a long and costly process with a particularly aggressive litigator. The additional pressure may easily prompt some Governments to accept highly disadvantageous deals;[5]

(d) Sue the country for reimbursement of the full value of the bond, plus interest and procedural costs. If the debtor State does not surrender to the claims of the vulture funds, then the next step in the strategy is to file legal claims seeking reimbursement of an amount much higher than the price they paid in the secondary market (usually the face value of the bonds), increased with interest, delay penalties and legal expenses. To ensure that they get a favourable court decision they make sure that "creditor-friendly" jurisdictions are involved in the resolution of the dispute.[6] The courts of debtor countries may increasingly become an option, as weaker legal systems are easily overwhelmed by the level of technical detail involved in this kind of litigation. Procedures are particularly protracted (on average six years), costly and burdensome (with annualized returns ranging

[3] See African Development Bank Group, "Vulture funds in the sovereign debt context", available from www.afdb.org/en/topics-and-sectors/initiatives-partnerships/african-legal-support-facility/vulture-funds-in-the-sovereign-debt-context/.

[4] Because big institutional investors do not like to sue sovereign States, they seek to obtain some return by selling their defaulted debt to vulture funds on the secondary market. See Devi Sookun, *Stop Vulture Fund Lawsuits: a Handbook* (London, Commonwealth Secretariat, 2010), p. 11.

[5] To force the targeted State to pay, vulture funds resort to lobbying and other pressure tactics, such as filing actions to attach assets and organizing press campaigns to discredit debtor States. See Romina Kupelian and María Sol Rivas, "*Vulture Funds: the Lawsuit Against Argentina and the Challenge They Pose to the World Economy*" (Centro de Economía y Finanzas para el Desarrollo de la Argentina, working paper No. 49, February 2014), p. 7.

[6] New York and London are the primary locations for external sovereign borrowing and related legal disputes. Over 70 per cent of international bonds are issued under New York State law, while most of the remainder are issued under English law. See Julian Schumacher, Christoph Trebesch and Henrik Enderlein, "Sovereign defaults in court", CESifo working papers (February 2018), p. 1.

from 50 per cent to 333 per cent).[7] As a consequence, the financial and reserve management capacities of the debtor State remain compromised for a long period.

(e) "Chase" the country to enforce the judgment: once vulture funds have obtained a favourable judgment, they seek its enforcement before different courts through "forum shopping" practices, until they secure the enforcement action they desire. Figures show that attachment of a country's assets abroad has become a particularly common legal strategy in past years.[8] Despite many unsuccessful attempts, such pressures have often helped vulture funds to achieve a favourable out-of-court settlement. Such outcomes reinforce the legal strategy pursued by vulture funds of chasing States before courts worldwide in the hope of eroding State immunity, which shields certain State properties and assets from seizure;[9]

(f) Obtain exorbitant profits: vulture funds have achieved, on average, recovery rates of some 3 to 20 times their investment, equivalent to returns of 300–2,000 per cent. In some cases, the claims of vulture funds constitute a significant portion (12–13 per cent) of a country's gross domestic product (GDP);[10]

(g) Operate in jurisdictions where bank secrecy rules apply: most vulture funds are incorporated in tax havens, where there is no obligation to disclose information on benefits or ownership and it is feasible to hide gains to avoid or evade taxation.[11] Such jurisdictions facilitate the secretive manner in which vulture funds operate and the flight of much-needed capital, particularly from developing countries (A/HRC/14/21, paras. 13–14).

III. Case studies

9. The predatory practices of vulture funds in relation to developing countries, particularly heavily indebted poor countries, have a long history. The countries most commonly targeted have unsustainable debt burdens and lack both the capacity and the resources needed to face such complex and protracted judicial processes. In recent years, vulture funds have aimed their profit expectations at middle-income countries, particularly Argentina. With more than 50 lawsuits filed by commercial investors after the default of 2001, the country accounts for a third of the total number of lawsuits brought by vulture funds.[12] The analysis of the following examples will provide a clearer understanding of the human rights impact deriving from the activities of vulture funds.

A. *Donegal International Ltd. v. Zambia*

10. By 1984, the Government of Zambia was unable to service a $30 million debt owed to Romania for the acquisition of agricultural equipment. In early 1997, the firm Debt Advisory International (which later incorporated Donegal International Ltd.) began to put

[7] See African Development Bank Group, "Vulture funds in the sovereign debt context".

[8] For example, a ruling of the High Court of the United Kingdom of Great Britain and Northern Ireland in 2005 allowed Kensington International Ltd. to intercept the proceeds of oil sales of the Republic of the Congo to recoup a $39 million debt. The profits realized by the Congo from the sale of oil can be seized until a claim of $90 million is repaid.

[9] See Schumacher, Trebesch and Enderlein, "Sovereign defaults in court", pp. 5–9.

[10] For example, in Liberia in the 2000s, lawsuits amounted to an extraordinary 41.6 per cent of GDP, ibid., p. 15. See also African Development Bank Group, "Vulture funds in the sovereign debt context".

[11] For example, Donegal International Ltd. is based in the British Virgin Islands, Kensington International Ltd. in the Cayman Islands and FG Hemisphere in Delaware, United States of America. The particularities of such jurisdictions are well known: opacity (bank secrecy or other mechanism such as trusts); low taxation or exemption from taxation for non-residents; regulations favourable to the establishment of front companies without real activity on the territory; lack of cooperation with the tax, customs and/or judicial authorities of other countries; and weak or non-existent financial regulation. See Renaud Vivien, "FG Hemisphere vulture fund's latest victory against the Democratic Republic of Congo. What is Belgium doing?", Committee for the Abolition of Illegitimate Debt, 2 January 2011.

[12] See Schumacher, Trebesch and Enderlein, "Sovereign defaults in court" p. 11.

forward proposals for acquiring the debt. In 1999, just as Zambia was about to reach the decision point for comprehensive debt relief under the Heavily Indebted Poor Countries Initiative, Romania sold the debt to Donegal International for about $3 million, 11 per cent of the face value.

11. In 2003, in controversial circumstances involving allegations of corruption and the bribing of public officials, Zambia signed a settlement agreement with Donegal International by which it agreed to waive sovereign immunity from litigation and to pay approximately $15 million of the then $44 million face value of the debt. The agreement also included penal rates of interest in the event of default and the application of United Kingdom law to any future dispute arising from it. After paying off a total of $3.4 million, the Government of Zambia stopped fulfilling the terms of the agreement, arguing that it was tainted with corruption (A/HRC/14/21, para. 24).

12. In 2006, only months before Zambia was due to receive debt cancellation under the Heavily Indebted Poor Countries Initiative, Donegal International sued the country in the United Kingdom courts for a total of $55 million, nearly 17 times the amount the company paid for the debt. It finally received a favourable ruling, obtaining US$ 15.4 million.

13. The Government of Zambia reportedly recognized the judgment and allocated about 65 per cent of the amount received, already earmarked for health programmes, to service the debt (ibid., para. 25).[13] As a result of the litigation, vulture funds removed from the country almost 15 per cent of its total social welfare expenditure, funds that could have been channelled instead towards education, health care and poverty alleviation.[14]

B. *FG Hemisphere v. Democratic Republic of the Congo*

14. In 1980, the Democratic Republic of the Congo entered into a credit agreement with Energoinvest, a company based in Sarajevo, for the construction of a high-voltage electric power transmission facility. The country soon defaulted on its repayment obligations.

15. In 2003, the International Chamber of Commerce made two arbitral awards in favour of the company. In 2004, a District Court in the United States of America confirmed the amounts to be paid: $18.43 million and $11.725 million, plus 9 per cent interest and the costs of the arbitration. At that point, the company decided to transfer the right to recover the claim to FG Hemisphere, a company based in the State of Delaware (a tax haven in the United States).[15] It reportedly purchased the debt for $37 million.[16]

16. FG Hemisphere then pursued its claim on the debt by attempting to seize the country's assets worldwide. In 2005, the Government's failure to provide the courts in the United States with detailed information about the location of any assets worth more than $10,000 led to a weekly fine of $5,000, to increase periodically to a maximum of $80,000.[17]

17. To enforce the 2003 rulings, FG Capital Management (formerly FG Hemisphere) managed to freeze hundreds of millions of dollars owed to the Democratic Republic of the Congo and obtained enforcement judgments from a number of courts around the world. In November 2008, a South African court effectively halted sales of electricity from the country by ruling that FG Hemisphere could seize any payments for services sold by the

[13] See also See Romina Kupelian and María Sol Rivas, "*Vulture Funds: the Lawsuit Against Argentina and the Challenge They Pose to the World Economy*", p. 9 and Thomas Laryea, "Donegal v. Zambia and the persistent debt problems of low-income countries", *Law and Contemporary Problems*, vol. 73, No. 4 (Fall 2010).

[14] See Lydia Polgreen, "Unlikely ally against Congo Republic graft", *New York Times* (10 December 2007).

[15] The sale was approved by the former Prime Minister of Bosnia and Herzegovina, who was investigated on corruption charges relating to his tenure at Energoinvest. See "Vulture funds–the key players", *The Guardian*, 15 March 2011.

[16] See Michael J. Kavanagh, "Congo, U.S.-controlled venture lose $100 million vulture claim", Bloomberg (3 November 2010).

[17] See Devi Sookun, *Stop Vulture Fund Lawsuits: a Handbook*, p. 45.

Democratic Republic of the Congo to South Africa. In February 2010, the Court of Appeal in Hong Kong froze about $100 million of a signing bonus for a $6 billion minerals-for-infrastructure agreement between the Democratic Republic of the Congo and China until the International Chamber of Commerce awards had been resolved.[18] The agreement included a payment of $221 million in mining entry fees to the Government, which FG Hemisphere sought to receive towards payment of the arbitral award. The Government claimed State immunity, but the Court of Appeal ruled that the country had no immunity in commercial proceedings.[19]

18. That is an unfortunate event for a country that needs money for development. The Democratic Republic of the Congo is rich in natural resources but is recovering from more than four decades of dictatorship and war that have destroyed its infrastructure. In fact, it is difficult to see how a country with one of the lowest Human Development Index rankings (176) can service its external debt obligations without at the same time harming its poverty reduction and economic development prospects (A/HRC/14/21, para. 20). The negative impact of vulture funds on the capacity of the State to create the conditions necessary to fulfil its human rights obligations is therefore evident.

C. *NML Capital Ltd. v. Argentina*

19. The deteriorating economic, financial and social situation that led Argentina to a catastrophic collapse in 2001 has been well documented (see, for example, A/HRC/25/50/Add.3). Soon after defaulting, the Government recognized the need to restructure roughly $81 billion of debt. In two successive exchanges of offers, in 2005 and 2010, Argentina succeeded in reaching an agreement with more than 92 per cent of its creditors, which agreed to take an approximately 70 per cent "haircut" on their bond holdings.

20. A group representing 1.6 per cent of bondholders, led by NML Capital Ltd. (a hedge fund based in the Cayman Islands), refused to restructure and decided to sue the country in the New York State courts for the full amount.[20] Some of the defaulted bonds had been bought on the secondary market just before the country's default in 2001, but most were purchased afterwards, at bargain prices. The vulture funds allegedly paid about $48.7 million for more than $220 million in defaulted bonds soon after the default; others were purchased even after the bond exchanges of 2005 and 2010 (ibid., para. 32).

21. In November 2012, a New York district court judge ordered Argentina to pay NML Capital and other "hold-outs" in full (about $1.3 billion), an amount that may represent a profit of about 1,600 per cent.[21] The court ruling was first confirmed by a decision of the United States Court of Appeals for the Second Circuit and subsequently endorsed by the Supreme Court, which stated that the country could not pay the creditors that had accepted the exchange offers until the "hold-out" creditors had been paid in full.

22. Those rulings represented a major departure from the traditional market or legal understanding of the *pari passu* clause, a common component of bond contracts.[22] NML

[18] See Michael J. Kavanagh, "Congo, U.S.-controlled venture lose $100 million vulture claim".

[19] Kathryn Crossley, "Case analysis: *Democratic Republic of the Congo and Ors v. Hemisphere Associates LLC*", Asian Legal Business (17 June 2011).

[20] Elliott Management investment fund controls NML Capital and has brought actions against Argentina and many other countries. The chief executive officer, Paul Singer, is one of the main financial backers of the Republican Party in the United States, which gives him enormous lobbying power, as well as substantial political and legal support for carrying out these operations. See Romina Kupelian and María Sol Rivas, "*Vulture Funds: the Lawsuit Against Argentina and the Challenge They Pose to the World Economy*", p. 10.

[21] See letter dated 9 July from Axel Kicillof, Minister of Economy and Public Finance of Argentina, to the *Financial Times*.

[22] "By equal step or without preference": the international financial markets have long understood that this clause protects a lender against the risk of legal subordination in favour of another creditor. See Lee C. Buchheit and Jeremiah S. Pam, "The pari passu clause in sovereign debt instruments", *Emory Law Journal*, vol. 53 (special edition, 2004).

Capital contended that the country was not granting the same treatment to the creditors that did not participate in the exchange because it had agreed only to pay its debt to the exchange bondholders.[23]

23. In February 2016, with a newly elected Government in office in Argentina, the United States court set a number of conditions for effectively lifting the injunction and allowing Argentina to service its restructured debts. Events accelerated from then on and in April 2016, ceding to massive financial pressure, Argentina abruptly reversed its previous policy regarding the claims and agreed in an out-of-court settlement to pay $6.5 billion dollars to the "hold-outs".

24. That settlement represented a further setback in the process aimed at setting up an international sovereign debt restructuring mechanism based on the equal treatment of creditors. Paying vulture funds much more than was paid to cooperative creditors in previous debt restructuring is a disturbing outcome. Rewarding those who refuse to participate in debt restructuring efforts sends the wrong message.[24]

25. From a human rights perspective, that kind of settlement raises important concerns. In the short term, putting an end to more than a decade of judicial disputes contributes to restoring a country's credibility, opening its access to financial markets. However, in order to pay the "hold-outs", the Government was forced to increase its debt burden, a fact that, in the long run, may hinder the ability of the State to comply with its commitments in the area of economic and social rights, exacerbating inequality and financial instability.

26. In any event, the long judicial dispute highlights the pressing need to regulate speculative investment practices in order to bring them into line with human rights approaches and requirements. Furthermore, it has prompted a process aimed at establishing a multilateral mechanism with a mandate to resolve sovereign debt litigation in an independent and impartial manner.

27. Although the legal consequences of this case should not be underestimated, its final outcome must be read in the light of the particular circumstances that surrounded the dispute and the evident political implications involved. There is no doubt, however, that the United States rulings will certainly incentivize vulture funds to pursue such strategies in the future.[25]

IV. Disruptive litigation: a growing trend

28. The case of Argentina is not an exception, but forms part of a more general trend. Increasingly, non-cooperative creditors are reaping extraordinary profits owing to settlements reached or judgments obtained after disruptive litigation. Not only do investors' expectations of obtaining high returns by suing countries asphyxiated by onerous financial terms benefit from the lack of a global mechanism on debt restructuring, but they may also be at the origin of this state of affairs.

29. In fact, statistics show that lawsuits and attempted attachments are increasingly becoming a common way of solving sovereign debt disputes, entailing costly and protracted judicial processes for the defaulting State.[26] In the period from 1976 to 2010, there were about 158 lawsuits against 34 defaulting countries in the United States and the United

[23] Instead, the clause is broadly interpreted as providing factual preference to "hold-out" creditors over those acting in good faith. See John Muse-Fisher, "Starving the vultures: *NML Capital v. Republic of Argentina* and solutions to the problem of distressed-debt funds", *California Law Review*, vol. 102, No. 6 (2014).

[24] See www.ohchr.org/_layouts/15/WopiFrame.aspx?sourcedoc=/Documents/Issues/IntOrder/Info_Note_Argentinian_VultureFunds_EN.pdf&action=default&DefaultItemOpen=1.

[25] Debt and Development Coalition Ireland, "Stop debt vultures: implications of the vulture attack on Argentina" (1 September 2014), p. 4.

[26] See Schumacher, Trebesch and Enderlein, "Sovereign defaults in court", p. 12.

Kingdom alone.[27] The high success rate (72 per cent) certainly encourages this worrying tendency. Since the 1990s, the percentage of debt crises involving litigation has grown from 10 per cent to almost 50 per cent.[28]

30. Africa has been by far the most harassed region, with an average of eight cases filed every year. Not for nothing African countries have the lowest rate of winning cases and have disbursed more than 70 per cent of the nearly $1 billion awarded to vulture funds as a result of lawsuits.[29] It is against that backdrop that some specific initiatives to protect States receiving funds from the International Monetary Fund (IMF) and the World Bank have developed.[30]

31. Remarkably, the African Legal Support Facility, established by the African Development Bank in 2008, provides legal support and technical advice to States facing lawsuits launched by vulture funds.[31] In 2006, the Commonwealth secretariat set up an "HIPC legal clinic" to assist States in the negotiation and renegotiation of foreign debt. Despite the fact that information on the implementation of those programmes is not available, the evidence is that vulture funds are progressively changing their business focus from heavily indebted poor countries to middle-income countries and territories, such as Greece, Puerto Rico and the Bolivarian Republic of Venezuela.[32]

32. In other countries particularly hit by the financial crisis, such as Ireland or Spain, vulture funds are developing speculative strategies in relation to non-performing private loans.[33] In that context, their strategy is quite similar: they acquire distressed real estate assets, taking advantage of the difficulties people are having to repay their loans to the banks and wait until the mortgage is in default. In such a way, vulture funds progressively get a dominant position in the housing market that ends by allowing them to influence rents and house prices. Speculation drives up property costs and makes housing unaffordable for low-income households. In a letter sent to Blackstone Group L.P., the world's largest private equity firm, United Nations human rights experts expressed concerns about the grave impact that the "financialization" of housing was having on the enjoyment of the right to adequate housing for millions of people across the world.[34]

V. National legislation

33. At present, only three countries, Belgium, France and the United Kingdom, have enacted some sort of legal framework to discourage disruptive litigation initiated by vulture funds. Attempts to enact similar initiatives in the United States have failed so far.

[27] This number does not include litigation resulting from bilateral investment treaties or before international arbitration bodies, which are increasingly being used by vulture funds to deploy their strategies.

[28] See Schumacher, Trebesch and Enderlein, "Sovereign defaults in court", p. 2.

[29] African Legal Support Facility, "Medium term strategy 2013–2017", p. 10.

[30] Currently, 36 States are classified as heavily indebted poor countries, i.e., countries with high poverty levels that are eligible for financial assistance from IMF and the World Bank. In 2017, seven African States among them were facing commercial litigation, IMF factsheet, "Heavily Indebted Poor Countries (HIPC) Initiative and Multilateral Debt Relief Initiative (MDRI). Statistical Update" September 2017, p. 45.

[31] As of January 2016, the facility consists of 52 States, African States and others (Belgium, Brazil, France, the Netherlands and the United Kingdom) and 7 international organizations. In 2010, the Management Board approved support for the first case involving vulture fund litigation against the Democratic Republic of the Congo.

[32] See Committee for the Abolition of Illegitimate Debt, "*Fonds Vautours. Les Ailes de la Dévastation* (2017).

[33] See, for example, Michael Byrne, "From Puerto Rico to the Dublin docklands; vulture funds and the global South", Debt and Development Coalition Ireland (2016) and Luis Doncel, "Los fondos buitre reinan en España", *El Pais* (21 April 2018). In Ireland, 60 per cent of all assets sold by one of the banks have been acquired by Texas-based Lone Star Capital.

[34] See OHCHR, "States and real estate private equity firms questioned for compliance with human rights" (26 March 2019).

34. While these national laws have played an important deterrent role, it is evident that concerns raised by the activities of vulture funds can only be effectively tackled if more countries pass national laws to limit their claims. To avoid "forum shopping" strategies, regulation is particularly needed in those jurisdictions preferred by vulture funds for starting litigation or enforcing attachments.

35. National legislators may resort to useful guidelines deriving from existing domestic laws and experience of implementation, namely: (a) protection should be extended to any debt-distressed country and not only to heavily indebted poor countries; (b) procedures should allow for the identification of debts that are protected from the claims of vulture funds, on the basis of objective criteria; (c) concerns about the socioeconomic situation of the debtor State and the well-being of its population should be adequately incorporated and addressed by the legislator; and (d) issues regarding the lack of transparency in the secondary debt market and the operation of vulture funds in tax havens should be also tackled.

Belgium

36. Belgium was the first country to enact national legislation against the activities of vulture funds.[35] In 2008, a first law responded to the numerous lawsuits lodged by vulture funds before national courts aimed at seizing official funds allocated by Belgium to official development aid to certain countries.[36]

37. In 2015, a new law set out a more detailed framework, fixing limits to the amount that vulture funds could legitimately claim.[37] A threshold (the price paid to repurchase the loan or debt) was established for those cases where it could be demonstrated that the creditor's repurchase pursued an "illegitimate advantage".

38. There is such "illegitimate advantage" when:

(a) There is a "manifest disproportion" between the repurchase prices of the loan or debt and the face value of the amounts that the creditor seeks to recover from the State;

(b) One or more of the following criteria is met:

(i) The debtor State was insolvent (or a default was imminent) at the time of the debt buy-back;

(ii) The creditor is based in a tax haven or similar jurisdiction;

(iii) The creditor systematically uses legal proceedings to obtain repayment;

(iv) The creditor refused to take part in debt restructuring efforts;

(v) The creditor abused the weakness of the State to negotiate a repayment which is manifestly unbalanced;

(vi) The total reimbursement of the amounts demanded by the creditor would have a measurably adverse impact on the public finances of the State and would be likely to compromise the socioeconomic development of its population.

39. The law is not limited to heavily indebted poor countries and provides comprehensive protection against litigation by vulture funds. It integrates human rights concerns, while taking due account of the important public interests at stake when dealing with sovereign debt.[38] Requiring the judges to make an assessment of the impact that the repayment of the debt might have on the socioeconomic situation of the debtor State and on the well-being of its population is certainly an innovative element and one of the most prominent aspects of this legislation.

[35] Law aimed at preventing the seizure or transfer of public funds allocated to development aid, particularly by the strategies of vulture funds, 6 April 2008.

[36] Ten lawsuits were lodged against the Democratic Republic of the Congo in 2007 alone.

[37] Law relating to the fight against the activities of vulture funds, 12 July 2015.

[38] Chamber of Representatives of Belgium, Draft law relating to the fight against the activities of vulture funds, doc. 54 0394/001, 7 October 2014.

40. In May 2018, the Belgian Constitutional Court declared inadmissible the recourse filed by NML Capital to challenge this legislation.[39] In a landmark decision, the Court refused all arguments put forward by the vulture funds, in particular that the application of the law would lead to a violation of the creditor's rights to property and to a fair trial, as provided by the European Convention for the Protection of Human Rights and Fundamental Freedoms and its Protocol No. 1.

41. The Court found that the limitations to the creditor's rights to property introduced by the 2015 law were both justified by the public interest and proportionate to the aim pursued. In precise terms, the legislation seeks to protect the most vulnerable countries by preventing the activities of vulture funds from contributing to making the situation worse. It provides national judges with objective criteria to identify creditors that pursue an "illegitimate advantage" in light of the "manifest disproportion" existing between the repurchase price and the face value of the amounts the creditor claims.

42. The law does not exclude entirely the creditor's right to claim before the Belgian courts, but limits the repayment to the actual price of the sovereign debt, since the right to claim up to that amount remains untouched. According to the Constitutional Court, the difference between the treatment of creditors that pursue an illegitimate aim and others is reasonably justified to achieve the aims of the law.

United Kingdom of Great Britain and Northern Ireland

43. Following discussions on a draft bill to limit the maximum recoverable amount of the defaulted sovereign debts of developing countries, in 2010 Parliament passed a law limiting the amount recoverable of claims related to "qualifying debts".[40] The regulation applies to any national and foreign judgments enforceable in the United Kingdom, as well as to arbitral awards. However, its scope is limited to heavily indebted poor countries.

44. Section 3 (2) of the law refers to the debts of countries that have reached decision point under the Heavily Indebted Poor Countries Initiative, defining the relevant proportion by referring to the reduction as applied under the Initiative when a country reaches the decision point. The percentage reduction calculated by IMF and the World Bank is required from all creditors holding debts included in the Initiative, in order to reduce the country's indebtedness to a sustainable level.[41]

45. The aim of the law is to ensure that courts in the United Kingdom neither render nor enforce a judgment that allows recovery of covered debts of those countries in excess of the amount calculated as sustainable debt under the Initiative. The creditor may not recover more than the existing debt, even in cases of renegotiation or new agreements. While there is no provision for cancellation of a debt, enforcement is limited to the recoverable amount under the existing debt, irrespective of the law applicable to the debt or claim.[42]

France

46. In 2016, an amendment to the law on the fight against corruption introduced rules aimed at protecting foreign States that are beneficiaries of French official development assistance facing sovereign default from speculation by abusive creditors.[43] The new regulation prohibits the seizing of goods or properties of a foreign State if (a) the debtor State was the recipient of ODA at the time the debt was issued; (b) it was in default or close to it at the time the creditor acquired the debt; (c) the situation of default (or close to it) with respect to the specific claim dates back less than four years (or six years in cases of

[39] Decision No. 61/2018, Action for annulment of the law of 12 July 2015 relating to the fight against the activities of vulture funds, introduced by NML Capital Ltd. incorporated in the Cayman Islands.

[40] Debt Relief (Developing Countries) Act 2010.

[41] See explanatory notes to the law, para. 22, and Francis D. Chukwu, "Refocusing on the objectives: a critique of the U.K.'s Debt Relief (Developing Countries) Act, 2010" (1 May 2011).

[42] See Michael Waibel, "Debt relief to poor countries: rules v. discretion", *Journal of International Banking and Financial Law* (May 2010).

[43] Law No. 2016 1691 of 9 December 2016 relating to transparency, the fight against corruption and the modernizations of economic life, JORF No. 0287 of 10 December 2016, art. 60.

manifestly abusive behaviour); or (d) a restructuring proposal has been accepted by two thirds of the creditors. Seizures are allowed, but only up to the amount obtained by good-faith creditors, namely those that participated in debt restructuring negotiations and accepted their results.[44]

47. Given that the French law is a positive step against the activities of vulture funds, it is regrettable that it will not apply to debts acquired before its entry into force. That leaves out of its scope the great majority of "unprotected" sovereign bonds.[45]

Comparison of laws on vulture funds by country	*Applies to all countries*	*Applies to old debts*	*Applies to new debts*	*Applies to all companies*	*Prevents suing for more than paid for debt*	*Prevents suing for more than other creditors have accepted*
Belgium (2015)	√	√	√	/X	√	X
France (2016)	X	X	√	√	X	√
UK (2010)	X	√	X	√	X	√

Source: Jubilee Campaign.

VI. Forging an international consensus

48. A growing consensus on the need to curb the activities of vulture funds has emerged over the past 10 years. A number of States have expressed in several forums their support for undertaking common actions aimed at protecting heavily indebted poor countries from vulture funds and, more generally, at the establishment of an international mechanism for orderly debt restructuring.

49. At a meeting of the Group of Eight, held in May 2007, finance ministers and governors of central banks expressed their concern about the problem of aggressive litigation against heavily indebted poor countries and urged all sovereign creditors not to sell claims on those countries.

50. The same year, Commonwealth finance ministers emphasized the need for concerted international action to address vulture funds litigation and urged Governments to introduce legal protection to ensure that debt relief was provided, as a minimum, on terms equivalent to the heavily indebted poor countries framework.

51. In 2008, the member States of the European Union committed not to sell claims on heavily indebted poor countries to creditors unwilling to provide debt relief. A year earlier, the Paris Club had endorsed a similar position.

52. The signatories of the 2008 Doha Declaration on Financing for Development expressed identical concerns.[46] The declaration welcomed steps taken to prevent aggressive litigation against "HIPC-eligible countries" and called on creditors not to sell claims on such countries to those refusing to participate adequately in debt relief efforts.[47]

53. In 2009, a recommendation of the Parliamentary Assembly of the Council of Europe strongly condemned the activities of vulture funds, which "have no compunction in taking

[44] See Fanny Galois, "*Fonds vautours. La France réagit aussi*" (10 April 2018), available from www.cadtm.org.

[45] According to the IMF, the 70 per cent of the bonds that do not contain enhanced clauses to protect good-faith bondholders will expire in the next 10 years. In 2014, its Executive Board endorsed the inclusion of enhanced clauses (*pari passu* provisions and collective action clauses) in all new international sovereign bonds. See IMF, "Third progress report on inclusion of enhanced contractual provisions in international sovereign bond contracts" (December 2017).

[46] See General Assembly resolution 63/239, annex.

[47] Ibid., para. 60. In the Addis Ababa Action Agenda, signatories reiterated their concern at non-cooperative creditors who had demonstrated their ability to disrupt timely completion of debt restructuring (para. 98).

advantage of opportunities arising from debt waivers granted by creditor countries, particularly European, or blocking worldwide the assets of the countries concerned and threatening them with bankruptcy".[48]

54. In 2014 and 2015, the Ministers for Foreign Affairs of the member States of the Group of 77 and China recognized that the speculative activities of vulture funds posed a risk to all future debt-restructuring processes, for both developing and developed countries. They further stressed the importance of not allowing vulture funds to paralyse the debt-restructuring efforts of developing countries and affirmed that those funds should not supersede the right of a State to protect its people under international law (A/69/423, annex, para. 29, and A/70/410, annex, para. 33).

55. In 2018, the European Parliament passed a resolution in which it acknowledged that "vulture funds targeting distressed debtors and interfering with the debt-restructuring process should not receive legal or judicial support for their pernicious activities". It also called on European Union member States to adopt, on the initiative of the European Commission, a regulation based on the Belgian law on combating debt speculation by vulture funds.[49]

VII. Towards a multilateral framework on debt restructuring

56. Responding to the increasing demand for international action, in September 2014 the General Assembly adopted its landmark resolution 68/304 entitled "Towards the establishment of a multilateral legal framework for sovereign debt restructuring processes", in which it called for a legal framework aimed at facilitating the orderly restructuring of sovereign debts and capable of deterring creditors from disruptive litigation. The Assembly expressly emphasized that the activities of vulture funds undermined the purpose of debt restructuring processes by forcing indebted countries to divert many of their resources to handling such litigation. One year later, the Assembly endorsed a set of principles that should guide the establishment of an international orderly sovereign debt-restructuring workout.[50]

57. The principle of sustainability entails promoting sustained and inclusive economic growth and development that leads to stable debt situations. That means that debt sustainability is only achieved when debt service does not result in violations of human rights and human dignity, and does not prevent the attainment of international development goals (see A/HRC/40/57, paras. 12.2 and 12.3).

58. It is in that context that in its resolution 27/30, the Human Rights Council called upon States to curtail the activities of vulture funds by implementing national frameworks and expressly recognized the negative impact the repayment of debts under predatory conditions caused to the capacity of a State to fulfil its human rights obligations. Some months before, 100 civil society organizations worldwide had supported the establishment of an international mechanism for the restructuring of sovereign debt "based on the obligation of States to respect, protect and enforce human rights, both in their territory and extraterritorially".[51]

59. In view of the efforts and the progress made over the past years, it is difficult to understand the reasons behind the current political deadlock in the process aimed at setting up a debt-workout institution, building on General Assembly resolution 69/319 on Basic Principles on Sovereign Debt Restructuring Processes. In April 2018, the European Parliament insisted on the need to set up an international debt-workout mechanism capable

[48] See recommendation 1870 (2009), available from http://assembly.coe.int/nw/xml/XRef/Xref-XML2HTML-en.asp?fileid=17748&lang=en.

[49] See resolution of 17 April 2018 on enhancing developing countries' debt sustainability (2016/2241(INI)), paras. 32 and 37.

[50] See resolution 69/319.

[51] See "The conflict between Argentina, the vulture funds and the judicial branch of the United States exposes a global problem that impacts on human rights".

of solving debt crises in a fair, speedy and sustainable manner.[52] According to the resolution adopted by the Parliament, the road map on sovereign debt workout developed by the United Nations Conference on Trade and Development (UNCTAD) and the proposal to establish an international debt-restructuring court should be at the heart of the new mechanism.[53]

60. Meanwhile, vulture funds make the most of the absence of an international regulatory framework by exploring new ways to enforce the terms of their sovereign bonds, particularly through the international investment arbitration system. Despite the fact that the system is not designed to hear disputes over financial assets, it seems that arbitrators have opened the door to speculative claims (A/72/153, para. 60).

61. Furthermore, the mechanism appears to be manifestly inadequate to solve complex sovereign debt-restructuring disputes, as investment tribunals too often tend to ground their decisions in purely economic terms while ignoring the broader human rights implications of such situations.

62. The impact of such a worrying trend on the process towards orderly negotiated settlements should not be underestimated. Upholding the rights of investors without taking due account of the broad human rights implications of debt crises incentivizes vulture funds to continue their disruptive strategies. Increased power for hold-out creditors and vulture funds would lead to increased liability for debtor States and a higher risk that human rights obligations are undermined, as economic recovery is impaired and funding for public services giving effect to human rights reduced (ibid., paras. 54 and 59).

VIII. Impact of the activities of vulture funds on human rights

63. Human rights monitoring bodies have underscored the negative impact deriving from the activities of vulture funds on the capacity of the State to fulfil its human rights obligations (see, in particular, A/HRC/14/21).[54] The Independent Expert on foreign debt has observed that the settlement of excessive claims by vulture funds against poor countries with unsustainable debt levels has a direct, negative effect on the capacity of Governments to fulfil their human rights obligations. Economic, social and cultural rights, particularly the rights to health, water and sanitation, food, housing and education, are among the most affected. Empirical research supports the finding of negative economic and financial consequences deriving from protracted aggressive litigation against debt-distressed and poor States.[55]

64. Through lengthy and costly litigation, vulture funds contribute to diverting State resources from other, more pressing developmental, social and human rights issues (A/HRC/14/21, para. 35). Protracted litigation may cause important delays in resolving the debt crisis and limit the capacity of a State to commit the resources and efforts necessary to bring the country out of its debt crisis. It may worsen the already significant economic and financial consequences attached to the crisis and lead to policies that have a severe impact on the enjoyment of human rights (A/72/153, para. 6).[56] Some of the most prominent negative impacts deriving from the activities of vulture funds are described below.

[52] See resolution 2016/2241(INI), para. 32.

[53] See UNCTAD, "Sovereign debt workouts: going forward. Roadmap and guide" (April 2015); Martin Guzman and Joseph E. Stiglitz, "Creating a framework for sovereign debt restructuring that works" in *Too Little, Too Late*, Martin Guzman, José Antonio Ocampo and Joseph E. Stiglitz, eds. (New York, Columbia University Press, 2016); and "A soft law mechanism for sovereign debt restructuring", Developing Economics (13 November 2017).

[54] The duty to fulfil imposes on the State an obligation to take appropriate legislative, administrative, budgetary, judicial and other measures towards the full realization of economic, social and cultural rights.

[55] The effects of disruptive litigation on the debt sustainability of heavily indebted poor countries have been tracked on an annual basis by the Millennium Development Goals Task Force and the IMF.

[56] A debt crisis may entail a great deal of economic destruction and economic reversal along with sacrifice in human rights terms. A country can lose 5–15 per cent of its GDP.

Activities of vulture funds hinder the capacity of a State to fulfil economic, social and cultural rights

65. Litigation by vulture funds represents a substantial burden on the budgets of already poor countries. Harmful conditions of loans or high and abusive interest rates may make repayment extremely difficult. The State having to repay far more than the amount originally borrowed may be obliged to redirect resources into debt service that had been previously allocated to essential public services or even worse, to introduce long-term austerity policies (ibid., para. 59). Such a course of action hinders the capacity of a State to fulfil economic, social and cultural rights (namely to adopt appropriate measures towards their full realization) and, ultimately, has an impact on the economic growth and development of the country.[57]

66. Human rights monitoring bodies have analysed how an excessive burden of high external debt repayments can significantly reduce the resources available for social investment. In fact, it has been demonstrated that in many countries, debt repayment is often carried out at the expense of basic human rights, including the rights to food, health, education, adequate housing and work. In the case of Ecuador, for example, the Committee on Economic, Social and Cultural Rights noted that the high percentage of the annual national budget (about 40 per cent) allocated for foreign debt servicing seriously limited the resources available for the effective enjoyment of economic, social and cultural rights (E/C.12/1/Add.100, para. 9).

67. The case of Malawi may be extreme, but it shows how debt repayment affected the country's capacity to create the necessary conditions for the realization of economic and social rights. In 2002, the Government had to sell the maize from its national food reserve agency to raise the funds needed to repay loans. Unfortunately, a poor harvest that year, left 7 million people, out of a population of 11 million, facing serious food shortages (A/HRC/11/10, para. 30).

Activities of vulture funds jeopardize international poverty reduction initiatives

68. The ability of vulture funds to jeopardize the objectives of the IMF and World Bank Heavily Indebted Poor Countries Initiative is striking, particularly bearing in mind that it aims to ensure the debt sustainability of poor countries.[58] In a number of cases, it has been clearly demonstrated that resources freed up for development and poverty reduction programmes were used to service debt owed to vulture funds. That situation has led human rights monitoring bodies to urge the States concerned to reallocate international development aid and other resources to priority sectors and to ensure that international development aid is used for the progressive realization of the rights to an adequate standard of living (see, for example, E/C.12/COD/CO/4, para. 29).

69. A good example is the case of the Democratic Republic of the Congo. In 2014, a district court in the United States ruled that the country had to pay nearly $70 million to a vulture fund for an $18 million debt acquired in 2008, dating back to the regime of former dictator Mobutu Sese Seko in the 1980s.[59] On the basis of the improved fiscal situation resulting from international debt reduction programmes, the country was ordered to pay the claims of the vulture funds. This example shows how domestic rulings can clearly

[57] The obligation of a State to fulfil requires positive measures when other measures have not succeeded in ensuring the full realization of such rights and can entail issues such as public expenditure, governmental regulation of the economy, the provision of basic public services and infrastructure, taxation and other redistributive economic measures. See OHCHR, *Economic, Social and Cultural Rights: Handbook for National Human Rights Institutions* (United Nations publication, Sales No. E.04.XIV.8), p. 18.

[58] The scheme was first launched in 1996 and was supplemented in 2005 by the Multilateral Debt Relief Initiative.

[59] See *Themis Capital, LLC and Des Moines Investments Ltd. v. Democratic Republic of Congo and Central Bank of the Democratic Republic of the Congo*, 14 July 2014.

undermine the intent of the Heavily Indebted Poor Countries Initiative, which is often not taken into account by national courts.[60]

70. This is not an isolated case, however. In 2013, the World Bank and IMF reported that commercial litigation was ongoing against eight heavily indebted poor countries. The authors of the report stressed that such legal struggles not only had adverse financial consequences for the poorest countries, but also took up considerable amounts of the time and resources of debtor government authorities.[61]

71. Thus, under present circumstances, funds obtained by the poorest countries from debt relief may easily be channelled to repay an outstanding loan pursuant to court rulings. As a result of aggressive, disruptive litigation, a debtor State may be forced to divert money earmarked for poverty reduction and basic social services, such as health and education, to settling the substantial claims of vulture funds.[62]

Activities of vulture funds contribute to increased debt service

72. Debt burden adversely affects the protection of economic and social rights, not only because of the diversion of funds from social purposes to debt servicing, but also because of the situation of dependency in which it puts the debtor States.[63] It has been observed that such dependency "might result in a factual loss of sovereignty over their economic and social policies and in the imposition of policies with potentially negative consequences for the protection of social rights".[64]

73. Against that background, a reduction in debt service and/or debt cancellation can effectively create the conditions necessary for the realization of economic, social and cultural rights. The evidence is that such measures have allowed many countries to invest more in public services such as health care, education and water and sanitation, and to abolish user fees for some of those services, which had previously been introduced as part of austerity measures imposed by the international financial institutions.[65] However, it remains a controversial issue as to whether a State might be under an obligation not to repay its debt to vulture funds if it can do so only at the expense of neglecting the basic social needs of its people.

74. Under present circumstances, debtor States often have little choice but to prioritize their contractual debt obligations, contrary to what human rights law would require. That suggests that a more human rights-centred approach is needed. The obligation of a State to ensure the enjoyment of at least the minimum core of economic and social rights should take priority over its debt service obligations, particularly when such payments further limit the country's ability to fulfil its human rights obligations (see, for example, E/C.12/GRC/CO/2, para. 8). That is particularly the case when increased debt service is derived from harmful conditions linked to speculative claims that further limit the country's ability to fulfil its human rights obligations.

75. It is then a logical consequence of the evolution of human rights law that a State cannot decide to service debt at the expense of meeting its human rights obligations (see

[60] See *Taking Stock of the Global Partnership for Development: Millennium Development Goals Gap Task Force Report 2015* (United Nations publication, Sales No. E.15.I.5), footnote 16.

[61] See *The State of the Global Partnership for Development: Millennium Development Goals Gap Task Force Report 2014* (United Nations publication, Sales No. E.14.I.7), p. 41.

[62] As has been observed, they "profiteer at the expense of both the citizens of HIPCs and the taxpayers of countries that have supported international debt relief efforts" (A/HRC/14/21, para. 69).

[63] In 2006, for example, 10 developing countries spent more on debt service than on public education, while in 52 countries debt service amounted to more than the public health budget. See *Delivering on the Global Partnership for Achieving the Millennium Development Goals: Millennium Development Goals Gap Task Force Report 2008* (United Nations publication, Sales No. E.08.I.17), p. x.

[64] See Sabine Michalowski, "Sovereign debt and social rights – legal reflections on a difficult relationship", *Human Rights Law Review*, vol. 8, No. 1 (January 2008).

[65] See Cephas Lumina, "Sovereign debt and human rights", in *Realizing the Right to Development: Essays in Commemoration of 25 Years of the United Nations Declaration on the Right to Development* (United Nations publication, Sales No. E.12.XIV.1), pp. 289 and 294.

A/70/275). Sovereign debt workouts must not lead to violations of economic or social rights or prevent the attainment of internationally agreed development goals. UNCTAD has observed in this regard that "full debt sustainability is only achieved when debt service does not entail intolerable sacrifices for the well-being of society".[66]

Activities of vulture funds undermine the realization of the Sustainable Development Goals

76. Lawsuits brought by vulture funds may slow down the progress made by both developed and developing countries in realizing the Sustainable Development Goals. Successful implementation of Goal 17 to strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development requires strengthening domestic resource mobilization and assisting States in attaining long-term debt sustainability. That implies "coordinated policies aimed at fostering debt financing, debt relief and debt restructuring, as appropriate, and addressing the external debt of highly indebted poor countries to reduce debt distress" (target 17.4).

IX. Strengthening a human rights-based approach

77. Vulture funds take advantage of the lack of adequate regulation of a financial system that has traditionally been based on purely commercial interests and foreign to human rights-based approaches and concerns. Although relevant actions have been undertaken in previous years and human rights monitoring bodies have provided some valuable guidance in striking a better balance between the different interests at stake, human rights should be further mainstreamed in debt crisis contexts.

78. The international community should work to provide the basis for shaping a more coherent framework, where both commercial interests and human rights concerns are accommodated. Human rights law sets out a number of standards that are applicable in such contexts and provides guidance to States, both individually and at the international level, on how to tackle the negative impact of the activities of vulture funds. Recent developments also require that the linkages between an enhanced capacity of States to fulfil economic, social and cultural rights and sustainable development be strengthened.[67]

International level

79. The adverse impact of the activities of vulture funds on human rights cannot be tackled effectively in an isolated or partial manner. States are expected to cooperate in good faith in the process leading to the establishment of an international mechanism for sovereign debt restructuring. In that context, they should ensure that the obligation to service their debts does not lead to derogating from the minimum core obligations relating to economic and social rights. The process of restructuring should aim to reach an agreement that enables States to service their debts without compromising their capacity to fulfil their human rights obligations (A/HRC/20/23 and Corr.1, annex, principle 18).

National level

80. States should undertake concrete steps aimed at regulating the disruptive litigation of vulture funds concerning sovereign debt. National laws should thus expressly exclude the possibility of seizing development cooperation funds and of undertaking litigation against States in debt distress. It is a good practice to limit the value of the claim to the discounted price originally paid by the creditor. In addition, States should ensure that vulture funds domiciled in their territory or operating in their jurisdiction respect human rights throughout their operations (A/HRC/17/31, annex, principle 3).[68] Domestic regulations

[66] UNCTAD, "Sovereign debt workouts: going forward. Roadmap and guide", p. 24.

[67] See, Tahmina, Karimova, *Human Rights and Development in International Law* (Routledge, 2016).

[68] See also Human Rights Council resolution 26/9.

should also recognize the extraterritorial obligation of States to fulfil economic, social and cultural rights.[69]

81. National law should provide the basis for regulating the behaviour of abusive non-cooperative creditors in restructuring processes by providing that they cannot enjoy better treatment than those that are acting in good faith.[70] Guarantees should be provided that the amount of debt recoverable by a vulture fund cannot exceed that recovered by cooperative creditors (A/HRC/20/23 and Corr.1, annex, principle 61).

82. Steps should be taken to regulate the trading of sovereign debt on the secondary market and guarantee transparency. In the absence of an international restructuring mechanism, all efforts must be directed towards achieving a negotiated settlement (ibid., principle 59).

83. Finally, States should assess whether servicing debt owed to vulture funds would result in derogation from their minimum core obligations with respect to economic, social and cultural rights. Debt sustainability analysis should include an evaluation of the level of debt a country can carry without undermining its capacity to fulfil its human rights obligations and the realization of the right to development (ibid., principles 8, 48 and 65).

Management of vulture funds

84. Under the Guiding Principles on Business and Human Rights, vulture funds have a responsibility to respect human rights (ibid., principles 11 and 17).[71] That responsibility includes the obligation to assess whether adverse human rights impacts are expected from their activities (A/HRC/17/31, annex, principles 13 (a) and 15). The management of vulture funds must thus refrain from any predatory or obstructive behaviour that could compel States to act in contravention of their human rights obligations in order to repay debts, or that could directly impact the capacity of States to meet those obligations (see A/HRC/40/57, principle 16.3 in relation to principle 15.2).

85. Despite the fact that the general framework is fully applicable to vulture funds, it is not expected that they will adjust their behaviour accordingly, which underscores the need for appropriate national and international regulation.

X. Conclusions and recommendations

86. **Vulture funds are inherently exploitative. They deploy predatory financial strategies to obtain disproportionate and exorbitant gains at the expense of the realization of human rights, particularly economic, social and cultural rights, and the right to development. Seeking the repayment in full of a sovereign debt from a State that has defaulted, or is close to default, is an illegitimate purpose. In a debt crisis, more than financial obligations are at stake.**

87. **Excessive claims awarded to vulture funds have allowed them to reap profits at the expense of the welfare and sustainable development of the poorest countries, without taking due account of the negative consequences of such actions on the capacity of a State to fulfil its human rights obligations.**

88. **The duty to observe due diligence to prevent a negative impact on and potential violations of economic, social and cultural rights applies to all States and stakeholders, including the management of vulture funds. The impact of their activities on the**

[69] See "Maastricht principles on extraterritorial obligations of States in the area of economic, social and cultural rights" (2013), principle 32.

[70] This encompasses the basic requirements of fairness, honesty and trustworthiness. See UNCTAD, "Sovereign debt workouts: going forward. Roadmap and guide", p. 22. See also UNCTAD, "Principles on promoting responsible sovereign lending and borrowing" (January 2012).

[71] A direct link of causality between the activities of vulture funds and their negative human rights impact is not generally required. See also www.ohchr.org/Documents/Issues/Business/LetterOECD.pdf.

enjoyment of economic, social and cultural rights should therefore be systematically assessed.

89. **The Advisory Committee recommends that the Human Rights Council:**

(a) **Maintain the issue of vulture funds and human rights on its agenda in order to assess the impact of their activities on economic, social and cultural rights and the right to development, and support further initiatives aimed at identifying and curtailing illegitimate activities by vulture funds;**

(b) **Explore further ways of mainstreaming human rights in the context of debt-restructuring workouts and of operationalizing processes aimed at assessing and monitoring the negative impact of the activities of vulture funds on the full enjoyment of economic, social and cultural rights and on the realization of the Sustainable Development Goals;**

(c) **Commend the work of the African Legal Support Facility, and call upon States to support the expansion of this mechanism so as to assist developing countries in their disputes with vulture funds and other similar speculative ways of manoeuvring on financial markets;**

(d) **Adopt a new resolution, following the examination of the present report, entrusting the Advisory Committee with the follow-up to this issue, with a view to making concrete recommendations to States and relevant stakeholders. A further study reviewing relevant national legislation and case law, as well as good practices, would help States in the process of establishing an adequate legal framework.**

90. **The Advisory Committee recommends that Member States:**

(a) **Enact legislation aimed at curtailing the predatory activities of vulture funds within their jurisdictions. Domestic laws should not be limited to heavily indebted poor countries but should cover a broader group of countries and apply to commercial creditors that refuse to negotiate any restructuring of a debt. Claims that are manifestly disproportionate to the amount initially paid to purchase a sovereign debt should not be considered. The laws in Belgium and the United Kingdom provide valuable examples for other States in drafting national laws aimed at limiting the practices of vulture funds;**

(b) **Adopt measures aimed at limiting disruptive litigation by vulture funds in their jurisdictions. National courts or judges should not give effect to foreign judgments or conduct enforcement procedures in favour of vulture funds that are pursuing a disproportionate profit. It is a good practice to limit the value of the claims of vulture funds to the discounted price originally paid for the bonds;**

(c) **Enhance and promote transparency by ensuring that the owners and shareholders of vulture funds are disclosed and made subject to appropriate taxation. Transparency on sovereign debt in the secondary market should be particularly ensured and courts and other relevant national authorities must have access to all relevant documents and information on the amounts concerned and the identity of creditors;**

(d) **Ensure that adjudication bodies, including the International Centre for Settlement of Investment Disputes and the Permanent Court of Arbitration, integrate into their practices the duty of arbitrators to assess at a preliminary stage the bona fides of vulture fund claims, as well as the standing of the claimant, by requiring that the details of the debt be disclosed;**

(e) **Ensure that the principle of bona fides is adequately reflected in national legislation and applied by the domestic courts in relation to litigation concerning sovereign debt restructuring processes by ensuring that abusive creditors do not enjoy better treatment than cooperative creditors acting in good faith.**

Annex 512

"Secretary-General's remarks to Major Economies Forum on Energy and Climate [as delivered]", *United Nations*, 17 September 2021

United Nations | Secretary-General

New York

17 September 2021

Secretary-General's remarks to Major Economies Forum on Energy and Climate [as delivered]

António Guterres, Secretary-General

President Biden,

Thank you for inviting me.

Excellencies,

You represent the world's leading economies.

And the world now needs your leadership more than ever.

The recent report of the Intergovernmental Panel on Climate Change was a code red for humanity.

But it also made clear that it is not too late to meet the Paris 1.5-degree target.

We are rapidly running out of time.

We must step up our efforts.

Today, the United Nations Framework Convention on Climate Change published its synthesis report on the Nationally Determined Contributions.

We need a 45 per cent cut in emissions by 2030 to reach carbon neutrality by mid-century.

Today's data implies an increase of 16 per cent in emissions in 2030 compared to 2010 levels.

The world is on a catastrophic pathway to 2.7-degrees of heating.

There is a high risk of failure of COP26.

It is clear that everyone must assume their responsibilities.

We need more ambition on finance, adaptation and mitigation.

On finance, developed countries must fulfil the longstanding pledge to mobilize $100 billion dollars a year to support climate action in developing countries.

Today, the OECD, that essentially represents the developed world, published its annual report on climate finance.

They still reveal a gap of at least 20 billion dollars.

This is a crucial question of trust.

Support from international financial institutions is also critical.

So is the mobilization of assistance from the private sector — both financial and technological.

Moving to adaptation, we know levels of finance for this crucial component are still far too low.

Developing countries received only $16.8 billion dollars in 2018 – compared to adaptation costs of some $70 billion.

These costs are expected to grow to as much as $300 billion dollars a year by 2030.

We must commit at least 50 per cent of climate finance to adaptation.

I thank Denmark, Sweden and the Netherlands who have stepped up in this direction.

We need more to join this coalition.

On mitigation, I do understand the principle of common but differentiated responsibilities.

And developed countries certainly need to take the lead.

But it is essential for several emerging economies to go the extra mile and effectively contribute to emissions reductions.

I want to mention one specific challenge.

Energy, coal in particular.

If all planned coal power plants become operational, we will not only be clearly above 1.5 degrees — we will be well above 2 degrees.

The Paris targets would go up in smoke.

We need coalitions of solidarity – between countries that still depend heavily on coal, and countries that have the financial and technical resources to support transitions.

Excellencies,

The fight against climate change will only succeed if everyone in this room comes together to promote more ambition, more cooperation and more credibility.

The world demands that all of us but especially you as the leading economies of the world take immediate action to lead us towards a sustainable and resilient future.

I ask you to rebuild the spirit of collaboration, cooperation and goodwill that were the hallmarks of the Paris Agreement.

I ask you to consider how we can deliver success in Glasgow.

Prime Minister Johnson and I have invited you all to the leaders' dialogue we are convening in New York on 20 September to continue this conversation.

I look forward to your engagement.

Thank you.

ON THE JOB

- Daily Schedule
- Appointment Process
- Role of the Secretary-General
- Former Secretaries-General
- Official Travels

THE TEAM

- Deputy Secretary-General
- Senior Management Group
- Global Leadership
- Messengers of Peace

RESOURCES

Annex 513

"Nature-Related Risks in the Global Insurance Sector", *United Nations Development Programme Sustainable Insurance Forum,* November 2021

Sustainable Insurance Forum

Hosted by UNDP

SIF SCOPING STUDY:

NATURE-RELATED RISKS IN THE GLOBAL INSURANCE SECTOR

NOVEMBER 2021

The UNDP Sustainable Insurance Forum (SIF)

Established by the United Nations with the support of the International Association of Insurance Supervisors (IAIS), the Sustainable Insurance Forum (SIF) is a global network of 33 insurance supervisors and regulators working together to strengthen responses to sustainability and climate change challenges facing the insurance sector. Launched in December 2016, the SIF provides a platform for international collaboration among supervisors, facilitating knowledge sharing, dialogue, and uptake of policy innovations. The SIF is hosted by the United Nations Development Programme (UNDP).

More information on the SIF is available at: www.sustainableinsuranceforum.org or from: Ms. Sarah Zaidi, SIF Coordination and Networking Manager sarah.zaidi@undp.org.

United Nations Development Programme (UNDP)

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More information on the UNDP FSH is available at: sdgfinance.undp.org or from: Mr. Marcos Neto, Director marcos.neto@undp.org.

Photo: Scott Webb | Unsplash

About this report

Funded by the Executive Office of the Secretary-General of the United Nations Nations and Sustainable Finance Ireland, this report has been commissioned by the SIF Secretariat, and authored by Prajwal Baral.

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Comments are welcome and should be sent to Mr. Prajwal Baral prajwal.baral@undp.org.

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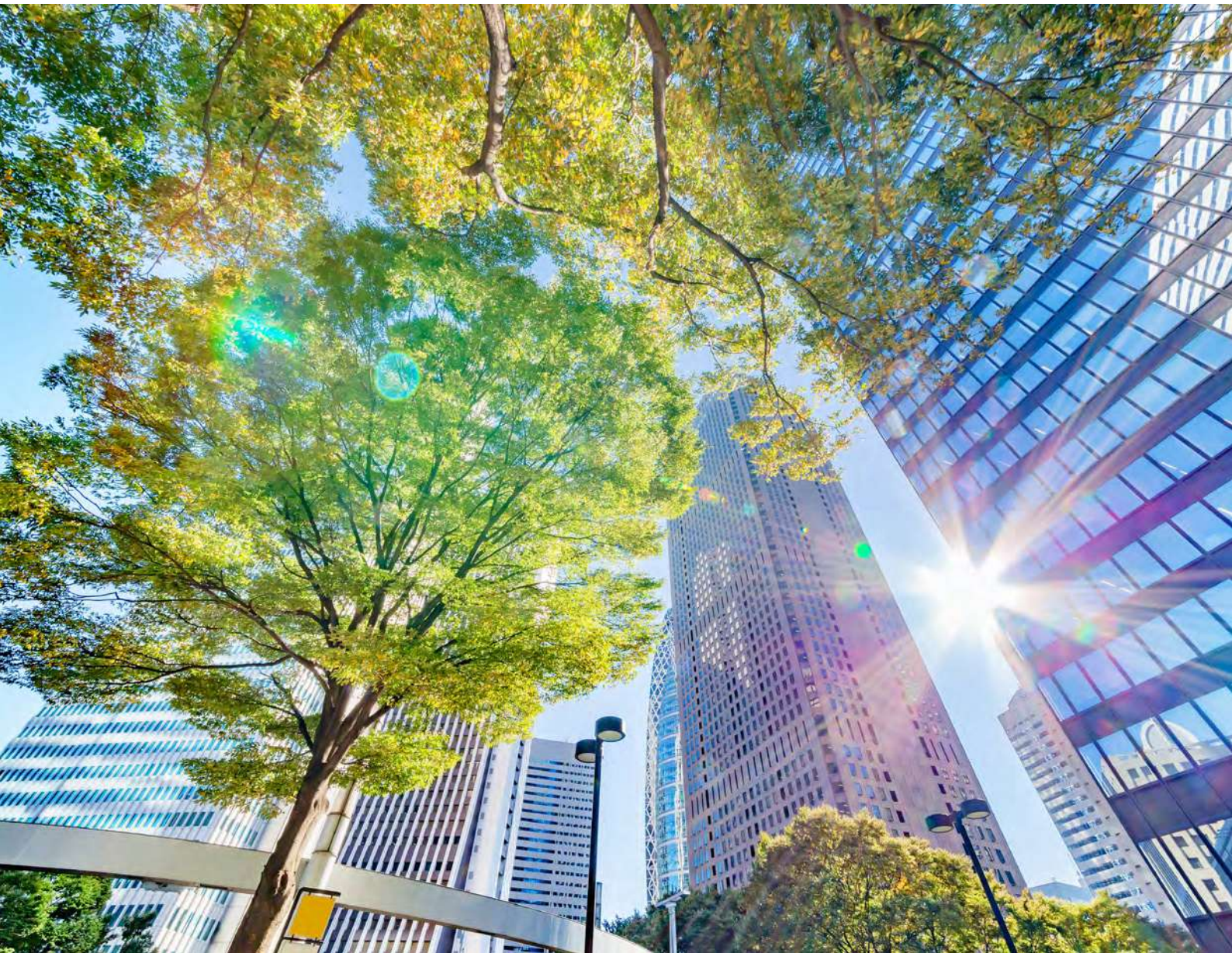


Abbreviations

BES	Biodiversity and ecosystem services
CBD	United Nations Convention on Biological Diversity
ES	Ecosystem services
ESG	Environmental, social and governance
ETF	Exchange-traded fund
G7	Group of Seven
G20	Group of Twenty
GDP	Gross domestic product
GHG	Greenhouse gas
IAIS	International Association of Insurance Supervisors
IASB	International Accounting Standards Board
IFRS	International Financial Reporting Standards
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
ISSB	International Sustainability Standards Board
IT	Information and technology
L&H	Life and health (Insurance)
NGFS	Central Banks and Supervisors Network for Greening the Financial System
P&C	Property and casualty (Insurance)
SIF	Sustainable Insurance Forum
TCFD	Task Force on Climate-related Financial Disclosures
TNFD	Taskforce on Nature-related Financial Disclosures

Photo: Philip Brown | Unsplash

Executive Summary

The world's natural capital has been declining globally at rates unprecedented in human history. The global insurance sector is beginning to take a wider view of nature-related risks,[1] expanding beyond climate and natural hazard risks. In 2020, the SIF members agreed to build on existing work by exploring how losses in nature can translate into financial risks for the insurance sector. The SIF Secretariat has produced this report with input from SIF members, experts and industry participants to support insurance supervisors and insurance companies in better understanding and responding to these risks.

Nature loss can manifest into two main types of financial risks for the insurance sector's underwriting and investing business: physical and transition. Physical risks result from the material destruction of natural capital, leading to the disruption to natural services, which in turn leads to financial losses for businesses, insurance companies and other financial institutions. Transition risks include those risks that occur due to global policy, regulatory, economic and market shifts toward a "nature-positive" future.

The effects of nature loss are first transmitted to the real economy at the micro and macro levels, which then manifest into financial risks for the insurance industry. The transmission of micro- and macroeconomic shocks to financial risks for the underwriting and investing business of the insurance sector occurs in the form of insurance, operational, liquidity, market and credit risks. The macroeconomic risks and financial risks resulting from such nature loss can amplify each other.

In principle, as the loss of natural assets increases, associated financial and economic risks could increase in magnitude and frequency, and thus pose potential threats to the safety and soundness of insurance companies and broader financial stability.

Given the infancy in understanding nature-related financial risks, this study has employed a mixed research methodology and a survey of 108 insurance sector participants from 32 countries, 57 percent of whom were insurers and reinsurers, 10 percent insurance industry associations and 5 percent insurance brokers. At the global level, the re/insurance sector's capacity to understand nature-related risks, collect relevant data and design tools to assess these risks is at an early stage of development. The lack of data and information, including relevant methodologies, was the reason most cited by re/insurers for not assessing nature-related risks.

Some re/insurers have started taking steps to develop measurement tools and methods to understand, disclose and respond to these risks. Industry frontrunners, despite the limited availability of uniform metrics and indicators for nature-related risks, have typically used ESG or sustainability frameworks and (very recently), climate change frameworks to incorporate some potential nature-related risks into their assessment, disclosure and management practices.

Building on supervisory and regulatory work on frameworks and processes to supervise climate-related risks, increased supervisory attention is also turning to broader nature-related risks. When nature-related risks are established as material, re/insurance supervisors may wish to develop guidance, recommendations and standards for their regulated entities. This report presents examples of such guidance and recommendations from a range of jurisdictions – Australia, California, Germany, the Netherlands, and Singapore. Similarly, although industry-led, the Taskforce on Nature-related Financial Disclosures (TNFD) has gathered support from several governments and is aiming to develop and test disclosure metrics and methodologies for nature-related financial risks and disseminate those for proposed wider adoption by 2023.

An acceleration in global policy developments to mitigate nature loss could raise expectations that supervisors would act on nature-related financial risks. In June 2021, the G7 leaders agreed to a historic 'Nature Compact', which supports new global targets to protect and conserve at least 30 percent of global land and at least 30 percent of the global oceans by 2030. In July 2021, the G20 Environment Ministers committed to continue and increase their efforts to address the interconnected challenges of nature-related risks and climate change. The upcoming second part of the UN Biodiversity Conference (COP 15) in Kunming is also expected to adopt a "Post-2020 Global Biodiversity Framework" with ambitious targets for increasing protected areas and recognition of nature-based solutions in global climate mitigation efforts.

Recommendations

- To the re/insurance industry:
  - » Continue to identify and build data, analytical tools, forward-looking metrics, and indicators to assess and measure nature-related risks.
  - » Disaggregate asset-level nature-related risks by regions, sub-regions and countries as well as by types of risks.
- To re/insurance supervisors:

1 The risks related to climate change and natural hazards, together with risks from broader environmental issues such as pollution, desertification and water depletion make up nature-related risks.

» Deepen understanding and raise awareness of nature-related risks among regulated entities.

» As a more accurate understanding of nature-related risks to the insurance sector is under way, consider supporting the development of non-prescriptive guidelines, options and tools towards the better assessment and management of forward-looking nature-related financial risks.

» Consider encouraging regulated entities to undertake voluntary disclosure of nature-related financial risks in incremental steps and complement industry-specific reporting metrics for nature-related risks in the insurance sector, preferably aligning with relevant initiatives by other standard-setting bodies.

Next Steps for the SIF

- Organize webinars to disseminate the finding of this study.
- Develop an online self-learning tutorial on understanding and assessing nature-related financial risks.
- Facilitate supervisor- and industry-led collaborative workshops to discuss challenges as they relate to nature-related financial risks.
- Facilitate, design and develop a survey questionnaire that the supervisors could use to understand how domestically regulated insurers are considering nature-related issues.
- Carry out further research to quantify insurance premium and investment exposure to nature-related risks, which will be done after nature-related risk measurement methodology and metrics are developed.

Photo: Tomoko Uji | Unsplash

1 BACKGROUND

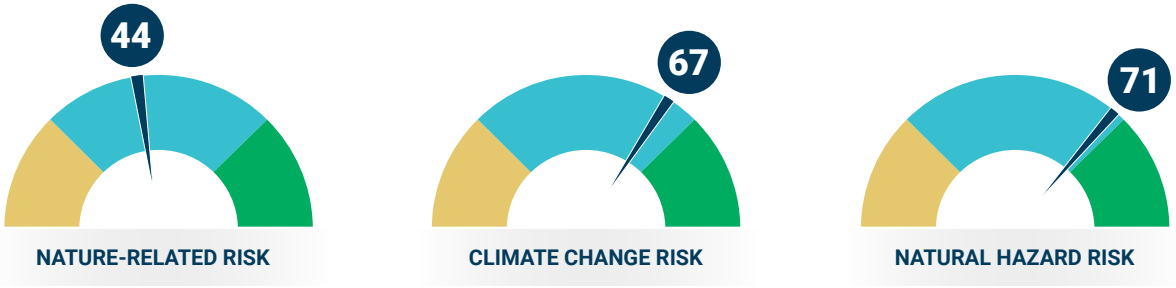
Photo: Qingbao Meng | Unsplash

1. Background

1.1 Rationale for and objective of the study

This study marks a pioneering effort to explore and understand the global insurance sector's dependence on nature, what nature-related risks[2] could be, and whether and how nature-related risks are financially material to the sector's underwriting and investing business. The latest global risk perception survey[3] by the World Economic Forum[1] of 35 global risks[4] ranked human environmental damage and biodiversity loss among the top five risks by likelihood; it also ranked biodiversity loss, natural resources crises and human environmental damage among the top six risks by impact. As this is a relatively nascent area of research compared to climate change, the levels of understanding of nature-related financial risks within the global financial community are uneven, as acknowledged by the Central Banks and Supervisors Network for Greening the Financial System (NGFS).[2] Due to the perceived urgency of the topic, regulatory work is often concentrated on climate-related risks, sometimes also incorporating environmental risks as a less specific and broader concept. A recent study of 127 European financial companies conducted by the Alliance for Corporate Transparency on the disclosure of environmental and societal risks and impacts pursuant to the European Union (EU) legislation[3] found that only 2.2 percent of companies identified specific risks for the use of natural resources, less than 1 percent for polluting discharges, and 2.2 percent for biodiversity and ecosystem conservation compared with 31.9 percent for climate change. This illustrates that while the perception of nature-related financial risks at the global level has increased significantly due to the spotlight thrown by COVID-19 on the link between nature and human health, the actual understanding of what such risks could be and how they could impact corporates and the financial institutions that lend to, invest in and insure these corporates is very low. A recent global survey of the insurance industry conducted by SIF similarly found that the current level of understanding of nature-related risks is the lowest among other related risks such as climate change and natural hazard risks[5] (see Figure 1).

Figure 1 **Insurance industry's current level of understanding of risks in both underwriting and investing business (on a scale of 0 to 100, from left to right)**



Source: SIF 2021 Global Survey

2 This report uses the term 'nature' to broadly refer to the concepts of natural capital, ecosystem, ecosystem services and biodiversity; further explained in Section 1.3. The terms 'nature-related risks', 'nature loss risks' and 'risks related to nature loss' are synonymous, and have been interchangeably used in parts of the report wherever use of one term gives more clarity than the others. Similarly, the term "environmental risk" is synonymous with "nature-related risk".

3 The survey respondents were 39 percent from business sector, 16 percent from government and the rest from other sectors such as academia, NGO and international organizations. Similarly, 46 percent of respondents were from Europe, 17 percent from North America, 9 percent from East Asia and the Pacific, and the rest from other regions.

4 These 35 global risks were (A) Economic (Asset bubble burst in large economies; Collapse of a systemically important industry; Debt crises in large economies; Failure to stabilize price trajectories; Proliferation of illicit economic activity; Prolonged economic stagnation; Severe commodity shocks); (B) Environmental (Biodiversity loss and ecosystem collapse; Climate action failure; Extreme weather events; Human-made environmental damage; Major geophysical disasters; Natural resource crises); (C) Geopolitical (Collapse of a multilateral institution; Fracture of interstate relations; Geopolitization of strategic resources; Interstate conflict; State collapse; Terrorist attacks; Weapons of mass destruction); (D) Societal (Collapse or lack of social security systems; Employment and livelihood crises; Erosion of social cohesion; Failure of public infrastructure; Infectious diseases; Large-scale involuntary migration; Pervasive backlash against science; Severe mental health deterioration; Widespread youth disillusionment); (E) Technological (Adverse outcomes of technological advances; Breakdown of critical information infrastructure; Digital inequality; Digital power concentration; Failure of cybersecurity measures; Failure of technology governance).

5 Definitions of the terms 'nature-related risk', 'climate change risk', and 'natural hazard risk' are given in Section 1.3.1. The latter two are subsets of the former. 'Nature-related risk' comprises risks from climate change, natural hazard as well as risks from broader environmental issues such as pollution, stratospheric ozone depletion, etc.

Chapter 1 of the study discusses the central concepts of nature and nature-related financial risks and sets the boundaries for this study. Chapter 2 then extends the discussions in Chapter 1 to the insurance sector and takes a deep dive into the sector's dependency on nature along with risks arising from nature loss and their impacts. Chapter 3 explores the risk management and response strategies adopted or planned by the insurance sector in response to nature-related risks. Finally, Chapter 4 proposes issues that need further deliberation and research.[6]

1.2 Methodology of the study and limitations

The study employs a mixed research methodology – desk research, structured interviews of and consultations with relevant stakeholders (i.e. insurance supervisors and regulators, insurers, reinsurers, insurance brokers, legal professionals, academic researchers, and professionals from not-for-profits, think tanks and international development organizations; see Annex I), and a survey of 108 insurance sector participants from 32 countries[7] (both developed and developing), hereafter called 'SIF 2021 Global Survey' (surveying insurers, reinsurers, insurance brokers and agents, and insurance associations, among others, see Annex II). The SIF Secretariat conducted this survey, supported by the UN Environment Programme's Principles for Sustainable Insurance (PSI). The survey was open for two weeks in June 2021 and received 108 responses from insurance sector market participants. 57 percent of the respondents were insurers and reinsurers, 10 percent insurance industry associations and 5 percent insurance brokers – a total of 72 percent from the private insurance industry. The remaining were insurance sector professionals and experts from academia, non-governmental organizations (NGOs), regulatory bodies, accounting firms, asset management companies and others.

This study covers property and casualty (P&C) insurance,[8] and life and health (L&H) insurance[9] along with reinsurance for P&C and L&H insurance.

Since the current understanding around nature-related financial risks is extremely limited, this study has employed some proxies to get a directional estimate of such risks and these estimates must be interpreted accordingly. Furthermore, data for this study come from several public sources and SIF cannot guarantee their validity. However, SIF has applied its expert judgment in using and contextualizing external data sources.

1.3 Central concepts of nature

Defining nature and nature-related terminologies

Since several terms such as nature, environment, natural capital, natural resources, environmental resources, ecosystem, ecosystem services and biodiversity are interchangeably used in popular literature, fora and the media, it can often complicate communication among various stakeholders. Figure 2, therefore, simplifies the understanding of these terms by taking 'nature' or 'environment' as an all-encompassing term for everything natural. Below are streamlined definitions of each of these widely used terms. In Annex III, the most commonly used scientific definitions of these terms are also presented for a more thorough understanding.

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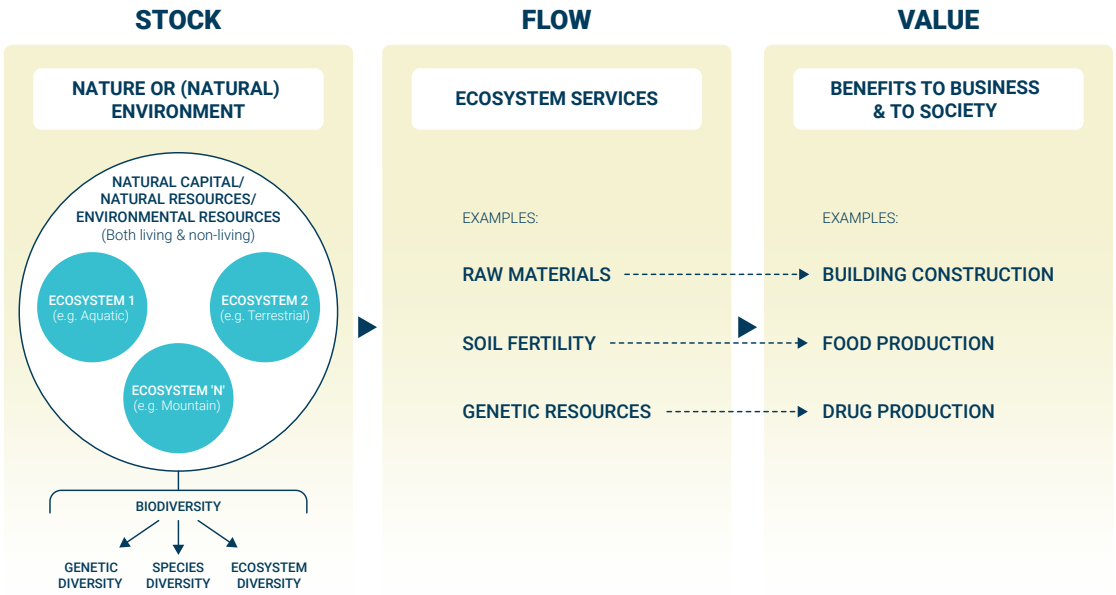
6 The annexes provide more details on several topics and annexes describe the interviewees and experts consulted; the survey questionnaire; nature-related terminologies, natural capital and ecosystem services; key characteristics of the global insurance industry; an assessment of nature-related physical risks to various economic sectors; and methodology adopted for determining physical risks to economic sectors.

7 Europe (14); South-east Asia (6); Latin America and the Caribbean (4); Africa (3); South Asia and the Pacific (2); North America (2); Middle East (1)

8 The term "property and casualty (P&C)" is more commonly used in the United States while in many other parts of the world, it is also called "general" or "non-life" insurance. Property insurance provides protection coverage against most risks to property such as fire, smoke, explosion, vandalism and theft, and weather-related damages. Popular policies under property insurance include, among others, homeowner's insurance, condo insurance, auto insurance, renter's insurance, landlord insurance and flood insurance. Casualty insurance typically offers liability coverage to an individual or organization for negligent acts or omissions. Liability losses are losses that occur as a result of the insured's interactions with others or their property. It covers losses stemming from accidents, injuries and damage to other people or their belongings (for example, auto accident insurance, event cancellation insurance, travel insurance, workers' compensation insurance, business interruption insurance, trade credit insurance and fidelity insurance).

9 Life insurance offers coverage for the risk of loss of life, where the insurer promises to pay a designated beneficiary a sum of money upon the death of an insured person. Some life insurance contracts trigger payment in events of terminal or critical illness as well. Life insurers also offer investment products such as annuities. Health insurance provides coverage for medical expenses related to illness or injuries. Under the OECD classification of insurance activities, health/accident and sickness insurance are classified as non-life businesses. In this report, non-life or P&C insurance does not include health insurance.

Figure 2 **Conceptual framework for defining the concepts of natural capital, ecosystem, biodiversity, nature, and ecosystem services**



Source: adapted from Capitals Coalition and Cambridge Conservation Initiative, 2020[4]

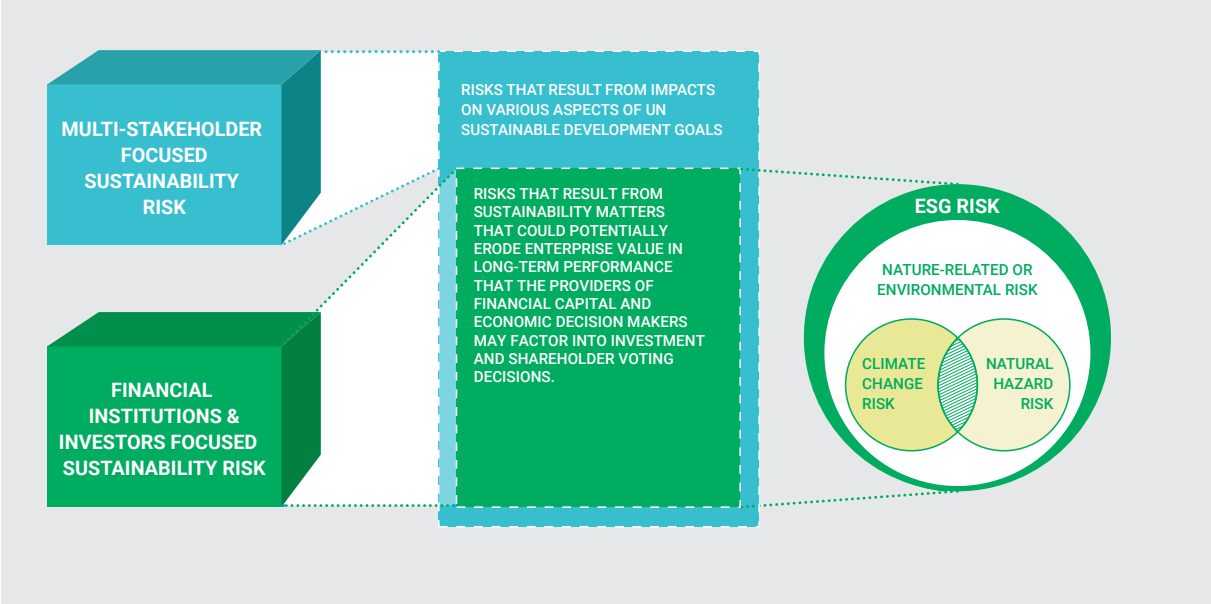
It is common among international development practitioners and the financial community to use the terms 'environment', 'nature', 'biodiversity' and 'ecosystem' interchangeably. The Taskforce on Nature-related Financial Disclosures (TNFD),[5] launched in 2020, uses the term "nature" and "nature-related" (adopted by this report) and aims at developing a framework for corporates and financial institutions to assess, manage and report on their dependencies and impacts on nature, aiding in the appraisal of nature-related risk and the redirection of global financial flows away from nature-negative outcomes and towards nature-positive, or at least nature-neutral, outcomes. The term 'biodiversity' is used by the NGFS and the International Network for Sustainable Financial Policy Insights, Research, and Exchange (INSPIRE), who jointly announced the launch of a study group on biodiversity and financial stability[6] in April 2021. In addition, in the recent Dasgupta Review on the Economics of Biodiversity,[7] terms such as 'nature', 'natural capital', 'natural environment', 'biosphere' and 'natural world' are used interchangeably. While different initiatives use different terms, the end objective in all cases is to understand risks emanating from environmental degradation and deterioration and their impacts on the economy and the society. With this acknowledgement, this report uses the term 'nature' to broadly refer to the concepts of natural capital, ecosystem, ecosystem services and biodiversity.[8] Wherever needed, specific terms will be used for better clarity.

1.3.1 Framing nature-related risks in the context of ESG and broader sustainability risks

A useful framework to analyse the various kinds of risks is presented in Figure 3. This framing is not intended to establish one layer as more or less important than any other. Since the financial industry is conversant with sustainability and environmental, social and governance (ESG) concepts, the attempt here is to illustrate where nature-related risks fit within the industry's current understanding of broader risks. Care must be taken to assess the relative importance/weighting of E, S, G, and other categories such as the broader Sustainable Development Goals (SDGs) when looking at potential risks for a company or the industry.

Sustainability risk in a broader and multi-stakeholder sense comprises risk arising from impacts on one or several aspects of the SDGs. Sustainable development has been defined most frequently as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".[9] As such, sustainability is a broader concept which incorporates evolving societal and stakeholders' expectations. ESG risks form a subset of the multi-stakeholder definition of sustainability risks, and comprise information that investors and other providers of financial capital require to identify sustainability factors that are material to short-, medium- and long-term enterprise value.

Figure 3 **Framework to understand nature-related risks vis-à-vis ESG and sustainability risk**



Source: Adapted from International Federation of Accountants, 2021[10] *and UN Environment, 2016*[11]

ESG is the most commonly used framework by financial institutions and authorities. Below the ESG layer comes nature-related or environmental risks. Nature affects E and S, and one needs strong G to deal with the E and S. Most existing ESG frameworks in the market, under the component "E", already include nature-related elements to varying extents. For example, the European Framework, as specified in the European Banking Authority's 2021 report on management and supervision of ESG risks for credit institutions and investment firms[12] includes water, air, soil pollutants, biodiversity and protection of healthy ecosystems, waste management, land degradation, desertification, soil sealing, water use and management, energy use and efficiency, and greenhouse gas (GHG) emissions. Similarly, some international frameworks[13] even include innovation in environment-friendly products and services under "E".

The innermost layer consists of climate change- and natural hazard-related risks, which together with risks from broader environmental issues such as pollution, desertification, water depletion, etc. make up "nature-related risks".

- Climate change risk: The United Nations Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."[14] Risk induced by climate change is defined as climate change risk.
- Natural hazard risk: This refers to risk from hazards that are due to natural variability (i.e. not human-induced). Examples of natural hazards include geologic hazards (earthquakes, tsunami, volcanic eruptions, landslides, floods), atmospheric hazards (tropical cyclones, tornadoes, droughts, severe thunderstorms, lightening), and other hazards (insect infestations, naturally occuring wildfires). The variability in nature is a regular and normal phenomenon (e.g. natural cycles of droughts), but climate change has increased the frequency and intensity of natural hazards. This is the reason some natural hazards overlap with climate change-induced events.
- Nature-related risk: A decline in the quantity and quality of nature (i.e. biodiversity/nature loss), hence resulting in the decline in the provision of ecosystem services is nature loss. Examples of this include reductions in the quality of the air and local climate, reduced water security, and reduced pollination. Risk because of such nature loss is termed in this report as "nature-related risk".

There are varying degrees of overlaps and feedback loops among climate change, natural hazard and broader nature-related risks, which are discussed in the following section.

1.3.2 Relationship among climate change, natural hazard, and broader nature-related risks

First, the overlap between climate change and natural hazard risks is large – the risks in the innermost layer of the framework in Figure 3. There is strong evidence that human-caused climate change has increased the likelihood and intensity of weather-related natural hazards, including droughts, fires and floods.[15] These extreme weather events will continue to worsen if no strong action is taken to curb climate change.

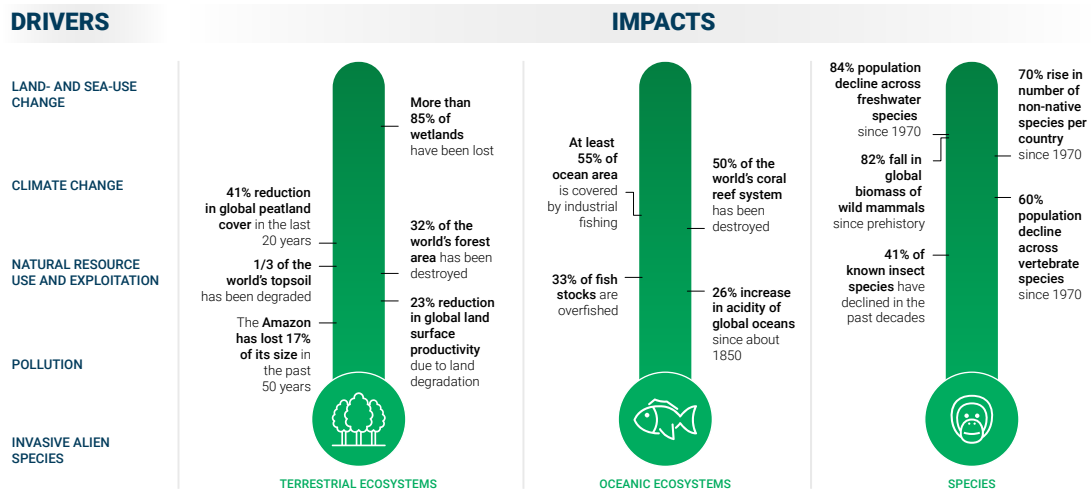
Second, there is also a close relationship between climate change and broader nature-related risks such as the deterioration of air, water and soil quality, the degradation of forests, the depletion of fish stocks and seagrasses in oceans. On the one hand, climate change is both a driver and amplifier of nature-related risks. For example, the absorption of excess carbon dioxide (CO_2) by oceans has increased their temperature and acidity, making it difficult for many marine species such as shellfish to form their calcium shells. As a result, many such species at the bottom of marine food chains are disappearing, with negative impacts on the growth and distribution of fish stock higher up in the food chain. On the other hand, nature loss could also become a driver and amplifier of climate change. For example, the destruction of marine life in the oceans leads to a decrease in the capacity of oceans to sequester CO_2 from the atmosphere, hence accelerating global warming. The destruction of marshes, mangroves and seagrasses alone releases an estimated 0.15–1.02 billion tonnes of CO_2 per year – equivalent to 3–19 percent of emissions from global deforestation.[16] The Amazon rainforest, which has served as a carbon sink for centuries, has now turned into a net emitter of CO_2 due to logging for soy and beef as well as mining for gold and mercury.[17] Another illustration of a linkage and feedback loop between climate change and nature loss is soil erosion.[18] On the one hand, soil erosion triggers the release of carbon from organic soils into the atmosphere – hence contributing to climate change, which might lead to more soil erosion through an increase in extreme events such as floods and droughts. On the other hand, soil erosion leads to a loss of nutrients and soil moisture that reduces the structural diversity of the vegetation cover, which could lead to reduced soil conservation and hence more soil erosion.

It is important to recognize the self-reinforcing feedback loops between nature loss and climate change. As such, talking about climate change in isolation misses the complete picture.

1.4 Current state of nature

According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)'s global assessment on biodiversity and ecosystem services,[19] 90 percent of nature loss in the past 50 years can be attributed to five direct drivers: land- and sea-use change, climate change, natural resource use and exploitation, pollution and invasive alien species. Figure 4 illustrates these drivers and the major impacts on nature.

Figure 4 **Drivers and status of nature loss across different ecosystems**



Source: WEF, 2020[20] with updates from WWF, 2020[21] and IPBES, 2019[22]

The drivers of nature loss across different ecosystems include:

Land- and sea-use change: As per IPBES (2019), 75 percent of the total land surface and 40 percent of the ocean area are severely altered because of the expansion of agricultural land as well as the increase in cattle ranching, fisheries and aquaculture. The impacts of land use change are most severe in tropical and subtropical savannas and grasslands, and are associated with increased soil degradation, including soil erosion, acidification and salinity – directly affecting land surface productivity.

Climate change: Global climate change has caused long-term geophysical and biological changes in nature. These include, increased precipitation in tropical areas and decreased precipitation in subtropical areas, increased frequencies and intensities of extreme events, and faster than normal warming of land and oceans. These have directly altered land and marine productivity, and increased damages to property, infrastructure, livelihoods and service provision.

Natural resource use and exploitation: The extraction of living and non-living materials has increased considerably, mainly for use in construction, agriculture, fishery, forestry and mining. Such overexploitation has cascading effects, manifested as biodiversity loss, freshwater depletion and climate change, seen most prominently in tropical forests, marine, coastal and polar ecosystems. The unsustainable extraction and use of these resources have also caused land- and sea-use change, hence further amplifying nature loss.

Pollution: The industrial and agricultural runoffs, dumping of waste and toxic compounds in rivers, lakes and oceans, and increasing particulate matter in air due to industrial and transportation emissions have led to unprecedented levels of air, water and land pollution. These have caused loss of nature in most ecosystems. In coastal waters, for example, nutrient runoff from fertilizers applied to agricultural land has stimulated excessive algae growth that depletes oxygen levels and blocks sunlight from underwater plants. Some algal blooms are harmful to people due to elevated levels of toxins and bacterial growth. The resultant aquatic hypoxia ("dead zones") can devastate the primary and secondary productivity of marine lives. Similarly, plastic fragments in waste dumped into water or land are ingested by fish, birds and other animals, leading to their untimely death, disturbance of the natural food pyramid and the introduction of microplastics into human food chains via trophic transfer.

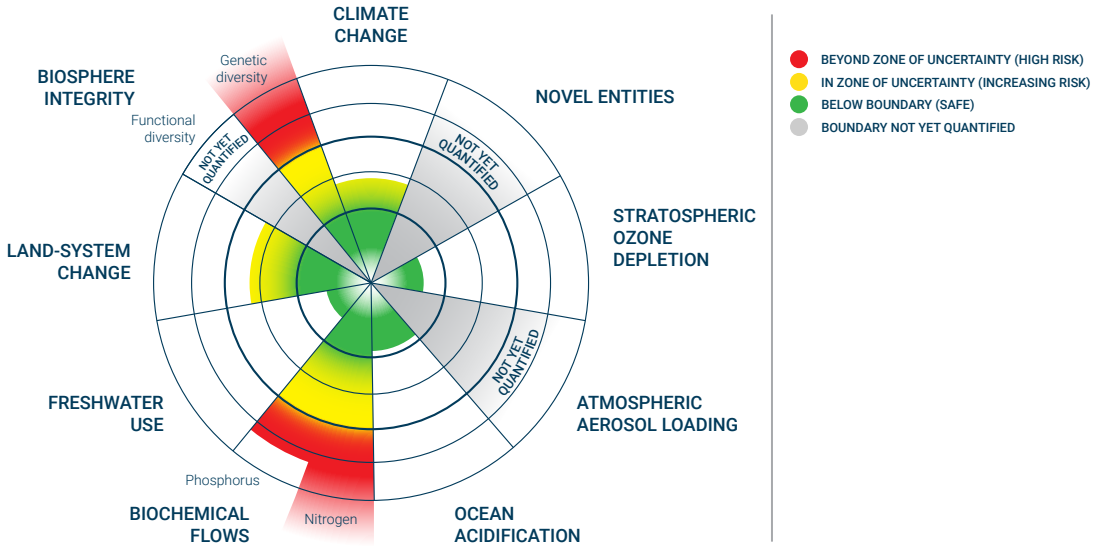
Invasive alien species: IPBES (2019) estimates that non-native species have increased by 70 percent in the last 50 years, and their rates of invasion on native species and ecosystem services have also risen. The introduction of alien species is further aggravated by increased trade and transport and accelerated climate change. The invasion by alien species has caused extinction of local species that are important to maintain ecosystem functions.

According to a 2021 analysis by Environmental Business International (EBI),[23] out of US$38 quadrillion[24] of the Earth's economic value, US$5 quadrillion has already been damaged by humans, mostly through continued deforestation and atmospheric pollution. This alarming level of nature loss is equivalent to 60 times the current global gross domestic product (GDP).

1.4.1 Why it is time to move beyond climate change envelope and start assessing nature-related risks

In 2009, Rockström *et al.*[25] published a landmark study proposing a framework for the Earth system called planetary boundaries within which humanity can continue to develop and thrive for generations to come. The authors used the Holocene – the last 10,000 years of the period of stability where the planet's environment was unusually stable – as a reference point. During the Holocene, environmental changes occurred naturally within the Earth's regulatory capacity. However, since the Industrial Revolution, human activities have driven a global environmental change, pushing the Earth system outside the stable environmental state of the Holocene, hence exceeding planetary boundaries of some of the nine control variables that the authors identified in Figure 5.

Figure 5 **Current global status of the control variables for seven of the nine planetary boundaries**



Source: Steffen et al., 2015[26]

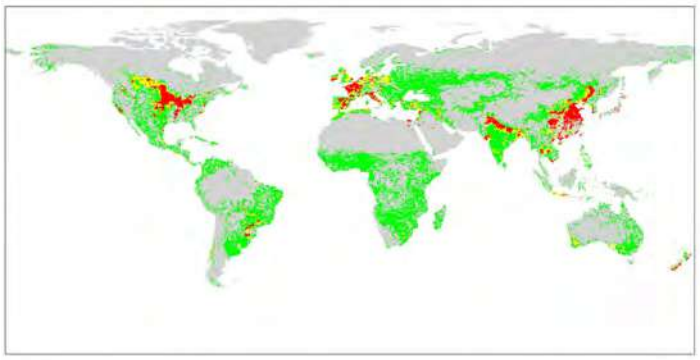
In an updated and extended analysis of the original planetary boundary framework, Steffen *et al.* (2015) found that anthropogenic perturbation levels of four of the Earth system processes/features (climate change, biosphere integrity, biogeochemical flows and land-system change) have already exceeded the proposed planetary boundary. Two more – stratospheric ozone depletion and ocean acidification – are also close to crossing the safe boundary.

The global business and financial community, including the insurance sector, therefore urgently needs to understand nature-related risks rather than limit their risk horizon to climate and natural hazard risks only. Chapter 1.4 has already established that we have entered an era of "ecological emergency", which could be bigger than "climate emergency" by an order of magnitude. One estimate shows that only 11–16 percent of biodiversity loss is currently attributable to climate change.[27]

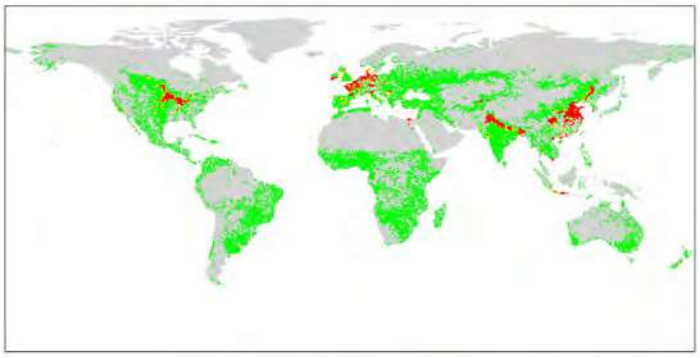
In a further sub-global level analysis (see Figure 6), Steffen *et al.* (2015) found that some control variables that indicate a safe operating space at the global level have already been exceeded in many parts of the world.

Figure 6 **Sub-global distributions and current status of the control variables for biogeochemical flows of phosphorus and nitrogen, land-system change and freshwater use**

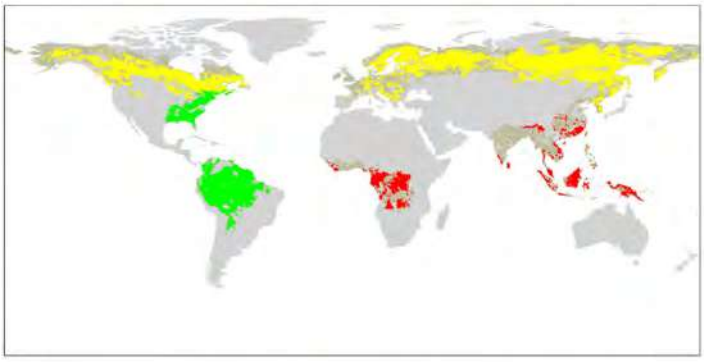
A **Phosporus**



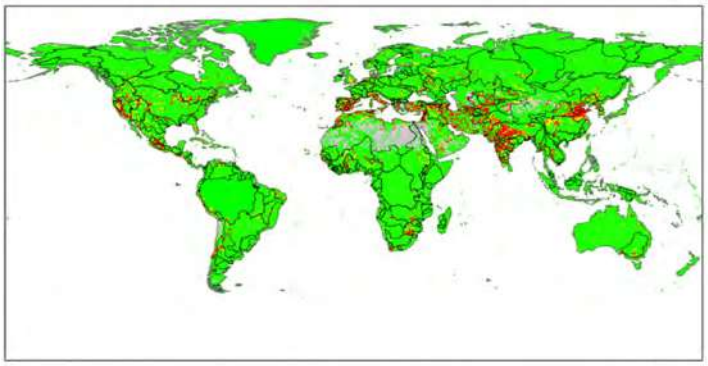
B **Nitrogen**

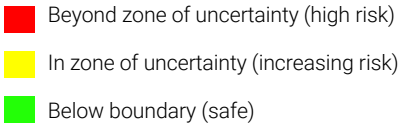


C **Land-system change**



D **Freshwater use**



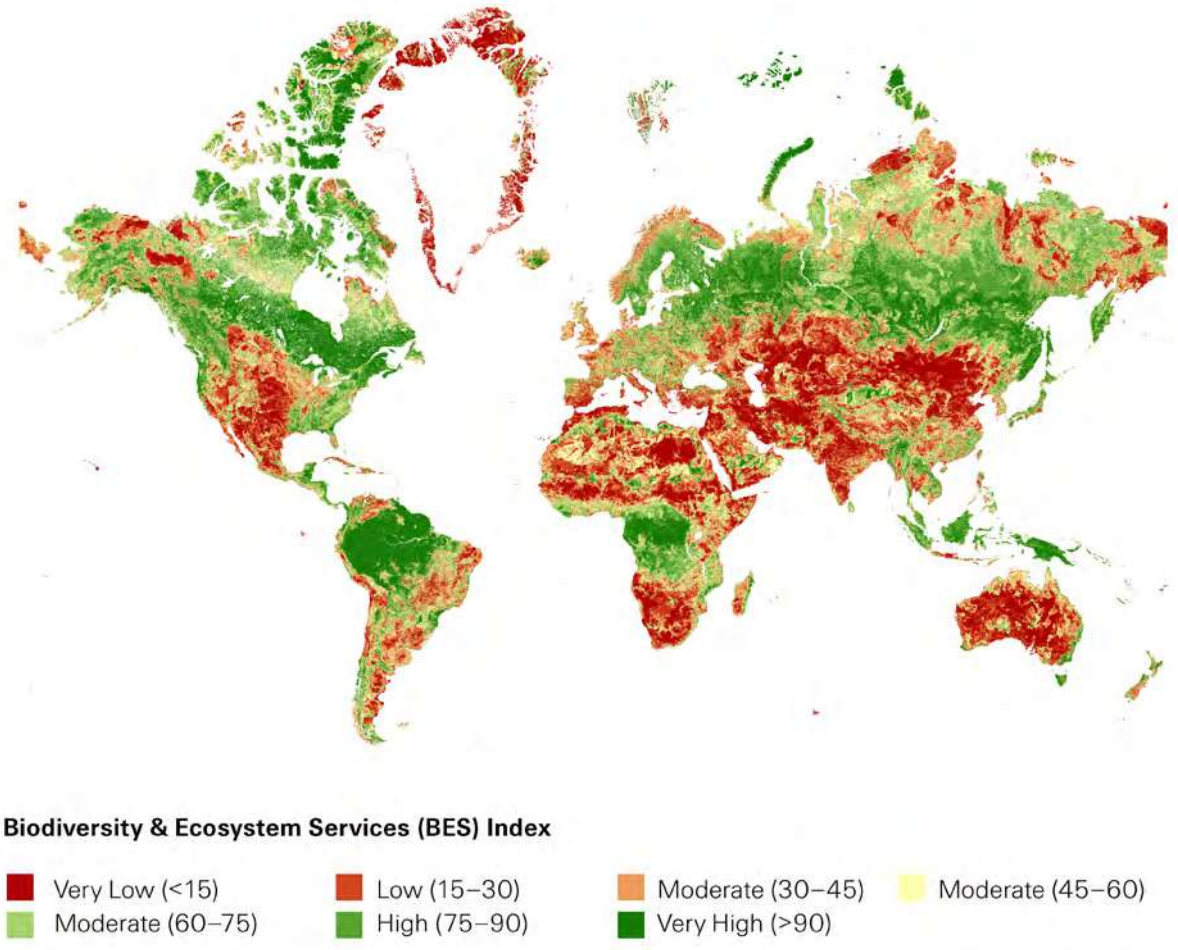


Note: Grey areas in (A) and (B) are areas where P and N fertilizers are not applied; in (C), they are areas not covered by major forest biomes; and in (D), they are areas where river flow is very low so that environmental flows are not allocated.

Source: Steffen et al., 2015[28]

For localized analysis, the Swiss Re Institute has identified ten ecosystem services (ES)[10] that are relevant to insurance business and developed a biodiversity and ecosystem services (BES) index[29] by aggregating those ten ES. The index provides a visualization of the state of ecosystem services for every square kilometre on Earth (see Figure 7) and shows wide disparities across the globe (red indicating areas where BES are comparatively fragile).

Figure 7 **Global Swiss Re Institute biodiversity and ecosystem services index map at 1 km² resolution**



Source: Swiss Re Institute, 2020[30]

Figures 6 and 7 illustrate that the balance sheets of companies in different parts of the world might be differently exposed to nature-related risks. Hence, depending on each company's resources as well as data and information availability, regional, national, and local level risk analysis can be carried out to gain a thorough understanding of the landscape of nature loss and potential risks and impacts originating from such loss.

10 These ecosystem services focus on "terrestrial ecosystems" only and include (1) habitat intactness; (2) pollination; (3) air quality & local climate; (4) water security; (5) water quality; (6) soil fertility; (7) erosion control; (8) coastal protection; (9) food provision; and (10) timber provision.

2 GLOBAL INSURANCE INDUSTRY: NATURE-RELATED DEPENDENCIES, RISKS AND IMPACTS

2. Global insurance industry: nature-related dependencies, risks and impacts

2.1 Key characteristics of the global insurance industry

The global insurance industry can be broadly divided into three lines – life, property and casualty, and health. Key financial characteristics of both underwriting and investing businesses are discussed in Annex V.

2.1.1 Underwriting

The global insurance premiums written in 2019 amounted to US$6 trillion, including the reinsurance industry.[31] As illustrated by Figure 24 in Annex V, North America and Western Europe comprised about 66 percent of the global total, followed by Asia-Pacific (28 percent), Latin America, the Middle East, Eastern Europe and Africa (jointly a total of about 6 percent). However, developing Asia-Pacific countries had the fastest growth of premiums across all insurance lines, most prominently in health.

An initial estimate by the author found that the total global P&C insurance premium is distributed among 18 economic sectors,[11] as illustrated by Figure 25 in Annex V. When combined with global health insurance (i.e. P&C plus health insurance), the business sector contributing the most to global insurance premium is pharmaceutical, healthcare, life sciences and biotechnology, followed by the automotive or motor sector.

2.1.2 Investing

The global insurance industry is one of the largest groups of institutional investors, holding about US$33 trillion of financial assets.[32] These assets are mostly exposed to bonds (corporate and sovereign/municipal) or other fixed income securities and stocks. Mortgage loans on real estate and real estate constitute two other important areas of investment for the insurers, more so for L&H than P&C. The overall exposure of the insurance investment to economic sectors is illustrated by Figure 26 in Annex V. The highest exposure is to financial services followed by real estate; telecom, IT, media, and entertainment; utilities; and pharmaceutical, healthcare, life sciences and biotechnology.

2.2 Dependency of economic sectors on nature and risks from nature loss

The economic value of global ecosystem services is estimated at US$160–180 trillion per year,[33] which is almost twice the size of global GDP. According to the World Economic Forum[34] and as further reassessed by Swiss Re Institute,[35] 55 percent of the world's GDP, or nearly US$50 trillion, is moderately or highly dependent on nature and its services.[12] However, there is little research on individual economic sectors' dependency on nature – the very sectors that are either insured by or form part of the investment portfolio of the global insurance industry. Based on Figures 25 and 26, and a global survey conducted by SIF, the underwriting and investing activities of the insurance sector are predominantly concentrated in 17 economic sectors[13] that are dependent on nature to varying degrees. Figure 8 illustrates the potential dependency of these economic sectors on various ecosystem services[14] and natural capital using the Natural Capital Finance Alliance's ENCORE database. This assessment also aligns with results from similar dependency exercises conducted by Swiss Re Institute[36] and the World Economic Forum.[37]

Annex VI elaborates on each economic sector's level of potential dependency on various ecosystem services and assigns nature-related physical risk level to each economic sector. The level of nature-related physical risk is derived using the framework for planetary boundaries in Figure 5 and in consultation with experts in nature and biodiversity. The risk level is assigned by mapping the potential dependency with the level of nature loss, whose methodology is further explained in Annex VII.

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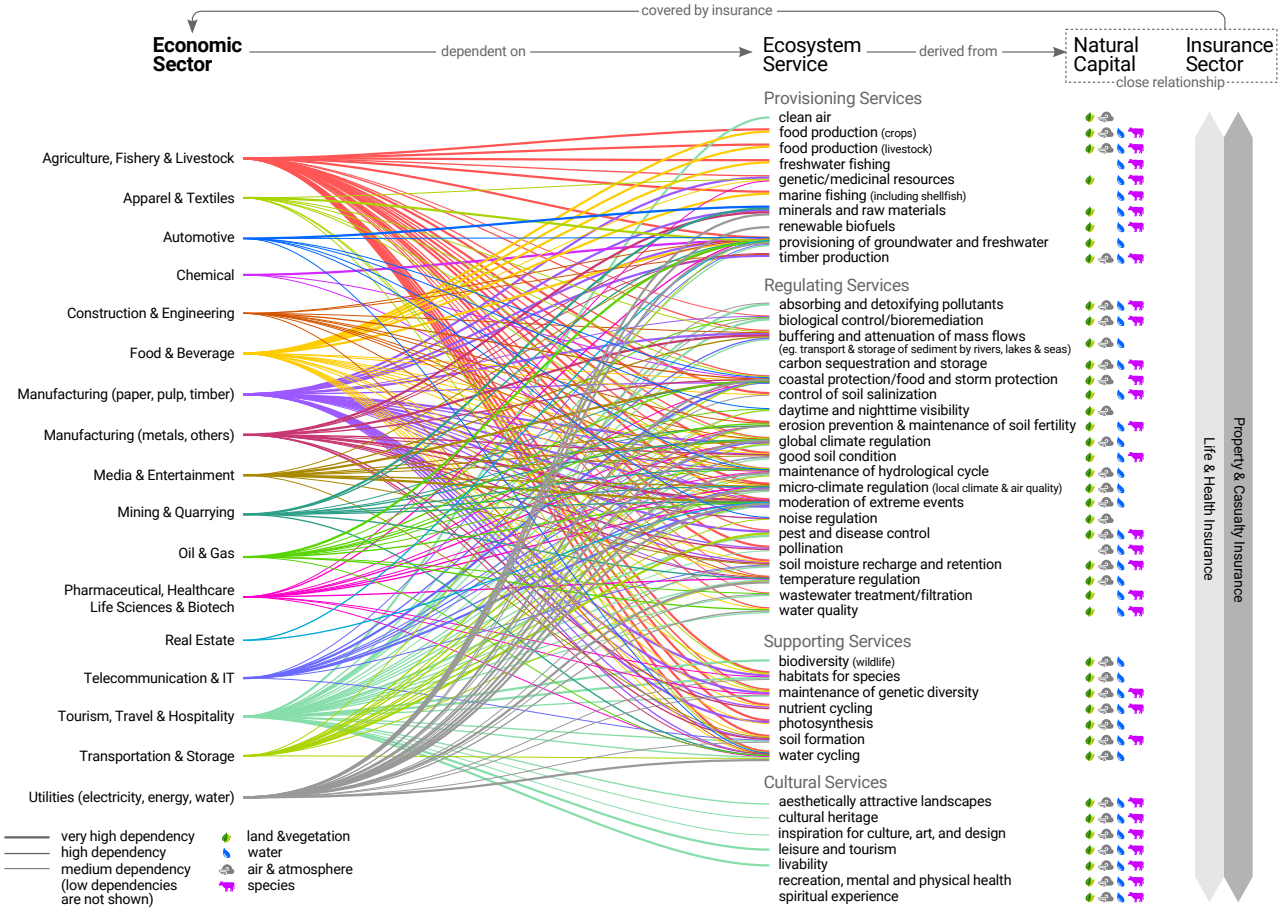
11 These sectors are: (1) agriculture, fishery & livestock; (2) apparel (clothing, footwear, etc.) & textiles; (3) automotive; (4) chemical (excluding pharmaceuticals); (5) construction & engineering; (6) financial services; (7) food & beverage; (8) manufacturing (paper, pulp, timber); (9) manufacturing (others; e.g. metals); (10) media & entertainment; (11) mining & quarrying; (12) oil & gas; (13) pharmaceutical, healthcare, lifesciences & biotech; (14) real estate/home; (15) telecommunications & IT; (16) tourism, travel & hospitality; (17) transportation & storage; (18) utilities (electricity, energy, water).

12 29 percent highly dependent and 26 percent moderately dependent.

13 Financial services excluded because financial services contribute to functioning of rest of the other sectors in the economy.

14 The list of ecosystem services derived from natural capital stocks is given in Annex IV.

Figure 8 **Inter-relationship among business sectors, ecosystem services, natural capital stocks and insurance industry**

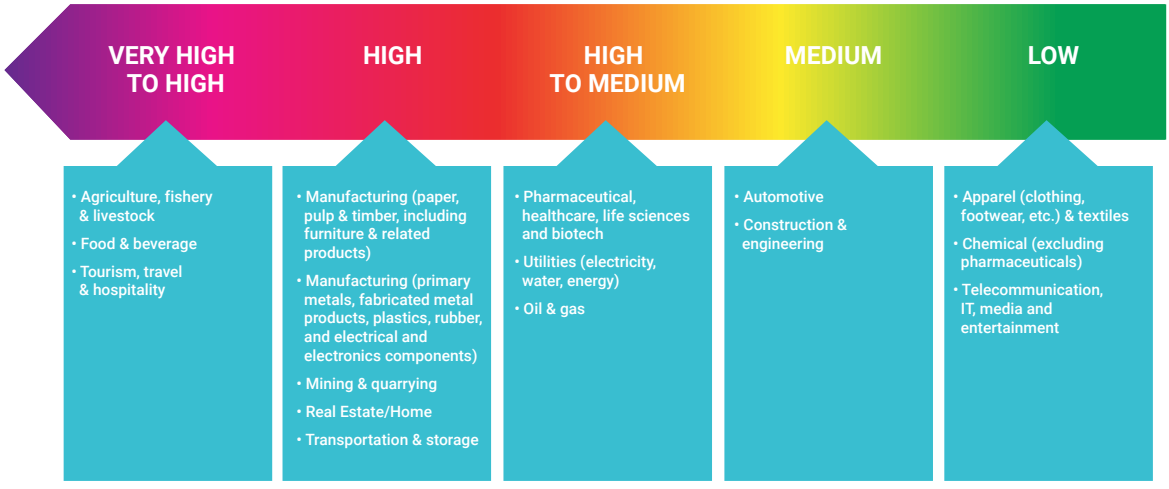


Source: WEF, 2020[38] *NCFA, 2021*[39] *Watson and Newton, 2018*[40]

2.2.1 Nature-related physical risks to business sectors

Based on an extensive analysis shown in Annex VI, Figure 9 illustrates the level of nature-related physical risks in several business sectors. The physical risk levels in this report also align with a recent assessment of environmental exposure of several business sectors,[41] conducted by Allianz Global Corporate & Specialty.

Figure 9 **Nature-related physical risks to business sectors**



2.2.2 Moving beyond physical risks: transition risks to economic sectors

Transition risks encompass those that arise as a result of the global governmental and economic shift towards a nature-positive or nature-neutral future. When businesses negatively impact the natural functioning of ecosystem services and affect the broader society and the economy, they are more exposed to transition risks than the businesses with a negligible, low or even positive impact (e.g. ecotourism) on ecosystem services. The drivers for transition risks include: changes in policy and regulation; shifts in consumer behaviour; reduced demand for products and services; increased cost of research and development to design and develop products responding to new market preferences; changes in legal landscape (liability and litigation risks); and reputational damage caused by failure to address and adapt to the changes mentioned above. The bigger and more catastrophic the *expected* physical risks are, the stronger these drivers get, causing increased transition risks. The various transition risks are discussed below.

Stronger global and national nature-related targets

Globally, there is an increasing recognition of the planetary emergency and hence a push to have an international deal for nature, similar to the 2015 Paris Climate Agreement. In June 2021, the G7 leaders agreed to a historic 'Nature Compact',[42] which supports new global targets to protect and conserve at least 30 percent of global land and at least 30 percent of global oceans by 2030. In addition, the leaders agreed to 'lead by example, effectively conserving or protecting at least the same percentage of their national land, including terrestrial and inland waters, and coastal and marine areas by 2030, according to national circumstances and approaches, including, where appropriate, with legislation and adequate resourcing and enforcement to drive delivery'.[43] In 2019, the United Nations General Assembly also declared 2021–2030 the UN Decade on Ecosystem Restoration,[44] following a proposal for action by over 70 countries. The upcoming second part of the UN Biodiversity Conference (COP 15) in Kunming in April 2022 is also expected[45] to adopt a "Post-2020 Global Biodiversity Framework" with ambitious targets for increasing protected areas and a recognition of nature-based solutions in global climate mitigation efforts.

Similarly, on a national level, 192 of the 196 Parties to the CBD[15] have submitted their National Biodiversity Strategies and Action Plans (NBSAPs).

Given that only 16.64 percent of terrestrial and inland water areas and 18.1 percent of marine areas are globally covered as protected or conservation areas,[46] global targets to increase such areas considerably could pose transition risks to businesses operating in or benefiting from those areas. Sectors such as mining, agriculture, fishing, timber and non-renewable energy could be impacted in the short term and negatively impact local economic activity. The impacts could come in the form of compliance and maintenance costs to operate in or near the protected areas or loss of profits resulting from the banning of activities in or near those areas or the stranding of assets located in those areas. However, given that local economic activity could be strengthened by diversifying businesses or avoiding future losses by investing in natural infrastructure, decreased activity in some resource extraction industries could provide for more stable local economic activity in the long term.

Change in policy and regulation

As nature loss has recently gained global attention partly due to COVID-19 and the spate of wildfires across the United States of America, Siberia, Australia, the Amazon, etc., it is likely that countries around the world will enact more and enhanced policy and regulatory measures to conserve and restore nature and increase sustainable practices. These measures could come in the form of new standards for air and water quality, green taxes on water, land and other natural resources, moratoriums on new permits to operate in certain areas, licensing and permitting procedures with higher environmental standards, enforcement of payment for cleanup or compensation cost in case of environmental damage, and restrictions on or limited access to natural resources.[47] Such measures could increase the cost of operations and, in extreme cases, completely or partially shut down certain businesses. The latter could also generate stranded assets along the way. For example, land use regulations such as the implementation of land-clearing controls could prevent grazing or cropping activities, hence negatively affecting the market value of farmland – a potential driver of asset stranding.[48] Stranding risks could affect several actors along the supply chain, from farmers to food processing companies and consumer companies. Another example is the EU Biodiversity Strategy[49] that mandates at least 25 percent of the EU's agricultural land to be farmed organically by 2030, which can materially impact the business and cost structure of chemical companies but also support a more sustainable farming sector for the long term.

Shifting consumer behaviour

The transition risk is immediate for consumer-facing sectors such as automobile, apparel, and food and beverage. 81 percent of the respondents in a global consumer confidence survey[50] felt strongly that companies should help improve the environment and were extremely or very concerned about environmental issues such as air/water pollution, packaging/food waste, water shortages and pesticides use in agriculture. Demand patterns in these markets are beginning to reflect these changes in consumer preferences. For example, a 2019 study by Kantar UK[51] found that 77 percent of British grocery shoppers switched, avoided or boycotted buying certain products based on environmental policies of the brands.

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15 Note that the United States is the only country that has not yet ratified the agreement.

Increased research and development cost for transition technology and business models

As natural resources become scarce, consumer preferences change and environmental regulations proliferate, business sectors are compelled to look for alternatives that are resource-efficient and environmentally friendly. This will likely necessitate increased research and development expenditure for companies. Although certain businesses may eventually[52] recoup such expenditure through increased production efficiency and reduced input costs, this will likely hit the balance sheets of the companies in the short to medium term. Similarly, the emergence of innovative companies as a response to growing environmentalism could displace business-as-usual companies from the market. For example, plant-based meat companies are growing much faster than traditional meat companies,[53] as customers are increasingly concerned about the large-scale deforestation caused by cattle ranching and soy-based animal feed.

Changing liability landscape

Businesses are increasingly finding that the scope of what is traditionally considered environmental damage has been expanding in recent years and falls out of standard commercial general liability policies. The magnitude of nature-related liability risks depends on the unique characteristics of the legal framework and economy within which the business operates.[54] Nature-related liability risks are also broader than litigation, and unlike litigation, are not confined to court orders for damages. This is an important distinction because liability risks affect actors in the economy beyond the direct claimants and defendants, through, for instance, regulatory fines or a determination outside the courtroom of who is legally responsible.[55] The claimants could go beyond prevailing or additional 'environmental' or 'conservation' laws and utilize causes of action under a broad range of prevailing commercial and administrative laws.[56] For example, a claim of breach of fiduciary or statutory duty could be brought (by shareholders or creditors) against the directors of a company if the company's business model depends on ecosystem services and suffers financial losses as a result of physical or transition risks associated with unmanaged and unmitigated deterioration of ecosystem services.[57] In a similar vein, a claim could be brought against a company (e.g. an automobile company) for being unable to manage the foreseeable consequences of nature-related loss (e.g. supply chain disruption of metals due to water scarcity at a mine location).[58]

In 2020, at the request of Swedish parliamentarians, the Stop Ecocide Foundation[59] launched a project to draw up a legal definition of "ecocide" as a potential international crime that could sit alongside war crimes, genocide and crimes against humanity. A draft law was unveiled in June 2021, which defines ecocide as "*unlawful or wanton acts committed with knowledge that there is a substantial likelihood of severe and widespread or long-term damage to the environment being caused by those acts*". Even if it fails to get the support of the International Criminal Court,[16] several countries might enact their own national ecocide laws in the future, which could potentially increase the number of nature-related liability claims against companies and governments contributing to the destruction of nature in those countries. Although not enforced fully, ten countries already have national ecocide laws. It is important to note that "future possible liabilities may be a relevant driver of materiality, notably in jurisdictions that tend to favour intense, extended litigation".[60]

Similarly, the concept of giving nature legal rights is also gaining momentum. Nearly 30 countries already have existing or pending legislation giving legal rights to nature (e.g. rivers and forests).[61] In 2008, Ecuador became the first country to enshrine the rights of nature in its constitution in 2008. Following this, when the provincial government of Loja violated in 2011 the Vilcabamba river's right "to exist, to be maintained and to the regeneration of its vital cycles, structures and functions" by constructing a road next to it, the defendant was required by the court later "*to adhere to environmental recommendations made by the Ministry of Environment, including performing rehabilitative and corrective actions like storing the rubbish from the construction elsewhere*".[62] Such concepts have widened the net of nature-related liability risks for companies around the world.

Reputational risks

Nature-related reputational risks arise when businesses degrade natural resources through their direct operations or supply chain activities and fail to mitigate such degradation. These actions expose businesses to reputational risk linked to increasingly stringent expectations from consumers, policymakers and the civil society, and underpin the growing pressure from capital providers to assess, manage and report nature-related risks.

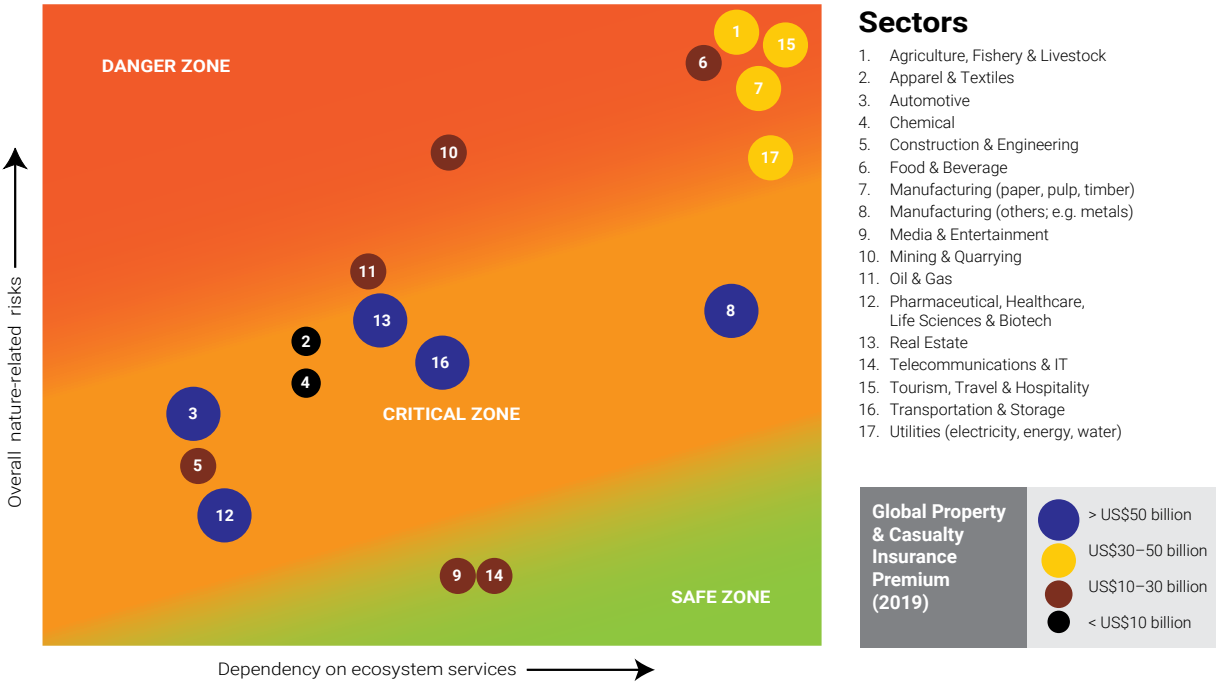
16 Countries such as China, India, the Russian Federation and the United States are not members of the International Criminal Court, but executives of corporations of one of those countries with operations in one of the member states could fall under the court's jurisdiction.

Transparency is key and potentially the first step in addressing reputational risks arising from nature-related risks. In 2019, CDP[17] requested water-related data[63] from 139 Climate Action 100+ (CA100+)[18] companies (mostly energy producers) for reporting to investors. However, over 40 percent (59 companies) declined to provide data. These companies generate substantial proportions of their revenue from activities with potential negative impacts on water quantity or quality across the entire value chain. Similarly, CDP requested forest-related data from 65 CA100+ companies (mostly energy and automobile producers), of which nearly 80 percent (52) declined to provide data. This lack of transparency may mask significant reputational risks for businesses.

2.2.3 Overall risks to economic sectors

Figures 9 has already provided a directional estimate of nature-related physical risks for 17 business sectors studied in this report. Based on expert consultations and qualitative research, a directional estimate of the overall risks, including transition risks, is presented below vis-à-vis the dependency of each business sector on nature, as shown in Figure 10. This estimate does not take into account risks cascading from one business sector to the next, which could be severe for sectors such as chemical (which depends heavily on mining and quarrying), or automobile (which depends on the manufacturing of metals and electronic equipment).

Figure 10 **Directional estimate of overall nature-related risks for economic sectors**[19]



Danger Zone: Where business operation will potentially be highly disrupted
Critical Zone: Where business operation will potentially be moderately disrupted
Safe Zone: Where business operation will likely continue as business-as-usual

Source: Author's estimations and calculations based on McKinsey & Company's Global Insurance Pools database, publicly available insurance premium data from various market research firms and consultation with insurance industry experts

17 CDP is a not-for-profit charity that runs the global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts. It tracks company level disclosure on water security and deforestation, in addition to climate change.

18 Launched at the end of 2017, this is a five-year investor initiative to engage with the world's largest corporate greenhouse gas emitters to curb emissions, strengthen climate-related financial disclosures and improve governance on climate change. The initiative acts a global coordination body between five investor networks: Asia Investor Group on Climate Change (AIGCC); Ceres; Investor Group on Climate Change (IGCC); Institutional Investors Group on Climate Change (IIGCC); and Principles for Responsible Investment (PRI). www.unpri.org/collaborative-engagements/climate-action-100/6285.article

19 A partial quantification of insurance premium at risk is done only for P&C insurers. The same could not be done for L&H insurers and investment portfolio because of lack of disaggregated data by sectors, which is recommended for future research.

Figure 10 suggests that seven economic sectors, contributing to about 10 percent[20] of the global P&C insurance premium, could be exposed to significant disruption as nature-related risks become more severe. However, such disruption might not be evenly spread among firms and geographies because of firm- and geography-specific characteristics. Similarly, the next eight economic sectors, contributing to approximately 77 percent[21] of the global P&C insurance premium, could experience moderate disruption. When the global health insurance premium is also considered, more than 90 percent of the global non-life insurance premium depends on economic sectors that are at high or moderate risk from nature loss. Only two economic sectors (media and entertainment, and telecommunications and IT) are currently in the safe zone. Figure 10 also aligns with similar studies conducted by ISIS Asset Management (now F&C)[64] and the World Economic Forum.

It is also important to examine the geographical exposure to nature-related risks of these economic sectors. It is likely that some sectors currently in the critical zone might move to the danger zone if both the dependency of those sectors on nature and the corresponding nature loss are very high in a particular geography that the sectors or their supply chains are located in. For terrestrial ecosystems, Figure 7 provides some directional indication of countries or regions where the degradation of nature is already severe. By overlaying these data with a business sector's operational or supply chain dependency on specific countries or regions, location-specific business risks could be estimated. This is beyond the scope of this study and recommended for future research.[65]

2.3 Transmission of nature-related business risks into financial risks – impacts on the insurance sector

Insurers are exposed to nature-related risks on both their assets and liabilities. While large insurers could be exposed to nature-related risks in multiple geographies and business lines, small insurers could have risks concentrated in limited geographies and business lines without the diversification enjoyed by larger peers.

To understand how nature-related risks translate into financial risks for the insurance industry, a transmission mechanism framework (see Figure 11) is used. The transmission of (physical and transition) nature-related risks, as discussed in the preceding chapter, into financial risks for the insurance sector can be direct or indirect.

2.3.1 Direct transmission

Physical and transition risks can impact re/insurance companies directly (without an intermediary channel). Some examples are presented below.

Physical risks

- A water utility company insured against disruption of water availability of submits claims resulting from the depletion of an underground reservoir that is the primary source of water for the company.
- Individuals or a large population with life and health insurance coverage submit claims resulting from the unexpected impacts of zoonoses due to the destruction of the natural habitat of pathogens.

Transition risks – Market and technology

- Without enough data and market insights, re/insurance companies could suffer from a potential underpricing or mispricing of new insurance products on or investments in new nature-tech (e.g. data-driven precision agriculture) and business models.
- An insurance company has invested in a company's equity that is exploiting resources in a rainforest area that is put under environmental protection prohibiting any commercial use.

Transition risks – Liability

- An insurer could suffer underwriting losses if the potential risks of nature-related litigation have not been efficiently priced into relevant products or if the policy terms are not clear. The risks are somewhat mitigated with the short-term policies written, a movement away from occurrence policies[22] by P&C insurers, and imposing caps on the total coverage offered on occurrence policies.

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20 Based on author's estimations and calculations. Please refer to Figure 25 in Annex V for a breakdown of premiums for sectoral blocks. The insurance premium corresponding to an individual sector was estimated based on McKinsey & Company's Global Insurance Pools database, publicly available insurance premium data from various market research firms and consultation with insurance industry experts.

21 Idem.

22 An occurrence policy has lifetime coverage for incidents that occur during its policy period, regardless of when the claim is reported.

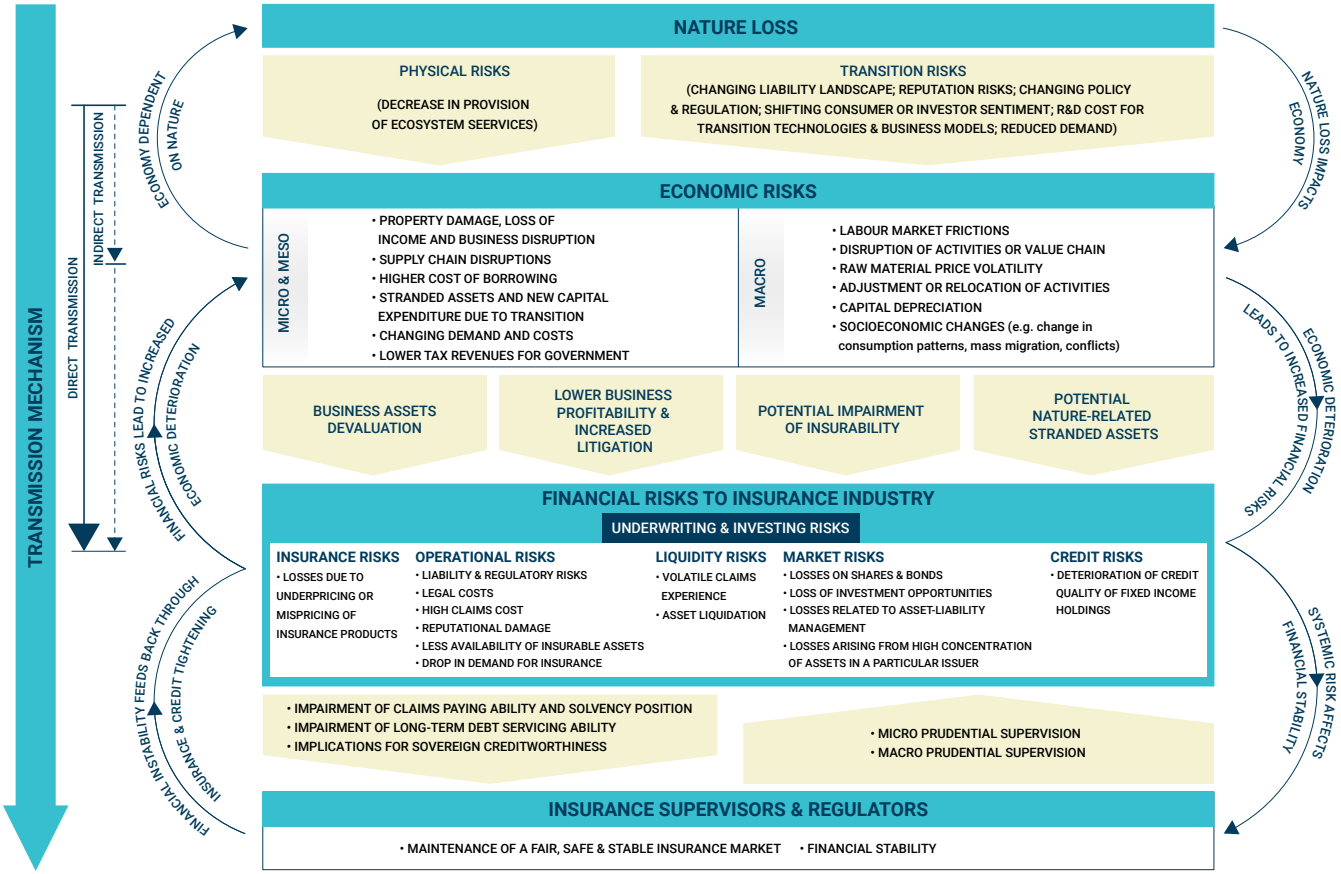
Transition risks – Reputation

- An insurer could face negative publicity for underwriting businesses or investing in companies that directly contribute to the deterioration of nature. This, in turn, could result in potentially significant costs from the loss of clients/policyholders and divestment of stakeholders along with damaged stakeholder relationships going forward.

2.3.2 Indirect transmission

An indirect transmission occurs through the propagation of physical and transition nature-related risks through clients/policyholders or investees of insurance companies that are embedded into our broader economy (see Figure 11).

Figure 11 **Transmission mechanisms: Nature-related business risks to economic and financial risks**



Source: adapted from NGFS and INSPIRE, 2021[66] CISL, 2021[67] Coalition of Finance Ministers for Climate Action, 2021[68] NGFS, 2020[69] Swiss Re Institute, 2020[70]

2.3.2.a Business risks to economic risks

Chapter 2.2 laid out physical and transition nature-related risks for various economic sectors (businesses) that constitute a significant part of the global real economy. While a global study examining the economic impact of a nature-related disruption of all business sectors covered in this report is not available, studies looking at sub-sectors of the economy give a directional estimate of potential impacts. For example, a recent study by Johnston *et al.* (2021)[71] estimates at 2.3 percent (US$2.7 trillion) the annual drop in global GDP by 2030 as a result of the collapse of selected ecosystem services (see Figure 12), impacting sectors such as agriculture, forestry, fisheries, and related industries that rely on a select number of ecosystem services, namely crop pollination by wild pollinators, climate regulation from carbon storage and sequestration, provision of food from marine fisheries, and provision of timber. A previous study by the Word Wide Fund for Nature (WWF)[72] had estimated GDP losses of over 0.67 percent annually by 2050.[23]

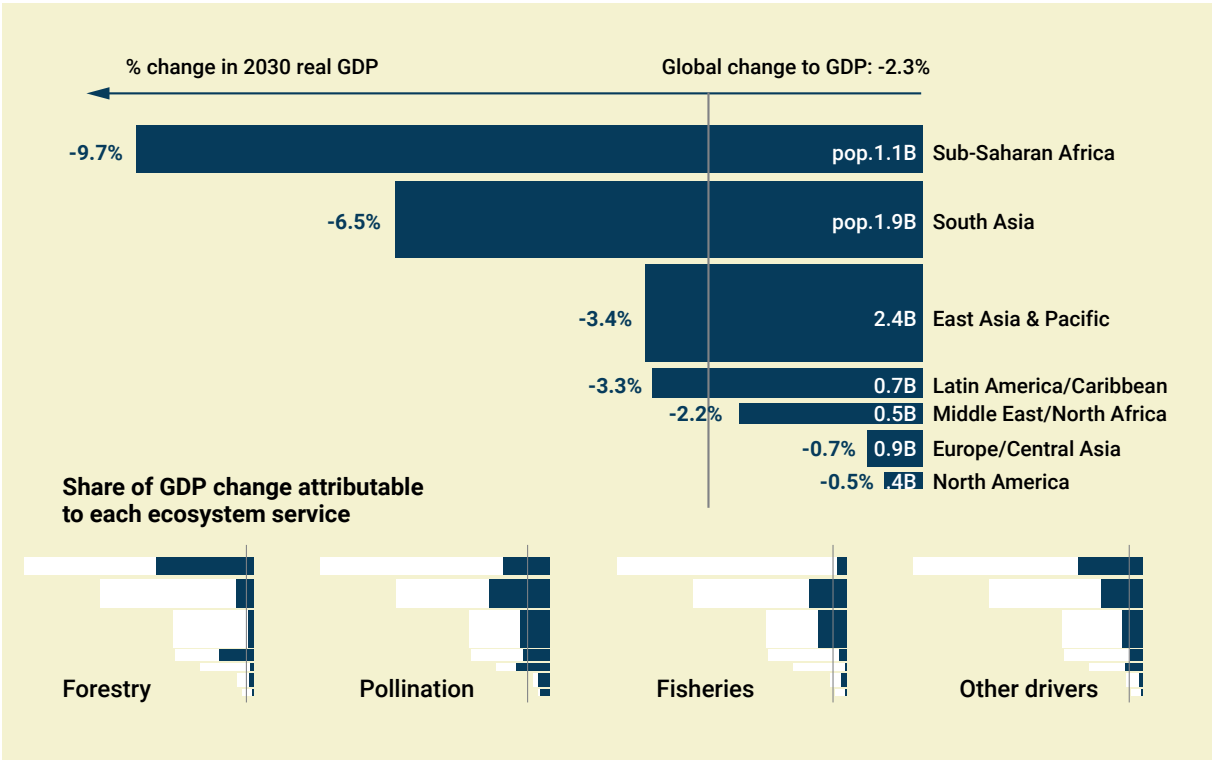
23 The model employed by WWF included only the following ecosystem services: pollination; coastal protection; water yield; timber provision; carbon storage (climate regulation); and marine fish provision.

Since the studies to date have considered only limited ecosystem services and business sectors, the economic impact of the collapse of multiple other ecosystem services could be on a larger scale. Multiple ecosystem services are likely to be interlinked with one another, and the deterioration of one could have cascading impacts on others. For example, the Dasgupta Review (2021) highlights that the processes governing the supply of regulating and supporting ecosystem services are complementary to one another, which means that if one of them is disrupted sufficiently, others will be disrupted as well.[73]

As shown in Figure 11, the nature-related risks for businesses are transmitted to the broader economy at the micro, meso and macro levels. An accumulation of economic impacts at the micro level (e.g. disruption at a coastal manufacturing facility because of coastal erosion from the degradation of nearby mangroves that used to protect the coastline, causing loss of income and supply chain disruptions) can lead to impacts at the meso level (e.g. governments losing tax revenues from a manufacturing plant shut down by a nature-related disaster). When nature loss occurs at a larger scale (country-wide, regional or global), it leads to macroeconomic impacts such as the disruption of economy-wide value chains, raw material price volatility, the adjustment or relocation of business activities (e.g. in response to emerging environmental compliance regulations), or an increased rate of capital depreciation.

As an example, the Amazonian forest's water recycling system (one of the ecosystem services) has been severely damaged over the last decade because of deforestation. This, in turn, has resulted in water shortages for irrigation and the loss of soil moisture, directly impacting Brazil's farming industry, which accounts for 30 percent of the country's GDP. The water shortages also mean less water for the country's hydroelectric plants, causing competition among several industries for limited electricity production. This, along with the increasing use of more expensive thermal power as an alternative, is projected to increase electricity prices for businesses and households up to 40 percent in 2021.[74] Since Brazil is one of the leading global exporters of agricultural commodities like soy, these price increases can have a global macroeconomic impact.

Figure 12 **Change in 2030 real GDP under the partial ecosystem collapse scenario compared with the no-tipping-point scenario, by region**



Source: Johnson et al., 2021[75]

Research (2021)[76] shows that the economic impact resulting from ecosystem collapse is likely to be significantly more pronounced in low-income regions such as sub-Saharan Africa and South Asia, where the relative contraction of real GDP is estimated to be 9.7 percent and 6.5 percent per annum respectively by 2030 (see Figure 12). This illustrates that the economic impact is likely to be uneven around the world, and that it should also be a concern for those companies that are located in relatively safer regions but still have a global business footprint through their supply chains. In turn, it should be a concern for insurance companies underwriting or investing in those companies, which is discussed further in the following section.

2.3.2.b Economic risks to financial risks for the insurance sector

The transmission of macroeconomic shocks to the insurance sector is discussed below for both underwriting and investment of insurers.

Underwriting risks

An indirect transmission of nature-related underwriting risks could occur in the form of insurance, operational and liquidity risks.

As nature-related physical risks rise in frequency, intensity and concentration, the affected policyholders (both companies and individuals) are likely to submit increasing numbers and amounts of claims. Such claims will likely have geographic or sectoral concentrations in the short term. As risks start becoming systemic because of the non-linear characteristic of nature loss, the claims could become widespread globally in the long term. When risks are widespread, risk diversification starts to fail. In extreme cases, where the claims volume is much larger than normal, insurers might need to liquidate assets at a loss to cover those claims where insurers are not holding significant shorter-term assets. To factor in future claims of a similar nature and remain profitable, insurers then might start raising premiums for covering those risks. The prospective policyholders, however, might not be willing to pay higher premiums for insurance, particularly in an economy where there are frequent nature-related business disruptions and corresponding increases in unemployment and poverty. This could make insurance products unaffordable, hence leading to reduced demand and loss of existing subscriptions.

The rise in insurance premiums, for instance, for coastal property at risk (from sea level rise or coastal erosion), may also have a negative macroeconomic impact through a reduction in property value and a corresponding decrease in property tax revenues for the local government, in particular for countries with a long coastline. This illustrates a self-reinforcing feedback loop between financial impacts and macroeconomic impacts.

Further, as nature-related physical and transition risks increase, assets of businesses and geographies that are heavily dependent on nature could become stranded, hence reducing the availability of insurable as well as investable assets for the insurance companies in these businesses and geographies.

The uncertainties associated with the future path of nature loss as well as changing consumer environments also means that there are pure-play financial risks of structuring relevant underwriting products.

Case study: Underwriting deep sea mining (DSM)

Most existing insurance policies do not yet cover nature-related losses such as groundwater depletion and the destruction of wetlands. It is, therefore, challenging to get any hard number on underwriting losses as a result of physical risks from nature loss. However, as nature loss becomes more severe and transition risks kick in, insurance companies might not be completely immune to indirect nature-related claims.

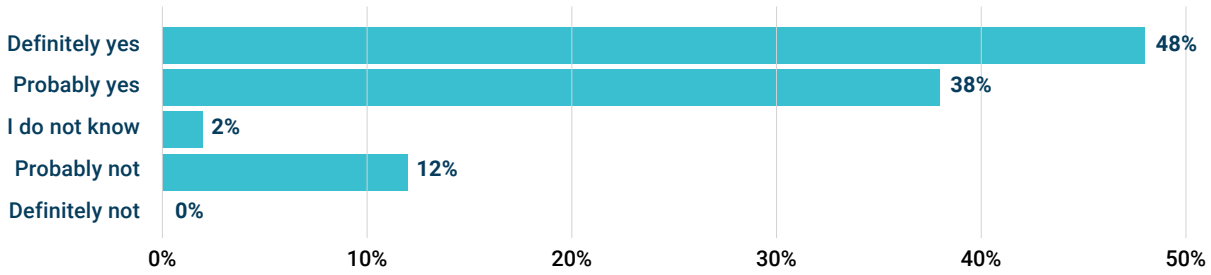
DSM is one such area where transition risks (e.g. potential liability claims) resulting from evolving global rules on seabed mining[24] could affect underwriting coverage provided to more than 20 companies that have received exploration contracts from the International Seabed Authority and could soon start mining deep sea metals. Furthermore, a global call for a moratorium on seabed mining has already come from leading global NGOs such as WWF and multinational companies such as BMW Group, Samsung SDI, Google and Volvo Group. This poses a reputational risk for insurers who provide coverage to the DSM companies. Although the insurance coverage might be limited to physical risk insurance for ocean-going equipment, the indirect environmental liability and reputational risks are hard to ignore. A corollary could be drawn from the 2015 Bento Rodrigues dam disaster in Brazil, where the Samarco joint venture between BHP and Vale faced multiple lawsuits from individuals, utility companies and churches, amounting to billions of dollars of losses in settling environmental liability claims and clean-up costs. The insurers were estimated to face up to US$600 million in claims[77] in this disaster with a single underwriter liable to pay 80 percent of the covered amount.

According to a 2018 analysis[78] of 100,000 insurance industry claims over five years, environmental liability losses such as those resulting from pollution and agricultural run-off are increasing in frequency.

The recognition that nature-related underwritten risks are financially material to the industry is also reflected in the latest global survey conducted by SIF (see Figure 13). Nearly 50 percent of re/insurers surveyed recognized the financial materiality of these risks for their underwriting business.

24 The International Seabed Authority (ISA), a 168-member body created by the United Nations to both promote and regulate seabed mining, is in the process of drafting regulations that govern seabed mining in the High Seas. The regulations will also affect the Exclusive Economic Zone (EEZ) seabeds of nation states as the United Nations Convention of the Law of the Sea (UNCLOS) requires its signatory states to govern their seabeds as per the ISA standards.

Figure 13 **Number of re/insurers agreeing that nature-related risks are financially material to the underwriting business**



Source: SIF Global Survey 2021

Investment risks

The indirect transmission of nature-related risks also occurs in the form of investment risks. These risks could cascade from impacts of nature loss on businesses and financial firms in the broader economy and occur in the form of market and credit risks.

As illustrated by Figure 26, insurers are one of the largest groups of institutional investors, and are invested in bonds, stocks and other products. Increased nature loss could lead to underperformance and depreciation in value of these investments. The underperformance and depreciation in value could result from physical risks to underlying assets, hence impacting revenue and debt servicing capacity, or from transition risks impacting the market valuation of the company. No matter whether the insurance company is directly or indirectly invested in that company as an equity or bond holder, the underperformance or depreciation in value of that company will directly affect the insurer's balance sheet.[25]

In a macroeconomic environment with increasing environmental scrutiny, there may be a mismatch between supply and demand for low nature-risk opportunities, creating a risk of a nature bubble, akin to what some market participants see as a green bubble building up in renewable energy.[79] The investment opportunities could also be impacted by the repricing of certain assets (transition risk) due to market shifts driven by environmental regulations or changes in consumer behaviour.

Nature-related risks could potentially impair the valuation of insurers' fixed income holdings, including their sovereign bond holdings. For example, if an insurer is invested in real estate debt, cash flow from that investment can be impacted by nature loss events such as coastal erosion, reducing the debt servicing capacity and collateral valuation of the underlying properties.[80] The feedback loop between nature loss and climate change described earlier can result in climate-vulnerable economies having lower resilience to climate risks such as sea level rise, inland flooding and wildfires if they do not protect their natural defense mechanisms, e.g. mangroves, forest cover, soils or wetlands. High climate vulnerability and low resilience can result in a higher cost of sovereign borrowing. Insurers that hold large amounts of sovereign debt from such affected economies may see their valuations being impaired over time.

Case Study: Insurers' risk in Brazilian sovereign bonds

Brazil's sovereign health[81] is highly dependent on its natural capital base as income from exporting soft commodities (e.g. soy, corn and, meat) makes a significant portion of the country's national income. For instance, the agribusiness sector accounted for 27 percent of Brazil's GDP in 2020. Among the G20 countries, Brazil ranks second in terms of dependency of export income on natural capital assets. However, the degradation of nature, particularly illegal deforestation, has increased in recent years. In 2020 alone, 11 000 square kilometres of the Brazilian Amazon were deforested, the highest figure since 2008. The deforestation has threatened the potential of double cropping of soy and corn with an estimated loss of gross revenue of US$3.8 billion by 2050 compared with 2016. An estimated 75–80 percent of Brazil's pastures have also been heavily or moderately degraded, which could make it progressively more challenging to achieve continued crop yield improvements. In addition to these nature-related challenges, importers of Brazilian products in various continents and industries have adopted increasingly more stringent deforestation policies, which threatens Brazil's exports, leading to a higher revenue-at-risk. The reputational risk value has also increased due to more NGO and media attention to the impacts of deforestation on global climate change. In contrast, Brazil's revised Nationally Determined Contribution (NDC) submitted to the UNFCCC in 2020 has no commitments to reducing deforestation, and the Ministry of Environment faced a budget cut in 2021, reducing environmental monitoring expenditures.

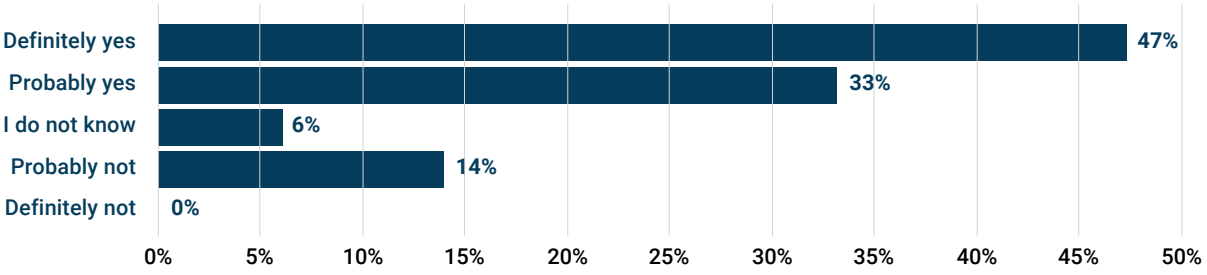
25 It should be noted that in jurisdictions where insurers' fixed income holdings are held at amortized costs and held to maturity, only a credit event would have an adverse effect.

Global insurance companies, as institutional investors, invest a major share of their assets in traditional asset classes such as sovereign bonds. While accurate data are not available, many insurers are invested in Brazilian sovereign bonds, either as direct investors or investment through asset management companies. Planet Tracker's updated assessment of Brazil's sovereign health shows that it remains on an environmentally unsustainable path to 2030 and beyond (despite encouraging moves by the Brazilian central bank over the past year), bringing systemic risks to its sovereign bonds, particularly to foreign investors holding the US$113 billion of Brazil's debt repayable after 2030. If structural changes are not made, Brazil will potentially face negative implications for the cost and availability of sovereign and commercial capital. Existing credit ratings, which mostly discount the impact of longer-term problems such as nature loss and do not easily allow investors to differentiate between countries with strong ESG credentials and those with weaker credentials, are not providing investors with sufficient warning of the risks created by Brazil's depletion of its natural capital.

Source: Adapted from Elwin et al., 2021[82]

The recognition that nature-related investing risks are financially material to the industry is also reflected in the latest survey conducted by SIF (see Figure 14). Nearly 50 percent of re/insurers surveyed recognized the financial materiality of these risks for their investment business.

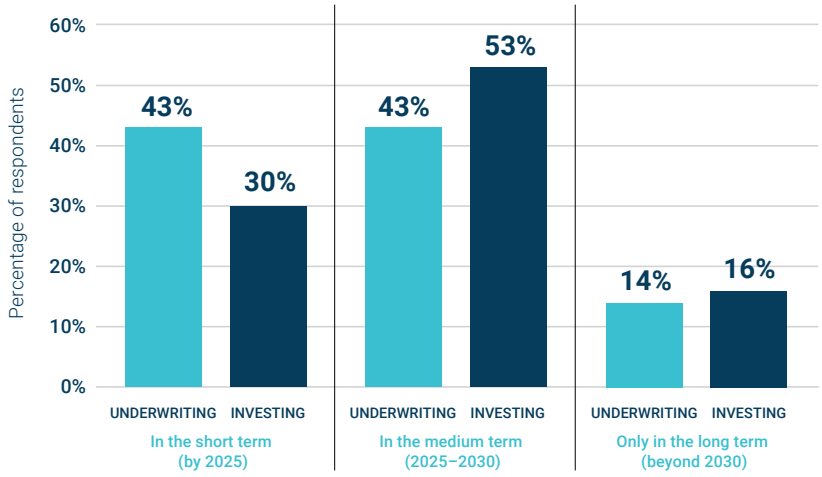
Figure 14 **Number of re/insurers agreeing that nature-related risks are financially material to the investing business**



Source: SIF Global Survey 2021

Although there is a fair degree of consensus among re/insurers on the potential financial materiality of nature-related risks to the insurance sector, the same level of consensus is absent on the expected time horizon of such materiality for the underwriting versus investing business. The SIF Global Survey 2021 (see Figure 15) shows that re/insurers consider that materiality for both underwriting and investing is foreseeable before 2030, with the underwriting business experiencing materiality sooner than the investing business.

Figure 15 **Time period by when re/insurers foresee the impacts of nature-related risks on underwriting and investing activities of the insurance sector**



Source: SIF Survey 2021

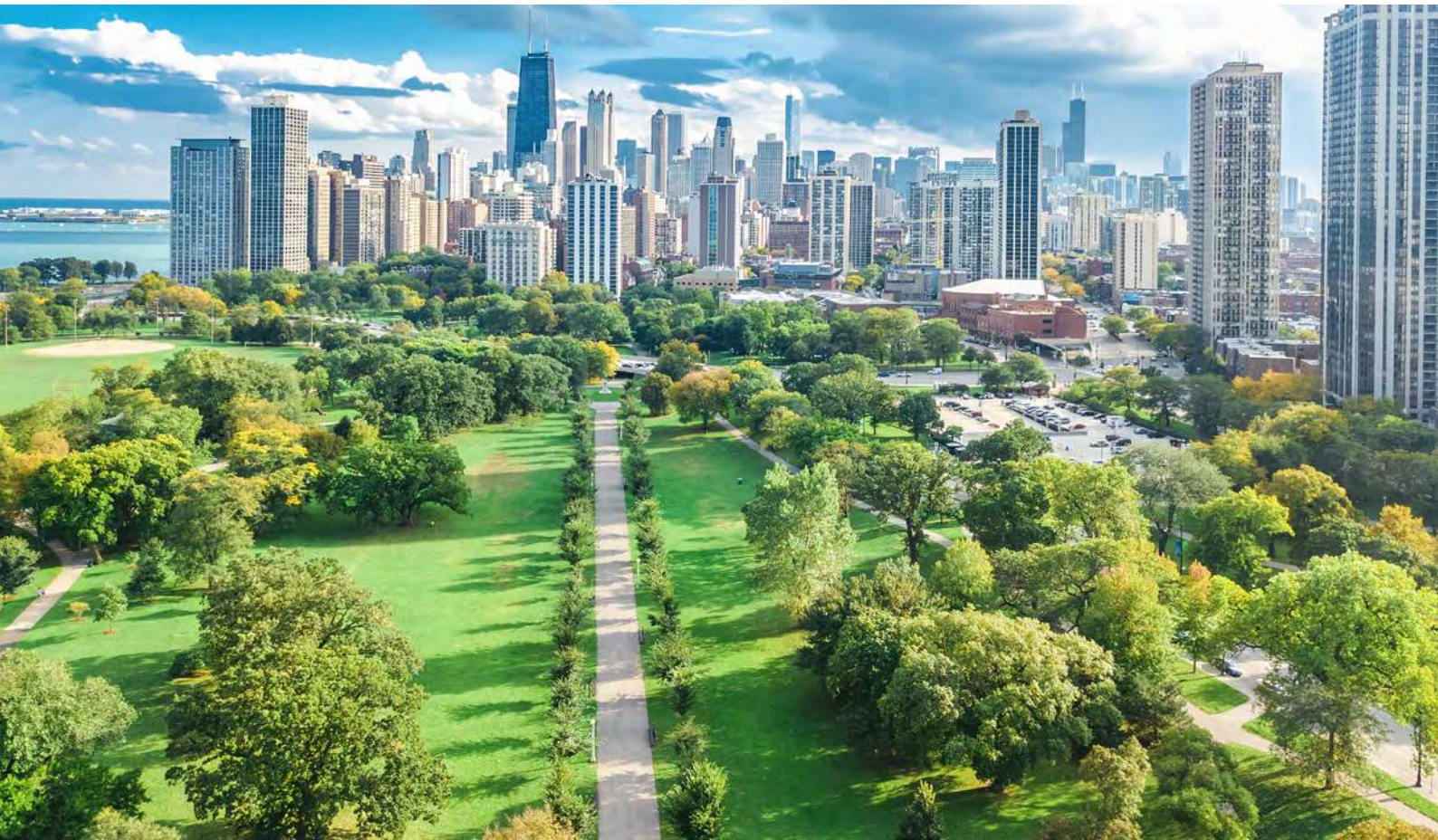
However, bilateral interviews with several re/insurers indicated that the potential materiality is expected to surface sooner in the investing business than on the underwriting side. This is because transition risk signals are underpinned by policy direction and controversy alerts, and are more near-term in nature, hence financial markets could reprice these risk signals quickly if insurance firms are not well prepared for the possible change of policy direction. The physical and liability risks are expected over a relatively longer term compared to transition and reputational risks, hence the materiality for the underwriting business will likely surface later.

The investment risks for L&H insurers are also expected to be larger than for P&C insurers whose investment portfolios tend to comprise shorter tenor instruments, so longer-term market/credit fluctuations are not that much of an issue. L&H insurers have asset portfolios with longer duration instruments and may have to crystallize losses on underperforming assets if liquidity is needed prior to the maturity date.

2.3.2.c Financial risks for the insurance sector to potential financial stability risks

As described above, ongoing nature loss could significantly hamper real economic activities, the adverse effects of which could then result in direct and indirect insurance sector-specific financial risks. These financial risks and economic risks can amplify each other. For example, if more assets start becoming uninsurable because of increased nature loss (hence a loss of insurance sector clients – a financial vulnerability), a continued economic activity based on those assets could trigger further nature loss through spillover effects (hence potentially causing irreversible damage to the relevant part of nature and an eventual halt to those economic activities – a macroeconomic shock). The macroeconomic shocks can therefore be both a cause and a result of financial vulnerability. As nature loss increases, these financial and economic risks could increase in magnitude and frequency, thus posing a potential financial stability threat.

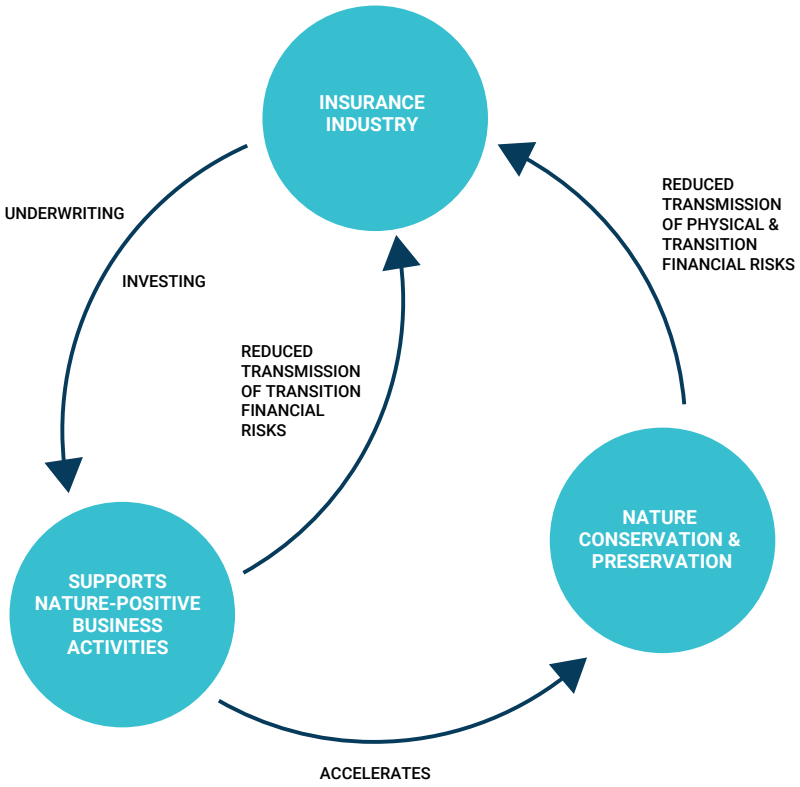
In the insurance sector, any widespread significant mispricing of nature-related risks may pose a financial stability risk due to increased payments that could further lead to liquidity and solvency issues, as well as the potential limitation or withdrawal of coverage, in particular for P&C insurance, if proper risk management and risk control fail in the short term. Hypothetically, if nature-related risks are underpriced by the entire insurance industry within a given jurisdiction over a period of time, the solvency positions of affected insurers could deteriorate. In response, the industry is likely to seek capital support to increase its capital buffers. In times of severe nature loss and assuming a challenging economic environment that constrains profit-making, the setting aside of additional capital buffers amidst a period of underwriting losses can amount to a dual impact to the insurance industry, with possible knock-on effects on the stability of the financial system of that jurisdiction. Furthermore, should a large number of insurers abruptly raise premiums or withdraw coverage from assets exposed to nature-related risks within a jurisdiction, this can bring about systemic financial shocks through self-reinforcing business failures. In extreme cases, the state and local governments might be required to intervene and provide coverage to absorb nature-related losses in the economy (i.e. unpriced liabilities) that is already impacted by underperforming or failed businesses. As the tax base is eroded by economy-wide disruptions, the state may face increasing fiscal pressures and become less able to service its debt. This could result in a higher probability of municipal bond defaults, impairing the state's sovereign creditworthiness.[83]



2.4 Impacts of the insurance industry on nature

Some stakeholders expect insurers to conduct their business responsibly and limit the negative impacts on nature of their underwriting and investing activities (i.e. impact lens). The smooth functioning of the insurance industry is underpinned by the conservation, restoration, and the sustainable use of nature (i.e. financial risk lens). As illustrated by Figure 16, nature-positive or nature-neutral business activities insured or financed by the insurance industry contribute to the conservation and preservation of nature, feeding back to reduced physical and transition risks to the businesses, which are otherwise transmitted as financial risks to the insurance industry. It is, therefore, critical to take stock of whether and how the insurance industry is contributing to nature loss.

Figure 16 **Financing nature-positive business activities reduces nature-related financial materiality through feedback loops**



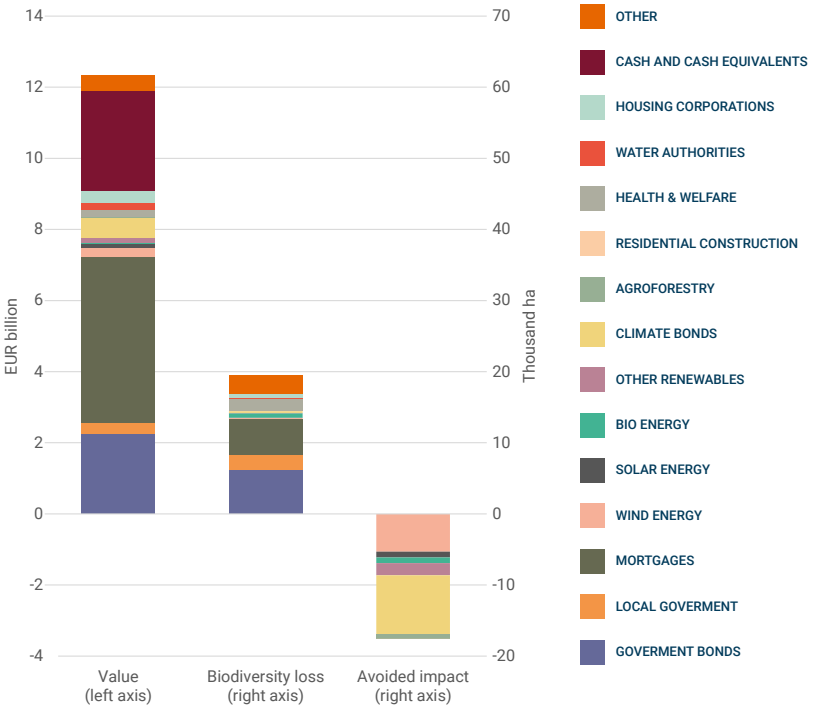
Source: adapted from SUERF, 2021[84]

From its direct operations, the insurance industry neither emits a large amount of carbon nor consumes a large amount of natural resources compared to other sectors. However, the activities that it underwrites or invests in can create negative impacts on nature. While there is no global study on the extent of nature-related externalities generated by the insurance industry, some examples are presented below.

- To get an indication of how the investing business of the insurance industry could negatively impact nature, the Dutch bank ASN Bank[85] recently conducted an exercise to calculate its biodiversity footprint (see Figure 17). The bank expressed its impacts on nature in terms of the number of hectares where all biodiversity is lost by assessing the impacts of economic activities[26] facilitated by its loans and investments. The assessment found that most of the negative biodiversity impacts were attributed to mortgages (26 percent) and government bonds (32 percent), while the most avoided impacts were achieved with investments in climate bonds (48 percent of all avoided impacts) and wind energy (30 percent of all avoided impacts). The total net impact for the bank's balance sheet was estimated at 78,600 hectares where all biodiversity was lost. The assessment also found that land use resulting from construction and government bonds contributed to the highest negative impact on biodiversity. An analogous study could be performed for an insurance company to assess the net impact of its investment on nature.

26 The impact categories used were marine water ecotoxicity; fresh water ecotoxicity; terrestrial ecotoxicity; freshwater eutrophication; acidification; terrestrial ozone formation; water use; land use; and climate change.

Figure 17 **Total value and total biodiversity impacts of investments on the ASN Bank balance sheet in 2019**



Source: PRé Sustainability, 2021[88]

• Another recent study from Portfolio Earth[86] found that the world's largest 50 banks invested more than US$2.6 trillion in 2019 in sectors that are the primary drivers of nature loss, and none of them have put in place a measure to monitor or measure the impact of their loans on nature. As seen in Figure 26, the insurance sector, being one of the major investors in financial services including banking, could be indirectly contributing to the nature loss through its investments.

• Another recent survey of 70 of the world's largest insurance companies[87] found that the current engagement of insurers with their clients on how their business operations impact nature is very low. It also found that there is a low level of understanding among insurers of how their underwriting activities may be contributing to nature loss. For insurers that are committed to creating positive impacts on society, and for supervisors that have mandates beyond financial risks, starting to develop such understanding would be a first step.

Case study: Nature-related impacts of beached and illegal, unreported, and unregulated (IUU) fishing vessels

A study done by Planet Tracker has shown that between 2014 and 2020, fishing vessels with a cumulative gross tonnage of at least 219,000 tonnes were dismantled and removed from the global oceans. 75 percent of the dismantled vessels can be traced back to companies from the Russian Federation, the United States, Taiwan (Province of China), or the Republic of Korea, in tonnage terms. Half of those dismantled vessels ended up in India and Bangladesh, where they are beached (i.e. laid ashore or grounded deliberately in shallow water), and broken apart. Since ship recycling costs ship owners US$3–7 million more than shipbreaking, and the environmental cost of doing so is much lower in countries with lax environmental regulations, India and Bangladesh have become the preferred destinations. Some companies also change their vessels' flags of convenience before being scrapped to bypass the shipbreaking legislation of their countries and send them instead to India or Bangladesh for beaching and breaking.[89]

Beaching in India and Bangladesh has resulted in grave consequences for the local marine environment. Hazardous materials from ships along with metal remnants and rust have contaminated sands and sediments, and are transported to the marine environment through ocean currents and tides. In Chattogram (Bangladesh), 21 species of fish and crustaceans have been wiped out by the local shipbreaking industry, and at least 60,000 mangrove trees have been cut along a 14 km coastline to make way for more dismantled ships.[90]

While it is difficult to estimate how many of these dismantled ships can be traced back to insured companies, it is likely that some of those companies contributed to the 2019 global marine insurance premium of US$28.7 billion.[91] *Underwriting such companies could pose significant reputational risk to the global insurance industry. In addition, fishing vessels linked to IUU fishing act as another source of nature-related reputational risk to the insurance industry. For example, vessels involved in IUU fishing use prohibited gear such as drift nets that not only damage reefs, seamounts and other vulnerable marine ecosystems but also reduce the number of marine species by catching nontarget species such as sharks, turtles or dolphins.*[92]

This is an example of how the insurance industry has both a responsibility and financial imperative to ensure that its underwriting and investing practices do not lead to the unintended damage of nature and in turn to their own financial bottom line through both nature-related physical and transition risks. The general provisions for the investment, such as the prudent person principle, and underwriting activities, such as actuarial principles, have to be complied with.

3 RESPONSE TO NATURE-RELATED RISKS

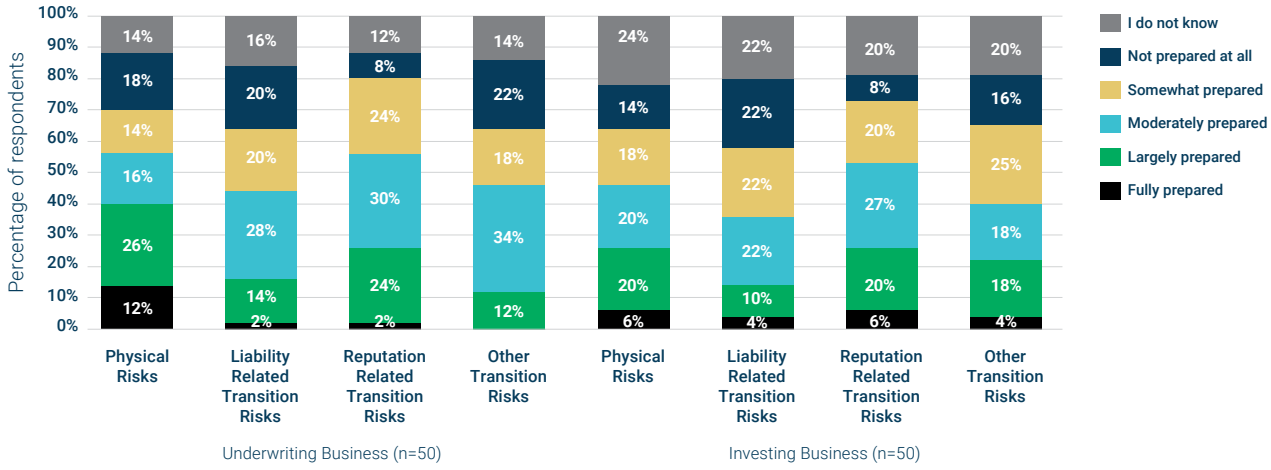
3. Response to nature-related risks

3.1 Resilience of the insurance industry

The insurance industry's underwriting promotes macroeconomic stability by absorbing risks in the economy. Through risk-based pricing, the industry also provides critical economic signals of the changing risk environment.[93] Traditionally, the industry has relied on the principle of statistical stationarity of risks and used historical patterns for the actuarial modelling of future risks.[94] However, as ecological thresholds are exceeded for various elements of nature, the resulting risks and impacts start to show signs of statistical non-stationarity and non-linear trends. How accurately potential risks can be modeled and reflected in product pricing determines the adaptive capacity or resilience of the industry. For this, forward-looking scenarios and stress testing are critical.

As of today, the capacity to understand ecological interactions, collect relevant data and design tools to forecast nature-related risks are at an early stage of development. The capacity for modelling and quantitatively understanding nature-related risks is slowly increasing. As illustrated by Figure 18, across most risk categories, many re/insurers say they are moderately or somewhat prepared to respond to the potential impacts of nature-related risks. However, a considerable percentage of the industry is not yet fully or largely prepared to respond to such risks.

Figure 18 **Level of preparedness of the insurance industry to respond to the potential impacts of nature-related risks**



Source: SIF 2021 Global Survey

While the industry is not able to accurately model and quantify future nature-related risks, mispricing risks could potentially overexpose insurers to nature-related risks. In a 2021 study by the French Museum of Natural History, the authors already argue that "if correctly priced, it could appear that the insurance industry is already overexposed to nature-related risks, and they would either need a higher reserve capital to meet the regulatory capital requirements or they would need to reduce their exposure to underwriting and/or investing positions, hence losing some profit potential".[95] As can be seen from Figure 10 and the explanation that follows, the underwriting and investing arms of the insurance industry are indeed already exposed to many economic sectors that are at high risk from nature loss.

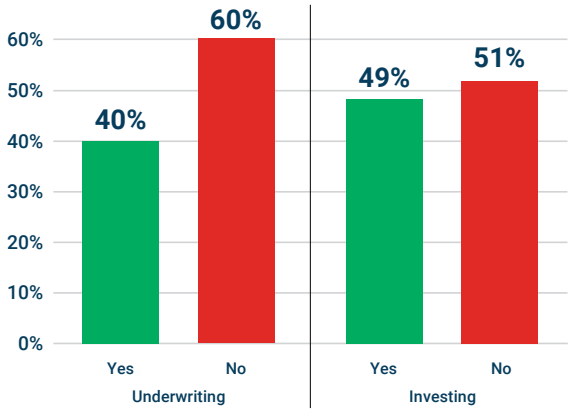
3.2 Insurance industry's response to risks and impacts

This paper examines the insurance industry's responses to nature-related risks in four ways – (1) whether and how they are assessing these risks, (2) the level of risk disclosure, (3) how these risks are being managed and the public commitments to avoid, reduce and restore nature loss, and (4) the development of appropriate insurance and financial products to address emerging risks.

3.2.1 Assessment of risks and impacts

The preceding chapters in this report along with survey results (Figures 13 and 14) indicate that many re/insurers do believe that the nature-related risks are material. The CRO forum, which counts some of the largest global insurers as its members, has identified five nature-related areas posing a medium level of risk to the industry – resource scarcity, new frontiers for resource extraction, environment pollution, food and water supply, and plastics and microplastics in its 2021 update of emerging risks.[96] Bassen *et al.* (2019)[97] have also presented with confidence that nature-related risks have adverse effects on the equity market, banking and real estate – all three areas where the insurance industry is moderately invested in. The SIF 2021 Global Survey asked the re/insurers whether they are currently assessing nature-related risks in their businesses. As illustrated in Figure 19, nearly 60 percent do not currently assess these risks in their underwriting businesses and 51 percent do not do so in their investing businesses.

Figure 19 **Number of re/insurers assessing nature-related risks currently**

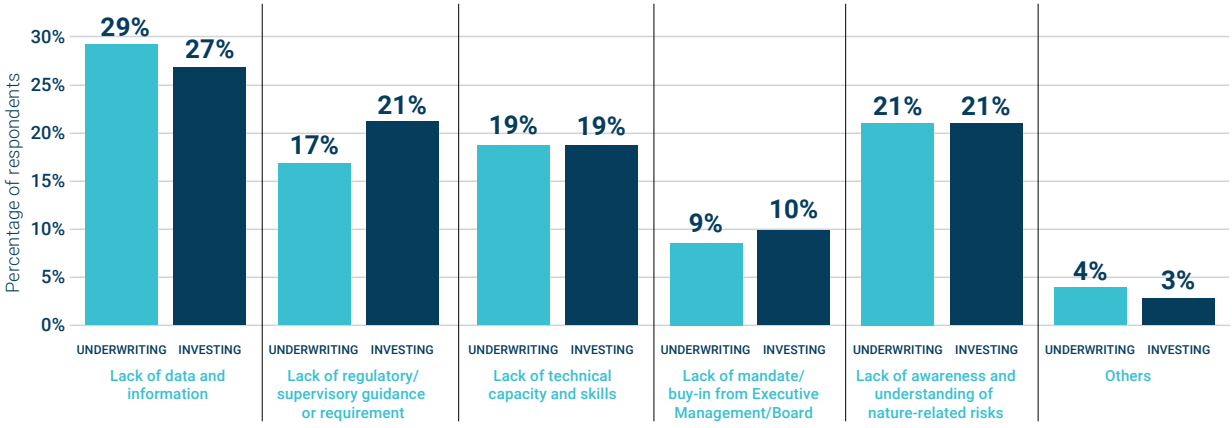


Source: SIF 2021 Global Survey

The lack of data and information, including relevant methodologies, was the reason most cited for not assessing nature-related risks (see Figure 20). Lack of awareness and understanding, lack of regulatory/supervisory guidance or requirement, and lack of technical capacity and skills were three other reasons commonly cited. On the lack of understanding and awareness, many companies also pointed to the general inability of most re/insurers to handle complex systems thinking and decision-making as that relates to nature-related risks. This is because nature-related risks are complex, interconnected and often overlap with climate and natural hazard risks, and are still poorly understood. It is hard to pinpoint a specific event, link the event to nature loss and then separate the actual value-at-loss attributable to the loss of a specific ecosystem service.

On the investing side, some re/insurers highlighted the unavailability of a GHG-equivalent protocol or metrics for nature and biodiversity as an impediment, similar to the finding from a recent Credit Suisse survey.[98] Many respondents also noted that concentrated focus on climate risks was taking attention away from nature-related risks. However, of the companies currently not assessing these risks, 53 percent have plans to do so while 9 percent do not plan and 38 percent do not know yet.

Figure 20 **Barriers to assessing nature-related risks in underwriting and investing business**

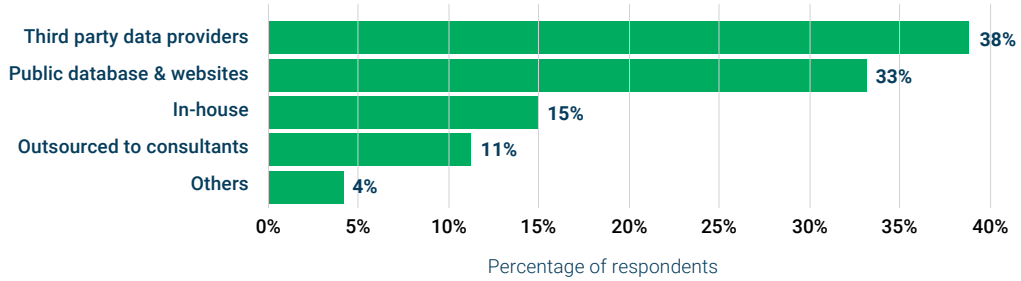


Source: SIF 2021 Global Survey

Of the companies assessing nature-related risks (as shown in Figure 19), less than 10 percent are using an exclusive quantitative approach and the rest are using either qualitative or a combination of qualitative and quantitative approaches. The companies have been using a combination of third-party data providers, public databases and websites, external consultants, and in-house experts to collect data and information on nature loss and its risks and impacts on insurers (see Figure 21). Companies use third party tools such as Global Forest Watch (GFW),[99] FAIRR,[100] IRIS+,[101] Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE),[102] Integrated Biodiversity Assessment Tool (IBAT),[103] and TRASE forest-risk commodity supply chain database.[104] Re/insurers can also leverage technology, such as Application Programming Interfaces (APIs) and Internet of Things (IoT) devices which can enable more accurate data acquisition while technologies like block chains can help to verify and share data on a trusted basis. For example, IoT devices could be deployed on-site to directly capture and assess relevant real-time data, such as consumption of water and other ecosystem services.

Some re/insurers have an in-house team of nature and biodiversity experts, however the majority do not have a dedicated expert team. However, nearly 45 percent of the surveyed companies plan to train their existing staff on nature and biodiversity.

Figure 21 **Re/Insurers' sources of data and information related to nature loss and associated risks and impacts**



Source: SIF 2021 Global Survey

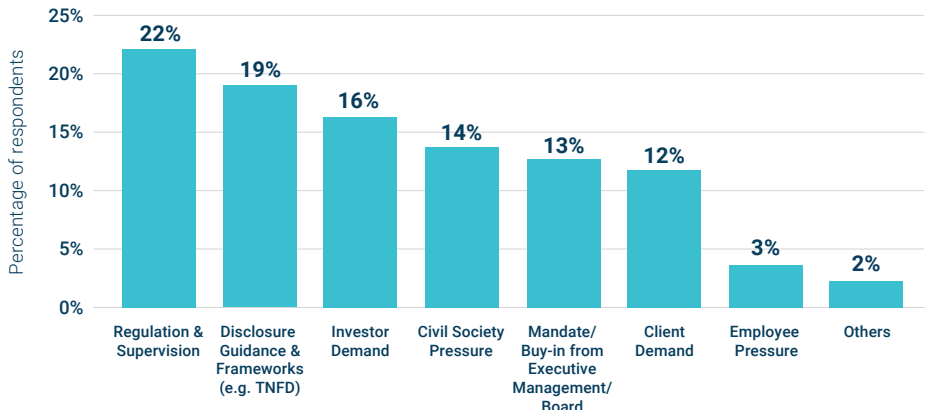
3.2.2 Reporting and disclosure of nature-related risks

In the financial industry, including insurance, there is no industry-wide ESG, sustainability, climate, or nature-related disclosure standard for disclosing or reporting on environmental, climate or nature-related risks. In addition, in most jurisdictions with notable exceptions like the European Union (with its Sustainable Finance Disclosure Regulation[105]) re/insurers are not required by law to disclose or report on one or more of these risks. However, with increasing awareness of the regulators to prioritize disclosure of these risks and the global regulations slowly starting to converge as well as increasing market pressures for insurers to make voluntary disclosures, many re/insurers have started to realize the potential future regulations around disclosure of and reporting on some of these risks. Most notable is the growing adoption of voluntary standards for ESG and climate risk-related financial disclosure. For example, nearly 80 re/insurers[106] have already supported the Task Force on Climate-related Financial Disclosures (TCFD), although the growing adoption of ESG and climate-related reporting and disclosure is more prominent in investing than in underwriting.[107] In general, it is important that insurers disclose relevant information, and that insurers themselves can find and get relevant information about, for instance, companies they consider investing in/underwrite business with in order to assess the potential impact.

The International Financial Reporting Standards (IFRS) Foundation is currently working towards the establishment of an International Sustainability Standards Board (ISSB) to sit alongside the International Accounting Standards Board (IASB). The ISSB will issue a global baseline of investor-focused sustainability standards to improve the consistency, comparability and reliability of sustainability reporting across jurisdictions. The standards are intended to be interoperable with complementary reporting requirements that seek to capture wider sustainability impacts. The ISSB will start with a climate disclosure standard and will then issue standards for other ESG matters, such as biodiversity. This work has been welcomed by both the G7[108] and G20[109] Finance Ministers and Central Bank Governors.

When it comes to nature-related financial disclosure, the general opinion of the insurance industry is that we are at an early stage. Despite that, the SIF 2021 Global Survey finds that 60 percent of the surveyed re/insurers are supportive of disclosure of nature-related risks while 35 percent are undecided. Only less than 5 percent are not supportive of such disclosure. Most respondents pointed to regulation and supervision as key enabling factors to enhance disclosure, as illustrated by Figure 22. Respondents highlighted other enabling factors such as disclosure guidance and frameworks, investor demand, civil society pressure, corporate mandate/executive buy-in, client demand and employee pressure. Some noted the need to raise awareness of nature-related financial risks and impacts.

Figure 22 **Key drivers needed to kickstart assessment and disclosure of nature-related risks in the insurance industry**



Source: SIF 2021 Global Survey

The timely disclosure of nature-related financial risks across business sectors, including financial services, is expected to present opportunities to insurance companies by helping them grow pools of risk, price risks properly and identify unseen investment opportunities. The TCFD experience showed that disclosures based on an initial set of metrics are refined over time, which can enable the insurance sector to measure risks with greater precision.

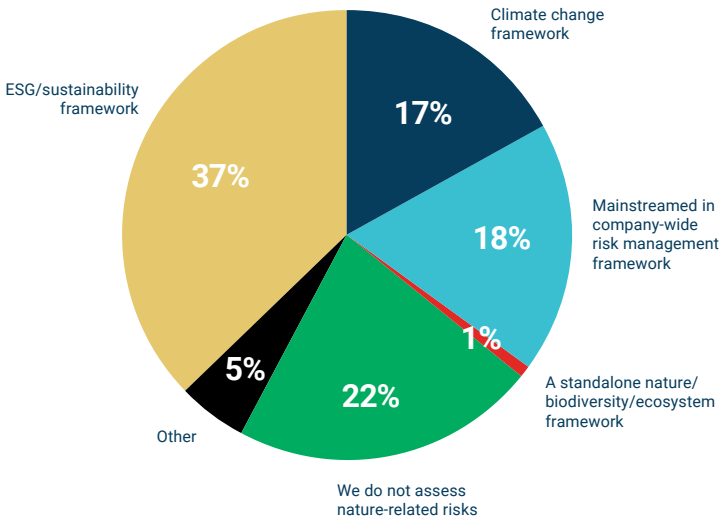
Moreover, the disclosure of risks will support wider stakeholder groups to focus their research and deliberation on cost-effective mitigation measures, which will ultimately benefit both insurers and their clients. Last, the increased transparency enabled by timely risk disclosure by the insurance industry also allows the broader financial system, including supervisors, to gradually respond to existing mispricing, avoiding a sudden nature risk-induced financial shock.

3.2.3 Current management of nature-related risks and commitments to nature-positive practices

Risks must first be assessed and measured before they can be managed and appropriately priced. There are no uniform metrics and indicators available for nature-related risks, hence industry frontrunners have typically used ESG or sustainability frameworks and very recently, climate change frameworks to incorporate some of the potential nature-related risks in their assessment and management practices. Thus far, this approach has only been used by the investing arms of the insurance industry to reduce negative impacts, through shareholder engagement and exclusions.

According to the SIF 2021 Global Survey, 18 percent of the surveyed insurers have mainstreamed nature-related risks in company-wide risk management frameworks and another 1 percent (see Figure 23) have a standalone nature-related risk management framework.

Figure 23 **Framework used by re/insurers to assess nature-related risks**



Source: SIF 2021 Global Survey

The development of approaches and methodologies to measure nature-related risks as well as nature-positive or nature-neutral investment opportunities is at an early stage. In the financial sector, AXA Investment Managers, BNP Paribas Asset Management, Sycomore Asset Management and Mirova partnered in early 2020 to develop and implement a tool to measure the impact of investments on nature.[110] Later that year, they partnered with two consulting firms to expand the Corporate Biodiversity Footprint, a metric that quantifies corporates' wider supply chain impact on biodiversity, to help investors integrate nature into risk assessments and research.[111] Similar initiatives for the insurance industry would provide the tools to allow insurance companies to assess risks and potential impacts on financial performance.

An increasing number of re/insurers are expressing their commitment to nature-positive or nature-neutral practices. For example, several insurers along with asset managers, banks and investment funds are signatories to the 'Finance for Biodiversity Pledge', who collectively represent over US$10 trillion in assets.[112] Similarly, Swiss Re's Sustainable Business Risk Framework[113] states that the company will exclude insurance coverage for projects and activities located in UNESCO World Heritage Sites or protected areas, wetlands protected by the Ramsar Convention, International Union for Conservation of Nature (IUCN) listed protected areas and habitats for IUCN Red list species, as well as those without credible environment impact assessments or in violation of local, national or international laws or binding agreements on illegal logging. Similarly, Achmea, one of the largest Dutch insurance companies, has engagement guidelines[114] that state portfolio companies should have a policy to protect biodiversity. In a similar vein, AXA has publicly committed to not knowingly underwrite vessels involved in IUU fishing – decreasing nature-related liability and reputational claims risks.

3.2.4 Development of nature-aligned insurance products

Nature-aligned insurance products can also lower underwriting losses for insurance companies, boost the growth of insurable assets, and simultaneously contribute to the restoration of damaged natural capital. The European Insurance and Occupational Pensions Authority (EIOPA), in its recent report on non-life underwriting and pricing,[115] used the concept of impact underwriting to refer to products and services developed to help insurers lower their exposure to climate-related risks and to limit GHG emissions. This could be an interesting concept to develop for nature-loss related risks as well. The Nature Conservancy, University of California Santa Cruz, and AXA[116] assessed the feasibility of developing and deploying a mangrove insurance product in the Caribbean region with positive results. The policy could be targeted at residential and commercial customers as well as public infrastructure, and policyholders would receive initial payouts quickly through parametric covers and assessed payouts through indemnity cover at a later stage. In a similar study conducted by Willis Towers Watson and the Nature Conservancy,[117] risk reduction and premium savings associated with ecological forestry were modeled and analysed for a range of parametric wildfire insurance structures in northern Sierra Nevada. The results showed that aggregate residential premiums decreased by over 40 percent from ecological forest management[118] of wildfire risk areas. If a 'community-based insurance' policy is written by an insurer and purchased directly by local government to cover homes in that community where homeowners pay a proportionate fee for such coverage, then the premium savings could be used by local government to issue wildfire resilience bonds to fund or finance ecological forestry. This in turn would reduce the fire risk and reduce the premium of wildfire resilience insurance. With such insurance products, wildfire insurance across California can continue to be available and affordable even for higher risk areas.

Case study: World's first coral reef insurance policy

The Mesoamerican Reef in Mexico is the second largest barrier reef in the world and protects Mexico's Caribbean coastline, which supports a US$10 billion tourism sector from environmental risks such as hurricanes. However, pollution, bleaching and other types of environmental degradation, as well as the extreme storms that the reef protects against, put the reef at risk. This has led the Mexican government, The Nature Conservancy (TNC), and others to establish the Coastal Zone Management Trust, which, in addition to its already established activities focusing on ongoing maintenance of the reefs and beaches, will now make payments to beneficiaries in the event that a storm hits to repair the coastline and reef damages. The solution is also cost-effective, with estimates from TNC stating that while repairing the reef could cost anywhere from US$50,000–150,000, an artificial measure like a seawall could easily cost US$1 million per half mile of protection.

Funding for the Coastal Zone Management Trust comes from an existing fee on beachfront property owners with contributions from both local government taxes and from the local tourism industry in Cancún and Puerto Morelos. Part of this will cover the cost of insurance premiums, paid to the Mexican-based insurer Afirme Seguros. The parametric insurance product states that in the case that a storm with wind speeds in excess of certain benchmarks, starting with 100 knots, hits predefined areas covered by the insurance, a payout would immediately be made to the trust, up to a maximum of US$3.8 million. For example, if wind speeds reach 110 knots, then 40 percent of the maximum payout would be delivered, while if they reach 130 knots and 160 knots then 80 percent and 100 percent of the maximum payout would be delivered, respectively. The terms state that 50 percent of the payout funds must be used for preliminary rehabilitation and restoration of beaches and 50 percent must be used for similar activities for the reef.

The administration of the payouts and delivery of the funding is managed by the Coastal Zone Management Trust.

Source: Global Canopy, 2021[119]

3.3 Supervisory and policy response to risks and impacts

3.3.1 Supervisory response

In the last few years, supervisors and regulators have developed and adapted frameworks and processes to supervise climate risks. More recently, supervisory attention is being paid to broader nature-related risks. The mandate of an insurance supervisor is typically related to key objectives of policyholder protection, financial stability and market conduct. A supervisory response to nature-related risks can therefore begin with an assessment of the relevance of nature-related risks to these objectives. For example, the Dutch Central Bank (DNB) found in its 2020 assessment that up to 36 percent (over EUR510 billion) of investments by Dutch financial institutions, including insurers, were highly or very highly dependent on one or more ecosystem services.[120] A similar 2021 assessment by the Banque de France found that 42 percent of the value of securities held by French financial institutions come from issuers that are highly or very highly dependent on one or more ecosystem services.[121]

When nature-related risks are established as relevant or material, the insurance supervisors may wish to develop guidance, recommendations and standards for their regulated entities.

- The DNB assessment recommended that "*supervisory authorities must ensure – for example through good practices – that financial institutions report in such a way that they produce a clear picture of their risk profile and resilience*"[122] as it relates to nature loss.
- The Australian Security Exchange Corporate Governance Council, in its fourth edition of the Corporate Governance Principles and Recommendations, recommended that "*a listed entity should disclose whether it has any material exposure to environmental or social risks and, if it does, how it manages or intends to manage those risks*".[123]
- The Guidelines on Environmental Risk Management for Insurers issued by the Monetary Authority of Singapore promote the adoption of sound environmental risk management practices. They cover the areas of governance, risk management, underwriting, investment and disclosures. They also have a broad focus on environmental issues, including climate change, loss of biodiversity, pollution and changes in land use.
- The BaFin has issued a "Guidance Notice on Dealing with Sustainability Risks",[124] which encourages supervised entities to focus more strongly on climate change risks but also take into account other environmental and social risks, such as the risk of biodiversity loss, acknowledging that the latter could have the same kind of serious financial impact as the former.
- The California Department of Insurance, in its recent Climate Insurance Report,[125] has made recommendations that include supervisory responses that encourage insurance company investments in nature-based solutions, and the insurance regulator to become a catalyst for pilot projects that link the risk reduction power of nature to community-wide insurance policies and potential risk pools for risks that have a very limited history of insurance coverages.

A recently published occasional paper, by the research initiative led by INSPIRE and the NGFS,[126] has also identified the need for a strategic and structured approach by central banks and supervisors to address the challenge of nature loss and the knowledge gaps around it. In its 2020 guide for supervisors in integrating climate-related and environmental risks into prudential supervision,[127] the NGFS recommended supervisors take adequate qualitative and quantitative measures to address environmental risks.

The recently launched TNFD,[128] although industry-led, has also gathered support of several governments along with sustainable finance platforms such as the Principles for Responsible Investment (PRI). Among others, the TNFD is expected to develop and test disclosure metrics and methodologies for nature-related financial risks, and finally disseminate those for wider adoption by 2023. In France, a new secondary legislation under Article 29 of the French Law on Energy and Climate requires all French financial institutions, including insurers, to disclose biodiversity-related risks in addition to climate risks.[129]

The Dasgupta Review, commissioned by the UK Government, has also acknowledged that emerging risks from the unsustainable use of nature are not currently incorporated in financial decisions and "there is a role for precautionary policy intervention by governments and financial regulators, to compensate for the inability of markets to react in the face of potentially catastrophic losses related to tipping points".[130]

3.3.2 Global policy response

An accelerated global political development on nature-related issues could raise expectations from supervisors to act on the risk of unprecedented nature loss. In June 2021, the G7 leaders agreed to a historic 'Nature Compact',[131] which supports new global targets to protect and conserve at least 30 percent of global land and at least 30 percent of the global ocean by 2030. In July 2021, the G20 Environment Ministers[132] committed to continue and increase their efforts to address the interconnected challenges of nature-related risks and climate change. The ministers welcomed the additional impetus towards achieving the vision of "Living in Harmony with Nature" by 2050 provided by the UN Decade on Ecosystem Restoration 2021–2030. The ministers also recognized the importance of work on nature-related financial disclosures and took note with interest of the establishment of the TNFD.

In March 2021, the European Commission approved a new statistical framework to better account for biodiversity and ecosystems in national economic planning and policy decision-making.[133] As the next step, the Commission will propose a revision of the Regulation on European Environmental Economic Accounts to expand its coverage to include a new module on natural capital accounting, following which the EU could become the first jurisdiction reporting on changes in ecosystems and their services.[134] The upcoming second part of the UN Biodiversity Conference (COP 15) in Kunming in April 2022 is also expected[135] to adopt a "Post-2020 Global Biodiversity Framework" with ambitious targets for increasing protected areas and recognition of nature-based solutions in global climate mitigation efforts. Just as the Paris Climate Agreement triggered climate-related global supervisory action, the focus on nature risks at a global policy level may trigger a similar supervisory response.

Photo: Wynand Uys | Unsplash

4 CONCLUSION AND RECOMMENDATIONS

Photo: Alan Emery | Unsplash

4. Conclusion and recommendations

This study qualitatively discussed the potential dependencies of the global insurance sector on nature, and the risks and impacts of nature loss. The assessments in this report demonstrate that nature-related risks, although less well understood than climate-related risks, could have impacts on the insurance sector. There is also a fair degree of consensus among insurance industry experts that nature-related underwriting and investing risks can be financially material to the industry. However, most re/insurers do not currently assess these risks in their underwriting and investing businesses because of several barriers, namely lack of data and information, including relevant methodologies; lack of regulatory/supervisory guidance or requirement; lack of technical capacity and skills; lack of mandate or buy-in from executive management or board of the company; and lack of awareness of nature-related risks. The supervisory response to nature-related issues, though picking up pace, has been limited thus far on this particular risk. This is partly also because insurers and supervisors are busy grappling with climate change risks and their impact to the insurance sector, and have limited resources and bandwidth to start assessing other risks. Considering these challenges and constraints, this report proposes the following recommendations and the next steps.

4.1 Recommendations

For the re/insurance industry

1. Continue to identify and build data, analytical tools, metrics and indicators to assess and measure nature-related risks.

There is a lack of reliable decision-useful data to quantify the negative impacts of nature loss on the insurance sector. The data and information derived from global environmental-energy-economic models provide some directional indication of potential impacts but are not accurate enough to base financial decisions on. The global insurance sector may consider starting collaboration with academics, companies in the real economy, the civil society, governments and other stakeholders to help them generate accurate and reliable data and enhance their capacity to analyse such data for the insurance sector's decision-making. However, as re/insurers invest in/underwrite business with companies from the real economy, it is important that they also get relevant data from those companies in order to assess the potential impact. The insurance sector can consider leveraging resources from existing global data initiatives such as the G20 Data Gaps Initiative,[136] the NGFS Bridging Data Gaps[137] and the Future of Sustainable Data Alliance[138] and from other public and private data providers that have collected nature-related data at the global and local level.

Following the activities mentioned above, the re/insurers may consider developing risk management tools such as forward-looking metrics and indicators to quantify nature-related dependencies, risks and impacts, which will help them factor in these variables in mitigating potential future risks. This may help, in the long run, designing nature-aligned insurance products and constructing a nature-aligned investment portfolio while complying with prudential rules for investing and underwriting. This may help them meet any forthcoming disclosure guidelines and requirements on nature-related risks.

Until insurance industry specific standards, metrics and indicators become widely available, the risk transmission framework used in this report (Figure 11) may be employed to qualitatively assess nature-related risks arising from various sectors that re/insurance companies are supporting. Re/insurance companies could also consider existing third-party risk assessment tools such as FAIRR, IRIS+, ENCORE, IBAT and TRASE forest-risk commodity supply chain database.

2. Assess nature-related risks by regions, sub-regions, and countries.

While some industry frontrunners have developed models to understand nature-related risks by regions, sub-regions, and countries (e.g. Global Swiss Re Institute's Biodiversity and Ecosystem Services Index) and started providing these assessments internally, there is still no publicly available model to assess insurance sector-specific nature-related risks in different regions. The global insurance community could benefit from collaborating and partnering with existing similar initiatives such as the Spatial Finance Initiative[27] and leveraging their own local models and databases to develop models to disaggregate asset-level nature-related risks by regions, sub-regions, and countries as well as by types of risks. This will help re/insurers with a globally diversified portfolio to better strategize risk management practices such as risk pooling.

For re/insurance supervisors

3. Become educated and raise awareness of nature-related risks among regulated entities.

For supervisors to be effective on supervising nature-related risks, they need to first become educated. This can be done through engaging with industry leaders, academics, and their peers in SIF. Supervisors can also play an important role in raising the awareness of nature-related risks and facilitate peer-learning among its regulated entities.

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27 The Spatial Finance Initiative's GeoAsset project is a public goods endeavour focused on making accurate, comparable, and comprehensive asset-level data tied to ownership publicly available across all major sectors and geographies. spatialfinanceinitiative.com

In order to fulfill this task, supervisors need to understand how domestically regulated firms are thinking about nature-related issues. For example, when the climate change-related discourse was at an early stage, supervisors conducted initial surveys of the insurance sector[28] that helped both engagement on the issue and supervisory understanding of how domestic firms thought about the issues. Similar work on nature-related issues at the domestic level would complement this report's work at the global level.

4. As a more accurate understanding of nature-related risks to the insurance sector is under way, support the development of non-prescriptive guidelines, options and tools towards a better assessment and management of nature-related risks.

Based on the best-known scientific evidence of nature-related risks and industry data calls, supervisors may consider developing non-prescriptive guidelines, options and tools to encourage risk management frameworks in their jurisdictions to systematically address both existing and forward-looking nature-related financial risks. After the general guideline is developed, the supervisors may consider collaborating with their regulated entities to develop sector-specific risk management guidelines for insurers (e.g. policies on deforestation, World Heritage Sites, water) for the sectors most at risk from nature loss in the long run.

5. Supervisors may consider encouraging regulated entities to voluntarily start disclosing nature-related financial risks in incremental steps and complement industry-specific reporting metrics for nature-related risks in the insurance sector, preferably aligning with relevant initiatives by other standard setting bodies.

The disclosure and reporting of risks along with other datasets is an important part of sound decision-making by both supervisors and the financial community and is conducive to market efficiency. The insurance supervisors may consider encouraging regulated entities to voluntarily start disclosing nature-related financial risks in incremental steps, based on aligned and common practices, bearing in mind the limitations on data availability from underwriting counterparties and investee companies.

In particular, supervisors can consider how to contribute to or leverage on the work of the International Financial Reporting Standards Foundation, which will establish an International Sustainability Standards Board to improve the global consistency, comparability and reliability of sustainability reporting. The ISSB will issue investor-focused sustainability standards, starting with climate, and then for other environmental risks, such as nature-related and social risks. The standards will include industry-specific guidance. The IAIS has stated that the consultative committee to be set up by the IFRS Foundation to promote interoperability with complementary reporting requirements should include the insurance supervisory community and stands ready to assist in the development of insurance industry-specific guidance.[139]

The SIF members may also consider following developments in the finance sector pertaining to sustainability disclosure and biodiversity within the ISSB, TNFD and other major initiatives. Given the need to develop capacity expeditiously, SIF members can collaborate by identifying common capacity needs and sharing best practices and expertise on supervision of nature-related risks.

4.2 Next steps

1. Organize webinars to disseminate the finding of this study.

SIF will organize webinars or in-person events on the sidelines of the upcoming biodiversity COP and relevant international conferences to disseminate the key findings of this study – in the form of easily understandable presentations and infographics. Such sessions will be recorded and uploaded on the SIF website or the Climate Training Alliance (CTA) platform.

2. Develop a self-learning tutorial on understanding and assessing nature-related risks.

In partnership with SIF members, observers or partners, SIF will develop an online self-learning tutorial that guides insurance supervisors/SIF members in understanding the fundamentals of nature loss and risk transmission channels from nature loss. The tutorial can also have a module on supervisory best practices in this space. The tutorial will be hosted by the CTA portal, facilitated by the Financial Stability Institute (FSI) of the Bank for International Settlements (BIS).

28 For example, the Australian Prudential Regulation Authority (APRA) conducted climate change survey of 38 large entities across the ADI, superannuation, and general, life and private health insurance industries. in mid-2018. The survey was designed to assist APRA in understanding and assessing industry maturity in responding to climate change risks and to inform APRA's supervisory approach. www.apra.gov.au/sites/default/files/climate_change_awareness_to_action_march_2019.pdf

3. Supervisor- and industry-led collaborative workshops to discuss challenges as they relate to nature-related risks.

SIF will facilitate a workshop inviting supervisors and industry executives to discuss key nature-related challenges that the insurance sector is likely to face. The industry executives are expected to walk through how they have been addressing nature-related issues, if at all, in their underwriting and investment decision-making, and what key challenges are. If any insurer has already applied a benchmark or standard to identify, assess, measure and respond to nature-related risks, such a case study will be further developed and shared widely with the global insurance community.

4. Conduct a survey of regulated entities to understand nature-related issues.

SIF will facilitate the design and development of a survey questionnaire that the supervisors could use to understand how domestically regulated insurers are thinking about nature-related issues – from nature-related definitions to data sources and metrics used to take stock of nature-related risks. The survey could be qualitative to start with. At a later date, results from surveys from different jurisdictions could be analysed by SIF to understand and collate best practices by both supervisors and industry and taken forward as an input to the TNFD process or a similar international initiative.[29] The findings from the survey could also feed into future research as proposed in the fifth next step below.

5. Conduct further research to quantify exposure to nature-related risks.

After nature-related risk measurement methodology and metrics are developed, future research could work to quantify the insurance premium and investments that are most exposed to sectors that are most sensitive to nature-related risks such as forestry and agriculture. In the long run, supervisor-led data collection could be used to inform nature-related risk exposure. However, it is important that sufficient conceptual consultation on data collection and credibility be done among insurers and insurance regulators and supervisors to make the process convincing enough for an eventual reporting on nature-related risks.

Photo: SJustin Roy | Unsplash

29 For example, the 2020 Issues Paper on the Implementation of the Recommendations of the Task Force on Climate-related Financial Disclosures drew on the results of a SIF Survey on the implementation of the TCFD recommendations and supplemental guidance, which was conducted during the first half of 2019. This survey was designed by SIF-IAIS and then SIF members individually sent it out their regulated entities. www.sustainableinsuranceforum.org/view_pdf.php?pdf_file=wp-content/uploads/2020/11/eb1f0b_365cc83062254d509c20d79313143868-2.pdf

ANNEXES

Annex I
List of interviewees and experts consulted

Name	Organization
United Nations, not-for-profit organizations, think tanks, academia, specialized consulting firms	
Ellie Mulholland	Commonwealth Climate and Law Initiative (CCLI)
Chris Hart	Global Canopy Programme Company
Pauline Becquey-Helary Roland Nussbaum	French Insurance Federation (FFA)
Odile Conchou	Secretariat of CBD
Faraz Uddin Amjad	UNDP (Insurance & Risk Finance Facility)
Butch Bacani	UN PSI
Nataliya Fedorenko Philipp Klais Shitij Gupta	McKinsey & Company
Insurance and re-Insurance industry, insurance brokers, rating agencies	
Pedro Nascimento de Oliveira	AEGON
Lucy Saye Maeve Sherry Miba Stierman Ria Exworthy	Aviva plc
Sylvain Vanston	AXA Group
Laurent Montador	Caisse Centrale de Réassurance SA (CCR)
Alex Wittenberg Amy Barnes Jennifer McPhillips Josh Darr Koenraad De Stickere Rob Bailey	Marsh McLennan
Jon Richter	MetLife
Ernst Rauch	MunichRe
Allison Spector	Nuveen, a TIAA company
Xiang Fei	PICC Property and Casualty Company Limited
Dennis Sugrue Maurice Bryson	S&P Global
Martin Weymann	Swiss Re
Oliver Schelske	Swiss Re Institute
Gerald Sussmann Peter Quell	Versicherungskammer Bayern
Insurance supervisors/supervisory associations	
Giorgis Hadzilacos James Orr	Bank of England (UK)
Emily Bell Joris van Toor	De Nederlandsche Bank (DNB) (Netherlands)
Elizabeth F. Brown Lindsey Baldwin Stephanie T. Schmelz	Federal Insurance Office, US Department of the Treasury
Saori Takahashi Yuri Ikeda	Financial Services Agency (FSA) (Japan)
Daniel Wang Jeanne Stampe	Monetary Authority of Singapore (MAS) (Singapore)
Yue (Nina) Chen	New York State Department of Financial Services (NYDFS) (US)
Gustavo Adolfo Araujo Caldas Paulo Roberto Miller Fernandes Vianna Sergio Luis Franklin	Superintendência de Seguros Privados (SUSEP) (Brazil)

Annex II
Survey questionnaire

1. **Which best describes your organization?**
   Insurer
   Reinsurer
   Agent
   Broker
   Insurance regulator
   Insurance association
   Academia
   NGO
   Other (please specify)

2. **If you are an insurer, which one of the following best describes your business? (Choose more than one, if applicable)**
   Property & Casualty/Non-Life
   Life & Health
   All lines/Composite
   Other (please specify)
   Not applicable

3. **What is your current role in your company?**
   Chief Executive Officer
   Chief Underwriting Officer
   Chair/Vice-Chair/Member of the Board
   Chief Sustainability Officer
   Risk Manager
   Sales & Marketing Manager
   Broker
   Investment Manager
   Chief Financial Officer
   Chief Risk Officer
   Chief Investment Officer
   Legal/Compliance Manager
   Claims Manager
   Underwriting Manager
   Regulator/Supervisor
   Other (please specify)

4. **In which country are you located?**

5. **On a scale from 0–10, how dependent are your company's business activities on nature? (The term 'nature' broadly refers to the concepts of natural capital, ecosystem, ecosystem services and biodiversity.)**

6. **Please rank the following elements of nature (technically called 'natural capital stocks') according to the level of dependence of your business on them.**
   Land, including vegetation
   Water
   Air/Atmosphere
   Species (plants, animals, microorganisms)
   Other (please specify)

7. **Please rank the following in order of sectors most at risk because of nature loss.**
(Please use "nature loss" lens, and not "climate change" lens although there is an overlap between the two)
Agriculture, Fishery & Livestock
Apparel (clothing, footwear, etc.) & Textiles
Automotive
Chemical
Construction & Engineering
Food & Beverage
Manufacturing (paper, pulp & timber)
Manufacturing (e.g. metals, plastics, rubber, electrical & electronics equipment)
Media & Entertainment
Mining & Quarrying
Oil & Gas
Pharmaceutical, Healthcare, Lifesciences & Biotech
Real Estate/Home
Telecommunications & IT
Tourism & Travel
Transportation (incl. distribution) & Storage
Utilities (electricity, energy, water)
Other (please specify)

8. **What is your company's current level of understanding of the following risks in your overall business (both underwriting and investing)?**
Climate change risk
Natural hazard risk
Nature-related risk

9. **Does your company assess nature loss-related risks in your underwriting process?**
Yes
No

10. **Does your company assess nature loss-related risks in your investment process?**
Yes
No

11. **If your company's underwriting process assesses nature loss-related risks, how have you been doing it?**
Quantitatively
Qualitatively
Mixed

12. **If your company's investment process assesses nature loss-related risks, how have you been doing it?**
Quantitatively
Qualitatively
Mixed

13. **What framework is your company using to assess nature-related risks?**
(Choose more than one, if applicable)
ESG/Sustainability Framework
Climate Change Framework
A standalone Nature/Biodiversity/Ecosystem Framework
Mainstreamed in companywide Risk Management Framework
We do not assess nature-related risks
Other (please specify)

14. How difficult is it for your company to draw links between nature loss and financial risk?

15. Do you agree that nature-related risks are financially material to your underwriting business?

Definitely yes
Probably yes
Probably not
Definitely not
I do not know

16. Do you agree that nature-related risks are financially material to your investing business?

Definitely yes
Probably yes
Probably not
Definitely not
I do not know

17. Which part of your company's business is/will be more impacted by nature-related risks?

Underwriting
Investing
Both equally
Both, but depends (please elaborate)

18. Has your company already observed impacts from nature loss-related risks on your underwriting performance?

Yes
No
Not assessed yet
I do not know

19. Has your company already observed impacts from nature loss-related risks on your investment performance?

Yes
No
Not assessed yet
I do not know

20. In terms of time scale, by when do you foresee the impacts of nature-related risks on underwriting vs investing activities of the insurance sector?

	In the short term (by or before 2025)	In the medium term (2025–2030)	Only in the long term (beyond 2030)
Underwriting			
Investing			

21. How prepared is your company to respond to the potential impacts of nature-related risks on your underwriting business?

	Fully Prepared	Largely Prepared	Moderately Prepared	Somewhat Prepared	Not Prepared at all	I do not know
Physical Risks						
Transition Risks						
Liability Risks						
Reputation Risks						

22. How prepared is your company to respond to the potential impacts of nature loss-related risks on your investing business?

	Fully Prepared	Largely Prepared	Moderately Prepared	Somewhat Prepared	Not Prepared at all	I do not know
Physical Risks						
Transition Risks						
Liability Risks						
Reputation Risks						

23. If your company does not assess nature-related risks today, do you have plans to assess these risks?

Yes

No

I do not know

24. If your company plans to assess these risks, when are you planning to start doing this?

Within 1 year

Within 1–3 years

Within 3–5 years

Other (please specify)

25. If your company does not assess nature-related risks today, could you please explain why?

26. What are the major barriers to assessing nature-related risks in your underwriting business? (Choose more than one, if applicable)

Lack of data and information

Lack of awareness and understanding of nature-related risks

Lack of technical capacity and skills

Lack of regulatory/supervisory guidance or requirement

Lack of mandate/buy-in from Executive Management/Board

Other (please elaborate)

27. What are the major barriers to assessing nature-related risks in your investing business? (Choose more than one, if applicable)

Lack of data and information

Lack of awareness and understanding of nature-related risks

Lack of technical capacity and skills

Lack of regulatory/supervisory guidance or requirement

Lack of mandate/buy-in from Executive Management/Board

Other (please elaborate)

28. Where do you find data and information related to nature loss and associated risks and impacts? (Choose more than one, if applicable)

Third party data providers

Public databases and websites

In-house

Outsourced to consultants

Other (please elaborate)

29. Does your company currently have an in-house team of experts on nature and biodiversity? (Please note that 'nature and biodiversity' experts are a subset of sustainability experts, and hence different.)

Yes

No

May be

I do not know

30. If your company currently has an in-house team of experts on nature and biodiversity, who do they report to?

Chief Executive Officer
Chief Underwriting Officer
Chief Risk Officer
Chief Investment Officer
Chief Financial Officer
Chief Sustainability Officer
Other (please specify)

31. Does your company plan to build an in-house team of experts on nature and biodiversity?

Yes
No
I do not know

32. Does your company plan to train its existing staff on nature and biodiversity?

Yes
No
I do not know

33. Is your company supportive of disclosure of nature-related risks by the insurance industry?

Yes
No
I do not know

34. Has your company disclosed nature-related risks already?

Yes
No
I do not know

35. What are the key drivers needed to kickstart assessment and disclosure of nature-related risks in the insurance industry? (Choose more than one, if applicable)

Regulation & Supervision
Investor demand
Disclosure guidance and frameworks (e.g. Taskforce on Nature-related Financial Disclosures - TNFD)
Mandate/buy-in from Executive Management/Board
Employee pressure
Client demand
Civil society pressure
Other (please elaborate)

36. Is your company aligned with any one of the following nature- or biodiversity-related goals or targets? (Choose more than one, if applicable)

Aichi Biodiversity Targets
National Biodiversity Strategies and Action Plans (NBSAPs)
European Union's 2030 Biodiversity Strategy
Other (please specify)

Annex III
Nature-related terminologies – accepted definitions

Natural capital is a way of thinking about nature as a stock that provides a flow of economic benefits to people and the economy.[140] It consists of natural assets such as water, forests and clean air. In simple terms, natural capital means natural resources or environmental resources, consisting of both living beings and non-living things. The term "capital" simply represents an economic-utilitarian perspective on nature, specifically those aspects of nature that people use (or anticipate to use).[141]

Ecosystem means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.[142]

Ecosystem services are the economic benefits people obtain from ecosystems. According to the original formulation of the Millennium Ecosystem Assessment (MEA), ecosystem services were divided into provisioning, regulating, supporting and cultural. Provisioning services describe material or energy outputs from ecosystems; regulating services regulate processes like quality of air, water or soil; supporting services underpin all other ecosystem services; cultural services include non-material or intangible benefits such as aesthetics or spiritual experiences elicited by nature. This classification, however, is superseded in the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services assessments by the nature's contributions to people (NCP) system. IPBES has identified 18 categories of NCP,[143] grouped into three overlapping categories – material contributions, non-material contributions and regulating contributions. NCP are all the contributions, both positive and negative, of living nature (i.e. all organisms, ecosystems and their associated ecological and evolutionary processes) to people's quality of life. Beneficial contributions include e.g. food provision, water purification, flood control and artistic inspiration, whereas detrimental contributions include e.g. disease transmission and predation that damages people or their assets.[144] It should be noted that in some cases those contributions only have a detrimental effect due to people's lack of adaptation to nature, e.g. non-resilient buildings. For the purpose of this report, the widely understood MEA classification will be used while acknowledging IPBES's recognition that many services fit into more than one of the four categories.[145]

Nature, according to Global Canopy and Vivid Economics,[146] is the global natural ecosystem in its entirety. This encompasses both the stock of natural capital as well as the way in which they interact with each other.

Biodiversity is the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This includes variation in genetic, phenotypic, phylogenetic and functional attributes, as well as changes in abundance and distribution over time and space within and among species, biological communities, and ecosystems.[147] Using the term 'biodiversity' to refer to natural capital and nature is extremely limiting, and should be avoided to provide better clarity to the financial practitioners.

Photo: AKris Mikael Krister | Unsplash

Annex IV
Natural capital and ecosystem services

According to the original formulation of the Millennium Ecosystem Assessment, ecosystem services were divided into provisioning, regulating, supporting and cultural. Provisioning services describe material or energy outputs from ecosystems; regulating services regulate processes like quality of air, water or soil; supporting services underpin all other ecosystem services; cultural services include non-material or intangible benefits such as aesthetics or spiritual experiences elicited by nature.

Natural Capital	Flow of Ecosystem Services[148]			
	Provisioning Services (products from ecosystem)	**Regulating Services** (regulation of ecosystem processes)	**Cultural Services** (non-material benefits from ecosystem)	**Supporting Services** (necessary for all other ecosystem services)
Land, including vegetation	• Clean air • Food production (crops) • Food production (livestock) • Genetic/Medicinal resources • Minerals & raw materials • Renewable biofuels • The provisioning of groundwater & freshwater • Timber production	• Absorbing and detoxifying pollutants • Biological control/ Bioremediation • Buffering & attenuation of mass flows (e.g. transport & storage of sediment by rivers, lakes and seas) • Carbon sequestration and storage • Coastal protection/ Flood and storm protection • Control of soil salinization • Daytime and nighttime visibility • Erosion prevention & maintenance of soil fertility • Global climate regulation • Good soil condition • Maintenance of hydrological cycle • Micro-climate regulation (local climate & air quality) • Moderation of extreme events • Noise regulation • Pest and disease control • Soil moisture recharge and retention • Temperature regulation • Waste-water treatment/ Filtration • Water quality	• Aesthetically attractive landscapes • Cultural heritage • Inspiration for culture, art, and design • Leisure and tourism • Livability • Recreation, mental and physical health • Spiritual experience	• Biodiversity (wildlife) • Habitats for species • Maintenance of genetic diversity • Nutrient cycling • Photosynthesis • Soil formation • Water cycling

Natural Capital	Flow of Ecosystem Services[148]			
	Provisioning Services (products from ecosystem)	**Regulating Services** (regulation of ecosystem processes)	**Cultural Services** (non-material benefits from ecosystem)	**Supporting Services** (necessary for all other ecosystem services)
Water	• Food production (crops) • Food production (livestock) • Freshwater fishing • Genetic/Medicinal resources • Marine fishing (including shellfish) • Minerals & raw materials • Provisioning of groundwater & freshwater • Renewable biofuels • Timber production	• Absorbing and detoxifying pollutants • Biological control/ Bioremediation • Buffering & attenuation of mass flows (e.g. transport & storage of sediment by rivers, lakes and seas) • Carbon sequestration and storage • Control of soil salinization • Erosion prevention & maintenance of soil fertility • Global climate regulation • Good soil condition • Maintenance of hydrological cycle • Micro-climate regulation (local climate & air quality) • Moderation of extreme events • Pest and disease control • Pollination • Soil moisture recharge and retention • Temperature regulation • Waste-water treatment/ Filtration • Water quality	• Aesthetically attractive landscapes • Cultural heritage • Inspiration for culture, art and design • Leisure and tourism • Livability • Recreation, mental and physical health • Spiritual experience	• Biodiversity (wildlife) • Habitats for species • Maintenance of genetic diversity • Nutrient cycling • Photosynthesis • Soil formation • Water cycling

Natural Capital	Flow of Ecosystem Services[148]			
	Provisioning Services (products from ecosystem)	**Regulating Services** (regulation of ecosystem processes)	**Cultural Services** (non-material benefits from ecosystem)	**Supporting Services** (necessary for all other ecosystem services)
Air/Atmosphere	• Clean air • Food production (crops) • Food production (livestock) • Timber production	• Absorbing and detoxifying pollutants • Biological control/ Bioremediation • Buffering & attenuation of mass flows (e.g. transport & storage of sediment by rivers, lakes and seas) • Carbon sequestration and storage • Coastal protection/ Flood and storm protection • Daytime and nighttime visibility • Global climate regulation • Maintenance of hydrological cycle • Micro-climate regulation (local climate & air quality) • Moderation of extreme events • Noise regulation • Pest and disease control • Pollination • Soil moisture recharge and retention • Temperature regulation	• Aesthetically attractive landscapes • Cultural heritage • Inspiration for culture, art, and design • Leisure and tourism • Livability • Recreation, mental and physical health • Spiritual experience	• Biodiversity (wildlife) • Habitats for species • Maintenance of genetic diversity • Nutrient cycling • Photosynthesis • Soil formation • Water cycling
Species	• Food production (crops) • Food production (livestock) • Freshwater fishing • Genetic/Medicinal resources • Marine fishing (including shellfish) • Minerals & raw materials • Renewable biofuels • Timber production	• Absorbing and detoxifying pollutants • Biological control/ Bioremediation • Carbon sequestration and storage • Coastal protection/ Flood and storm protection • Control of soil salinization • Erosion prevention & maintenance of soil fertility • Good soil condition • Pest and disease control • Pollination • Soil moisture recharge and retention • Wastewater treatment/ Filtration • Water quality	• Aesthetically attractive landscapes • Cultural heritage • Inspiration for culture, art and design • Leisure and tourism • Livability • Recreation, mental and physical health • Spiritual experience	• Maintenance of genetic diversity • Nutrient cycling • Soil formation

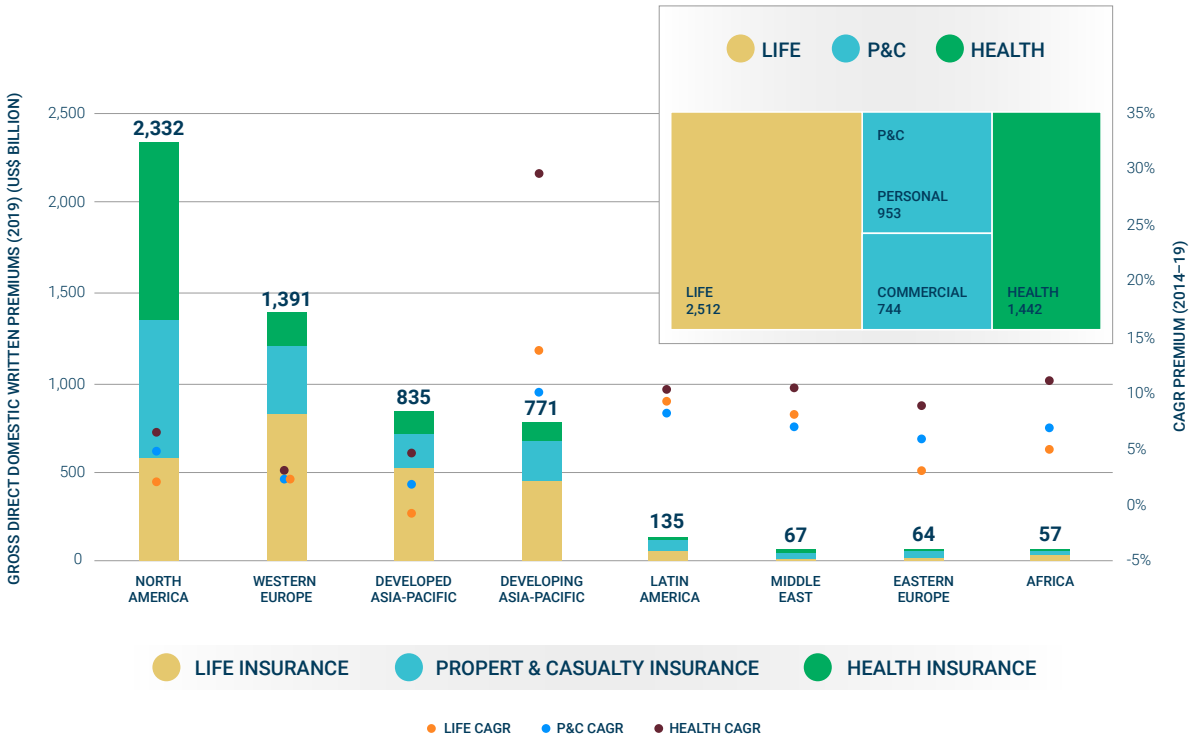
Annex V
Key characteristics of the global insurance industry

Underwriting

According to McKinsey Global Insurance Pools,[149] life insurance accounted for 44 percent of global insurance premiums in 2019. Annuity products comprised the bulk (30 percent) of life insurance products globally, followed by group, endowment, unit-linked products, and term life respectively.[150] P&C insurance contributed to 30 percent of global insurance premiums in 2019, 45 percent of which is motor insurance premiums. Lastly, health insurance accounted for 26 percent of global insurance premiums in 2019. Taken together, life and health comprised the majority (70 percent) of global insurance premiums written in 2019.[30]

P&C insurance can be broken down into personal and commercial lines, with personal comprising 56 percent of the total and commercial 44 percent in 2019.

Figure 24 **Gross domestic written premiums and their compound annual growth rate (CAGR) by region**



Source: McKinsey Global Insurance Pools[31]

30 A similar breakdown for life and health exists but has not been presented here due to lack of disaggregated data.

31 This data has been sourced from regulatory/ industry reports for 66 markets (amounting to more than 90 percent of the global insurance market) that constitute these regions; figures have been converted to US$ using the 2019 fixed exchange rate. Developed APAC included Australia; China, Hong Kong SAR; Japan; New Zealand; the Republic of Korea; Singapore; and Taiwan, Province of China. Developing APAC included China, mainland; India; Indonesia; Malaysia; the Philippines; Thailand and Viet Nam.

In total, the global insurance premiums written in 2019 amounted to US$6 trillion, including the reinsurance industry.[151] As illustrated by Figure 24, North America and Western Europe comprised about 66 percent of the global total, followed by Asia-Pacific (28 percent), Latin America, the Middle East, Eastern Europe and Africa (jointly a total of about 6 percent). However, in terms of growth of premium, developing Asia-Pacific countries led the pack across all insurance lines, most prominently in health (CAGR of nearly 30 percent between 2014 and 2019). Between 2014 and 2019, North America and Western Europe, currently the regions with the highest premium volume, grew at a rate below the global average for all insurance lines.

An initial estimate by the author found that the total global P&C insurance premiums is distributed among 18 economic sectors, as illustrated by Figure 25. When combined with global health insurance (P&C plus health insurance), the business sector contributing the most to global insurance premiums is pharmaceutical, healthcare, life sciences and biotechnology. It is followed by the automotive or motor sector.

Figure 25 **Distribution of global P&C insurance premium among economic or business sectors**

Note: Total insurance premium for each block is within the indicated range.
Source: Author's research, supported by data from McKinsey Global Insurance Pools

Investing

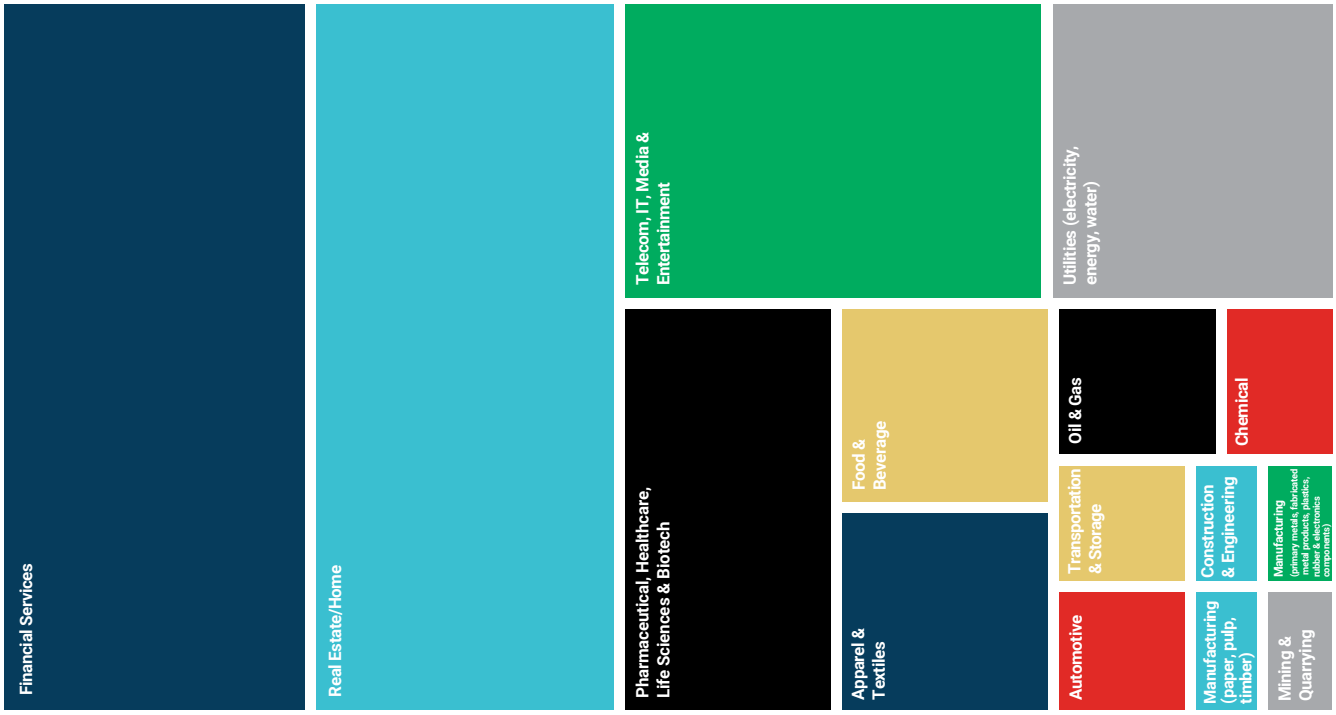
The global insurance industry is one of the largest groups of institutional investors, holding about US$33 trillion of financial assets.[152] It is therefore critical to understand the industry's investment exposure as it is estimated that approximately 90 percent of the industry's profit is derived from investment income[153] with the rest from underwriting.[32] Although the investment profit is relatively larger for life and health insurers, the ratio of investment to underwriting profit is still significantly large for P&C insurers, as indicated by NAIC's analysis of US P&C insurers in 2019.[154]

The investment data from US insurers indicate that about 60 percent[155] of P&C assets are invested in investment-grade bonds (mostly corporate, followed by municipal and other government bonds) or other fixed-income securities such as fixed-income exchange-traded funds (ETFs) while the same goes up to 90 percent[156] for L&H insurers. Similarly, P&C stock market exposure is around 25–30 percent while it is less than 10 percent for L&H insurers.[157] Apart from bonds and stocks, mortgage loans on real estate and real estate constitute two other important areas of investment for the insurers, more so for L&H than P&C. For a global average of the entire insurance industry, a 70 percent bond exposure could be assumed[158] while noting that regional variations do exist. Reinsurers have an investment exposure similar to P&C, with 65 percent in bonds and the rest in stocks and other investment products.[159]

32 Both underwriting and investing are subject to cyclical fluctuations and data from a single year should not be used towards establishing the characteristics of industry profitability. Also, the investment portfolios are not used solely for profit but to be able to pay out claims as they arise.

Since the investments of the global insurance industry, in aggregate, are predominantly exposed to sovereign and corporate bonds followed by stocks,[160] one could examine the economic sector exposure of the industry by analysing the top sectors for bonds and stocks, by volume. For corporate bonds, the US corporate investment-grade bonds[33] are used, for lack of better data, as a proxy[161] for getting an indication of the size of industry's corporate bond exposure. For municipal and sovereign bonds, the top sectors are public utilities, transportation, construction, health, education, industrial, and housing/real estate. For stocks, a broad market ETF could be a reasonable proxy[34] to get an indication of the insurance industry's stock market exposure. The overall exposure[35] of the insurance investment to economic sectors is illustrated by Figure 26 below.

Figure 26 **Distribution of global re/insurers' investments among economic sectors**



Note: The size of each sector represents the relative size of investments in that sector.

Source: Author's estimations

33 First, insurance industry's bond exposure is mostly investment grade (BBB-rated or above). Second, since the global corporate bond market, in terms of country of incorporation, is dominated by the US followed by Europe, China, and emerging markets, it is reasonable to use the US corporate bond market as a proxy to understand the global corporate bond exposure to business/economic sectors. It is, however, duly noted that the regional differences between investment mixes exist, and in some jurisdictions, the differences might be quite large. See International Capital Market Association (ICMA), 2020. Bond market size. www.icmagroup.org/Regulatory-Policy-and-Market-Practice/Secondary-Markets/bond-market-size

34 Since ETFs vary by sector weightings and each insurance company might have its own preference, S&P 500 Index sectors and their weights are used as a proxy for the insurance sector's equity exposure. www.etf.com/sections/etf-strategist-corner/sector-sector-sp-500?nopaging=1

35 More relative weightage is given to sectors with bond investments than stock investments to get a relative size of sectoral investments. This is based on the author's own assessment.

Annex VI
Assessment of nature-related physical risks to various economic sectors

Using Natural Capital Finance Alliance's ENCORE database, the following sections elaborate on each economic sector's level of dependency on various ecosystem services (very high, high and medium) and assign nature-related physical risk level to each business sector (very high, high and medium). The level of nature loss is derived using the framework for planetary boundaries in Figure 5 and in consultation with the experts in nature and biodiversity. The risk level is assigned by mapping the potential dependency with level of nature loss (very high, high and medium). The methodology is further explained in Annex VII.

Even though each of the following economic sectors depends on several ecosystem services, the illustration (in radial charts below) is provided only if physical risks corresponding to those services are very high, high, or medium. The ecosystem services that are at low physical risks or not applicable to the economic sector, are excluded from the illustration for clarity purposes. For a full picture of the dependency of each sector, please refer to Figure 8.

This assessment is important because a re/insurance company insures or invests in companies or businesses in the real economy, and the changes of the risk profile of an economic sector arising from nature loss makes them pertinent to the re/insurance companies.

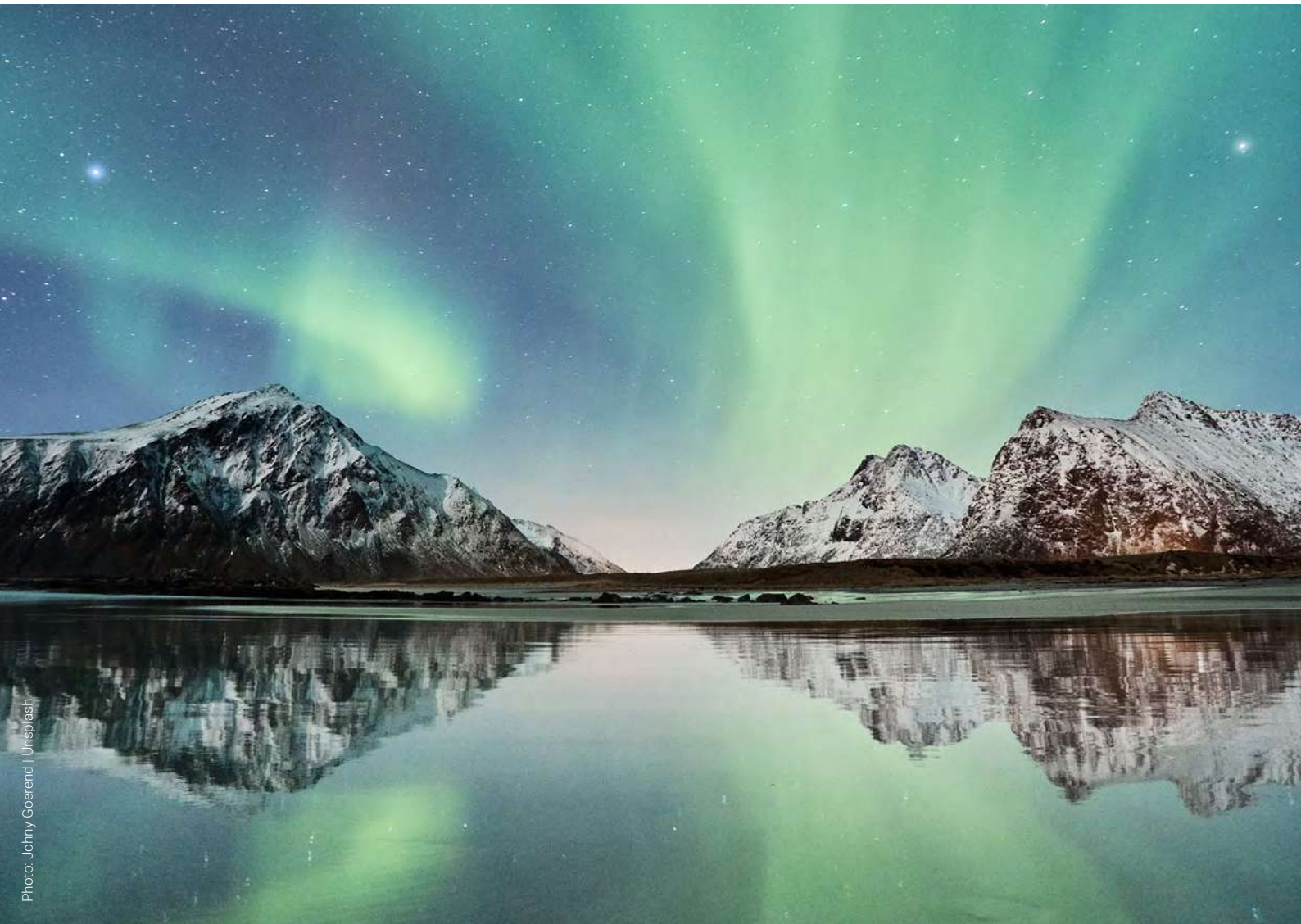
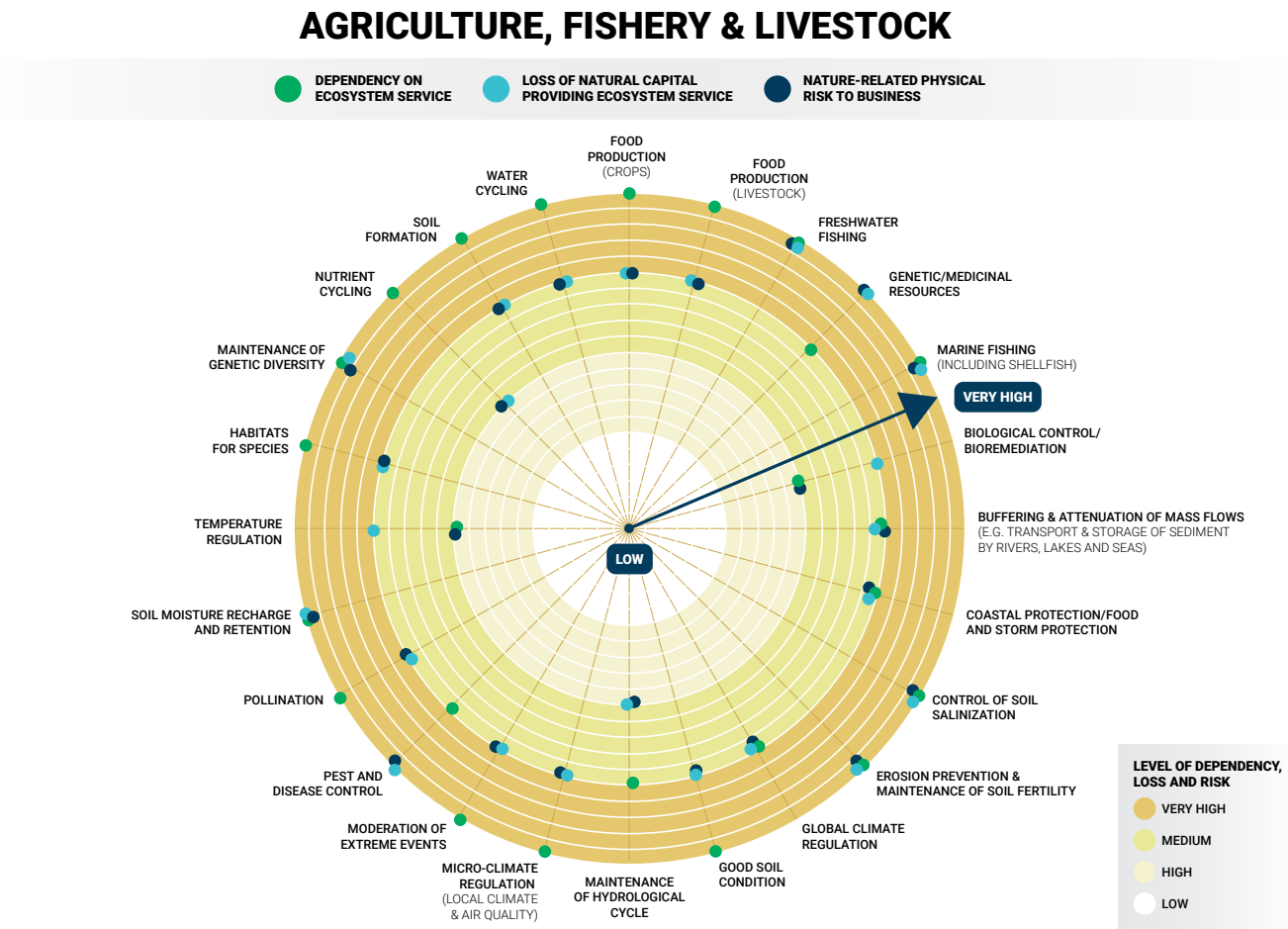


Photo: Johny Goerend | Unsplash

Agriculture, fishery and livestock

Agriculture, fishery and livestock businesses are very highly or highly dependent on several ecosystem services, most prominently the ones derived from water, land and species. While a net global assessment of the economic value these businesses generate from nature is not available, one estimate[162] places the global annual market value of animal-pollinated crops at up to US$577 billion, the first sale valuation of fisheries and aquaculture at US$362 billion per year, and the global annual value of seagrass nutrient cycling (e.g. the economic enhancement of commercial fish by seagrass) at US$1.9 trillion. A study by the Economics of Ecosystems and Biodiversity[163] found that a well-managed reef in the Indian and Pacific Oceans can provide between 5 and 15 tonnes of seafood can be provided per square kilometre each year, demonstrating the important role of coral reef habitats. Another study,[164] looking specifically at pest management ecosystem services (e.g. animals and birds feeding on potentially harmful pests), values the natural pest control in agricultural settings between US$54 billion and US$1 trillion. A study by WWF[165] shows that around 6,000 terrestrial plant species are domesticated today, of which nine account for two thirds of crop production.

Figure 27 **Dependency level of agriculture, fishery and livestock business sector on nature, and business risk as a result of nature loss**



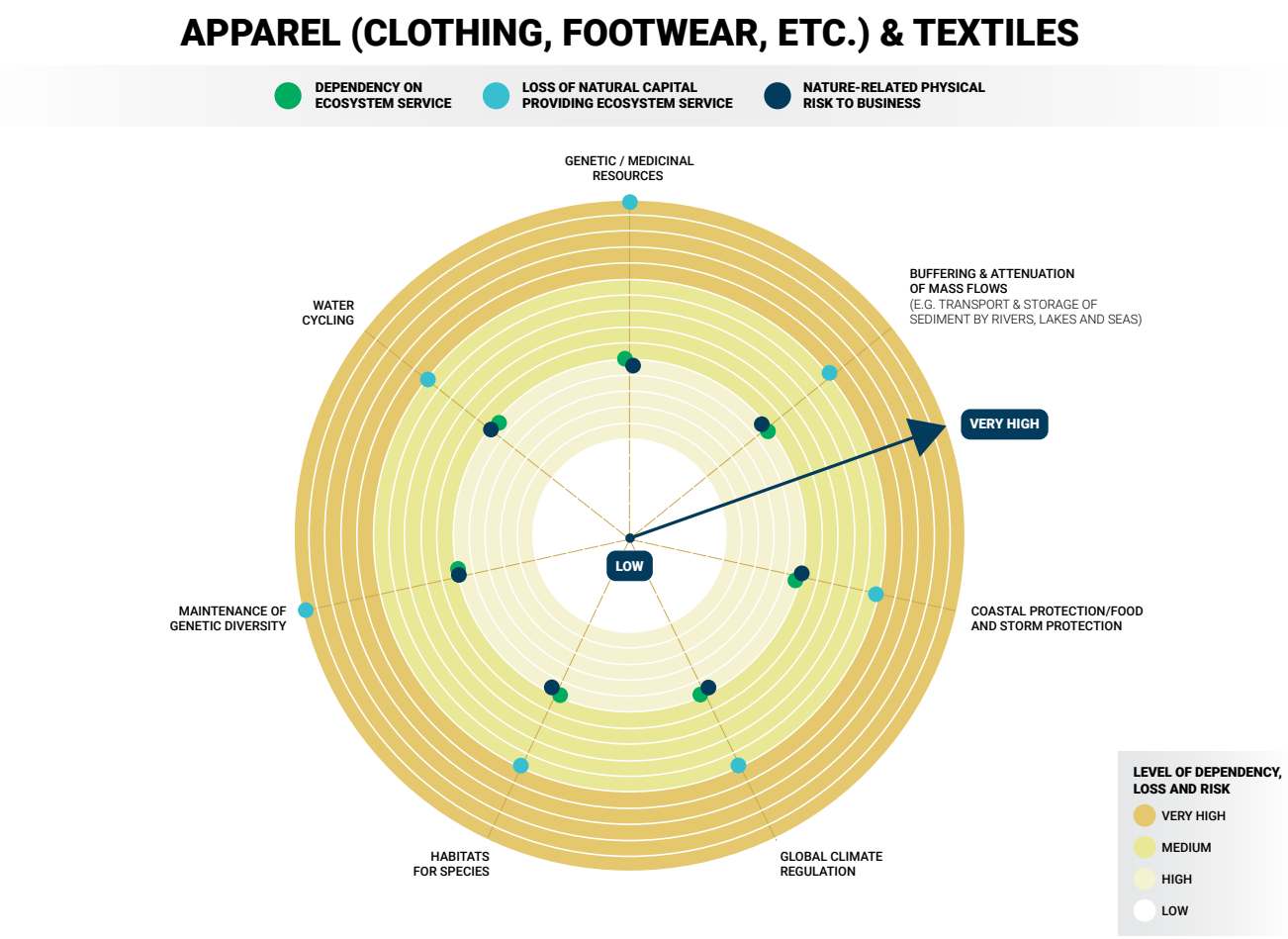
Source: Author

The physical risks to agriculture, fishery and livestock businesses are mostly very high and high because of their very high or high level of dependency on ecosystem services and the current very high or high global level of nature loss that has deteriorated the ecosystem services on which these businesses depend.

Apparel (clothing, footwear, etc.) and textiles

The apparel and textile sector is only moderately dependent on most ecosystem services. The provision of groundwater and freshwater is the only case where the dependence is very high, because textile production (including cotton farming) uses around 93 billion cubic metres of water annually, which represents 4 percent of global freshwater withdrawals.[166] Similarly, an estimated 342 million barrels of oil, a non-renewable natural resource, are used every year by the textile industry to produce plastic-based fibres.[167]

Figure 28 **Dependency level of apparel and textile business sector on nature, and business risk as a result of nature loss**



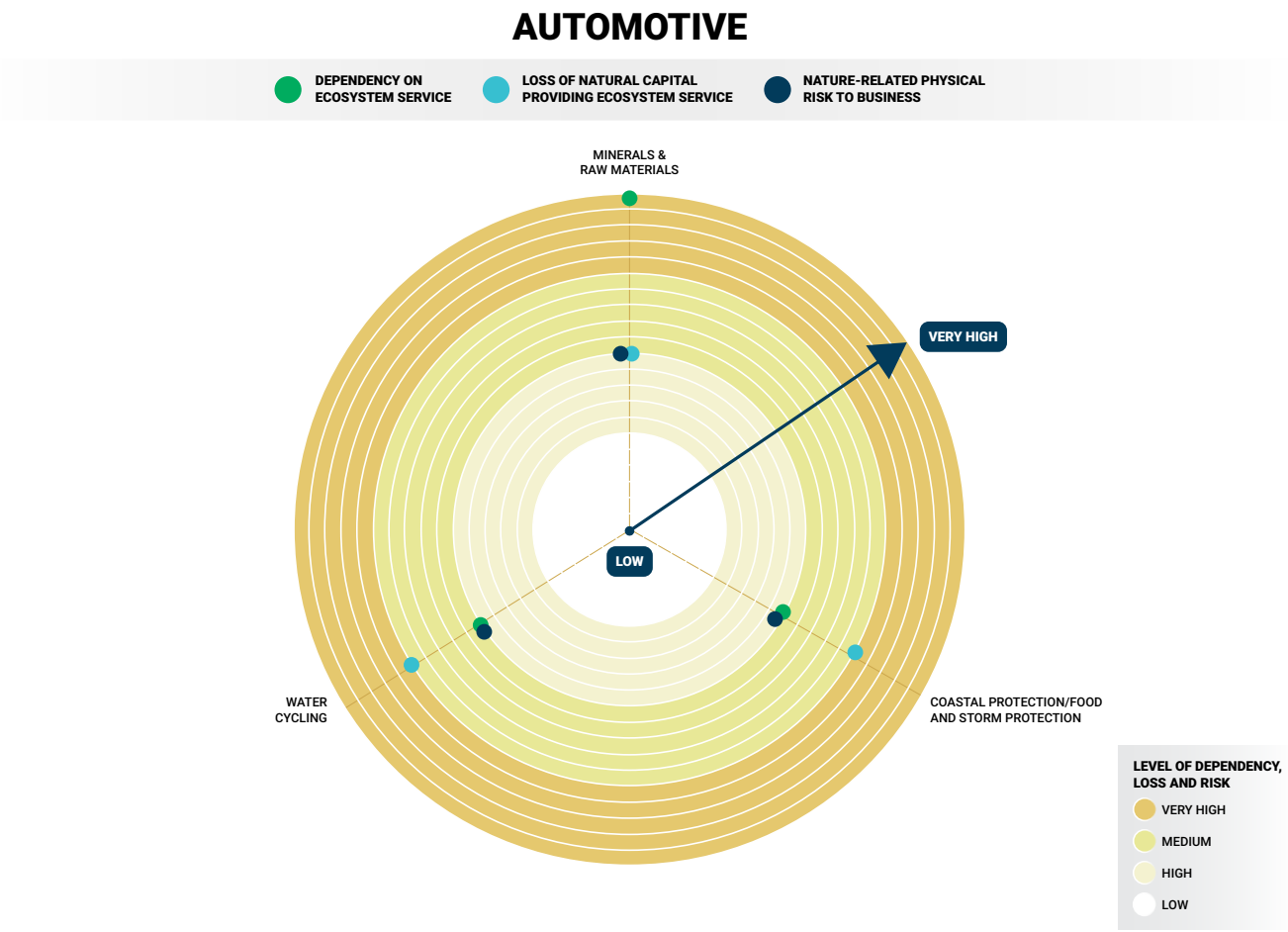
Source: Author

The level of physical risk to the business is low because of the low level of depletion of water resources at the global level. However, at the regional or sub-regional level, many parts of the world have already reached very high levels of freshwater and groundwater loss (see Figure 5), which should be a concern for apparel and textile companies operating in those regions.

Automotive

The automotive sector is below moderately dependent on most ecosystem services. The provision of minerals and raw materials is the only case where the dependence is very high. A study by Nissan[168] shows that automobiles are highly dependent on mineral resources, and metals account for approximately 80 percent by weight of the materials used to build a vehicle.

Figure 29 **Dependency level of automotive business sector on nature, and business risk as a result of nature loss**



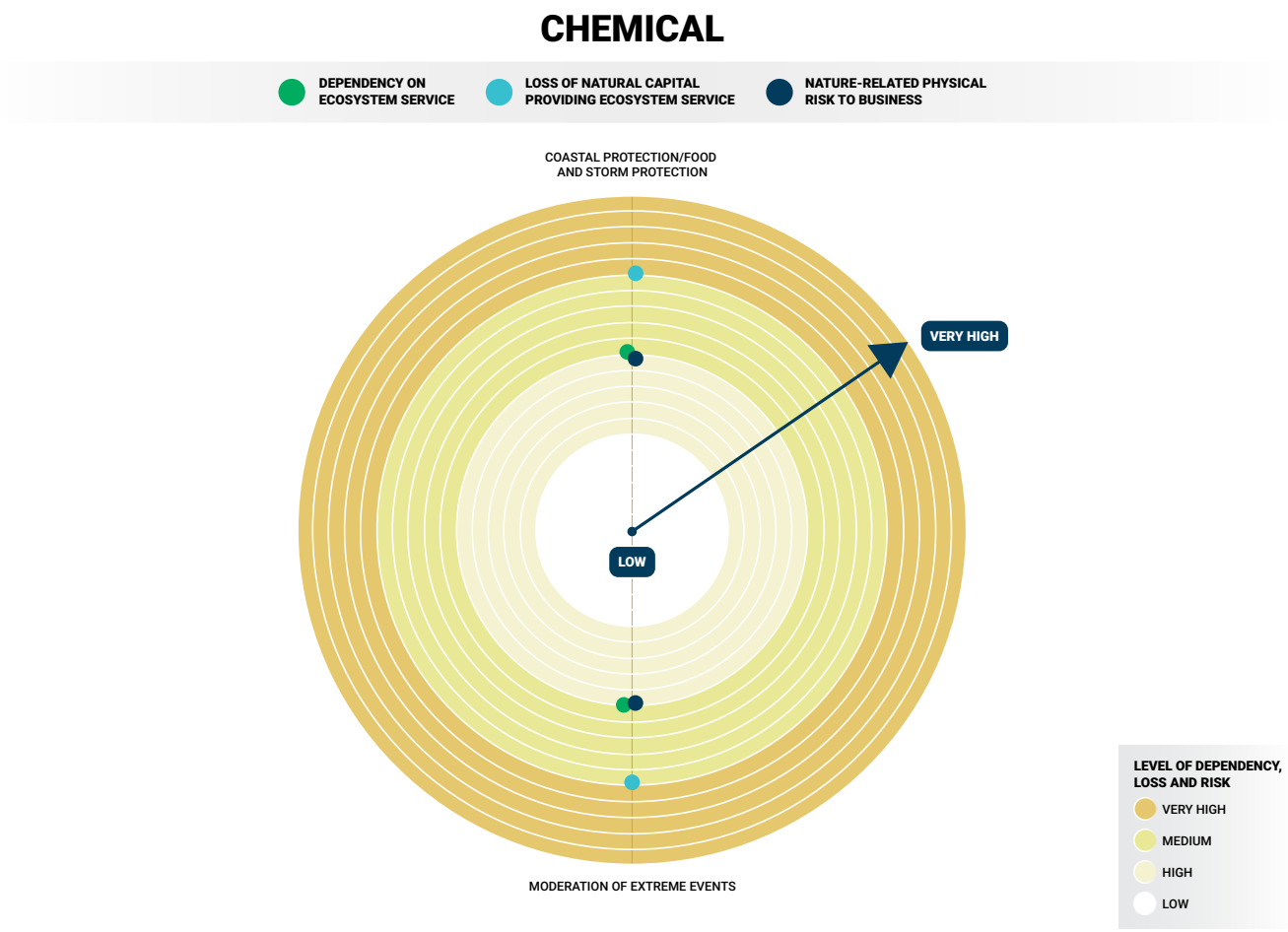
Source: Author

The level of physical risk to the business is medium because of the less significant depletion of minerals and raw materials at the global level. Although metals and minerals are overexploited in certain parts of the world, a study published in *Nature*[169] suggests that a direct reserve depletion is not a source of risk in metal and mineral supply over the coming decades.

Chemical (excluding pharmaceuticals)

The chemical business sector is below moderately dependent on most ecosystem services. The provision of ground and surface water, mainly used for process functioning, cooling, cleaning and transport, is the only case where the dependence is very high. The manufacturing phase is also moderately dependent on protection against floods, storms and extreme events, especially for sites that are located in flood-prone areas.

Figure 30 **Dependency level of chemical business sector on nature, and business risk as a result of nature loss**



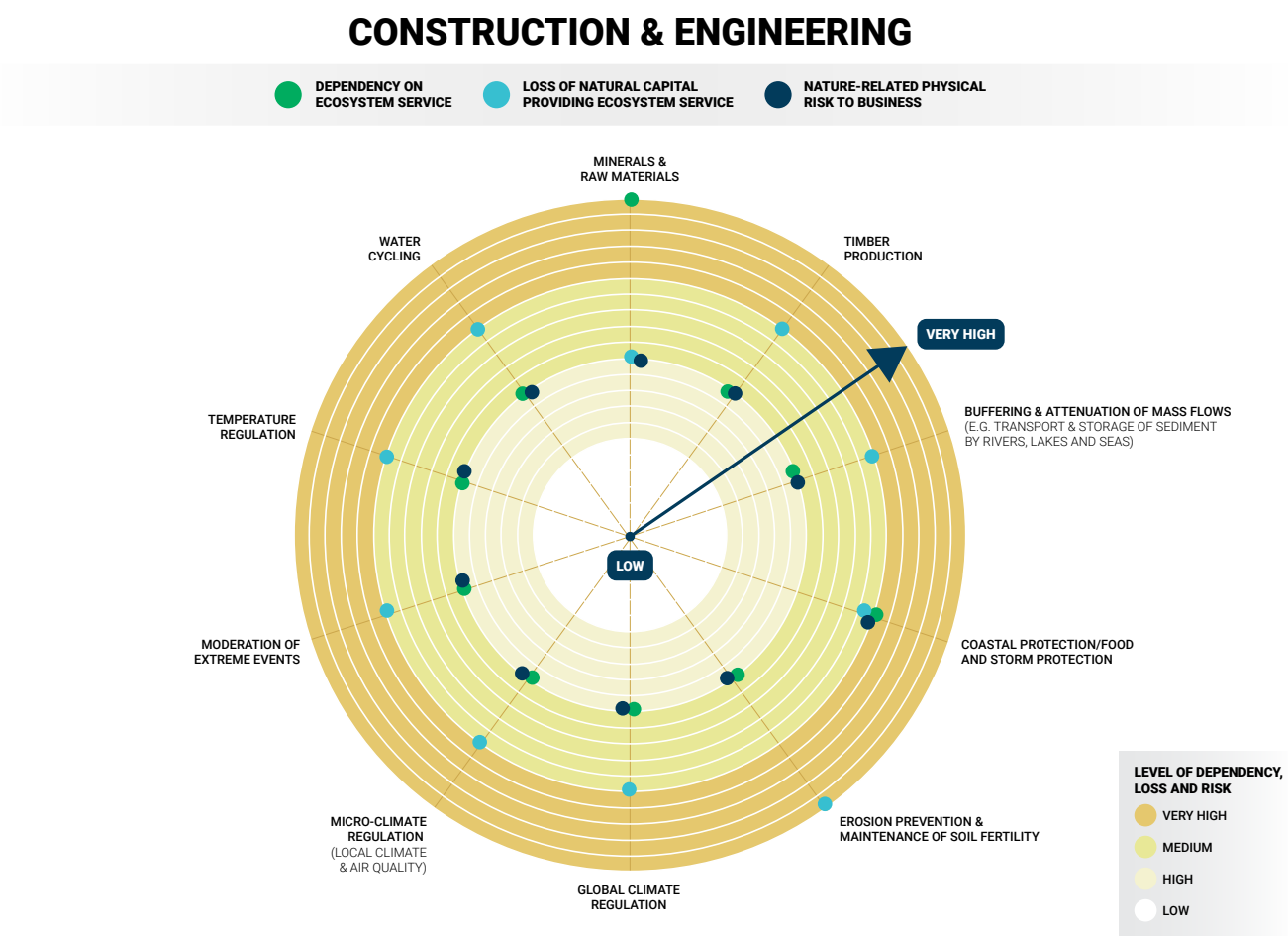
Source: Author

Despite a very high dependency on ground and surface water, the physical risk to the business is low because of the low level of depletion of ground and surface water at the global level.

Construction and engineering

The construction and engineering sector, consisting mainly of buildings construction and heavy and civil engineering construction, is moderately dependent on several ecosystem services, most prominently the provision of ground and surface water, timber production, erosion control, climate regulation, hydrological cycle and moderation of extreme events. The dependency is very high for minerals and raw materials, and high for flood and storm protection. In terms of raw materials, the global construction industry is the largest consumer of sand, whose extraction has increased by more than 300 percent over the last 30 years.[170] Since desert sand is too round for the cement to adhere, much of this sand is extracted from the oceans. Other raw materials heavily used in this industry are clay, limestone, stone, gravel, wood, iron, aluminum and copper, among others. In Europe, housing alone accounts for 30–50 percent of the use of these materials.[171]

Figure 31 **Dependency level of construction and engineering business sector on nature, and business risk as a result of nature loss**



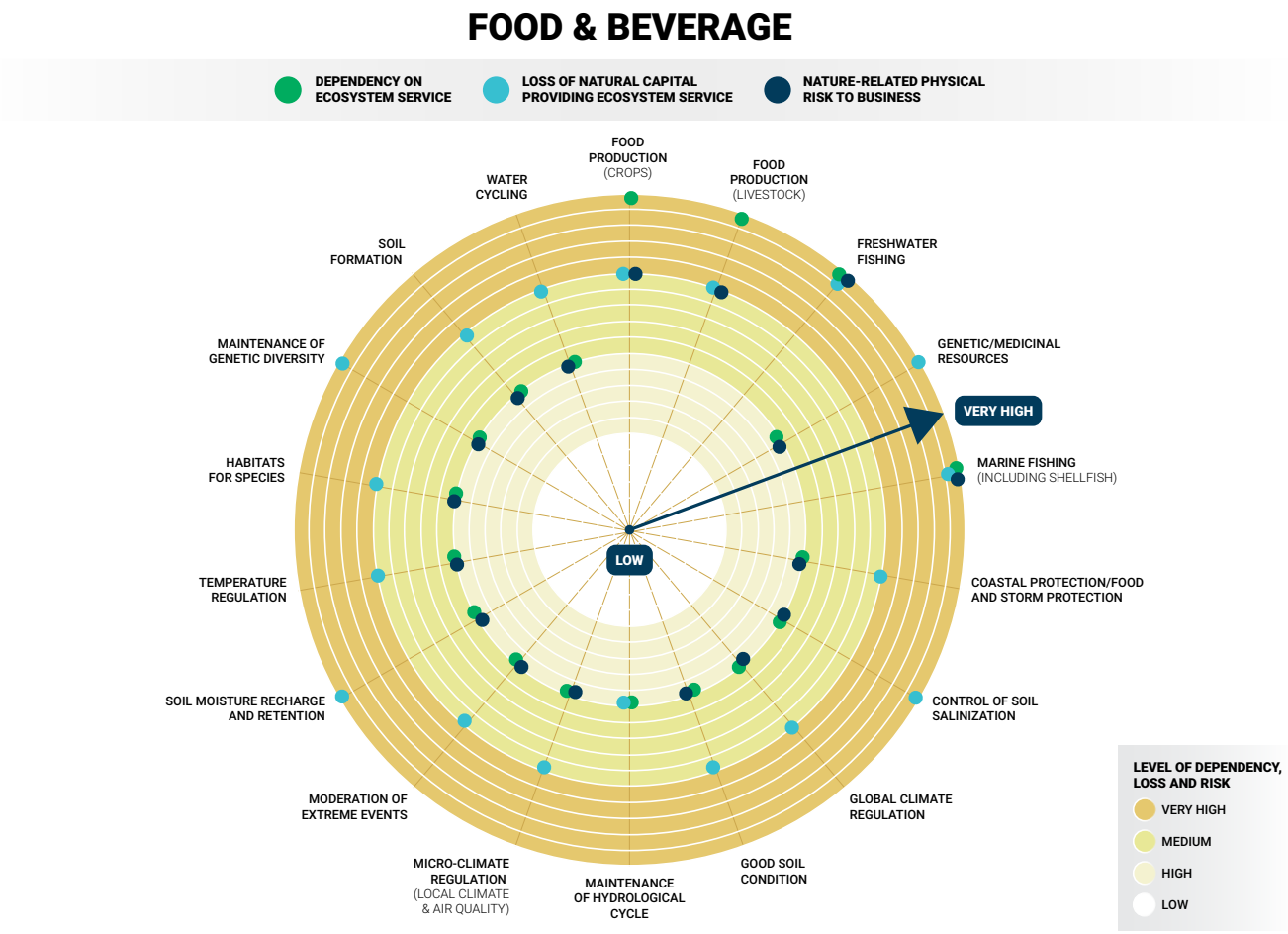
Source: Author

The physical risk to the business is moderate except in coastal areas where the risk is high because of the high level of coastal area deterioration on a global level.

Food and beverage

The food and beverage business sector is distinct from the agriculture, fishery and livestock sector covered in this report with some overlaps. The former is involved in the processing of raw food materials while the latter is involved in primary food production. The food and beverage sector is very highly or highly dependent on some ecosystem services, predominantly the provisioning of food production, and ground and surface water. A study by WWF[172] shows that humans use over 1,160 wild plant species, and at least 2,111 insect, 1,600 bird, 1,110 mammal, 140 reptile and 230 amphibian species as food. The same study shows that around 60 species of edible fungi are commercially cultivated by the food and beverage sector.

Figure 32 **Dependency level of food and beverage business sector on nature, and business risk as a result of nature loss**



Source: Author

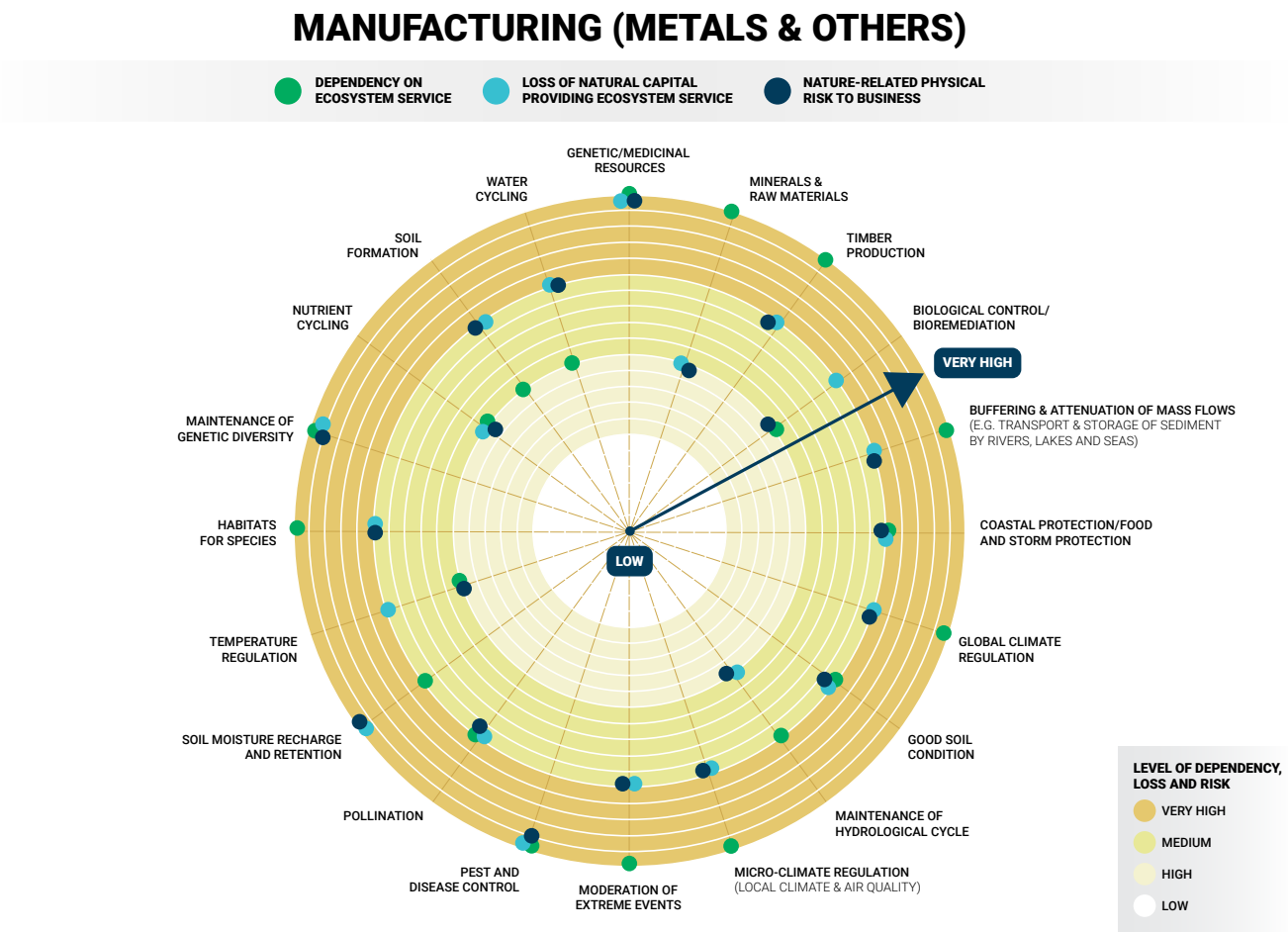
The physical risks to this business sector are similar to those for the agricultural sector because of the heavy reliance on agricultural products.

Manufacturing (e.g. metals, paper, timber)

Primary metals, fabricated metal products, plastics, rubber, and electrical and electronics components

The manufacturing of primary metals and electrical and electronics components is very highly or highly dependent on most ecosystem services, in particular on minerals and raw materials but also protection services for the manufacturing sites. Since the supply chains involved in this industry are globalized, it is important to examine nature dependencies at the supplier level as these dependencies are often indirect. For example, for subsectors such as rubber, ecosystem services such as good soil condition, soil moisture retention, nutrient cycling and soil formation are important because these services enhance soil macrofaunal activities, the distribution and protection of organic matter and the neutralization of soil pH[173] – all essential for the primary supply of rubber to the industry.

Figure 33 **Dependency level of manufacturing business sector (excluding paper, pulp and timber) on nature, and business risk as a result of nature loss**



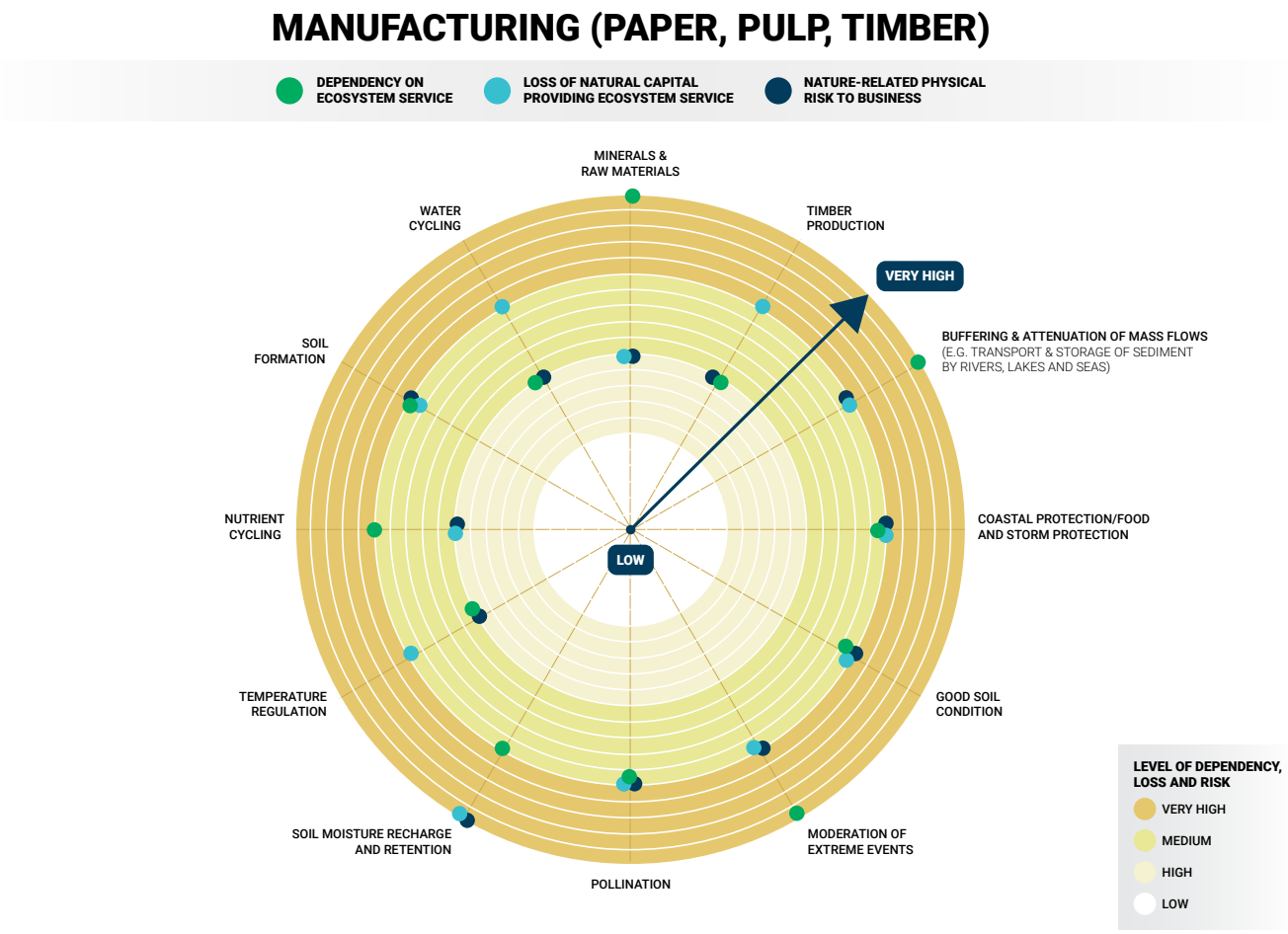
Source: Author

The physical risk to this sector is fairly high because of the already high level of loss of natural capital providing many of the ecosystem services on which the sector is highly dependent. In the figure above, no immediate physical risk has been identified corresponding to freshwater use because of the availability of freshwater on a global scale. However, as this industry is very water-intensive (e.g. it takes more than 30 litres of water to make a single computer chip), a regional and subregional assessment of water availability should be conducted to get a geographically disaggregated landscape of physical risks. For example, in Taiwan (Province of China), where multiple water reservoirs have dropped below 20 percent because of repeated drought events, the semiconductor industry, which uses 10 percent of the island's water,[174] faces risks of disruption to its chipmaking capacity.

Paper, pulp and timber (including furniture and related products)

The paper, pulp and timber manufacturing business is very highly dependent on most ecosystem services. The forest products contributing to the global timber, pulp and paper industry accounted for a total of US$390 billion in global exports in 2019.[175]

Figure 34 **Dependency level of paper, pulp and timber manufacturing business sector on nature, and business risk as a result of nature loss**



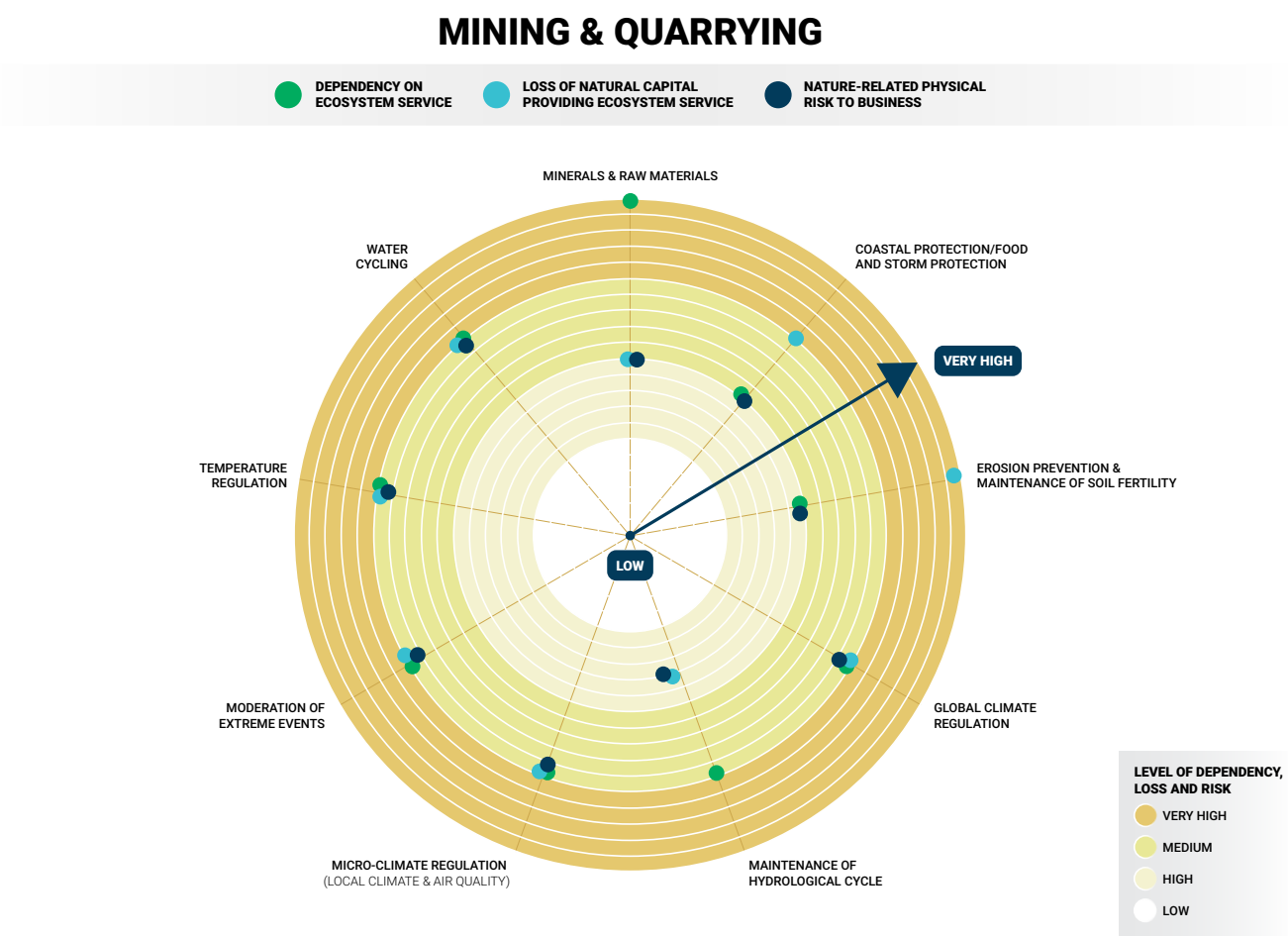
Source: Author

Since the level of loss of natural capital providing most ecosystem services is relatively high or medium, the physical risks to business are generally high.

Mining and quarrying

The mining and quarrying business sector is highly dependent on the provision of minerals and raw materials. In terms of total revenue generated by the top 40 mining and quarrying companies, the major commodities mined globally are copper (26 percent), iron ore (22 percent), coal (17 percent), gold (13 percent), aluminium (3 percent), platinum group metals (2 percent) and others, including phosphate, potash, silver and zinc (17 percent).[176] The raw materials used in the production of batteries, including lithium, nickel, cobalt, manganese and graphite represent less than 3 percent. As of 2020, the total market capitalization of the top 40 mining and quarrying companies was US$1.46 trillion.[177] As metals and minerals are directly extracted from the Earth's crust, the industry's dependency on nature is direct and the highest among all business sectors. The regulating and supporting ecosystem services such as flood and storm protection, moderation of extreme events and climate regulation are also highly important for this business sector.

Figure 35 **Dependency level of mining and quarrying business sector on nature, and business risk as a result of nature loss**



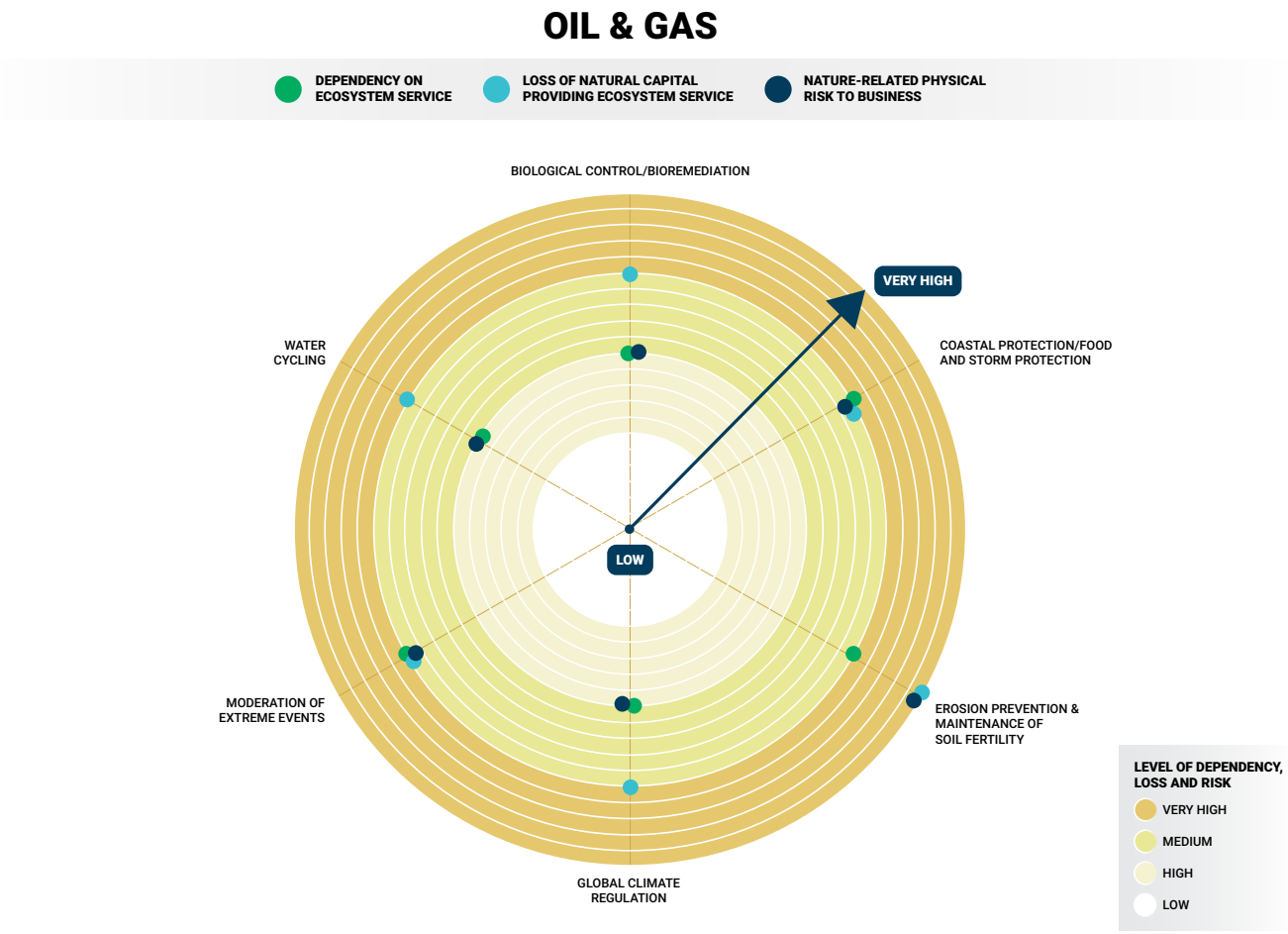
Source: Author

The relative physical risk of a direct reserve depletion of minerals and raw materials is not high according to a study published in *Nature*.[178] However, the overall physical risk to the sector is high because of the deterioration in supporting and regulating ecosystem services.

Oil and gas

The oil and gas business sector is moderately dependent on a limited number of ecosystem services as illustrated in the figure below. As oil and gas are directly extracted from the Earth's crust, the industry's dependency on nature is direct.

Figure 36 **Dependency level of oil and gas business sector on nature, and business risk as a result of nature loss**



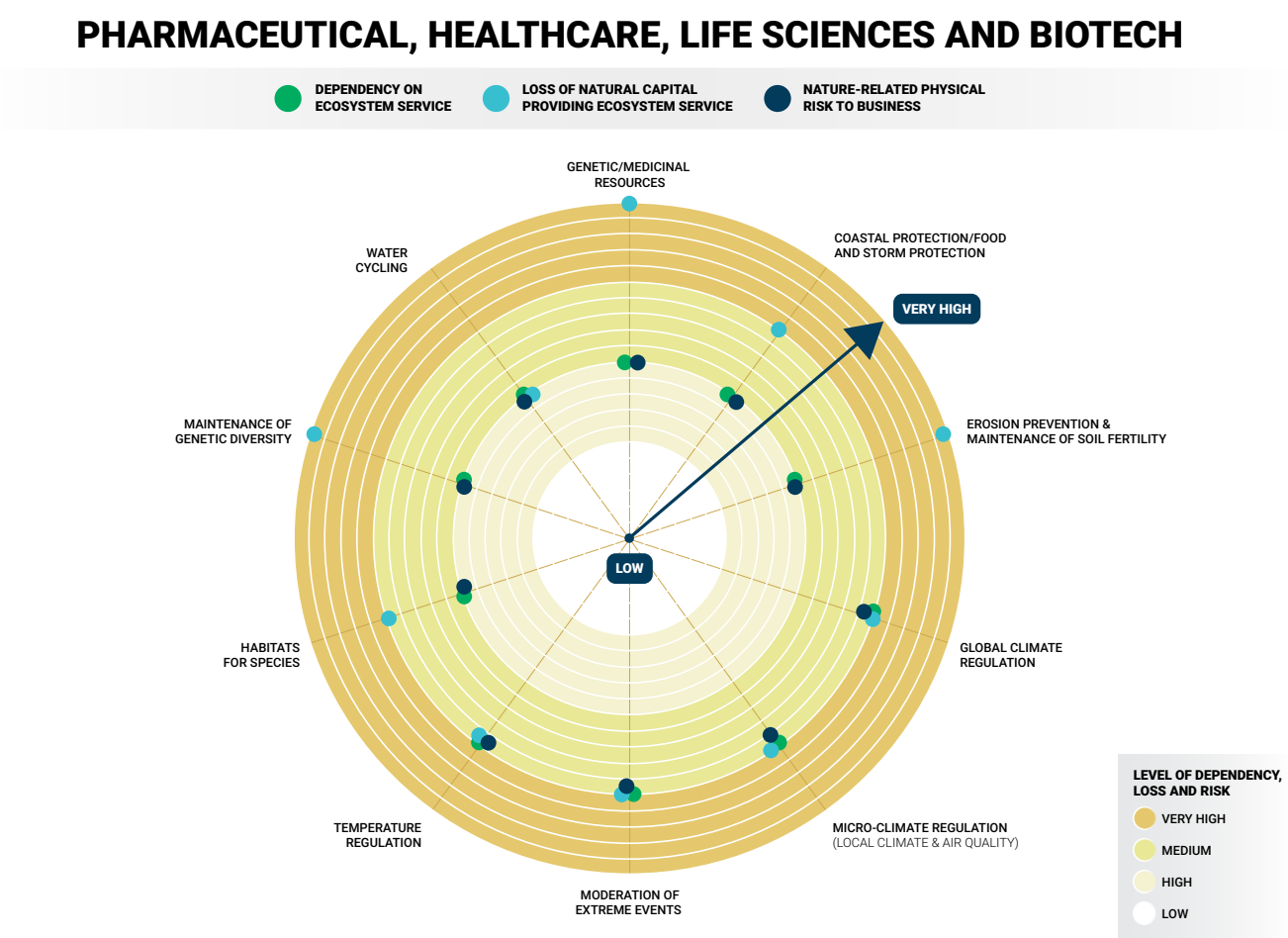
Source: Author

The overall physical risk to the sector is medium to high because of the deterioration in supporting and regulating ecosystem services.

Pharmaceutical, healthcare, life sciences and biotech

The pharmaceutical, healthcare, life sciences and biotechnology business sector is moderately dependent on a limited number of ecosystem services. According to an assessment by the OECD,[179] many drugs used today are derived directly from nature (e.g. digoxin from plant sources, exenatide from lizards, ziconotide from cone snails, penicillin from fungi, atorvastatin from a microbial natural product), which is only a fraction of the millions of plant, microbe and animal species on Earth that could be studied for their pharmacological potential. A US Environment Protection Agency analysis of the costs and benefits of its Clean Air Act between 1990 and 2020[180] shows that the benefits of cleaner air exceed costs, on average, by a factor of more than 30 to 1, leading to better health and productivity for American workers as well as savings on medical expenses for air pollution-related health problems. The same analysis estimates that the Clean Air Act Amendments will prevent over 230,000 early deaths in 2020, demonstrating the significant value of quality air to the global healthcare industry. A similar study[181] on the magnitude and value of the effects of trees and forests on air quality and human health across the United States showed lower incidences of acute respiratory symptoms in areas with trees than in those without.

Figure 37 **Dependency level of pharmaceutical, healthcare and biotechnology business sector on nature, and business risk as a result of nature loss**



Source: Author

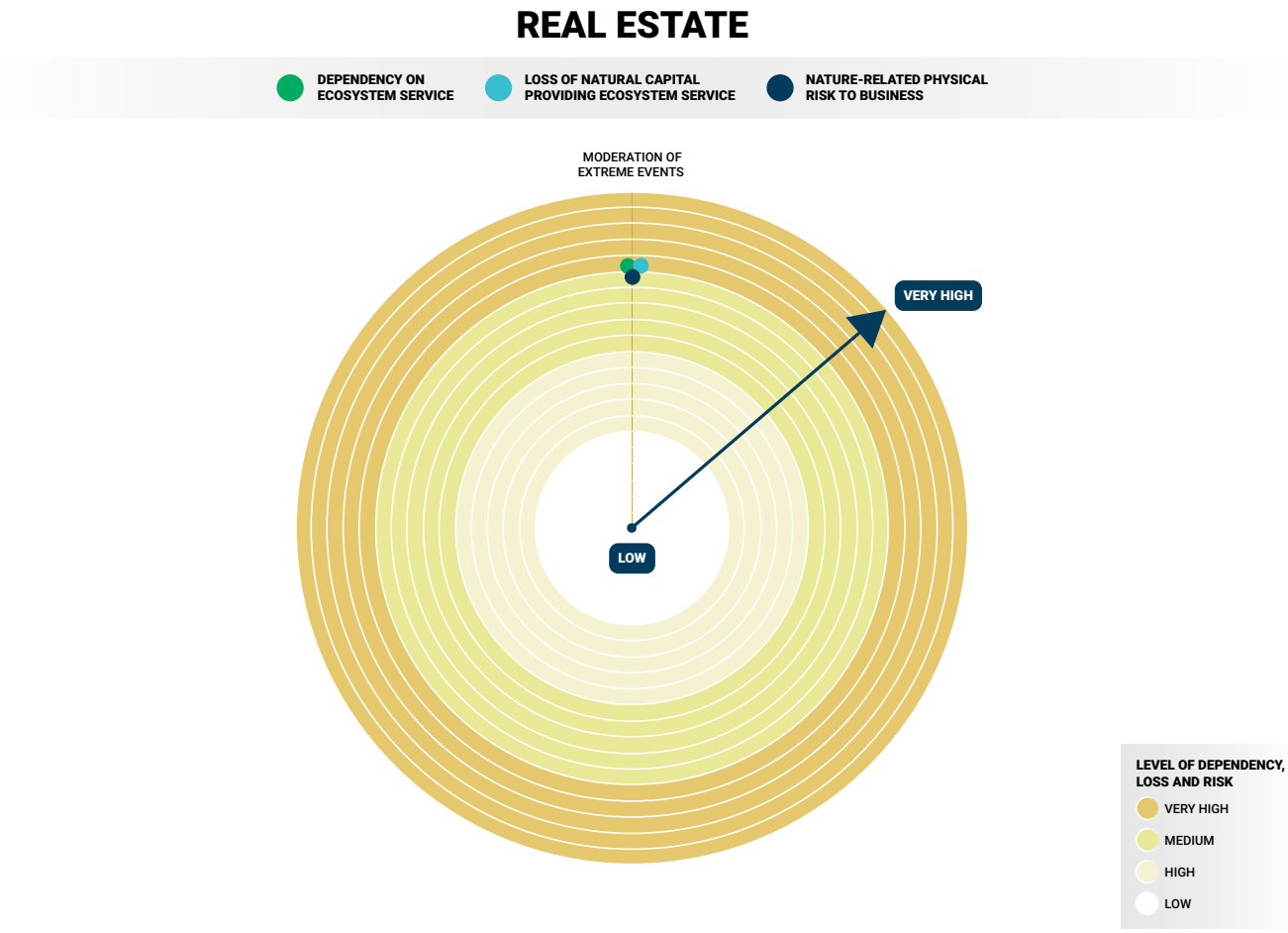
The physical risks to this sector because of nature loss are medium to high. The risks related to depletion of genetic resources are only moderate at this stage and could continue to remain so because of technological advancement in the production of synthetic genetic materials for drugs.

Real estate/home

When assessed separately from construction and engineering, the real estate business sector is relatively less dependent on most ecosystem services. The high dependency is only on the moderation of extreme events. By one estimate,[182] coral reefs reduce wave energy by an average of 97 percent, protecting nearly 50 percent of the global population living in low exposed areas near reefs from the increased frequency of natural hazards caused by storms, flooding and rising sea levels. Another study on the flood reduction benefits of mangroves to people and property in critical global hotspots found that such functions could generate an annual value of US$82 billion.[183]

From a valuation perspective, a University of Washington study suggests that "homes that are adjacent to naturalistic parks and open spaces are valued at 8–20 percent higher than comparable properties, and the presence of larger trees in yards and as street trees can add from 3 percent to 15 percent to home values throughout neighborhoods".[184]

Figure 38 **Dependency level of real estate business sector on nature, and business risk as a result of nature loss**



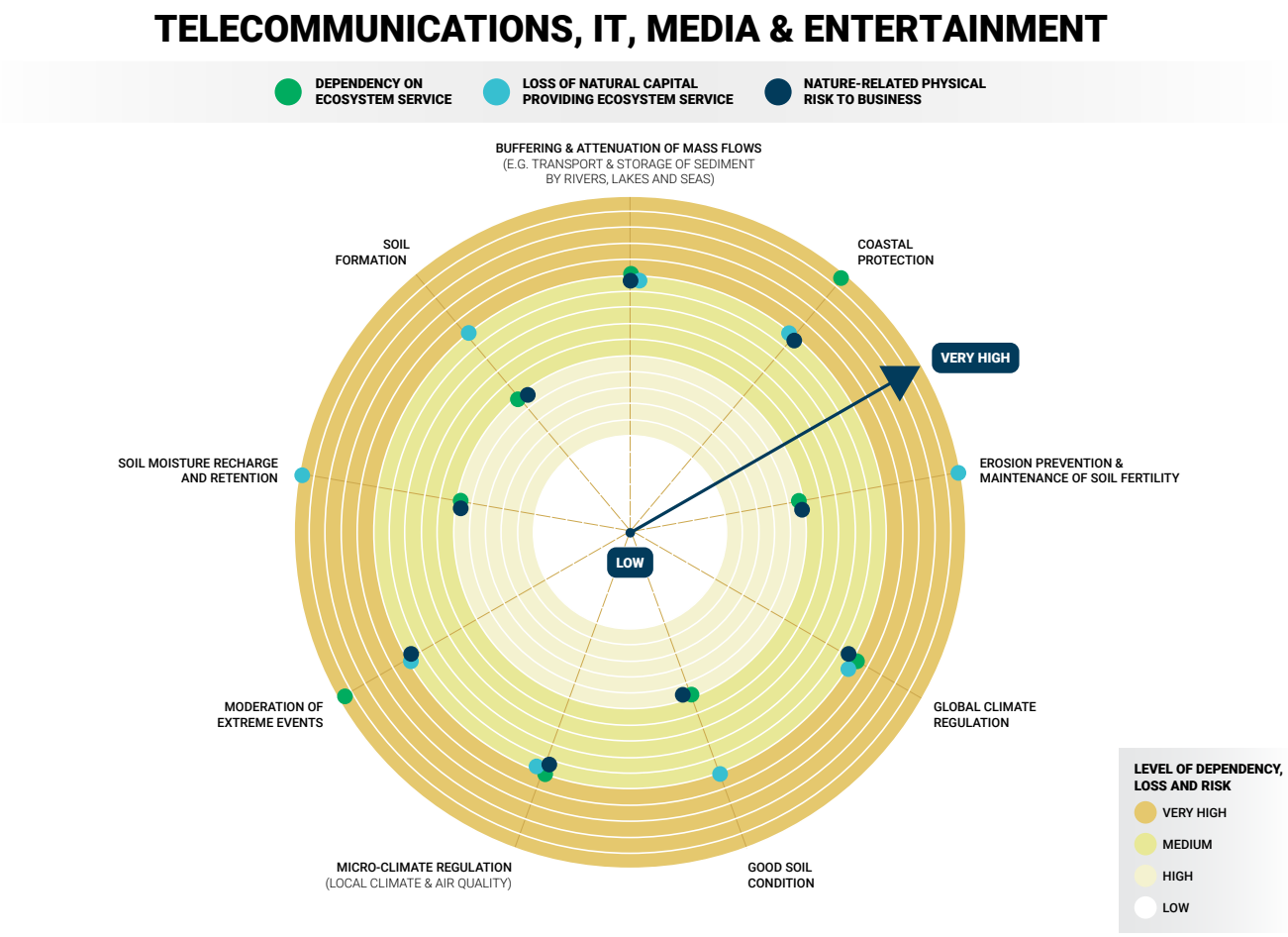
Source: Author

Over the last decade, extreme events such as flooding, storms, hurricanes and wildfires have become more frequent. On the other hand, natural defense systems such as mangroves are disappearing fast. Similarly, because of climate change and other human activities, forests are becoming thinner, less diverse and soil is becoming drier – increasing the intensity of wildfires. Hence, even though real estate's overall dependency on nature is low, the fast-paced loss of regulating and supporting ecosystem services makes the overall physical risk to this business sector high.

Telecommunications, IT, media and entertainment

When assessing the dependence of the telecommunications, IT (including data processing, hosting and related services), media (including publishing) and entertainment (e.g. broadcasting, music and sports) sector, the key focus is on the underlying infrastructure such as transmission lines and cables, broadcasting towers and data servers. Since the production of these parts (e.g. chip manufacturing) is already covered by other business sectors in this report, we consider installation infrastructure (e.g. telecom towers with different components) for our dependency study. This infrastructure is moderately dependent on regulating and supporting ecosystem services, similar to real estate.

Figure 39 **Dependency level of telecommunications and information technology business sector on nature, and business risk as a result of nature loss**



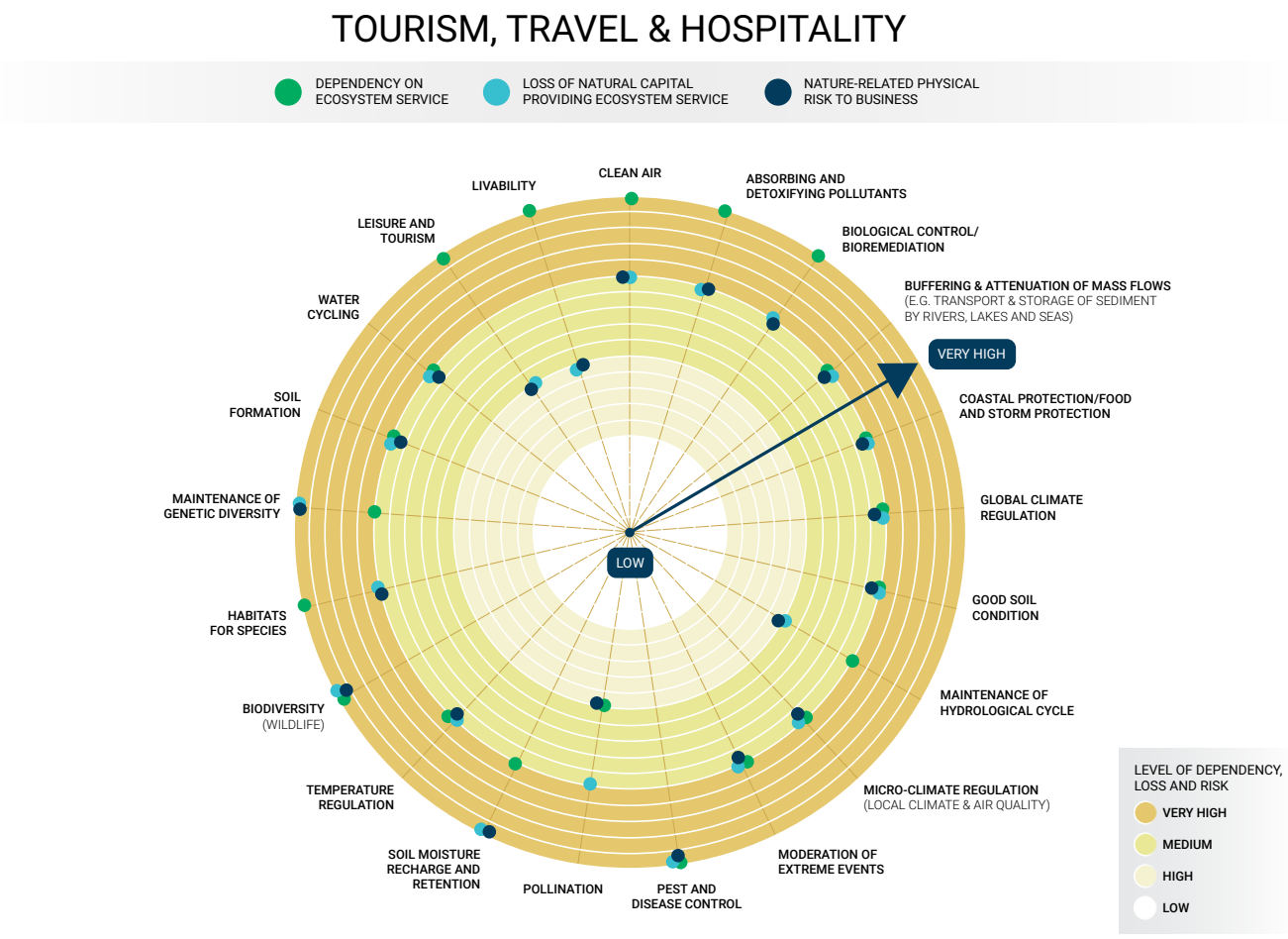
Source: Author

Since the relative vulnerability of this business sector's infrastructure (e.g. transmitters and cables) to natural or anthropogenic hazards such as landslides, floods and storms is high compared to real estate, the physical risks resulting from the loss of some ecosystem services is also high. However, the operational risk to business is relatively low because of the sector's superior repair and recovery options (mobile network antennas, poles and towers).

Tourism, travel and hospitality

The tourism and travel business sector is very highly or highly dependent on a large number of ecosystem services. While a net global assessment of economic value generated by tourism and travel business from nature is not available, an assessment by McKinsey[185] found that tourism linked to protected areas was worth approximately US$300 billion in revenues in 2019. An OECD study[186] estimated that global coral reef tourism has an annual value of US$36 billion and that the recreational benefits of French forest ecosystems have an annual value of US$10 billion. Another recent finding by the UK's Office for National Statistics[187] put nature's contribution to the British tourism and outdoor leisure business at US$17 billion in 2019.

Figure 40 **Dependency level of tourism business sector on nature, and business risk as a result of nature loss**



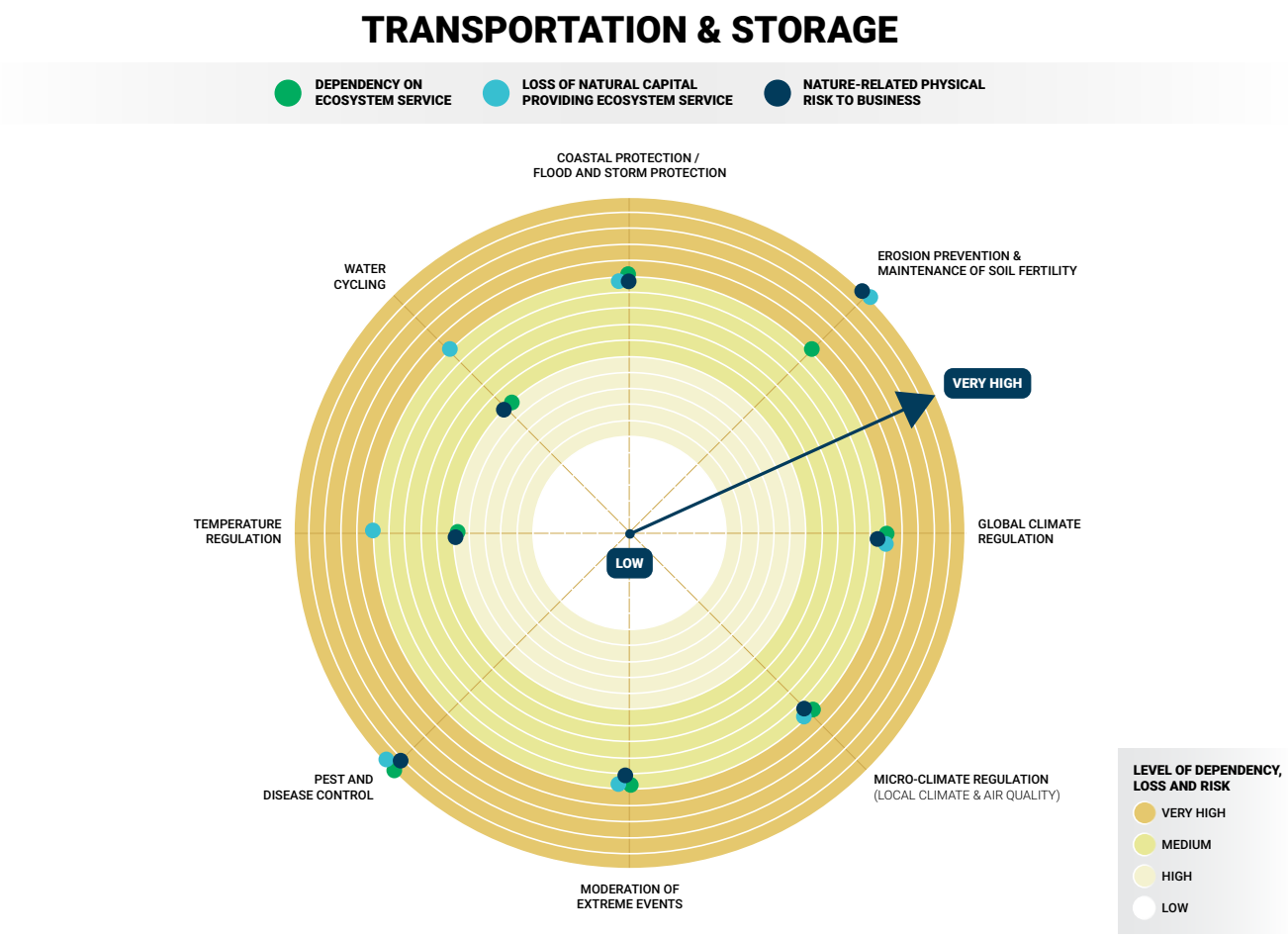
Source: Author

The physical risks to this business sector are high to very high because of the high dependence on ecosystem services as well as the high level of loss of natural capital providing these services. For example, nature's deteriorating capacity for bioremediation and detoxification of pollutants has resulted in more polluted lakes and rivers, and wasteland, which reduces the appeal for tourism. Similarly, habitat conservationists have argued that the increasing frequency of zoonotic diseases such as COVID-19 is a result of increasing encroachment into wild habitats and loss of natural habitat for species. A joint study by the World Tourism Organization (UNWTO) and the United Nations Conference on Trade and Development (UNCTAD) has estimated that as a result of COVID-19, the international tourism and its closely linked sectors suffered an estimated loss of US$2.4 trillion in 2020.[188]

Transportation and storage

The transportation (air, rail, water, truck, transit and ground passenger, and pipeline) and storage (including warehousing) business sector is highly or moderately dependent on regulating and supporting ecosystem services. For example, vegetation plays an important role in reducing the amount of sediment in runoff and storm water from reaching roadways and railways.

Figure 41 **Dependency level of transportation and storage business sector on nature, and business risk as a result of nature loss**



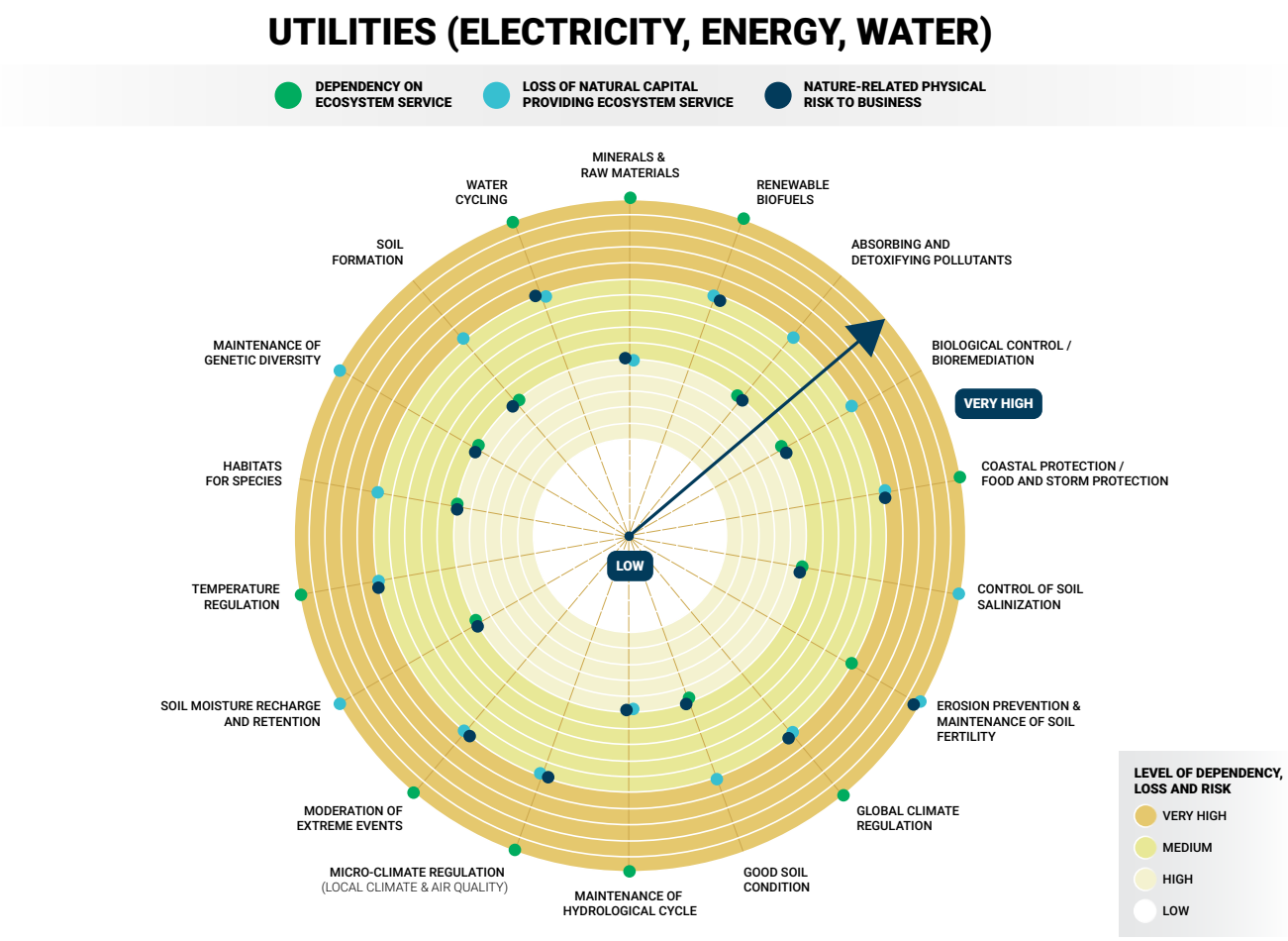
Source: Author

The physical risks of delays, disruptions, damage and failure across air, land-based and marine transportation systems are high because of the high to very high loss of natural capital providing ecosystem services such as erosion and flood control, and temperature regulation. For example, high temperatures can soften and expand roadways, creating potholes, particularly in high traffic areas.[189] Similarly, coastal storm surges could damage air transportation facilities such as airstrips. In areas with depleted vegetation cover, increased runoff from extreme precipitation events could cause silt and debris to build up, making shipping channels too shallow[190] and leading to weight restrictions for ships.

Utilities (electricity, energy, water)

The utilities business sector is very highly or moderately dependent on many ecosystem services. While a net global assessment of economic value generated by the utilities business from nature is not available, one could estimate the extent of benefits by examining individual ecosystem services. For example, the total flow of in-river nitrogen retention (in terms of water purification services) is valued at over US$20 billion annually in Europe.[191] An Ecorys study for the European Commission[192] found that the water supply and sewerage sector, which is 100 percent dependent on freshwater and groundwater supplies, accounts for 0.3 percent of the total EU economy. Similarly, for hydropower plants, conservation and maintenance of upstream forests could increase water flow and reduce sedimentation.

Figure 42 **Dependency level of utilities business sector on nature, and business risk as a result of nature loss**



Source: Author

Even though the physical risk of freshwater and groundwater loss at the global level is not high, the depletion of these resources has already reached an alarming level in many countries. This, in turn, poses a high risk for electricity utilities as well. According to UN Water,[193] 90 percent of the global power production consumes water – for raw material extraction, powering turbines and cooling thermal processes. In many countries, power plant cooling accounts for almost 50 percent of total freshwater withdrawals. As global energy demand is growing, physical risks arising from water stress will increase. Several regulating and supporting ecosystem services such as erosion and flood control are also rapidly deteriorating, which poses a medium to high risk to critical power and water infrastructure systems.

Annex VII
Methodology adopted for determining physical risks to economic sectors originating from nature loss

A re/insurance company insures or invests in companies in the real economy. To understand current nature-related physical risks to the re/insurance companies (D), it is first important to assess how companies in the real economy are dependent on nature (A), and what the current level of nature loss is (B).

A business sector's dependency on ecosystem services could be very high, high, medium, or low. In some cases, there is no dependency. The physical risk level related to each ecosystem service is derived by mapping these business dependencies to the current level of loss of natural capital providing the corresponding services. Although some authors think that higher dependency ultimately leads to higher risks[194] or at least higher *a priori* exposure to physical risks and vice versa, this may not always be the case, which is the reason this study also considers the current global loss as an additional variable in the equation. For example, a chemical plant operating in location X might be highly dependent on the provision of groundwater, but if there is no loss of groundwater level, the resulting physical risk for the plant could be negligible or low.

Since risk is a function of hazard, exposure, vulnerability and coping ability (see the formula and definitions below), the overall risk to a business sector is determined by assessing each of these individual variables.

For the purpose of this report, only a 'qualitative' assessment is conducted.

Potential dependency on ecosystem services (A)	Current global level of loss of natural capital stock providing these services (B)	Coping Ability (C)	Physical risk to business (D)[36]
Very high	Very high	Coping ability of each economic sector against a potential hazard resulting from loss of natural capital and deterioration of corresponding ecosystem services might be different, hence this variable is separately considered in sector-specific assessments in Annex VI.	Very high
Very high	High		High
Very high	Medium		Medium
Very high	Low		Low
High	Very high		Very high
High	High		High
High	Medium		Medium
High	Low		Low
Medium	Very high		Medium
Medium	High		Medium
Medium	Medium		Low
Medium	Low		Low
Low	Very high		Low
Low	High		Low
Low	Medium		Low
Low	Low		Low

36 D is a function of A, B and C. C is considered directly in sector-specific assessments in Annex VI.

Risk = Hazard × Exposure × (Vulnerability ÷ Coping Capacity) → Also called "Resilience"

where,

Hazard: Nature-related physical or transition events, trends or impacts.

Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services and resources, infrastructure or economic, social or cultural assets in places and settings that could be adversely affected.

Vulnerability: Susceptibility to damage, given a certain hazard event.

Coping Capacity: Capacity to cope with a hazard event.

Resilience: Capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation.

Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values or a range of possible outcomes. Risk, therefore, depends not only on the magnitude and frequency of hazards but also the exposure and vulnerability to any given hazard. For example, "the risk from flooding to human and ecological systems is caused by the flood hazard (the frequency and/or magnitude of flood events), the exposure of the system affected (e.g. topography, or infrastructure in the area potentially affected by flooding) and the vulnerability of the system (e.g. design and maintenance of infrastructure, existence of early warning systems)".[195]

Source: Cardona et al., 2012[196]

Photo: Paul Talbot | Unsplash

ENDNOTES

Alex Siale | Unsplash

Endnotes

[1] World Economic Forum (WEF), 2021. *The Global Risks Report 2021*, 16th Edition.

[2] NGFS, 2020. *Overview of Environmental Risk Analysis by Financial Institutions*.

[3] Alliance for Corporate Transparency Project, 2020. General results EUKI Research 2020.

[4] Capitals Coalition and Cambridge Conservation Initiative, 2020. *Integrating biodiversity into natural capital assessments*.

[5] Taskforce on Nature-related Financial Disclosures (TNFD).

[6] NGFS, 2021. *NGFS and INSPIRE launch a joint research project on 'Biodiversity and Financial Stability'*.

[7] Dasgupta, P., 2021. *The Economics of Biodiversity: The Dasgupta Review*.

[8] Some other reports have also adopted a similar approach. See Ninety One and WWF, 2020. *Climate & Nature Sovereign Index: Introducing a framework for a clear assessment of environmental risk*.

[9] World Commission on Environment and Development, 1987. *Our Common Future*.

[10] International Federation of Accountants, 2021. *Enhancing Corporate Reporting: Sustainability Building Blocks*.

[11] Lee, C. F. and Baral, P., 2017. *Green Finance Opportunities in ASEAN*.

[12] European Banking Authority (EBA), 2021. *EBA Report on Management and Supervision of ESG Risks for Credit Institutions and Investment Firms*.

[13] Ibid.

[14] United Nations, 1992. *United Nations Framework Convention on Climate Change*.

[15] IPCC, 2021. *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.

[16] Pendleton L., Donato D.C., Murray B.C., Crooks S., Jenkins W.A., Sifleet S. *et al.*, 2012. Estimating Global "Blue Carbon" Emissions from Conversion and Degradation of Vegetated Coastal Ecosystems. *PLoS ONE* 7(9): e43542.

[17] Goodyer, J., 2021. T*he Amazon rainforest now emits more carbon than it absorbs*.

[18] Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Desertification Synthesis*. World Resources Institute, Washington, DC.

[19] IPBES, 2019. *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. [Brondizio, E. S., Settele, J., Díaz, S., & Ngo, H.T. (eds.)]. IPBES secretariat, Bonn, Germany.

[20] World Economic Forum (WEF), 2020. *Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy*.

[21] WWF, 2020. *Living Planet Report 2020 – Bending the curve of biodiversity loss*.

[22] IPBES, 2019. *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. [Brondizio, E. S., Settele, J., Díaz, S., & Ngo, H.T. (eds.)]. IPBES secretariat, Bonn, Germany.

[23] Environmental Business Journal, 2020. Volume XXXIII, Numbers 7/8.

[24] 1 quadrillion = 1,000 trillion

[25] Rockström, J., Steffen, W., Noone, K. *et al.*, 2009. A safe operating space for humanity. *Nature* 461, 472–475.

[26] Steffen, W. *et al.*, 2015. Planetary boundaries: Guiding human development on a changing planet. *Science* 347: 736, 1259855.

[27] World Economic Forum (WEF), 2020. *New Nature Economy Report II: The Future Of Nature And Business*.

[28] Steffen, W. *et al.*, 2015. Planetary boundaries: Guiding human development on a changing planet. Science 347: 736, 1259855.

[29] Swiss Re Institute, 2020. *Biodiversity and Ecosystem Services: A business case for re/insurance*.

[30] Ibid.

[31] As per data from McKinsey Global Insurance Pools and author's own research.

[32] Pereira, R., 2020. Where insurers are placing their money. *IPE Magazine*.

[33] Costanza, R. *et al.*, 2014. Changes in the global value of ecosystem services. *Global Environmental Change*, Vol. 26, pp. 152–158.

[34] World Economic Forum (WEF), 2020. *New Nature Economy Report II: The Future Of Nature And Business*.

[35] Swiss Re Institute, 2020. *Biodiversity and Ecosystem Services: A business case for re/insurance*.

[36] Swiss Re Institute, 2020. *Biodiversity and Ecosystem Services: A business case for re/insurance*.

[37] World Economic Forum, 2020. *Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy*.

[38] World Economic Forum (WEF), 2020. *New Nature Economy Report II: The Future Of Nature And Business*.

[39] Natural Capital Finance Alliance, 2021. ENCORE Database.

[40] Watson, S.C.L. and Newton, A.C., 2018. Dependency of Businesses on Flows of Ecosystem Services: A Case Study from the County of Dorset, UK. *Sustainability*, 10, 1368.

[41] Allianz Global Corporate & Specialty, 2018. *Measuring and Managing Environmental Exposure – A Business Sector Analysis of Natural Capital Risk*.

[42] G7, 2020. *Nature Compact*.

[43] Ibid.

[44] United Nations, 2019. Resolution adopted by the General Assembly on 1 March 2019.

[45] Convention on Biological Diversity (CBD), 2020. *Zero draft of the post-2020 global biodiversity framework*.

[46] UNEP-WCMC and IUCN (2021) *Protected Planet Report 2020*.

[47] Cefic, 2013. *Biodiversity and Ecosystem services – What are they all about?*

[48] Caldecott, B., Howarth, N. and McSharry, P., 2013. *Stranded Assets in Agriculture: Protecting Value from Environment-Related Risks*.

[49] European Commission. *Biodiversity strategy for 2030*.

[50] Nielsen, 2018. *Global consumers seek companies that care about environmental issues*.

[51] Briggs, F., 2019. Over 75% of UK grocery shoppers switch, avoid or boycott brands because of environmental policies, says Kantar. *Retail Times*.

[52] McKinsey & Company, 2014. *Profits with purpose: How organizing for sustainability can benefit the bottom line*.

[53] CB Insights, 2020. *Our Meatless Future: How the $2.7T Global Meat Market Gets Disrupted*.

[54] Barker, S., Mulholland, E. and Onifade, T., 2020. *The emergence of foreseeable biodiversity-related liability risks for financial institutions - A gathering storm?* Commonwealth Climate and Law Initiative.

[55] Ibid.

[56] Ibid.

[57] Ibid.

[58] Ibid.

[59] Stop Ecocide, n.d.

[60] Finance for Biodiversity Initiative, 2020. *Aligning Global Finance with Nature's Needs: A Framework for Systemic Change*.

[61] Tam, C., 2020. *Should Nature be Given Legal Rights?*

62 Ibid.

63 CDP Worldwide, 2020. *Analysis of CA100+ Company Data for CDP Investor Signatories*.

64 ISIS Asset Management, 2004. *Is biodiversity a material risk for companies? An assessment of the exposure of FTSE sectors to biodiversity risk*.

65 World Economic Forum, 2010. *Biodiversity and business risk: A Global Risks Network briefing*.

66 NGFS and INSPIRE, 2021. *Biodiversity and financial stability: exploring the case for action*.

67 University of Cambridge Institute for Sustainability Leadership (CISL), 2021. *Handbook for nature-related financial risks: key concepts and a framework for identification*.

68 Coalition of Finance Ministers for Climate Action, 2021. *Climate-Related Risks for Ministries of Finance: An Overview*.

69 NGFS, 2020. *Guide for supervisors: Integrating climate-related and environmental risks into prudential supervision*.

70 Swiss Re Institute, 2020. *Biodiversity and Ecosystem Services: A business case for re/insurance*.

71 Johnson, J.A. *et al.*, 2021. The Economic Case for Nature : A Global Earth-Economy Model to Assess Development Policy Pathways. World Bank, Washington, DC.

72 Johnson, J.A. *et al.*, 2020. *Global Futures: modelling the global economic impacts of environmental change to support policy-making*. Technical Report.

73 Dasgupta, P., 2021. *The Economics of Biodiversity: The Dasgupta Review*.

74 Financial Times, 2021. *Worst drought in a century hits Brazil as it fights to overcome Covid*.

75 Johnson, J.A. *et al.*, 2021. *The Economic Case for Nature : A Global Earth-Economy Model to Assess Development Policy Pathways*. World Bank, Washington, DC.

76 Ibid.

77 Bautzer, T. and Alves, A., 2015. Insurers face $600 million claim in Brazil dam burst, sources say. *Reuters*.

78 Allianz, 2018. *Global Risk Dialogue – Analysis and Insight from the World of Corporate Risk and Insurance*.

79 Financial Times, 2021. *'Green bubble' warnings grow as money pours into renewable stocks*.

80 Chandellier, J. and Malacain, M., 2021. *Biodiversity and Re/insurance: An Ecosystem at Risk*. Muséum National d'Histoire Naturelle.

81 Planet Tracker and the Grantham Research Institute on Climate Change and the Environment have defined 'sovereign health' as the capacity of countries to issue debt and repay it in alignment with the UN's 2030 Sustainable Development Goals (SDGs). See Elwin, P., Robins, N., Willis, J. and Cozzolino, G., 2021. *Brazil: roadmap to a sustainable future - Nature-based challenges, opportunities and solutions*.

82 Elwin, P., Robins, N., Willis, J. and Cozzolino, G., 2021. *Brazil: roadmap to a sustainable future - Nature-based challenges, opportunities and solutions*.

83 Federal Reserve, 2021. *Climate Change and Financial Stability*.

84 Société Universitaire Européenne de Recherches Financières (SUERF), 2021. *Understanding the financial risks of nature loss: exploring policy options for financial authorities*.

85 PRé Sustainability, 2021. *ASN Bank Biodiversity Footprint - Biodiversity Footprint for Financial Institutions Impact Assessment 2014 – 2019*.

86 Portfolio Earth, 2021. *Bankrolling Extinction – The Banking Sector's Role in the Global Biodiversity Crisis*.

87 PRé Sustainability, 2021. *ASN Bank Biodiversity Footprint - Biodiversity Footprint for Financial Institutions Impact Assessment 2014 – 2019*.

88 ShareAction, 2021. *Insuring Disaster - A ranking of 70 of the world's largest insurers' approaches to responsible investment and underwriting*.

89 Planet Tracker. *Beached, not Stranded*.

90 Ibid.

91 IUMI, 2020. *IUMI's 2020 analysis of the global marine insurance market*.

92 The Pew Charitable Trust, 2013. *FAQ: Illegal, Unreported, and Unregulated Fishing*.

93 International Association of Insurance Supervisors (IAIS), 2021. *Application Paper on the Supervision of Climate-related Risks in the Insurance Sector*.

94 Chandellier, J. and Malacain, M., 2021. *Biodiversity and Re/insurance: An Ecosystem at Risk*. Muséum National d'Histoire Naturelle.

95 Ibid.

96 CRO Forum, 2021. *Emerging Risks Initiative – Major Trends and Emerging Risk Radar*.

97 Bassen, A., Busch, T., Lopatta, K., Evans, E. and Opoku, O., 2019. *Nature Risks Equal Financial Risks: A Systematic Literature Review*.

98 Credit Suisse Group AG, 2021. *Unearthing investor action on biodiversity*.

99 globalforestwatch.org

100 fairr.org/about-fairr/about-us

101 iris.thegiin.org/metrics

102 Natural Capital Finance Alliance, 2021. ENCORE Database.

103 ibat-alliance.org

104 trase.earth

105 Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector

106 fsb-tcfd.org/supporters

107 AM Best, 2020. *Special Report: Insurers and Reinsurers: Ignoring ESG Factors Poses Reputational Risk*.

108 G7 Finance Ministers and Central Bank Governors Policy Paper (5 June 2021).

109 G20 Finance Ministers and Central Bank Governors Communiqué (9–10 July 2021).

110 AXA Investment Managers, 2020. *Iceberg Data Lab and I Care & Consult selected to provide first of its kind biodiversity impact measurement tool for investors*.

111 ShareAction, 2021. *Insuring Disaster - A ranking of 70 of the world's largest insurers' approaches to responsible investment and underwriting*.

112 financeforbiodiversity.org/about-the-pledge

113 Swiss Re, 2020. Sustainable Business Risk Framework.

114 Achmea, 2021. Engagement Guidelines.

115 European Insurance and Occupational Pensions Authority (EIOPA), 2021. *Report on non-life underwriting and pricing in light of climate change*.

116 Beck, M.W. et al., 2020. *Reducing Caribbean Risk: Opportunities for Cost-Effective Mangrove Restoration and Insurance*. The Nature Conservancy.

117 The Nature Conservancy and Willis Towers Watson, 2021. *Wildfire Resilience Insurance: Quantifying the Risk Reduction of Ecological Forestry with Insurance*.

118 Controlled burning and removal of smaller trees and other vegetation in overgrown forests, i.e. ecological thinning.

119 Global Canopy, 2021. *The Little Book of Investing in Nature – A simple guide to financing life on Earth*.

120 De Nederlandsche Bank (DNB), 2020. *Indebted to nature - Exploring biodiversity risks for the Dutch financial sector*.

121 Swartzman, R., Espagne, E., Gauthey, J., Hadji-Lazaro, P., Salin, M., Allen, T., Berger, J., Calas, J., Godin, A. and Vallier, A., 2021. *A "Silent Spring" for the Financial System? Exploring Biodiversity-Related Financial Risks in France*. Banque de France Working Paper #826.

122 De Nederlandsche Bank (DNB), 2020. *Indebted to nature - Exploring biodiversity risks for the Dutch financial sector*.

123 ASX Corporate Governance Council, 2019. *Corporate Governance Principles and Recommendations - 4th Edition*.

124 BaFin, 2020. *Guidance Notice on Dealing with Sustainability Risks*.

125 California Department of Insurance, 2021. *Protecting Communities, Preserving Nature and Building Resiliency*.

126 NGFS and INSPIRE, 2021. *Biodiversity and financial stability: exploring the case for action*.

127 NGFS, 2020. *Guide for supervisors: Integrating climate-related and environmental risks into prudential supervision*.

128 tnfd.info

129 TNFD, 2021. *France's Article 29: biodiversity disclosure requirements sign of what's to come*.

130 Dasgupta, P., 2021. *The Economics of Biodiversity: The Dasgupta Review*.

131 G7 2020 Nature Compact.

132 G20 Environment Ministers Communiqué (22 July 2021).

133 DG Env, 2021. *Biodiversity: ground-breaking change to economic reporting accounting for nature's contribution to economy*.

134 Ibid.

135 Convention on Biological Diversity (CBD), 2020. *Zero draft of the post-2020 global biodiversity framework*.

136 G20 Data Gaps Initiative.

137 ngfs.net/en/about-us/governance/workstream-bridging-data-gaps

138 futureofsustainabledata.com

139 IAIS, 2021. *IAIS Comments on IFRS Foundation Constitution Amendments for ISSB Exposure Draft*.

140 Natural Capital Finance Alliance, n.d. What is Natural Capital and why is it important?

141 IPBES, 2019. *IPBES Global Assessment on Biodiversity and Ecosystem Services. Glossary*.

142 Convention on Biological Diversity (CBD), 1992. Article 2. Use of Terms.

143 Locke, H. et al., 2021. *A Nature-Positive World: The Global Goal for Nature*.

144 IPBES, 2019. *IPBES Global Assessment on Biodiversity and Ecosystem Services. Glossary*.

145 IPBES, n.d. Ecosystem Services.

146 Global Canopy and Vivid Economics, 2020. *The Case for a Taskforce on Nature-related Financial Disclosures*.

147 IPBES, 2019. *IPBES Global Assessment on Biodiversity and Ecosystem Services. Glossary*.

148 Adapted from Watson, S.C.L. and Newton, A.C., 2018. Dependency of Businesses on Flows of Ecosystem Services: A Case Study from the County of Dorset, UK. *Sustainability*, 10, 1368.

149 Based on a bilateral consultation with McKinsey & Company colleagues.

150 McKinsey & Company, 2021. *Global Insurance Pools statistics and trends: An overview of life, P&C, and health insurance*. Read more here and here

151 Nearly US$300 billion in global reinsurance premium, primarily providing reinsurance to P&C insurers.

152 Pereira, R., 2020. Where insurers are placing their money. *IPE Magazine*.

153 EY, 2019. *2020 Global Insurance Outlook*.

154 National Association of Insurance Commissioners (NAIC), 2020. *U.S. Property & Casualty and Title Insurance Industries – 2019 Full Year Results*.

155 As per the US P&C insurance sector data of 2019. See Federal Insurance Office, US Department of the Treasury, 2020. *Annual Report on the Insurance Industry*.

156 As per the US Life and Health insurance sector data of 2019. See Federal Insurance Office, US Department of the Treasury, 2020. *Annual Report on the Insurance Industry*.

157 Ibid.

158 Corporate bonds account for nearly 70 percent of the bond portfolios of each of the three insurance segments.

159 S&P Global, 2019. *Global Reinsurance Highlights 2019*.

160 International Association of Insurance Supervisors (IAIS), 2020. *The Global Insurance Market Report (GIMAR)*.

161 S&P Global, 2019. *U.S. Corporate Debt Market: The State of Play In 2019*.

162 OECD, 2019. *Biodiversity: Finance and the Economic and Business Case for Action, report prepared for the G7 Environment Ministers' Meeting, 5–6 May 2019*.

163 Russi D. *et al.*, 2013. *The Economics of Ecosystems and Biodiversity for Water and Wetlands*.

164 Kreye, M.M., 2019. *Understanding the Value of Wildlife in Pennsylvania*.

165 WWF, 2020. *Living Planet Report 2020 - Bending the curve of biodiversity loss*.

166 MacArthur Foundation, 2017. *A new textiles economy: Redesigning fashion's future*.

167 Ibid.

168 Nissan, n.d. *Ecosystem Services and the Automotive Sector*.

169 Jowitt, S.M., Mudd, G.M. and Thompson, J.F.H., 2020. Future availability of non-renewable metal resources and the influence of environmental, social, and governance conflicts on metal production. *Commun Earth Environ* 1, 13.

170 TradeMachines, 2018. *Why the world is running out of sand*.

171 Ecorys, 2014. *Resource efficiency in the building sector*.

172 WWF, 2020. *Living Planet Report 2020 - Bending the curve of biodiversity loss*.

173 Wongcharoen, A., 2010. *Biological activities of soils under rubber trees (Hevea brasiliensis) and interactions with trunk phloem necrosis*.

174 Fortune, 2021. *Taiwan's drought is exposing just how much water chipmakers like TSMC use (and reuse)*.

175 FAO, 2021. FAOSTAT: Forestry Production and Trade.

176 PwC, 2021. *Mine 2021 – Great expectations, seizing tomorrow*.

177 Ibid.

178 Jowitt, S.M., Mudd, G.M. and Thompson, J.F.H., 2020. Future availability of non-renewable metal resources and the influence of environmental, social, and governance conflicts on metal production. *Commun Earth Environ* 1, 13.

179 OECD, 2019. *Biodiversity: Finance and the Economic and Business Case for Action, report prepared for the G7 Environment Ministers' Meeting, 5–6 May 2019*.

180 US EPA, 2011. *The Benefits and Costs of the Clean Air Act from 1990 to 2020*.

181 Nowak, D., Hirabayashi, S., Bodine, A. and Greenfield, E., 2014. *Tree and forest effects on air quality and human health in the United States*.

182 Ferrario, F., Beck, M., Storlazzi, C. *et al.* The effectiveness of coral reefs for coastal hazard risk reduction and adaptation. *Nat Commun* 5, 3794.

183 Beck, M.W. *et al.*, 2018.*The Global Value of Mangroves for Risk Reduction. Summary Report*.

184 Wolf, K.L., 2010. Community Economics - A Literature Review. In: *Green Cities: Good Health*.

185 McKinsey & Company, 2020. *Valuing nature conservation*.

186 OECD, 2019. *Biodiversity: Finance and the Economic and Business Case for Action, report prepared for the G7 Environment Ministers' Meeting, 5–6 May 2019*.

187 Office for National Statistics, 2021. *Tourism and outdoor leisure accounts, natural capital, UK: 2021*.

188 United Nations Conference on Trade and Development (UNCTAD), 2021. *COVID-19 and Tourism – An Update: Assessing the economic consequences*.

189 United States Environmental Protection Agency (US EPA), n.d. Climate Impacts on Transportation.

190 Ibid.

191 Notte, A.L. *et al.*, 2017. Physical and monetary ecosystem service accounts for Europe: A case study for in-stream nitrogen retention. *Ecosystem Services*, Volume 23, Pages 18–29.

192 Spit, W. *et al.*, 2018. T*he Economic Value of Water - Water as a Key Resource for Economic Growth in the EU*. Deliverable to Task A2 of the BLUE2 project "Study on EU integrated policy assessment for the freshwater and marine environment, on the economic benefits of EU water policy and on the costs of its non- implementation". Report to Directorate-General for the Environment of the European Commission.

193 UN Water, n.d. Facts and Figures.

194 Swiss Re Institute, 2020. *Biodiversity and Ecosystem Services: A business case for re/insurance*.

195 Intergovernmental Panel on Climate Change (IPCC), 2020. *The concept of risk in the IPCC Sixth Assessment Report: a summary of cross-Working Group discussions*.

196 Cardona, O.D. *et al.*, 2012. Determinants of risk: exposure and vulnerability. In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* [Field, C.B., Barros, V., Stocker, T.F., Qin, D., Dokken, D.J., Ebi, K.L., Mastrandrea, M.D., Mach, K.J., Plattner, G.-K., Allen, S.K., Tignor, M. and Midgley, P.M. (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 65–108.

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Annex 514

Credit Rating Agencies and Sovereign Debt: Four proposals to support achievement of the SDGs, Policy Brief No. 131, *United Nations Department of Economic and Social Affairs*, March 2022

United Nations | Department of Economic and Social Affairs

FUTURE OF THE WORLD

POLICY BRIEF NO 131

Credit Rating Agencies and Sovereign Debt: Four proposals to support achievement of the SDGs

The COVID-19 pandemic has inflicted significant damage on global economic activity, exacerbated fiscal challenges worldwide, and impeded countries' ability to respond to the pandemic and achieve the Sustainable Development Goals (SDGs). Many countries experienced downgrades of their sovereign credit ratings, higher borrowing costs, and intensified risks of debt distress.

Developing countries have borne the brunt (over 95%) of credit rating downgrades, despite experiencing relatively milder economic contractions. The fear of ratings downgrades also hindered some countries' participation in official debt relief programs, such as the G20's Debt Service Suspension Initiative (DSSI). Three challenges related to developing country sovereign credit ratings stand out: (i) the impact of downgrades on countries' cost of borrowing and on financial market stability, including whether there is perceived bias, increased volatility, and "cliff effects"; (ii) how official actions, including official debt restructurings such as DSSI, are incorporated into ratings analysis; and (iii) the integration of climate change and other non-economic factors into rating methodologies.

These dynamics have led to a renewed focus on the credit rating agencies (CRAs) that determine sovereign ratings. CRAs also garnered attention following the 2008 global financial crisis, when calls for reform included reducing mechanistic reliance on ratings, enhancing competition, and addressing CRA conflicts of interest. Significant regulatory reforms were enacted to help address mechanistic reliance on ratings and try to address the conflicts of interest. Yet, there are still concerns about market concentration, some structural conflicts of interest, and remaining regulatory and investment mandate mechanistic reliance on ratings. There is limited market pressure on CRAs to change their practices as the three largest CRAs (Moody's, Standard and Poor's and Fitch) hold over 90 percent of market share.

Yet, fast-evolving changes in technology, the growing nature of systemic risks, the impact of the pandemic on access to finance, and the increasingly complex linkages in the financial system have underscored the need to re-evaluate the informational ecosystem supporting sovereign borrowing with a forward-looking approach that reflects a changing world. The current crisis creates an opportunity to do so.

Key messages

- Credit ratings play an important role providing information on sovereign borrowers. But financial markets, including credit ratings, often over-emphasize short-term economic concerns, and underweight longer-term issues, including environmental and social risks as well as investment in resilience and sustainability
- Fast-evolving changes in technology and the growth of global systemic risks are changing the informational ecosystem around sovereign debt, including for credit ratings.
- It is in the international community's interest to ensure that CRAs continue to adapt to these changes in ways that strengthen the quality of ratings and encourage investment in developing countries and in sustainable development.

CHALLENGES EXPERIENCED BY DEVELOPING COUNTRIES

CHALLENGE 1: THE IMPACT OF CREDIT RATINGS ON A COUNTRY'S COST OF BORROWING

Credit rating agencies provide information to investors and to financial markets to help them price risk, and thus can directly impact the cost of public investments aimed at delivering sustainable development. In particular, negative warning announcements by CRAs (i.e. "reviews," "watches," and "outlooks") have been linked to increases in the cost of borrowing, particularly for developing countries, at 160 basis points vs. 100 basis points for advanced economies. Valid criticisms of CRAs are not so much that they impact market prices (which would be expected), but whether they transmit inaccurate information and/or exacerbate market reactions and procyclicality. Since sovereign ratings often act as a country-level baseline for corporate ratings, they also affect the cost of corporate borrowing and investment in the SDGs[1].

Authors: Shari Spiegel, Peter Chowla, Poh Lynn Ng and Philipp Erfurth, Financing for Sustainable Development Office, UN DESA. See FSDO Policy Paper, "Credit Rating Agencies and Sovereign Debt: Challenges and Solutions", for a more detailed discussion. This policy brief also builds on Griffith-Jones, S. and Kraemer, M. (2021), "Credit Rating Agencies and Developing Economies," DESA Working Paper, United Nations Department of Economic and Social Affairs.

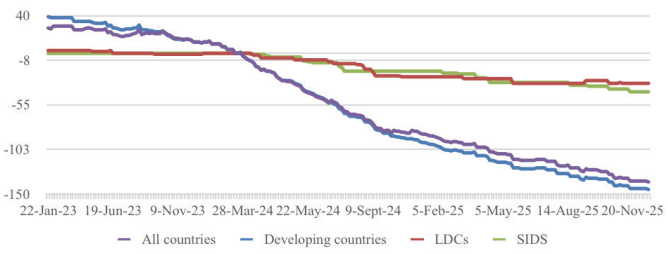
Sovereign ratings are structurally different from corporate ratings in that analyst judgement plays a much greater role in sovereign rating decisions. Political risks and "willingness to pay", which are critical to sovereign credit analysis, are more subjective than corporate rating methodologies. The more subjective nature of sovereign ratings has opened CRAs up to criticisms of potential bias.

First, ratings actions during the COVID-19 pandemic revived questions of potential biases against developing countries. Advanced economies received less than 5% of all downgrades (see figure)[2], while economic output of the advanced economies contracted at more than twice the pace of output contraction in emerging market and developing economies (-4.7% vs. -2.2%)[3], while also experiencing a significantly greater increase in debt. While this discrepancy could be due to a range of factors, the perception of bias can undermine confidence in ratings' quality and accuracy, underlining the importance of transparent methodologies.

Figure 1

SOVEREIGN RATINGS MOVEMENT OVER TIME, BY COUNTRY GROUPING

(index, 11 March 2020=0)



Source: DESA calculations, based on Moody's Analytics

Note: This figure shows an index of rating actions by Moody's analytics, with 0 on 11 March 2020, the date of declaration of the global pandemic by WHO. All sovereigns are weighted equally, each positive (negative) outlook is +1 (-1); a review for upgrade (downgrade) is +2 (-2); and a positive (negative) rating change is +3 (-3).

Second, ratings may also be linked to price volatility beyond what would be warranted by market fundamentals due to so-called cliff effects. When securities are downgraded from "investment grade" to "speculative grade" an issuer may face a wave of forced selling of its debt from investors that are not allowed to hold speculative grade debt.

Third, ratings can augment capital market volatility and procyclicality (with ratings rising in boom periods and falling during slowdowns), particularly during crises, such as the Asian and Mexican crises in the 1990s[4], when countries need financing the most. A study that examined 27 African countries between 2007 and 2014 also found that there was an increased probability that Fitch and Moody's upgraded ratings during boom periods and downgraded them during recessions.

CHALLENGE 2: ACCURATELY INCORPORATING INTERNATIONAL COOPERATION ON DEBT INTO RATINGS

International cooperation and debt relief programs, such as the DSSI, can help strengthen countries' balance sheets and ability to repay debt in the medium term. Nonetheless, some developing countries have been deterred from joining these programs, despite elevated debt distress risks, due to the fear that participation in these programs would trigger rating downgrades. If the method of incorporating such programs into ratings discourages participation in a debt relief initiative, this can have a negative impact on a country's long-term debt sustainability.

CHALLENGE 3: INCORPORATING LONG-TERM RISK FACTORS SUCH AS CLIMATE RISK

The current CRA "long-term" rating is meant to cover three to five years for non-investment-grade issuers and up to ten years for investment-grade issuers. In practice sovereign ratings use financial and economic forecasts up to three years, which may over-emphasize near-term economic business cycle expectations.

At the same time, the increasing frequency and magnitude of climate and other shocks has highlighted the impact of longer-term factors on a country's debt sustainability. Amid an increased recognition of the physical and transition risks arising from climate change, CRAs are already integrating climate and other environmental, social and governance (ESG) risks into their ratings. According to Moody's, 60% of its sovereign credit ratings of developing countries were negatively affected by ESG considerations in 2020[5].

A country's efforts to invest in the SDGs, including in resilience and climate adaptation, should conversely be viewed favorably in ratings. While financing these investments may increase public debt in the short term, in the long term, resilient and productive investment should stimulate growth, improve resilience, and strengthen countries' ability to repay[6]. A longer-term outlook is needed to realize this and other positive long-term impacts in ratings.

AREAS OF ACTION AND POLICY SOLUTIONS

Solutions to these challenges include both voluntary actions and structural reforms. Below are four proposals for immediate action, followed by a reference to additional proposals for structural reforms. (See Table 1 for a summary of proposals.)

1.Enhance transparency and update ratings methodologies making use of technological innovation

First, CRAs should be encouraged to strengthen transparency. While the big three CRAs publish an overview of their methodologies on their websites, many aspects of the methodologies remain opaque, such as the underlying assumptions. Second, a clear distinction between the model-based and discretionary components of ratings can help investors better assess the quality and objectivity of ratings. CRAs could publish the model-based assessments and then superimpose a "qualitative overlay" of analytical judgment. Transparent publication of this process could help address concerns over biased ratings and increase confidence in ratings' accuracy, while highlighting the value-added of different CRAs. Third, credit assessments should be less about predicting the future than about understanding how well countries respond to risks that are largely unknown, making use of technological innovation. CRAs should be encouraged to incorporate and publish scenario analyses and simulations on debt dynamics under different economic and non-economic assumptions, including climate transition pathways, as a core part of their methodologies.

2.Develop long-term ratings

Longer-term ratings, which could be published as a complement to existing assessments, would benefit long-term investors, issuers, and the global community. The use of scenarios for both economic and non-economic risks could make long-term assessments more manageable to produce. If well implemented, long-term sovereign credit ratings could: help investors more reliably gauge their risk exposure; lengthen investment horizons; support the issuance of longer-term bonds; and potentially counteract pro-cyclicality and short-term bias of financial markets. If CRA methodologies incorporate the positive effects of SDG investment, long-term ratings could also create incentives for such investment and help countries raise long-term capital for that purpose. Such ratings would also be better able to capture the positive effects of debt relief programmes, such as the DSSI.

3. Increase dialogue of CRAs with the public sector

Dialogue with the public sector could enable a deeper understanding of government policies, especially international official programs. These engagements would not be meant to influence rating decisions, but instead to close any informational gaps CRAs may have about the scope and terms of new initiatives or facilities, which would in turn improve the quality of ratings. This is particularly important when debt relief, debt suspension, or other debt sustainability initiatives, such as the DSSI and the Common Framework, are launched. In addition, the international community could support countries to quickly return to capital markets following a restructuring, working with CRAs. A standing framework for dialogue would also help level the playing field, as compared to current approaches, which can prioritise discussions with larger jurisdictions.

4. Move from a cliff-edge to a graduated approach

Regulators, standard setters, investors and CRAs need to work together to soften the cliff-edge dichotomy between investment-grade and below-investment-grade issuers. CRAs themselves do not promulgate the investment-grade cliff, which is an artifact of the regulatory approach since the 1930s. However, CRAs can more explicitly create overlapping tiers of ratings, providing a transitional time when a country's debt will not necessarily fall out of investment mandates. From the investor side, mandates should be based on the average rating of a portfolio rather than on rating of individual instruments. In the case of a downgrade, this would allow investment managers to maintain a sufficiently high average credit quality without forced selling of specific assets. Regulators could also adopt a more dynamic approach to risk weighting to correspond to a more gradual and graduated categorization of credit ratings to allow a smoother adjustment.

STRUCTURAL PROPOSALS

There are also proposals for structural reforms, such as publicly owned, not-for-profit, or cooperative CRAs to encourage competition and avoid the conflict of interest faced by private CRAs. Public CRAs would, however, also face conflicts of interest, and an open question is whether markets would trust ratings by any new agencies. One option would be for new (or existing) public institutions to develop pure model-based sovereign ratings for all countries, enabling investors to use this as a benchmark to help better distinguish between model-based ratings and value-added judgement inherent in CRA ratings. Indeed, the International Monetary Fund (IMF) already publishes macroeconomic projections for countries. These are not intended as credit assessments, but markets do react to IMF pronouncements.

CONCLUSION

Fast-evolving changes in technology and the growth of global systemic risks are changing the informational ecosystem around sovereign debt, including for credit ratings. It is in the international community's interest to ensure that CRAs continue to adapt to these changes in ways that strengthen the quality of ratings and encourage investment in developing countries and in sustainable development. While institutional reforms to CRAs would require political will and strong commitment from the international community, the 4 proposals outlined in this policy brief are ripe for action. However, these solutions may not spontaneously manifest. Long-term investors, such as pension funds and insurance companies, can encourage the development of long-term ratings. There may be a role for a private sector group, such as the Global Investors for Sustainable Development (GISD) Alliance, to collectively prompt such changes. International Organizations can also play a role if needed, such as in providing a benchmark to distinguish between model-based ratings and value-added judgement. But political leadership will also be needed to see changes through to conclusion.

APPENDIX: POLICY OPTIONS TABLE

Policy options *(including both voluntary and institutional actions)*	Benefits	Implementer	
		Market actors / International organizations	**Governments / regulators / norm-setters**
Update ratings methodologies ➢ Incorporate scenarios for economic and non-economic risks ➢ Better use of technology to improve model accuracy **Enhance ratings transparency** ➢ Publish model-based assessments, with a "qualitative overlay"	• Ratings will better reflect a rapidly changing global environment and growing systemic risks • Addresses concerns over biases • Highlights the quality and value-added of each CRA's qualitative evaluations	• Voluntary actions by the CRAs • Investors could advocate for changes, e.g. insurance companies and pension funds advocate for long-term ratings	*Additional measures could include:* • *Norm-setting bodies, e.g. (IOSCO), could include policies as standards for CRAs* • *regulators incorporate measures into national regulations*
Issue long-term sovereign ratings ➢ Develop ratings for long-term investment horizons, which incorporate sustainability into ratings; scenario analysis can make these more maneagable to produce	• Can reduce pro-cyclicality in ratings • Captures the positive effects of international support (such as DSSI) and long-term instruments (such as SCDI) • Encourages governments to invest in resilience and sustainability • Matches investment horizon of long-term investors	• Alternatively, international organizations, such as the International Monetary Fund (IMF), could publish model assessments as a benchmark to compare CRA ratings	
Increase dialogue between the CRAs and the public sector	• Improve understanding of international official programs, (e.g. DSSI) • Levels the playing field compared to bilateral discussions	• Dialogues between CRAs and the public sector	• Government and national regulators to engage in discussions with the CRAs
Move from a cliff-edge to a graduated approach ➢ Create overlapping ratings tiers ➢ Portfolio approach to investment mandates ➢ Adjust regulatory regimes (e.g. risk weighted asset regulations, temporal graduation)	• Reduces the risk of sharp selloffs after a rating downgrade	• CRAs explicitly create overlaps of rating tiers • Investors adjust investment guidelines	• Norm-setting bodies adjust regulatory standards • Regulators introduce necessary changes to national regulatory frameworks
Creation of new institutions ➢ National or regional publicly owned CRAs ➢ Non-profit institutions ➢ Cooperative institutions	• Encourages competition • Removes existing conflict of interest (but create new conflicts and would need to establish credibility with investors and governments)	• Cooperative institutions would be a financial sector-led process	• Public CRAs would be a government-led process

1 Kiff, et. al., 2012, op cit; Kaminsky, Graciela, and Sergio L.Schmukler, "Emerging market instability: do sovereign ratings affect country risk and stock returns?." The World Bank Economic Review 16.2 (2002): 171-195.

2 Griffith-Jones, S. and Kraemer, M. (2021)

3 International Monetary Fund (2021), "World Economic Outlook Database," available at https://www.imf.org/en/Publications/WEO/weo-database/2021/April

4 Ferri, G., Liu, L., Stiglitz, J. (1999), "The Procyclical Role of Rating Agencies: Evidence from the East Asian Crisis" Economic Notes, vol. 28 pp 335-355. Reisen, H. (2002), "Ratings Since the Asian Crisis" OECD Development Centre.

5 Marc Jones, "Climate and ESG risks hurting 60% of developing countries' ratings -Moody's", Reuters, 2021.

6 United Nations, Interagency Task Force on FFD, 2021 Financing for Sustainable Development Report

Annex 515

National Consultation: Sustainable Recovery and Resilience towards achieving the Sustainable Development Goals in the Commonwealth of Dominica, 14 March 2022

NATIONAL CONSULTATION

Sustainable Recovery and Resilience towards achieving the Sustainable Development Goals in the Commonwealth of Dominica

Date: Wednesday 16th March 2022
(2:00 to 5:00 pm– AST and EST)

Organizers:

United Nations Department of Economic and Social Affairs (DESA)
Division for Sustainable Development Goals (DSDG)

UNITED NATIONS OFFICE FOR SUSTAINABLE DEVELOPMENT (UNOSD)

United Nations Economic Commission for Latin America and the Caribbean (ECLAC)
Subregional Headquarters for the Caribbean

in close coordination with:
United Nations Resident Coordinator Office (UNRCO) and United Nations Country Team (UNCT)

in partnership with the Government of the Commonwealth of Dominica

CONCEPT NOTE

Background:

The 2030 Agenda for Sustainable Development and the accompanying Sustainable Development Goals (SDGs) embody the strategic vision and aspirations of all countries for the future of development. Its implementation will require comprehensive actions at the global, regional, and national levels, as indicated in General Assembly Resolution 70/1 on Transforming our World: the 2030 Agenda for Sustainable Development. With the 2030 Agenda for Sustainable Development and the SDGs, a new emphasis is placed on how policy coherence and better integrated planning mechanisms can help countries strengthen their planning processes, develop holistic development frameworks reflecting global, regional and special commitments, such as the SAMOA Pathway for SIDS, and achieve their national development objectives in a more effective, efficient, equitable and sustainable way, ensuring that 'no one is left behind'.

Considering the COVID-19 pandemic where the world faced an unprecedented fast-changing scenario for which developing countries and Small Island Developing States (SIDS) have limited capacity, the relevance of strong, integrated policies and policy coherence is reinforced.

The COVID-19 pandemic, which started out as a severe and acute public health emergency, has since become a socioeconomic crisis of immense proportion that has had significant impacts on social and economic systems, threatening many of the development gains made across countries. The primary cost of the pandemic has been the loss of many lives although the secondary effects of the pandemic on the economy, livelihoods and sustainable development prospects are more alarming. In a context of global contraction, Latin America and the Caribbean subregion have been hardest hit by the crisis stemming from COVID-19.

External challenges specific to the Caribbean subregion included the near total shutdown of air and cruise travel, significantly impacting the tourism sector which is the backbone of many of the economies in the Caribbean as well as foreign exchange earnings; stress in related supply chains (agriculture, construction, hotels, restaurants, entertainment and the culture, cultural and creative industries or the orange economy); a sharp contraction in larger economies, a downturn in commodities prices, the contraction of foreign direct investment (FDI) flows and remittances; disruption in transportation and global supply chains; risk aversion for external investors, and restrictions on foreign exchange availability.

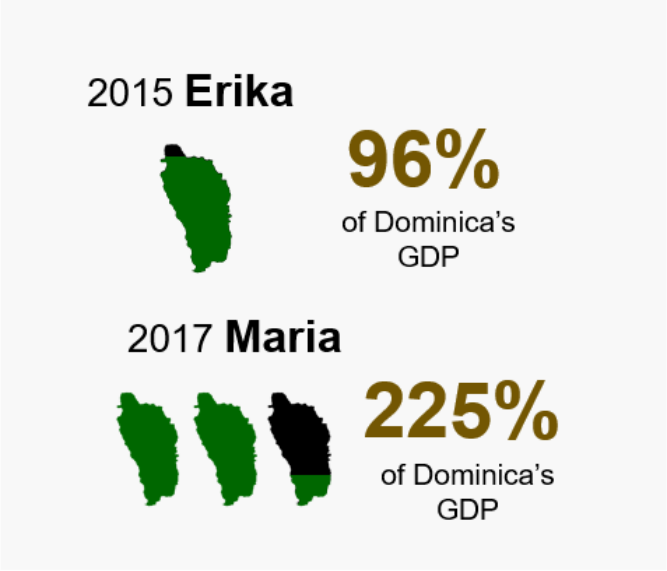
The impacts of COVID-19 on vulnerable groups - including persons with disabilities (PWDs), children, women and girls, female-headed households, and persons living with HIV/AIDS among others have been stark due to the economic fallout experienced by countries as well as the disruptions in access to basic social services. Many persons also have been impacted by the disruption of essential health services including services for sexual and reproductive health, non-communicable diseases and mental health support. These vulnerable groups and communities were challenged before the pandemic by economic hardship and social disparities.

Like many countries the world over, Caribbean countries also experienced several challenges in education due to school closures. Other social issues worth mentioning as a result of the pandemic include food insecurity, food gluts due to supply chain disruptions, and increases in gender-based violence although the latter has not been fully quantified.

At the start of the COVID-19 pandemic, Dominica was still rebuilding and recovering from Hurricane Maria in 2017, a category 5 hurricane that had significant impacts on the socioeconomic fabric of the country. Hurricane Maria resulted in losses amounting to 225 per cent of Dominica's GDP and was preceded by Hurricane Erika two years earlier in 2015 which cost the country 96 per cent of its GDP. Hurricane Maria resulted in for example:

- Estimated damages totaling approximately US$931 million and losses of another US$380 million. This amounts to almost 225% of the country's 2016 GDP.
- 30 persons losing their lives.

- Damage to the country's housing stock — 15 per cent of houses were totally destroyed, 75 per cent partially damaged, at an estimated cost of US$382million.
- Damage to critical infrastructure — roads, bridges, water systems, electricity, telecommunications.
- Impacts on the agriculture and tourism sectors, critical for supporting food security, economic activity and providing a livelihood for thousands.
- Uncalculated loss of ecosystem services provided by watersheds, wetlands and coral reefs



Dominica clearly highlights the multi-hazard environment that Caribbean countries and many other SIDS outside of the Caribbean exist in. Dominica is extremely vulnerable to natural disasters and climate change. Between 2014 and 2018, Dominica experienced 10 tropical storms and two hurricanes, rendering its economy ever more fragile as a result. During 1997-2017, it was the country with the highest GDP losses to climate-related natural disasters and ranked in the top 10 per cent among 182 countries for climate-related fatalities.

Notwithstanding, Dominica's Human Development Index (HDI) value for 2019 was 0.742— which put the country in the high human development category— positioning it at 94 out of 189 countries and territories. Between 2000 and 2019, Dominica's HDI value increased from 0.703 to 0.742, an increase of 5.5 percent. Despite this relatively high HDI value, 28.8 per cent of Dominica's population could be classified as poor, with 3.1 percent of this considered indigent.[1] In addition to those considered poor, a further 11.5 percent of the population can be considered vulnerable due to downturns in the economy and other exogenous shocks such as natural disasters.

Since the start of the pandemic, Dominica has recorded 9,032 COVID 19 cases and 51[2] deaths. Despite ample vaccines and testing availability, vaccination remains below 40.3 percent of the population due primarily to vaccine hesitancy.

Prior to the COVID-19 crisis, GDP growth was forecast at 5.47 per cent for 2020, according to the Eastern Caribbean Central Bank (ECCB). However, the pandemic reduced the gains that were expected to strengthen Dominica's economic position in the near term. GDP is estimated to have contracted by 11 per cent in 2020 and showed a modest recovery of 3.7

[1] https://prais.unccd.int/sites/default/files/2018-08/Dominica%20CPA%202009%20Main%20Report%20Final.pdf
[2]https://www.google.com/search?q=covid+19+cases+commonwealth+of+dominica&oq=covid+19+cases+commonwealth+of+dominica+&aqs=chrome.69i57j0i22i30j0i390l5.10673j0j7&sourceid=chrome&ie=UTF-8

per cent in 2021. This was partly due to the sharp reduction in tourism and related sectors. While the tourism sector is less important to growth in Dominica compared to several other Caribbean countries, tourism remains Dominica's largest foreign exchange earning activity and the sector is responsible for 56 per cent of all export earnings.[3] The downturn in the tourism sector will likely lead to a reduction in foreign exchange earnings.[4] Furthermore, about 70 per cent of persons employed in the accommodation and food services are female, highlighting a disproportionate impact of the falloff in tourism on females.

During the pandemic, efforts to recover from the impacts of Hurricane Maria led to strong growth in the construction sector, due to the large public investment programme in housing and infrastructure resilient to natural disasters, financed with record-high Citizenship by Investment (CBI) revenue of 30 per cent of GDP[5]. The high CBI revenue contributed to a reduction in the fiscal balance for 2020, despite declines in tax revenue and increases in spending. Public debt, however, increased to 106 per cent of GDP in 2020 due mainly to higher official borrowing. Also, the current account deficit widened to close to 30 per cent of GDP due largely to the loss of tourism exports and increase in imports related public investment and the increase in commodity prices.

Following the devastation as a result of back-to-back major storms in 2015 and 2017, Dominica announced its intention to become the first disaster resilient nation in the world and prepared and is implementing its National Resilience Development Strategy (NRDS), a comprehensive plan including policies, costs, and financing to build resilience against future natural disasters. The NRDS along with the Climate Resilience and Recovery Plan (CRRP) 2020 – 2030 are two good entry points for enabling integrated planning to support sustained recovery in Dominica and provides an excellent foundation for advancing the integrated recovery approach and leverage points for transformative change with the context of COVID-19 recovery.

Objective:
The National Consultation represents Phase II of the UNDESA and ECLAC cooperation with Dominica that aims at strengthening the integrated recovery planning and decision-making capacity of the national stakeholders in **DOMINICA** and other participating Caribbean States involved in mitigating the impacts of the COVID-19 pandemic and building back better towards achieving the 2030 Agenda and its Sustainable Development Goals.

The National Consultation aims at discussing with stakeholders the progress in formulating and implementing sustainable recovery plans in Dominica and receiving input and concrete recommendations on building back better and accelerating the implementation of the country's national development plans, in this case the NRDS towards advancing the achievement of the sustainable development goals.

[3] Moore, Winston. 2021. Commonwealth of Dominica: COVID-19 Heat Report: Human and Economic Assessment of Impact. UNDP, UNIEF, UN Women Eastern Caribbean
[4] https://www2.unwomen.org/-/media/field%20office%20caribbean/attachments/publications/2020/human%20and%20economic%20assessment%20of%20impact%20-%20commonwealth%20of%20dominica.pdf?la=en&vs=2852
[5] https://www.imf.org/en/News/Articles/2021/12/03/mcs-120321-dominica-staff-concluding-statement-of-the-2021-article-iv-mission

Target Audience:
The national consultation will bring together a wide range of Government, CSOs, academia, indigenous peoples and private sector representatives engaged in: the national implementation of the NRDS, CRRP and other COVID-19 recovery plans, the 2030 Agenda for Sustainable Development and the SDGs; and the development of the country's first Voluntary National Review on the SDGs. The national consultation also will include relevant the UN Country Team in Dominica, and UN Country Teams in the Organization of Eastern Caribbean States (OECS) and UN System partners. Some possible organizations that could be targeted for the consultation include:

Public Sector – Relevant Government Ministries	**Civil Society**
• Blue and Green Economy, Agriculture and National Food Security • Economic Affairs, Planning, Resilience and Sustainable Development, Telecommunications and Broadcasting • Education, Human resource Planning, Vocational Training and National Excellence • Environment, Rural Modernization and Kalinago Upliftment • Finance and Investment • Foreign Affairs, International Business and Diaspora Relations • Governance, Public Service Reform, Citizen Empowerment, Social Justice and Ecclesiastical Affairs • Health, Wellness and New Health Investment • Housing and Urban Development • Public Works and The Digital Economy • Sports, Culture and Community Development • Tourism, International Transport and Maritime Initiatives • Trade, Commerce, Entrepreneurship, Innovation, Business and Export Development • Youth Development and Empowerment, Youth at Risk, Gender Affairs, Seniors' Security and Dominicans with Disabilities	• Oxfam • Red Cross • Missionary Flights International • The Dominica National Council of Women • Dominica Conservation Association • ISRAaid • Kibe'kuati Inc. • Caribbean Natural Resources Institute • Dominica Crisis Centre • The West Dominica Children's Federation • Dominica Crisis centre • The West Dominica Children's Federation • EACH • Association for Senior Citizens of Dominica • Dominica Council on Ageing • Dominica Association of Persons with Disabilities • Parents Advocating for Children with disabilities (PACIS) • The Dominica National Council of Women • Minority Rights Dominica (MIRIDOM) • Dominica Employers Federation (DEF) • Dominica Christian Council
Private Sector	**Academia**
• Invest Dominica Authority • Dominica Hotel and Tourism Association	• Dominica State College • University of the West Indies (Open Campus)

• Dominica Association of Industry and Commerce • Dominica Manufacturers' Association • The Caribbean Network of Services Coalitions • Small Business Development Centre • Local Banks -	
Development Partners and Regional Organizations	**Youth and Indigenous Groups**
• UNDP Eastern Caribbean • ECLAC • ILO Decent Work Team and Office for the Caribbean • UNICEF Eastern Caribbean • Un Women Multi-Country Office • World Bank • Organization of Eastern Caribbean States • Eastern Caribbean Central Bank	• Dominica Youth Business Trust • Dominica Youth Environment Organization • Alliance for Youth Action • Representatives from the Kalinagos • 4-H Programme • Dominica Athletics Programme • Dominica National Youth Council

Strategy UNDESA and ECLAC Cooperation (Target Group/ main activities/ approach/methodology)

The National Webinar/Virtual National Consultation is included under Phase II of UNDESA and ECLAC cooperation in Dominica and includes:

Phase 1:

- **Provision of advisory support to the COMMONWEALTH OF DOMINICA** with focus on researching the COVID-19 pandemic, its impacts and evaluating the progress in recovery planning measures and methodologies in the Caribbean Region in general and in **DOMINICA.** The technical support will be provided through regional and national experts.

Phase 2:

- Organizing a **virtual national consultation/webinar in DOMINICA,** during February/March 2022 aimed at discussing the progress in formulating and implementing integrated recovery plans and strategies that are intended to accelerate the implementation of the country national development plan "National Resilience Development Strategy (NRDS): Dominica 2030 as well as the sustainable development goals. This consultation will also be aligned to the country's preparation of its first Voluntary National Review (VNR) for presentation at the UN High-Level Political Forum in July 2022

Phase 3:

- **Adapting the UNDESA – UNITAR e-learning course** "*Integrated Recovery Planning and Policy Coherence towards the SDGs*", with specific emphasis to the national context of Dominica. This will be undertaken over the period March – April 2022.

Phase 4:

- **Delivery of e-learning course** "*Integrated Recovery Planning and Policy Coherence towards the SDGs: The Dominica Context*", in Dominica using a Train-the-Trainer format targeting Government, Civil Society Organization representatives, Academia, Youth, the Kalinagos (Dominica's Indigenous People) and the Private Sector. The delivery of the training which will be face-to-face will be undertaken between April and May 2022.

National Consultation

Sustainable Recovery and Resilience towards the Sustainable Development Goals in the Commonwealth of Dominica

Date: Wednesday 16th March 2022
(2:00 to 5:00 pm – AST and EST)

Programme / Agenda

Welcome and opening (15:00 Minutes)

Moderated by Sami Areikat, UNDESA
Remarks by (Government and UN Agencies)

- Ministry of Planning, Economic Development, Climate Resilience, Sustainable Development and Renewable Energy (Ms. Gloria Joseph, Permanent Secretary)
- UNDESA (Mr.Amson Sibanda, Chief,NSCBB/DSDG)
- ECLAC (Mr. Abdullahi O. Abdulkadri, ECLAC)

Session 1 (45 Minutes): Assessment of the Social and Economic Impact of COVID-19 in Dominica

Moderated by Sami Areikat
Presentation: Elizabeth Emanuel

The session will include a brief presentation by UNDESA and ECLAC on the main findings of the research paper,
"Impact of COVID-19 on 5 Caribbean SIDS… *Evaluating Progress in Recovery Planning, Emerging Policy Options, Best Practices and Lessons Learned*", with specific reference to Dominica and focussed on the impacts of COVID-19 on the country.

This will be followed by inputs from key stakeholders from the public sector, private sector, academia, youth and civil society organizations sharing in 1.5 minutes each, the main impacts, including data on a single sector based on the guiding questions below that they are most engaged in. *Participants could also include responses to the questions in the Zoom chat or in the Google Doc that will be made available throughout the consultation.*

Guiding Questions for Stakeholders
What has been the experience and impact of COVID 19 in the Commonwealth of Dominica:

a. Impacts on the Economy
b. Impacts on the Labour Market
c. Impacts on Education
d. Impacts on Employment
e. Impacts on Population Health (outside of COVID-19 but with focus on NCDS, HIV/AIDS and other diseases)
f. Impacts on Tourism and MSMEs

g. Impacts on Livelihoods, Food Security and Access to Markets
h. Impacts on Indigenous Peoples (Kalinagos)
i. Impacts on Women and Girls (any stark differences to the impact on men and boys?)
j. Other Socio-Economic Impacts

Session 2 (30 Minutes): Stakeholders' Engagement and Capacities to Implement Recovery Plans Post COVID-19:

Moderated and presented by Ministry of Planning, Economic Development, Climate Resilience, Sustainable Development and Renewable Energy (TBC)

Brief Description

This session will explore the importance and role of stakeholder involvement and engagement, political commitment and building consensus and ownership for recovery planning post COVID-19. The session also will explore the importance of policy coherence and policy coordination mechanisms, especially in light of the country's preparation of its first Voluntary National Review of the SDGs. The session will begin with a brief presentation from the Ministry of Economic Affairs, Planning, Resilience and Sustainable Development, and address the following questions:

- How has the COVID-19 affected the implementation of the National Resilience Development Strategy and the Climate Resilience and Recovery Plan (CRRP) 2020 – 2030?
- What are some of the lessons learned with respect to recovery following Hurricanes Erika and Maria and practices in recovery planning that can be shared with other small island developing states?
- How has COVID-19 affected the progress towards implementation of the 2030 Agenda for Sustainable Development in Dominica?
- What was some of the immediate actions taken by the Government to reduce the overall socio-economic impacts on the population and the economy with specific emphasis on vulnerable groups, children and the most vulnerable?
- What steps are being taken to involve stakeholders to prepare the country's Voluntary National Review on the SDGs and what are some of the key areas of resilience that will be showcased in the Dominica's story to the UN High Level Political Forum?

Guiding Questions for Stakeholders – (Using a scale of 1 – 5, with 5 being the best possible outcome and 1 being the least favourable outcome).

- How effective do you think the Government's immediate actions were in reducing the overall socio-economic impacts of the pandemic on people, vulnerable groups, indigenous peoples and economic sectors?
- How important do you believe robust and inclusive stakeholder engagement is for a sustainable recovery process?
- How much of a role do you see for national stakeholders – public and private sectors, civil society organizations and academia in the recovery planning process and implementation efforts?
- How important is political commitment to the sustainable recovery?
- How strong do you believe current policy coherence and policy coherence mechanisms are in place in Dominica?

Participants would include responses to the questions in the Google Doc that will be made available throughout the consultation for this session.

Session 3 (45 Minutes): Building Forward Stronger Post COVID-19… The Road to a Resilient Recovery… Selected Options for Consideration in Dominica

Moderated by Elizabeth Emanuel
Presentation: Sami Areikat
Brief Description
This session will begin with a short presentation from UN DESA and ECLAC on Proposed Strategies and Transformative Initiatives for Consideration in Building Back Better, Building Forward Stronger, Fairer and Equal Post COVID-19. Initiatives that are aligned to the Multi-Country Sustainable Development Cooperation Framework (MSDCF) and the SDGs and which emerged from the research paper, "Impact of COVID-19 on 5 Caribbean SIDS… *Evaluating Progress in Recovery Planning, Emerging Policy Options, Best Practices and Lessons Learned*" will be presented. Following this presentation, participants will engage in a brainstorming exercise.

Brainstorming Exercise moderated by Elizabeth Emanuel
Participants will be asked to brainstorm using *Polling* to assess how they view each of the proposed initiatives presented. Using Polling, each participant will review the proposed initiatives and vote for the top 3 they believe are most critical for Dominica as the country seeks to build back stronger and to achieve a more resilient and sustainable recovery within the context of the country's NRDS and CRRP. The responses will then be collated across all participant responses and the top 5 priority areas for Dominica, based on the consensus of all groups will be shared. The analysis could also be further broken down to show top priority areas based on stakeholder groupings – e.g. public sector, private sector, youth etc.

Session 4: (30 Minutes): Financing for Sustainable Recovery and Development in the Era of COVID-19 and Beyond

Moderated by Abdullahi O. Abdulkadri

Brief Description
The session will take the form of a panel discussion involving UN and Regional Organization (OECS< ECCB) counterparts involved in the recovery process in Dominica and the wider Caribbean, with specific emphasis on the OECS. Panellists will share via 2-minute presentations on financing for development beyond COVID-19; and innovating financing instruments/tools and other resources available for advancing onto the road to a resilient recovery. This session will therefore take stock of the financial resources required and progress made so far to take the Caribbean Region and more specifically Dominica and the OECS from vulnerability to resilient development and sustainable recovery and dynamic growth, all within the thrust of 'leaving no one behind'. Panellists will address the following:

- What are the COVID-19 related debt and liquidity challenges facing the Caribbean Region and Dominica and possible measures to address them?

- How to mitigate the collapse of key economic sectors, including sectors such as MSMEs?
- How to engage private creditors, international and regional development banks and access concessional funding, with debt cancellation?
- What are the non-traditional forms of financing that could be explored (e.g. international philanthropic organizations, foundations, public-private partnerships, new financing vehicles for areas such as women's economic empowerment etc.)
- How to promote economic diversification and green and blue investments for resilience building in the Caribbean Region?
- What are some of the innovative financing tools available to Caribbean countries and how they can be applied (e.g. blended financing, debt swaps, green and blue bonds etc.)
- How can countries capitalize on the Addis Ababa Financing for Development Agenda which adopted a renewed global financing architecture to support the Sustainable Development Goals?
- What is the role of UN agencies to support countries in their thrust to building back better and equal?

Proposed Speakers

- UNDP
- ECLAC
- UNICEF Eastern Caribbean
- UN Women (Financing Vehicles for Women Economic Empowerment)
- OECS Commission
- Eastern Caribbean Central Bank
- Caribbean Development Bank
- Representatives of Financial sector in Dominica (i.e. Public Transportation, MSMEs, Education Trust Funds (students overseas)

Closing Remarks and Next Steps (15:00 Minutes)

Moderated by Sami Areikat

Government of the Commonwealth of Dominica
ECLAC
UNDESA

Annex 516

"Partnerships to Advance Climate Risk Approaches I Grenada, Jamaica, Saint Lucia", *United Nations Framework Convention on Climate Change,* 2023

English

Climate action 2023 UN Global Climate Action Awards Financing for Climate Friendly Investment

Partnerships to Advance Climate Risk Insurance Approaches I Grenada, Jamaica, Saint Lucia.

Content

Insurance solutions can play a significant role in dealing with the consequences of climate change. Mirroring its approach at the international level the

Munich Climate Insurance Initiative (MCII) has convened public and private stakeholders to develop the Livelihood Protection Policy (LPP), a parametric index-based micro-insurance product as a response to the vulnerability poverty nexus in the Eastern Caribbean.

This product is targeted at those who are the most vulnerable to extreme weather impacts living on the Caribbean islands of Saint Lucia, Jamaica and Grenada. The residents of these islands suffer from the aftermath of storms, hurricanes, and floods, with little support or access to financial assistance. The LPP helps people in the low-income segment of society to access climate risk insurance at a reasonable cost and without any restrictions vis-a-vis a specific sector or occupation. The results of the project are constantly being fed back into international policy-making processes to shape the international dialogue on climate risk insurance.

Key facts

- LPP has been in the market in Saint Lucia, Grenada and Jamaica for four hurricane seasons, accumulated USD 440,000 in the total sum insured, and paid out USD 132,824;
- It operates with a range of local partners, including primary insurers, social aggregators, risk management agencies, and national Ministries;
- The product is distributed to clients using social aggregators, like credit unions, farmers' cooperatives, and associations;
- Special provisions are made to existing regulatory frameworks to address parametric index insurance in existing insurance acts;
- Training on parametric index insurance and micro-insurance has successfully been provided to local stakeholders.

The problem

Extreme weather events related to climate change impact those least able to adapt to them. Low-income communities are often excluded from financial services like risk insurance, as they cannot afford the high premiums or fees of traditional insurance solutions. Access to finance in the aftermath of a disaster is often blocked due to a lack of a formal or regular income, insufficient credit history, low collateral, or proper identification.

Owing to the lack of insurance or other formal protection schemes, many at risk in developing countries are unable to raise sufficient capital to restore livelihoods following major catastrophe. This leads to affected people resorting to a variety of coping strategies (e.g. activity diversification, selling assets, reducing food consumption, taking children out of school or borrowing) in the event of a crisis. Applied on their own, these strategies might further trap them in poverty and impede development.

The solution

The Livelihood Protection Policy (LPP) designed by the Munich Climate Insurance Initiative was introduced to the Caribbean islands of Jamaica, Saint Lucia and Grenada, providing access to affordable micro-insurance for those most at risk from extreme weather events such as hurricanes and flooding. This means introducing new, simplified, and low transaction cost insurance and to consider climate risk insurance in the context of integrated climate risk management, as part of effective national and sectoral adaptation planning.

By extending financial protection to underserved vulnerable communities, MCII has demonstrated the role financial inclusion can play in climate change adaptation. The project also aims to improve linkages between the insurance product and disaster risk reduction measures and to streamline the regulation of climate risk micro-insurance approaches across the Caribbean.

To achieve this, MCII links important local stakeholders like national disaster management agencies, local insurance companies, social aggregators like farmers' associations, insurance regulators and relevant ministries, with a regional risk insurance pool (CCRIF SPC), independent climate service providers (DHI), enabling organizations (ILO's Impact Insurance Facility), and global reinsurance companies (Munich Re).

Helping the planet

Generally, transparent insurance programmes help pricing the risks of disasters. Creating such price tags can become an important motivator to undertake resilience creating activities; it can also help to indicate disaster costs and help to exemplify the cost of inaction to mitigate climate change.

Efforts are made to bundle any such micro-insurance or index-based products with activities and/or measures that support sustainable ecological practices to avoid unsustainable practices that would further harm the natural environment.

Helping people

This project aims to motivate a paradigm shift in addressing and dealing with climate risks among vulnerable populations in the low-wage sector. It also promotes international climate financing dialogue among political decision-makers at national and regional levels to development corporations and climate negotiators at the international level. By virtue of this initiative, payout recipients can get back on their feet faster than was previously possible without having to resort to erosive coping measures.

Overall, the project has increased the adaptive capacity of target stakeholders, as climate risk insurance enables people to access the resources needed to escape climate-related poverty and, the application of climate risk insurance, holds a direct incentive for risk reduction.

In the long term, the effects of climate risk insurance, such as economic diversification or the possibility to invest in their own livelihoods, will contribute to the increase in economic resilience and lead to a general improvement in the economic situation.

Spillover effect

Building the capacities of insurance regulators and primary insurers in the target countries has helped to lay the groundwork for effective upscaling of the Livelihood Protection Policy into other countries in Latin America and the Caribbean. Private sector stakeholders have expressed their interest in expanding the provision of weather risk insurance to vulnerable communities in 21 additional countries in the region. Having gained the first proof of concept, efforts are underway to revise the product to make it more suitable and further improve its performance. A new element is branchless banking, to decrease transaction costs and make premiums more affordable. The project currently explores ways of including additional perils in addition to the already existing coverage of damages through heavy rain and strong wind speed. Targeted extensive capacity-building and close cooperation with local actors has resulted in attempts to roll the project out across the Caribbean. The LPP Itself is an agile product that can be easily adapted to different circumstances in other countries and contexts. It is designed as a parametric index-based insurance product that

considers specific rainfall amounts or wind velocities to calculate a given payout. These trigger thresholds can be adjusted to local contexts by the calculation agent who monitors the underlying weather data and assesses the necessary parametric index. Payout levels can be adjusted to the needs of the target group in each location.

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Annex 517

"TSU Working Paper from Working Group 5(B)", *United Nations Framework Convention on Climate Change*, 21 August 2023

TSU WORKING PAPER FROM WORKING GROUP 5 (B)

This document provides options for new funding arrangements for addressing loss and damage that complement and include sources, funds, processes and initiatives under and outside the United Nations Framework Convention on Climate Change and the Paris Agreement.

The proposed options and approaches described in this paper do not constitute a recommendation by Technical Support Unit (TSU) nor reflect any particular views expressed by the TSU. The options are proposed for consideration by the Transitional Committee (TC) and does not prejudge the final recommendations of the TC on the scope and arrangements of the new fund and funding arrangements.

The document complements the Synthesis Report and is produced in synergy with working papers developed by the TSU focusing on decisions 2/CP.27 and 2/CMA.4, paragraphs 5(a), 5(c) and 5(d). To minimise duplications, this paper cross references these documents on relevant topics. The proposed options are builds on the discussions on the scope of the loss and damage fund and funding arrangements that have been initiated under the TC.

I. Introduction

1.1 Mandate

1. The 27th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP27) took a historic decision to establish 'new funding arrangements and a fund'[1] for responding to loss and damage, including establishing institutional arrangements, modalities, structure, governance and terms of reference for a fund[2], thereby sending a clear signal of solidarity with developing countries that are particularly vulnerable to climate change. Further, a Transitional Committee (TC) on the operationalization of the new funding arrangements and fund was established, to make recommendations for consideration and adoption by COP 28 and CMA 5.

2. The COP 27 responds to mounting scientific evidence of the Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change[3], and other best available science, noting the increasing gravity, scope and frequency of loss and damage that will continue to increase with additional fraction of a degree of temperature increases, including evidence of hard limits to adaptation in most vulnerable regions and ecosystems of Small Island Developing States and Africa.

3. This working paper is being prepared by the Technical Support Unit (TSU) in response to and further support the deliberations of the Transitional Committee (TC) during its first and second meetings. In particular TC requested during the second meeting to conduct further technical work on the understanding of the mandate to the TC with regards to decisions 2/COP.27 and 2/CMA.4, paragraph 5(b). This working paper is produced for consideration by the TC at its third meeting.

1.2 Scope

4. The scope of the working paper is to discuss options for new funding arrangements for addressing loss and damage that complement and include sources, funds, processes and initiatives under and outside the United Nations Framework Convention on Climate Change (the 'UNFCCC') and the Paris Agreement. These options for new funding arrangements aim to provide and assist in mobilizing new and additional resources, and that these new arrangements complement and include innovative sources, funds, processes and initiatives under and outside the Convention and the Paris Agreement4 to address loss and damage associated with the adverse effects of climate change in developing countries that are particularly vulnerable.

[1] Decisions 2/CP.27 and 2/CMA.4, paragraph 5b
[2] Decisions 2/CP.27 and 2/CMA.4, paragraph 5a
[3] Intergovernmental Panel on Climate Change. 2022. Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. H Pörtner, D Roberts, M Tignor, et al. (eds.). Cambridge: Cambridge University Press. Available at https://www.ipcc.ch/report/ar6/wg2/.
[4] Decisions 2/CP.27 and 2/CMA.4, paragraph 2

5. The structure of the working paper is as follows:

a) Section 2 provides a summary of findings and implications for new funding arrangements.
b) Section 3 reviews existing funding arrangements related to loss and damage and proposes three categories of potential new funding arrangements within a structured typology for addressing loss and damage used in the synthesis paper.
c) Section 4 discusses the processes of interaction of new funding arrangements under and outside of the UNFCCC and Paris Agreement

1.3 Approach

6. This working paper explores potential elements and options for new funding arrangements relevant to loss and damage, based on a review of existing funding arrangements, and best practices of funds and agencies, as well outlines implications and processes for establishing such new funding arrangements under and outside of the UNFCCC and the Paris Agreement.

7. In outlining the different options for new funding arrangements, the working paper draws on institutional and external resources, peer-reviewed literature, published reports, documents, and background materials relevant to financing for averting, minimizing, and addressing loss and damage.

II. Summary of findings

8. The existing funding arrangements for loss and damage fall short of responding to current and future scale of loss and damage, are not sufficient to address the existing funding gaps, and are fragmented for coherently supporting developing countries that are particularly vulnerable to the adverse effects of climate change. This is confirmed by the Synthesis Report *on existing funding arrangements and innovative sources relevant to addressing loss and damage associated with the adverse effects of climate change*[5], published by the secretariat in May 2023, the WIM/EXCOM paper on e*laboration of the sources of and modalities for accessing financial support for addressing loss and damage*[6] and outcomes of two Glasgow Dialogues conducted in 2022 and 2023. These reports highlight the limited scale and coverage of the entire spectrum of finance for loss and damage (e.g., extreme and slow onset events, economic and non-economic loss and damage, and mobility). Setting up a new fund for loss and damage and its interaction with the existing funding arrangements should therefore consider future climate risks, the need to facilitate increased scope and scale and the implications for implementation under and outside the UNFCCC and Paris Agreement.

9. Alongside the gaps in current funding arrangements is the issue of inadequacy in the amount of financial and other resources allocated to addressing current and future loss and damage

[5] https://unfccc.int/sites/default/files/resource/TC2_SynthesisReport.pdf
[6] https://unfccc.int/documents/196468

resulting from adaptation gaps, hard limits to adaptation and residual, unavoidable climate risks in vulnerable countries and regions, and collapse of critical ecosystems and ecosystem services. The information also reveals that with agencies focusing on project-based approaches, technical aspects of loss and damage, closely aligned with their mandates or priority areas, there are critical areas left with little or no financial support; long-term finance for slow onset events (SOEs), non-economic losses (NELs), mobility (displacement, planned relocation and migration) and large-scale irrecoverable events are mostly under-funded. In this regard, new funding arrangements should consider adequate support to rapid onset and slow onset events as well as the compounding, transboundary nature of such losses and damages.

10. Discussions though the TC meetings and workshops have highlighted the importance of strengthening and scaling up the broader loss and damage mosaic of funding arrangements and, finance instruments and solutions – complementary to the fund. Based on TSU review of existing arrangements and guided by TC deliberations, three categories of options are presented in this paper (ref. Annex 1):

a) New funding arrangements within existing climate funds under the UNFCCC;
b) New funding arrangements between funds and processes outside of the UNFCCC; and
c) Hybrid arrangements with multiple options for funding arrangements under and outside of UNFCCC processes.

11. The combination of options for new funding arrangements should allow comprehensive risk management support for loss and damage, in the context of finance for ongoing and ex post action (including recovery, rehabilitation and reconstruction), with adequate finance and arrangements for SOEs, NELD and mobility. It should also allow for the deployment of a variety of instruments though stakeholders and partners including inter alia regional and global risk pooling mechanisms such as the Caribbean Catastrophe Risk Insurance Facility (CCRIF), African Risk Capacity (ARC), Pacific Catastrophe Risk Insurance Company (PCRIC) and the Global Shield against Climate Risks; and leverage other forms of pre-arranged finance such as those deployed through the humanitarian architecture.

12. The new funding arrangements should complement the need for leveraging new financial instruments, innovative sources and targeted funding for underfunded areas. Based on this current situation, the new funding arrangements must consider the adequate treatment of all aspects of loss and damage. Many recommendations have also been put forward to the TC in that regard, through region and country specific case studies[7], and submissions[8]. For example, an understanding of how to adequately resource NELs such as cultural values, identity and indigenous knowledge, would necessitate direct delivery of finance and engagement with at-risk local actors that should be factored in the design of the new funding arrangements.

[7] https://unfccc.int/case-studies
[8] https://unfccc.int/submissions-to-the-transitional-committee

13. The new funding arrangements should consider coordination of and partnership of existing systems where new mandates and guidance can incentivize adaptation while scale-up support for preparedness, response, recovery, rehabilitation and reconstruction considering residual, unavoidable climate risks. At the same time, it should have the flexibility to allow country drivenness where country's plan and strategies for addressing loss and damage can be incorporated as they are developed though technical assistance, institutional readiness and improved policy coherence (e.g., enhancement of Nationally Determined Contributions, National Adaptation Plans and other climate and disaster risk reduction policies).

14. Scientific evidence points to future large-scale, irreversible loss and damage related to critical ecosystems[9], ecosystem services and globally significant biodiversity with cascading risks and compounding impacts e.g., loss of cryosphere and glaciers, collapse of ocean currents[10], and increasing acidification. These constitute irrecoverable losses and damages that are uninsurable, risking billions of people without water, food and shelter. Currently few to no funds and funding arrangements have the capacity and mandate to cover these large-scale SOEs. Arrangements with the UN Environment Assembly and UN General Assembly and related trust funds would need to be strengthened to cover large-scale events and losses as they relate to global common resources and transboundary risks and impacts.

15. Existing regional insurance mechanisms (e.g., CCRIF, ARC, PCRIC and Global Shield) play a critical role in pre-arranged finance but would benefit from integrating and strengthening anticipatory response measures through increased scale, affordability, coverage, and scope for different climate scenarios. The funding arrangements must therefore factor in collaborative arrangements for re-insurance as climate risks in regions and countries lead to plausible uninsurable scenarios. Development agencies and banks including partnerships at the regional and national levels play a role in scaling-up affordable insurance for climate change and must be considered in the new funding arrangements to broaden of the scale of finance and solutions at the (sub) national level.

16. The timeline for setting up a new fund and funding arrangements depends on the options selected, institutional arrangement and mandates from the COP and CMA processes. Setting up a new fund and funding arrangement for loss and damage could be quick if considered under an existing fund or institution under or outside the UNFCCC and Paris Agreement. However, such an approach may present some limitations, including among others challenges related to access, scope, and scale, based on the current arrangements for funds and institutions under the UNFCCC.

17. For options, especially those outside of the UNFCCC and Paris Agreement, accountability to COP and CMA will be a key limiting factor for new arrangements. As such, elements for the

[9] Intergovernmental Panel on Climate Change. 2019. IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. H Pörtner, D Roberts, M Tignor, et al. (eds.). Cambridge: Cambridge University Press. Available at https://doi.org/10.1017/9781009157964.002

[10] Ditlevsen, P., Ditlevsen, S. 2023.Warning of a forthcoming collapse of the Atlantic meridional overturning circulation. Nature Communication 14, 4254. Available at https://doi.org/10.1038/s41467-023-39810-w

TC to consider though the COP and CMA could include new mandates, platforms, fund to fund arrangements, sharing of information vis-a-via guidance on coherence, coordination and synergies among existing funding arrangements[11].

18. An option could include embedding multiple funding arrangements with the aim of setting up fit-for-purpose arrangements for underfunded areas of loss and damage. Such an approach will increase the likelihood of pooling resources and scale-up support to address non-economic losses and slow onset events, alongside extreme climate events, economic losses and humanitarian response. This approach will also allow for mobilization and use of a range of financial tools and instruments thereby maximizing the catalytic impact of the fund's resources leveraged to address loss and damage.

19. The coordination mechanism for the funding arrangements should be designed and inbuilt in the fund to from the onset to enhance areas of cooperation, facilitate greater understanding of solutions, enhance coherence, blending of financial instruments, and further catalyze action and support across multiple funds, initiatives and agencies in the mosaic of solutions. The funding arrangements should however not compromise on the speed, efficiency, and effectiveness in delivery of resources to countries for response and recovery from arrangements with multiple development, climate change and humanitarian agencies.

20. Financial resources for deployment of social protection measures, accounting for the particular needs of climate migrants, women, men, children, and displaced persons must accompany arrangements to deploy policy responses to effectively and consistently addresses loss and damage, in particular for slow onset events, humanitarian aid and NELs would be needed. Here coordination with UN processes related to mobility, NAP, NDC, and various others, would be vital as part of package of coordinated response to countries.

21. Selection of options for setting up new funding arrangements for loss and damage, under or outside the UNFCCC and Paris Agreement, needs to take into account various accountability requirements under the COP and CMA (e.g., reporting, governance, coordination of processes, and timelines) while capitalizing on the independence and flexibility of funding arrangements outside of UN processes (e.g., leveraging on arrangements, building on funding windows of independent institutions, potential for deploying large scale solutions, and use of comprehensive set of blended instruments). Requirements for setting up new funding arrangements vary depending on use of options.

22. Yet regardless of the association with the UNFCCC and Paris Agreement, some form of interaction of the new funding arrangements with the UNFCCC is critical to ensure accountability and reporting. The accountability requirements are critical as information on monitoring progress provides opportunity for course correction as needed, however reporting should not be onerous, and a simple format should be considered.

[11] Decisions 2/CP.27 and 2/CMA.4, paragraphs 5d and 6a

23. None of the proposed options is effective if selected individually and there is a need for blending, matching and combining options and solutions. This would present challenges, and there are multiple limitations and elements that should be considered by the TC under each of the three categories of options, including among others, the timeline for setting up the fund, trustee arrangements (if required), accountability to UNFCCC and Paris Agreement (where applicable), and explicit mandates and decision of the COP and CMA.

III. Existing and new funding arrangements with a focus on addressing loss and damage

3.1 Review of existing funding arrangements related to loss and damage

24. Various processes and reports under the UNFCCC and Paris Agreement have explored the limitations of existing funding arrangements relevant to averting, minimizing, and addressing loss and damage. In a technical paper published by the secretariat, the various sources of and modalities for accessing financial support for addressing loss and damage were elaborated, including finance for adaptation, disaster risk reduction, development, and humanitarian assistance, noting that these are imperfect proxies for understanding the landscape of funding for addressing loss and damage.

25. Under the UNFCCC, the paper identified the Adaptation Fund (AF), the Least Developed Countries Fund (LDCF), the Special Climate Change Fund (SCCF), the Green Climate Fund (GCF), and their relevance to financing actions to address loss and damage through adaptation finance. It is noted that while some of the activities supported by these funds – such as strengthening of climate services and early warning systems, and response systems – may be relevant to minimizing loss and damage, other aspects of addressing loss and damage – such as non-economic losses like loss of societal and cultural identities, territory, human mobility or rapid large-scale financing in the aftermath of extreme events – fall outside the scope of these funds.

26. Outside of the UNFCCC, the paper assessed multilateral climate funds and multilateral development banks, bilateral finance, domestic public climate and disaster expenditures, regional risk financing, thematic financing including disaster risk reduction finance, humanitarian assistance, and development finance, as well as private sector and philanthropic finance. It highlighted some opportunities within these external institutions and sources to support the financing of actions to address loss or damage. For example, it noted that multilateral development banks and development finance institutions can serve as intermediaries to support the implementation of risk transfer instruments; bilateral providers offer more opportunities for innovation in addressing loss and damage given their greater flexibility to work beyond established fund mandates and indicators; and in regional risk facilities, determining how contracts can be designed to meet the needs of very vulnerable groups.

27. The Synthesis Report mapped over seventy-five entries, highlighting existing funding arrangements under institutions ranging from the World Bank to regional risk facilities to bilateral agencies. Such funding arrangements vary widely in scope, scale and adequacy. The report

identified key gaps in funding arrangements, including data, knowledge, and capacity; policies to determine triggers and levels of funding to address loss and damage; financial resources across all domains; eligibility criteria; insurance; mechanisms to facilitate debt swaps; and policy coherence.

28. During the second Glasgow Dialogue, held from 8 to 10 June 2023, participants discussed the operationalization of the new funding arrangements established in decisions 2/CP.27 and 2/CMA.4, as well as maximizing support from existing funding arrangements relevant for, among other things, responding to economic and non-economic losses, slow onset events, and extreme weather events. The discussions during the dialogue highlighted a wide range of potential approaches to enhance support provided through existing funding arrangements. Examples included: for multilateral climate funds, facilitating pre-arranged finance and premium subsidies; for multilateral development banks, expanding eligibility for concessional resources and the use of climate resilient debt clauses; in the humanitarian system, establishing a dedicated climate window under relevant funds; and more.

29. Key considerations related to opportunities to maximize support from existing funding arrangements were also raised at the dialogue, including the importance of additionality of funding, ensuring that existing arrangements are adequately resourced to fulfill their mandates and take on any additional activities to address loss and damage, and recognizing the existing barriers to and challenges with accessing these existing arrangements faced by some countries.

3.2 Potential elements and options of new funding arrangements

30. While there are several gaps in current landscape of existing funding arrangements and related finance flows for addressing loss and damage associated with the adverse effects of climate change (discussed in section 3.1), new funding arrangements could be established to address the 'key' priority gaps that centers the new fund in the mosaic of funding arrangements and solutions.

31. The proposed category of options to consider focuses on leveraging various innovative sources, financial instruments, knowledge and coordination, which are potential ways to explore addressing of the priority gaps in the most effective ways, especially for the most vulnerable populations and the ecosystems on which they depend[12]. They cover, build on and scale-up a range of new arrangements from within existing climate finance, disaster risk reduction, development and humanitarian sectors, to leverage innovative solutions and initiatives (such as the Santiago Network on loss and damage, Global Shield against Climate Risks) for vulnerable countries.

32. With regards to the TC recommendations, the proposed options for new funding arrangements are grouped into three categories (ref. Annex 1 for further details):

a) New funding arrangements within existing climate funds under the UNFCCC;
b) New funding arrangements between fund and processes outside of the UNFCCC; and

[12] Decisions 2/CP.27 and 2/CMA.4, paragraphs 6c and 6d

c) Hybrid options with multiple funding arrangements with funds from under and outside of UNFCCC processes

33. Options under new funding arrangements with existing climate funds under the UNFCCC would be quick gains via expanding of mandates from the COP and CMA and ensuring coordination and complementarity with existing funding arrangements, including:

a) Enhancing complementing though existing portfolio of responses and incentivizing transformational adaptation through the operating entities of the financial mechanisms of the UNFCCC and Paris Agreement e.g., early warning, capacity building, institutional and readiness support, restoration and protection of critical ecosystems;
b) Creating new windows to cover funding gaps e.g., new result areas and windows for NELs, SOEs and mobility; and
c) Establishment or scale-up of micro and small grants windows to ensure speedy, direct access to local actors and at-risk communities.

34. In terms of new funding arrangements outside of the UNFCCC, there are multiple options for funding arrangements for responding to loss and damage. Elements of 'new' funding arrangements could include:

a) Partnership and cooperative arrangements in the form of MOUs to strengthen responses to address key gaps where the L&D fund would play a significant role in the mosaic of solutions;
b) Incorporating in the governing instrument of the funds options to receive contributions from innovative finance solutions e.g., levies, philanthropy and businesses, and leveraging private finance;
c) Contributory arrangements with national funds for implementation of solutions and regional risk financing mechanisms to increase coverage of insurance;
d) Fund-to-fund agreements to scale-up responses to mobility, NELs and SOEs;
e) Strengthened collaborations with existing platforms, initiatives and bodies (e.g., Taskforce on Displacement, Early Warning for All, Global Shield, MDB Coordination Platform on Economic Migration and Forced Displacement, Humanitarian partnerships and finance mechanisms);
f) Guidance through the COP/CMA to create new, specialized windows to address NELs, SOEs and mobility in funds outside of the UNFCCC and Paris Agreement;
g) Pooling of recovery and reconstruction funds and blending finance with MDBs, including COP guidance on use of disaster and climate-related clauses in lending operations Identification of options to maximize the use of low concessional financial instruments to address loss and damage; and
h) Coordination with funds, initiatives, platforms and agencies to ensure sharing information on new, innovative instruments and experiences to address loss and damage.

35. The final category of options under hybrid, multiple options for funding arrangements from under and outside of UNFCCC processes, includes combination of options under the first two categories. They mix funds, funding instruments, pool diverse sources and various response types for anticipatory, rehabilitation and reconstruction etc. solutions. A key limitation of the hybrid arrangement is that they require time for coordination, and new and expanded mandate, arrangements, and access modalities under the COP/CMA. It is recommended that the hybrid modality of options is considered as an appropriate category from the onset of the development of fund in determining the suitability of 'new' funding arrangements such as partnerships and provide/receive contributions from a range of sources.

36. For each category of options, elements for TC consideration are presented that could be factored in the design, operations and performance of the loss and damage fund to ensure scale, adequacy, speed, accessibility, and flexibility to engage in future arrangements. Examples from relevant funds, initiatives and partnerships and platforms are provided that can be used to further elaborate on the design of new funding arrangements.

IV. Interaction of new funding arrangements under and outside of the UNFCCC and Paris Agreement

37. Considering the coherence, policy, structural and financial gaps in the landscape of existing funding arrangements to address loss and damage, the category of proposed options for new funding arrangements and the new fund for loss and damage (ref. TSU working paper under 5a) should be undertaken alongside establishing the coordination function of the fund to ensure enhanced partnership, collaboration for implementation, streamlined reporting and accountability at global, national and local levels (ref. TSU paper under 5d).

38. As such, in addition to financing solutions, the new fund is expected to ensure a catalytic and coordination role of the funding arrangements for loss and damage. This role would help promote, coordinate and ensure collaboration between the fund and the new funding arrangements that could be structured under the UNFCCC and the Paris Agreement. Based on the existing mechanism for support for climate change adaptation and mitigation under and outside the UNFCCC, the proposed options below are outlined for consideration by the TC that can ensure accountability and reporting.

Option 1: Accountability and reporting mechanism under the UNFCCC and Paris agreement

39. This option applies to new funding arrangements if setup under the UNFCCC and Paris Agreement with direct accountability mechanisms – the current model of GEF and GCF serving as operating entities of the financial mechanism of the UNFCCC, and AF as serving the UNFCCC and Paris Agreement are relevant examples.

40. Under this option, the new funding arrangements under the operating entities of the financial mechanism of the UNFCCC will interact with the new loss and damage fund, and ensure

accountability and reporting to the UNFCCC through the COP/CMA. As a COP/CMA decision might be required for scaling up the funding for loss and damage activities, a process of interaction with the UNFCCC will follow guidance and reporting during each COP/CMA. An interinstitutional coordination could be setup using the current arrangements between the AF, GEF, GCF and CIF (ref. TSU paper under 5d for further details).

41. This option also applies for cases where the new funding arrangements are set up as a new window to scale up existing loss and damage of climate funds under the UNFCCC. The current model of LDCF and SCCF under the GEF allows such interaction with the other climate funds and a direct reporting and accountability to the convention and Paris Agreement.

42. While this option allows for direct reporting and accountability to the Convention, it does not enhance effective coordination with new funding arrangements set up outside the UNFCCC (e.g., CIF's model). It also limits the effective coordination with other key actors supporting loss and damage including humanitarian, MDBs and other non-UNFCCC actors (e.g., various insurance schemes).

Option 2: Accountability and reporting mechanism outside the UNFCCC and Paris Agreement

43. Considering the diversity of institutions and initiatives proposed as options for new funding arrangements (see Annex 1) of which many operate outside the UNFCCC and Paris Agreement, a process of interactions and accountability under the UNFCCC would be challenging and ineffective. This applies to new funding arrangements described under categories 2 and 3 above.

44. Recognizing the different governance structures of funding arrangements (climate funds, MDBs, Insurance, IMF, national funds, multi-donor trusts etc.), a single approach or mechanism is not realistic and could create additional challenges in terms of addressing the coherence, policy and structural gaps in the current landscape of funding arrangements for loss and damage.

45. Further, the universal participation in the Enhanced Transparency Framework (ETF) under the Paris Agreement could also be explored for accountability and support to countries on loss and damage finance and technical support. Led by the principles of collaboration, mobilization and action, the Universal Participation in the ETF initiative[13] strives to engage and unite countries, support organizations, the business community, non-governmental organizations and other stakeholders who share a common interest in realizing the benefits of transparent climate-relevant data and information.

46. Since most of the funding arrangements proposed under categories 2 and 3 are hosted in institutions outside of the UNFCCC, the interaction process with the Convention can be envisaged at two levels : (1) a set of guidance can be issued by the COP/CMA for consideration by the funding arrangements including options for voluntary reporting and (2) a generic, template MoU

[13] https://unfccc.int/universal-participation-ETF

or partnership agreement between the UNFCCC through its Secretariat and the new funding arrangements, that outlines the interaction and tracking of activities addressing the gaps for addressing loss and damage, that represent the broader 'mosaic' of solutions/funds/funding arrangements.

Option 3: Accountability and reporting mechanism under a third-party body (e.g., the UNGA)

47. To ensure a comprehensive tracking, reporting and accountability to Parties in relation to financing efforts to address loss and damage, and considering the gaps and challenges above, a third option could be envisaged, involving a third-party body that has the mandate and/or ability to serve as convening actor for all stakeholders involves.

48. The United Nations General Assembly through its secretariat could play such catalyzer role considering its significant role in the tracking and monitoring of SDGs, UNFCCC and Paris Agreement, Sendai Framework including their relationship of financing of loss and damage. Such an approach is also feasible considering that most institutions serving as funding arrangements have a relationship to or reporting mechanism with the UNGA in one form or another.

Annex 1. Potential options for new funding arrangements from under and outside the UNFCCC

Options for new L&D funding arrangements	Purpose	Scope of arrangement[14]	Pros and Cons	Elements for TC, COP and CMA consideration	Relevant Examples
<u>Category 1</u> – New funding arrangements with existing climate funds under the UNFCCC					
1. *Strengthen existing windows of Climate Funds under UNFCCC* *[Link to parra 5d, Decisions 2/CP.27 and 2/CMA.4]*	Complement existing portfolio of responses and incentivise transformational adaptation under climate funds to scale-up existing L&D responses (e.g., EWS, ecosystem degradation and loss)	Pr, Re, Rh	<u>Pros</u> - Quick setup - Track record on capacity building and preparedness - Adaptation result areas can cover EWS, some NELs and SOEs - Alignment with UNFCCC and PA principles - Accountability and reporting to CMA <u>Cons</u> - Limited scale - Limited reach – IAs, Accredited entities - Limited scope (not all 5R) - Limited coverage of SOE and NELS - Inadequate or slow disbursement speed for Rs - Transitional option	Guidance through COP and CMA to existing Funds to expand scope of funding to scale-up loss and damage in existing operational and programming policies Arrangements that extend L&D programming authority to existing climate funds, including simplified approval processes/access and fast-tracking applications from countries for Rs, Re, Rh and Rc support In some cases, further guidance from the COP and CMA would be required to clarify that the relevant loss and damage activities fall within their respective mandates.	GEF LDCF and SSCF Theme Early Warning and Climate Information Systems, GEF Small Grants GCF Adaptation Result Areas (EWS, Ecosystems etc), Readiness and Preparatory Support and Enhanced Direct Access, Simplified Approval processes AF single country and regional windows for EWS/DRR and Ecosystems, Enhanced Direct Access, Innovation facility and readiness support

[14] Coverage of scope of funding arrangements: Pr – Preparedness; Rs – Response; Re – Recovery; Rh – Rehabilitation; Rc - Reconstruction

Options for new L&D funding arrangements	Purpose	Scope of arrangement[14]	Pros and Cons	Elements for TC, COP and CMA consideration	Relevant Examples
2. *Create new windows in existing Climate Funds under UNFCCC* *[Link to parra 5d, Decisions 2/CP.27 and 2/CMA.4]*	Create new dedicated L&D funding areas and windows to cover SOE, NELS and mobility options (e.g., displacement, relocation, resettlement)	Pr, Re, Rh	Pros - As above - Programmatic approaches of some funds could favour long-term funding for Re, Rh, Rc Cons - Need for new mandate by CMA and alignment with institution - Limited reach – IAs, Accredited entities. - Requires governing body approvals. - High risk investment areas require adequate strengthening of safeguard standards. - Project-based funding - Set-up of new result areas, guidance and changes to governing instruments - Potentially lengthy setup process	Mandate though COP and CMA to existing FMs to create new funding windows, instruments and strategy funding priorities on NELS, SOE, NELS Cooperative arrangements or agreements for exchange of information on creation of new windows to address L&D In some cases, further guidance from the COP and CMA would be required to clarify that the relevant loss and damage activities fall within their respective mandates.	GEF Impact Programmes, Small Grants Existing GCF windows for readiness, mitigation, adaptation and private sector AF single country and regional windows, Enhanced Direct Access, Innovation facility and readiness support
3. *Scale-up or create new micro-small grants windows*	Simplified, quick and direct access to at-risk communities, micro-small enterprises and civil societies	All	Pros - Targets CSOs, communities and NGOs - Can build on country-specific execution arrangements established by funds (e.g. GEF, UNEP) for cost-efficiency Cons - Project-based and varying capacity for execution by CSOs, community-based organisations - Areas to be identified in respective country programmes implemented by GEF and GCF – takes time	Mandate though COP to FMs to establish small and micro-grant windows for direct access to communities for L&D, or expand current small grant windows to cover L&D Mandate to GEF and GCF agencies for technical programme identification and development of L&D initiatives	GEF Small Grants Programme UNEP-IUCN Global EbA Funds AF Climate Innovation Accelerator (AFCIA) AF Enhanced Direct Access window

Options for new L&D funding arrangements	Purpose	Scope of arrangement[14]	Pros and Cons	Elements for TC, COP and CMA consideration	Relevant Examples
4. *Scale-up anticipatory response though Early Warnings for All Initiative*	Funding to direct early warning and other ex-ante and anticipatory measures to all at-risk and vulnerable countries	Pr	Pros - Established partnership and advisory panel of leaders of UN agencies, MBD, humanitarian organisations, civil society, insurance and IT companies - Alignment with UNFCCC principles Cons - Limited accountability to UNFCCC	Mandate though COP to direct funding and support for EWS and Climate Services through the Early Warnings for All Initiative Synergies with related process, new fund and SNLD.	Climate Risk Early Warning Systems (CREWS) UN Early Warning for All WMO Systematic Observation Financing Facility (SOFF) GCF Strategic Plan 2024-2027, which highlights expansion of climate information and early warning systems in line with the Early Warning for All initiative
<u>Category 2</u> – New funding arrangements b/w fund and processes and funds outside of the UNFCCC					
5. *Invite additional contributions and resources from innovative sources to the fund* *[Link to para 5c, Decisions 2/CP.27 and 2/CMA.4]*	Broaden the scope of current funding contributions for L&D, including innovative solutions for prearranged grant financing and innovative sources – multilateral, bilateral, private sector and levels	All	Pros - New, innovative sources of finance e.g., Air passenger levy - Sustainable finance Cons - No accountability to UNFCCC - Limited sphere of influence of COP mandates on outside processes - Need for new mandate by CMA on sources of funds	Governance arrangements to allow for the L&D Fund to receive financing from all sources, in addition to ODA, based on Principles of the Convention Investment strategy on ways to maximise non-donor-based contributions to UN funds Fiduciary principles and standards of (initial) contributions to the Fund	Global Fund to Fight AIDS, Tuberculosis and Malaria - Private sector, nongovernment and foundation contributions. COP 15 decision on Global Biodiversity Framework Fund

Options for new L&D funding arrangements	Purpose	Scope of arrangement[14]	Pros and Cons	Elements for TC, COP and CMA consideration	Relevant Examples
6. *Collaborate on enhancing knowledge management and addressing NELs*	Strengthen responses to loss of societal identity, cultural heritage protection and biodiversity and ecosystem loss	All	Pros - Existing funds/facilities/platforms can mobilise finance though variety of delivery channels - Most are grant based - No requirements for co-contributions/co-finance Cons - New guidance on L&D windows subject to individual fund institutional and governance arrangements	Guidance through COP on creation of dedicated funding windows or special calls for funding to address NELs	UNESCO Heritage Emergency Fund UNEP-IUCN Global EbA Funds UN Decade on Restoration AF Innovation Facility Global Biodiversity Framework Fund CIF Nature, People & Climate Program Community Resilience Partnership Program Trust Fund WIM Excom NELDs Expert Group
7. *New Resolution through the UN Environment Assembly and Environment Trust Fund on large scale loss of global common resources*	Scale-up efforts to restore, protect and monitor large scale loss of ecosystems, ecosystem services, irrecoverable scenarios, including directing Environment Trust fund to address losses uninsurable global common resources	All	Pros - Capitalise on the UNEA and UNGA to bring focus on NEL especially loss of global common resources e.g., cryosphere, glaciers and collapse of ocean currents - UNEA resolutions implicate UNGA resolutions Cons - COP/CMA arrangements to work with UNEA - Environment Trust fund contributions are generally by member states, and would compete with L&D fund contributions	Guidance though COP on cooperation with UNEA and UNGA on protection of loss of global common resources and critical ecosystem services	UN Trust Fund in support of activities for glaciers' preservation Environment Fund, established by the UN General Assembly (Managed by UNEP)
8. *MOUs, cooperative arrangements and partnerships*	Scale-up insurance coverage in geographical and damage coverage through risk pooling,	Pr, Re, Rh and RC	Pros - Quick partnerships with established regionally driven risk transfer and risk sharing mechanisms	Mandate on improved and scaled-up effectiveness of Insurance in LDCs and	InsuResilience Solutions Fund (ISF)

Options for new L&D funding arrangements	Purpose	Scope of arrangement[14]	Pros and Cons	Elements for TC, COP and CMA consideration	Relevant Examples
with global and regional risk financing facilities	micro-insurance and investment in catastrophe bonds/resilience bonds + explore instruments for SOEs		- Governments can use these schemes to eliminate delays in disaster response - Link early warning to early response for the quick mobilization of funds to implement pre-planned response activities Cons - Unlikely to work in areas facing escalating and frequent extreme events - Lengthy start-up phase for new instruments for SOEs + readiness investments - Limited coverage of insurance in at-risk countries	SIDs to address coverage gaps, esp. risks of SOEs Identify opportunities to advance knowledge on new products, reporting, and coordinate outreach to insurance industry on products to address L&D	Global Shield Against Climate Risks, Solutions Platform and Finance Facility African Risk Capacity, Caribbean Catastrophe Risk Insurance Facility, Pacific Catastrophe Risk Insurance Company UNEP FI Principles for Sustainable Insurance Various partnership arrangements: Multilateral Investment Guarantee Agency partnership with the private insurance industry and Insurance Development Forum; UNDP and BMZ partnership on inclusive insurance; Insurance Development Forum
9. *Contribution agreements and partnerships to address different types of migration and displacement in relation to climate change, including planned relocation*	Strengthen the response including national planning that is inclusive of migrants, displaced people and refugees and to ensure access to relevant funding mechanisms for countries and communities that host refugees/displaced populations	All	Pros - Leverages safeguard standards of existing agencies - Leverages experience and knowledge/expertise of UNFCCC Taskforce on Displacement - Can address multiple drivers of mobility - Rapid financing through dedicated financial instruments or sources of coordinated platforms Cons	Guidance through the Taskforce on Displacement on funding arrangements to address different forms of mobility Fund to fund arrangements on deploying better-targeted instruments and resourced to address climate-induced mobility.	Migration Multi-Partner Trust Fund MDB Coordination Platform on Economic Migration and Forced Displacement ABD Expanded Disaster and Pandemic Response Facility Taskforce on Displacement and LDC Expert group – NAP

Options for new L&D funding arrangements	Purpose	Scope of arrangement[14]	Pros and Cons	Elements for TC, COP and CMA consideration	Relevant Examples
			- Require adequate strengthening of safeguard standards. - Finance may need changes to regional and domestic policies change addressing internal displacements - Lack of financial instruments in support of countries hosting refugees and displaced populations - Limited private sector engagement		
10. Contribution agreements and topping-up National Funds and Direct Budget Support	Maximising support to countries from mosaic of funds and funding arrangements relevant for responding to economic and non-economic losses, slow onset events and extreme weather events	Pr, Re, Rh and RC	Pros - Existing trust fund and public-private partnership agreements established in countries - Quick wins in terms of working at sub-national levels - Can target social protection schemes (social funds and reserve funds from national budget) and invite 'national level' contributors - Work with national L&D focal points Cons - Existing trust fund and public-private partnership agreements established in countries - Accountability of national funds to UNFCCC is limited	Mechanism for contributions to national level funds, direct budget support and ways to process support requests from countries on SOES, NELS Collaboration with national L&D focal points and UNFCCC FPs on country-specific L&D priorities to enhance coordination on funding pipelines	Existing national disaster funds (see examples in synthesis paper) or national accredited entities of the GCF
11. Guidance on debt swap mechanism	Promote and broker debt conversions with improved financial terms for recovery and reconstruction	Re, Rh and RC	Pros Increased impact of innovative instruments for addressing L&D Cons	Framework and guidance for brokering debt conversions with improved financial terms for recovery and	Debt2Health initiative of the Global Fund to Fight AIDS, Tuberculosis and Malaria

Options for new L&D funding arrangements	Purpose	Scope of arrangement[14]	Pros and Cons	Elements for TC, COP and CMA consideration	Relevant Examples
			- No accountability of creditors to UNFCCC - Limited sphere of influence of COP mandates on outside processes - Unpredictable financing	reconstruction, addressing NELS Partnerships arrangements for participation of government donors, civil society and philanthropy	
12. *Pooled funds with multi-donor humanitarian financing mechanisms*	Harmonise where funding/policies related to addressing climate related L&D, including greater investment shift to more anticipatory humanitarian action addressing drivers of loss and damage	Re, Rh and RC	Pros - Complementary to National Emergency Plan of Action budgets - Targets CSOs and NELS e.g., psychological support Cons - Funding tied to specific emergencies - Need to develop windows for SOEs	Partnership agreement to allow co-contributions and scaling of anticipatory action and localisation Coordinate and exchange experiences with humanitarian sector	IFRC Disaster Response Emergency Fund UN Central Emergency Response Fund (CERF) and Country-Based Pooled Funds (CBPFs) WFP Immediate Response Account (IRA), Anticipatory Action (AA) Trust Fund
13. *Pooling of recovery and reconstruction funds + blended finance with MDBs*	Scale up L+D related support through existing funds, instruments, and programs of the MDBs. Introduce new instruments and programs to support L+D related activities within MDB operations.	Pr, Re, Rh and RC	Pros - Established systems with proven track record - Recipient governments familiar with processes - Predictable source of financing - Allows MDBs to strengthen existing instruments from an angle of anticipatory actions and to scale up support for SOE (linked to adaptation) - All MDB operations are aligned with the goals of the Paris Agreement Cons - Limited accountability to UNFCCC	Fund's framework and guidance for grant and low concessional finance facility Guidance through the COP on use of disaster and climate-related clauses in lending operations Identification of options to maximise the use of low concessional financial instruments to address L&D	Coordinate with World Bank in the roll-out of the pause in debt repayments and Comprehensive Toolkit to support countries after natural disasters Scale up support through Asia Pacific Disaster Response Fund of the Asian Development Bank (ADB), which provides immediate grant assistance in the aftermath of a disaster in form of budget support.

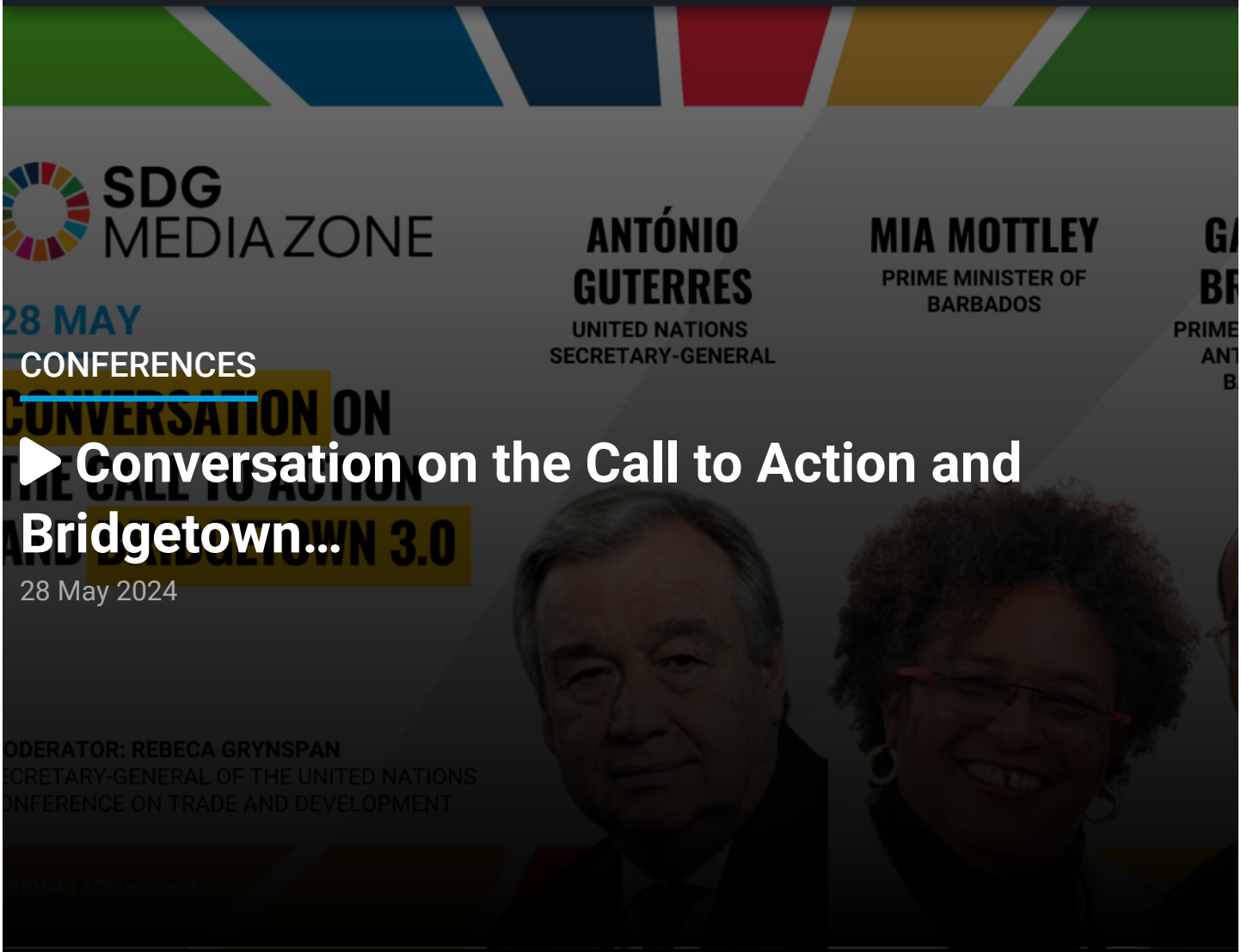
Options for new L&D funding arrangements	Purpose	Scope of arrangement[14]	Pros and Cons	Elements for TC, COP and CMA consideration	Relevant Examples
			- Limited availability of grant financing	Sharing information on new, innovative instruments and experiences	Scale up support for contingent disaster financing which is an example of a policy loan with payments linked to triggers associated with disaster events and attainment of pre-agreed policy actions (example, Cat DDO of World Bank and Contingent Disaster Financing of ADB) Scale up support of disaster risk insurance such as through support for regional catastrophe risk pool. Introduce new instruments such as climate resilient debt clauses (example, hurricane clause of IADB) Explore support for SOE under existing grant windows of MDBs (example Asian Development Fund of the ADB) Scale-up support for compounding effects of SOEs and sudden onset events through Global Bank Disaster Risk Reduction and Reconstruction Fund - Multi-donor Umbrella Trust Fund

Options for new L&D funding arrangements	Purpose	Scope of arrangement[14]	Pros and Cons	Elements for TC, COP and CMA consideration	Relevant Examples
<u>Category 3</u> – Hybrid options with multiple funding arrangements with funds from under and outside of UNFCCC processes					
14. Options 1 and 2 + pre-arranged finance + Fiscal Space for LDCs and SIDS + Humanitarian Assistance) under UNFCCC	Combination of Options 1 and 2 + pre-arranged finance + Fiscal Space for LDCs and SIDS + Humanitarian Assistance) Option 1 and 2 + pre-arranged (e.g., Global Shield model) + Humanitarian Assistance (e.g., CERF) + IMF/WB fiscal space	Pr, Rs, Re, Rh, Rc	Pro - New and expanded mandate, arrangements, and access modalities Con - MoU with UNFCCC/CMA for reporting - Lengthy time for coordination across agencies, funds - Global coordination platform to be setup for coordinated response and reporting	Build on existing arrangements and track record Comprehensive scope for L&D Possible fragmented response Fill priority and additive gaps Relative speed of disbursement Complex or inexistant reporting to CMA Challenging coordination arrangement	N/A

Options for new L&D funding arrangements	Purpose	Scope of arrangement[14]	Pros and Cons	Elements for TC, COP and CMA consideration	Relevant Examples
15. *Options 1 and 2 + pre-arranged finance + Fiscal Space for LDCs and SIDS + Humanitarian Assistance) outside of UNFCCC*	Options 1 and 2 + pre-arranged (e.g., Global Shield model) + Humanitarian Assistance (e.g., CERF) + IMF/WB fiscal space	Pr, Rs, Re, Rh, Rc	As above	Build on existing arrangements and track record Comprehensive scope for L&D Possible fragmented response Fill priority and additive gaps Relative speed Complex coordination No or fragmented reporting to CMA	N/A

Annex 518

"Conversation on the Call to Action and Bridgetown 3.0 - SDG Media Zone, SIDS4 (27-30 May 2024 - Antigua and Barbuda)", *UN Web TV*, 28 May 2024



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Summary

The fourth International Conference on Small Island Developing States (SIDS4) is held from 27 to 30 May 2024 in St John's, Antigua and Barbuda. Under the overarching theme of "Charting the course toward resilient prosperity", the Conference aims at assessing the ability of SIDS to achieve sustainable development, including the 2030 Agenda and its Sustainable Development Goals.

Description

The Secretary-General's conversation with H.E. Mia Mottley, Prime Minister of Barbados, and H.E. Gaston Browne, Prime Minister of Antigua and Barbuda.

The last four years have been a tumultuous period for the global economy—and small island developing States, in particular—marked by the COVID-19 pandemic, supply chain disruptions, rising interest rates, and climate-related shocks. This session will discuss the latest developments regarding the Bridgetown Initiative and the new Call to Action, and how these can help SIDS address unsustainable borrowing and debt sustainability.

Speakers:

- H.E. Mr. António Guterres, United Nations Secretary-General
- H.E. Ms. Mia Mottley, Prime Minister of Barbados
- H.E. Mr. Gaston Browne, Prime Minister of Antigua and Barbuda

Moderator: Rebeca Grynspan, Secretary-General of the United Nations Conference on Trade and Development

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Annex 519

"Natural Disaster Shocks and Macroeconomic Growth in Asia: Evidence for Typhoons and Droughts", ADB Economics Working Paper Series No. 503, *Asian Development Bank*, December 2016

NATURAL DISASTER SHOCKS AND MACROECONOMIC GROWTH IN ASIA: EVIDENCE FOR TYPHOONS AND DROUGHTS

Emmanuel Alano and Minsoo Lee

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Natural Disaster Shocks and Macroeconomic Growth in Asia: Evidence for Typhoons and Droughts

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ABSTRACT

Climate-related natural disaster shocks are expected to rise as the earth is getting warmer, which will adversely affect growth prospects globally. Current robust estimates of the effects of typhoons and droughts point to both short- and long-term declines in national incomes compared to predisaster trends and economic effects likely to persist up to 2 decades. Using the typhoon landfalls and damage in Asia, we analyze the wind–damage relationship and find damages to gross domestic product increase by 2.3% for an increase in maximum wind speed. The extreme projected temperature rise in Representative Concentration Pathway (RCP) 8.5 will result in higher damage by more than 50% in 2100. Vulnerable developing Asian economies could expect dampened growth with significant impacts on agriculture and tourism, a concern that may roll back years of development gains and exacerbate inequality. To cope with increasing disaster risks, both short-term adaptation strategies like relocation, government transfers, and other social safety nets, as well as long-term strategies like disaster insurance or similar ex ante mechanisms are needed.

Keywords: Asia, climate impact, drought, natural disaster, typhoon

JEL codes: I30, Q54

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I. INTRODUCTION

Risks associated with extreme events or shocks (heat waves, extreme precipitation, and coastal flooding) will continue to increase as the global mean temperature rises (IPCC 2014). Climate change, warmer sea temperatures in particular, will result in extreme weather patterns and more frequent high-intensity storms in selected ocean basins (Mei et al. 2015; Mendelsohn et al. 2012).

Climate-related natural disasters are expected to rise as the earth is getting warmer with the prospect of significant negative impacts on economic growth. Analyzing 750 empirical estimates, Klomp and Valckx (2014) show negative effects on economic growth per capita with developing countries severely affected by climatic shocks. Felbermayr and Gröschl (2014) find that natural disasters reduce per capita gross domestic product (GDP) by up to 6.8% on impact or in the year they occur.[1] A separate study also reports that both typhoons and floods negatively affect not only per capita GDP but also the debt ratio (Acevedo 2014).[2] Vulnerable economies like the Pacific islands could expect growth to drop by 0.7 percentage points due to damage equivalent to 1% of GDP in the year of the disaster (Cabezon et al. 2015).

More than 7,000 major disasters have been recorded in the Emergency Events Database (EM-DAT) since 1970, causing at least $2 trillion in damages, killing at least 2.5 million people, and adversely affecting societies.[3] Many researchers claim that extreme weather events have become more frequent and severe as a result of global warming.[4] An example is the destruction caused by Typhoon Haiyan in 2013, one of the strongest recorded typhoons to make landfall, resulting in a total economic loss of around $10 billion (EM-DAT) (see text box on the Philippines and natural disasters). The Philippines is no stranger to natural disasters, and Haiyan is the strongest tropical cyclone to ever hit the country and left 6,300 people dead and damaged over 1 million houses (NDRRMC 2013). Climate disasters have become a concern with the likelihood of rolling back years of development gains and exacerbate inequality (Karim 2016, Victoriano 2015).

Plotting the occurrence of all natural disasters (climate related and geophysical) from the EM-DAT database, there is a clear increasing trend of storms and floods (see figure on page 2). By limiting the period of observation from 1960 to 2015, there is in most regions of the world an upward trend in climate-related events, including drought, extreme temperature, flood, storm, landslide, and wildfire.

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1 A disaster is defined by the IPCC (2012) as "severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery."

2 Also called hurricane in the Atlantic and cyclone in the Indian and South Pacific Ocean. These terms are used interchangeably in this paper.

3 The EM-DAT, maintained by the Centre for Research on the Epidemiology of Disasters (CRED) at the Catholic University of Louvain, Belgium, is the most widely used database for research on disasters. Established in 1973, CRED has compiled data on global disasters since 1900. See EM-DAT website at http://www.emdat.be/

4 Studies in Herring et al. (2015) show that anthropogenic activity (greenhouse gas emissions and land use) influenced specific weather and climate events in 2014.

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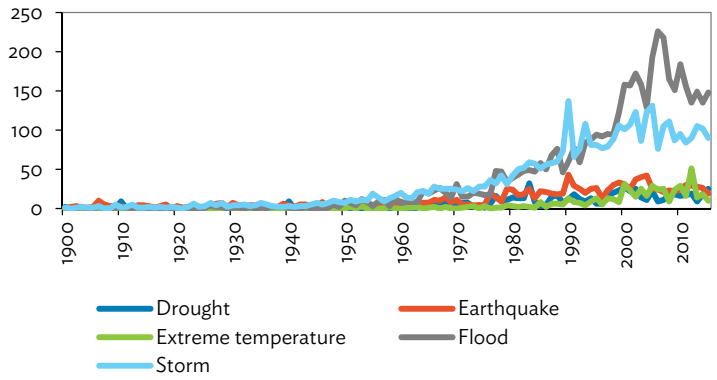
Frequency of Natural Disasters, 1900–2015 (EM-DAT)



EM-DAT = Emergency Events Database.
Note: The count includes events that meet at least one of the following criteria: (i) 10 or more people reported as dead, (ii) 100 people reported as affected, (iii) a declaration of a state of emergency, or (iv) a call for international assistance.
Source: Authors' calculation based on EM-DAT: The OFDA/CRED International Disaster Database. Brussels, Belgium: Catholic University of Louvain. http://www.emdat.be/

In Table 1, we see that earthquakes and storms generated the most damage to social and physical infrastructure. This includes catastrophic events like Hurricane Katrina in 2005, the Great East Japan earthquake in 2011, and Typhoon Haiyan in 2013. Aside from the lives lost, estimated total damages from climate-related disasters are staggering. From 1960 to 2015, storms caused at least $1.04 trillion in damages and floods $696 billion. Earthquakes, on the other hand, caused $771 billion in damages.

Table 1: Estimated Total Damages by Disaster Type, 1960–2015
($ billion)

Disaster Type	Total Damages
Storm	1,043
Earthquake	771
Flood	696
Extreme temperature	60
Wildfire	58
Landslide	9
Drought	0.1

Note: The count includes events that meet at least one of the following criteria: (i) 10 or more people reported as dead, (ii) 100 people reported as affected, (iii) a declaration of a state of emergency, or (iv) a call for international assistance.
Source: Authors' calculation based on EM-DAT: The OFDA/CRED International Disaster Database. Brussels, Belgium: Catholic University of Louvain. http://www.emdat.be/

Developing countries, especially the low- and middle-income economies, are most at risk and where most vulnerable populations are located. Data from EM-DAT show that since 1960, 99% of the affected population (87% middle income, 12% low income) and 97% of deaths caused by disasters (64% middle income, 32% low income) are in developing economies. Weighted by land area and population, small island states are exposed to more frequent natural disasters (Laframboise and

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Acevedo 2014). In terms of total damages caused by climate-related disasters (storms, drought, flood, extreme temperature, and wildfire), advanced economies were the hardest hit, mainly due to the higher cost of physical capital and infrastructure, followed by developing Asia (Table 2). Within the region, East Asia has the largest damages in United States (US) dollar terms.[5]

Table 2: Estimated Total Damages due to Climate-Related Disasters by Region, 1960–2015
($ billion)

Region	Total Damages
Advanced economies (OECD)	1,160
Developing Asia	610
East Asia	374
South Asia	122
Southeast Asia	108
Central Asia	3
The Pacific	2
Latin America and the Caribbean	141
Rest of the world	57
Middle East and North Africa	26
Sub-Saharan Africa	14

OECD = Organisation for Economic Co-operation and Development.
Source: Authors' calculation based on EM-DAT: The OFDA/CRED International Disaster Database. Brussels, Belgium: Catholic University of Louvain. http://www.emdat.be/

Due to their geographical location and archipelagic features, most of the low-income countries and small states, particularly in Sub-Saharan Africa and Pacific island states, are vulnerable to natural disasters. From 1985 to 2015, these countries were hit almost twice as often by climate-related disasters like floods, storms, and droughts (Farid et al. 2016). Among the Asian countries included in the World Risk Report since 2011 as having the highest disaster risks are Pacific island states like Vanuatu, Tonga, Solomon Islands, Timor-Leste, and Papua New Guinea as well as archipelagic countries like the Philippines.[6] The proportion of the domestic population affected by natural disasters is also higher compared with high-income countries, particularly for small developing and low-lying coastal states. Within these countries, the poorest 25th percentile of countries, mostly in Sub-Saharan Africa, faces the highest natural disaster risks (Farid et al. 2016).

Climate-related natural disasters and temperature rise harm growth and exacerbate poverty in developing countries. Natural disasters may reduce developing country GDP growth by an estimated 1–3 percentage points, depending on the type of disaster.[7] Temperature rise is also linked to lower growth, for example, Dell, Jones, and Olken (2012) find that in poor countries a 1°C rise in temperature from a country's annual mean temperature reduces economic growth by 1.3 percentage points on average, mainly by reducing agricultural output. Results from Lee, Villaruel, and Gaspar (2016) show the projected reduction of developing Asia's average per capita income level by 11% in 2100 under the

5 Includes Japan; the Republic of Korea; Hong Kong, China; Taipei,China; and the PRC.

6 Created by the United Nations University Institute for Environment and Human Security (UNU-EHS), the World Risk Report was started in 2011 and indicates the risk of disaster due to extreme natural events for 171 countries. It is available at http://www.worldriskreport.org/

7 See Farid et al. (2016) for macroeconomic impacts specifically, Raddatz (2007) and Loayza et al. (2012) on climatic disasters, Fomby, Ikeda, and Loayza (2009, 2013) on severe droughts, Acevedo (2014) on impacts for the Caribbean, and Cabezon et al. (2015) on the Pacific Islands. These studies combine EM-DAT data and exogenous variables.

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RCP8.5 scenario.[8] Increasing temperature and rainfall volatility together with extreme weather events reduce agricultural productivity in low-income countries, an important growth channel given agriculture's large share in output in these countries (Farid et al. 2016). However, the study by Lee, Villaruel, and Gaspar (2016) confirms that aside from agricultural production, industrial production and investment are potential channels through which temperature significantly affects the overall economic productivity. Climate change and natural disaster risks worsen poverty due to loss of productive economic assets combined with limited savings (Hallegatte et al. 2015) and food vulnerability. Countries with weak institutions and unstable domestic food production as measured by food supply per capita growth tend to experience frequent food crises, while countries with sound macroeconomic fundamentals such as low fiscal deficit and higher food reserves experience a lower likelihood of a food crisis (Adedeji, Gieck-Bricco, and Kehayova 2016).

A. Effects of Natural Disasters to the Economy

1. Typhoons

The distribution of intense cyclone events is expected to shift toward fewer low-intensity cyclones but more frequent high-intensity events. Modeling studies project substantial increases in the frequency of the most intense cyclones, with an increase of about 20% in the precipitation rate within 100 kilometers of the storm center (Knutson et al. 2010). The average typhoon intensity is also projected to increase by an additional 14% by 2100 (Mei et al. 2015).

The observed increase in sea surface temperatures has led to concerns about more intense cyclones. Historical records indicate that the greatest damage during cyclones results from storm surges. The scientific evidence to date suggests that increased sea surface temperature will intensify cyclone activity and heighten storm surges. Surges will be further elevated by a rising sea level due to thermal expansion and melting of ice caps (World Bank 2016).

A large number of empirical studies in the literature on the effects of natural disasters on economic growth focus on four hypotheses:

(i) A natural disaster might permanently set a country on a lower growth path (no recovery).
(ii) It might temporarily derail growth only to get back to its predisaster trend (recovery to trend).
(iii) It might lead to even greater growth, as reconstruction enables new investment to replace destroyed assets (build back better).
(iv) It might not only stimulate growth but also replace whatever outdated infrastructure was holding the country back with more modern and efficient capital goods (creative destruction).

Hsiang and Jina (2014) disentangle these hypotheses and assert that growth effects brought on by tropical cyclone strikes linger for almost 2 decades, with economies not recovering in the long run. Using 60 years of cyclone (in terms of wind speed) and economic data to estimate the long-term effects of climatic disasters on output, they find that national incomes substantially decline compared to predisaster trends and economic recovery does not happen for 20 years both for poor and rich

[8] Scenario with extreme projected temperature rise should the world fail to meet the 2015 United Nations Climate Change Conference (COP21) targets. See note in Table 7.

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countries (Table 3). Devastating cyclones like Hurricane Katrina or Typhoon Haiyan can have longer-lasting effects than a financial crisis. Reductions in per capita GDP range from 3.6% to 14.9% lasting for 2 decades. Projected estimates of monetary damages from cyclones up to 2100 range from 6% of GDP or $860 billion for the case of the US to 83% of GDP or $300 billion for the Philippines.

Table 3: Effects of Cyclones and Other Shocks to Gross Domestic Product Per Capita

Event Type	Effect on Income	Observed After	In-Sample Probability
Temperature increase (+1 ◦ C)*[a]	–1.0%	10 years	6.4%
Temperature increase (>1 ◦ C, SSP5)**[b]	–23.0%	>20 years (by 2100)	...
Civil war[c]	–3.0%	10 years	6.3%
Tax increase (+1% GDP)***[d]	–3.1%	4 years	†16.8%
1 standard deviation cyclone	–3.6%	20 years	14.4%
Currency crisis[c]	–4.0%	10 years	34.7%
Weakening executive constraints[c]	–4.0%	10 years	3.7%
90th percentile cyclone	–7.4%	20 years	5.8%
Banking crisis[c]	–7.5%	10 years	15.7%
Financial crisis[e]	–9.0%	2 years	<0.1%
99th percentile cyclone	–14.9%	20 years	0.6%

... = data not available, GDP = gross domestic product, SSP5 = Shared Socio-economic Pathway 5.
* Poor countries only. ** Poor and rich countries. *** United States only. †Number of quarters with any tax change.

[a] Dell, Melissa, Benjamin Jones, and Benjamin Olken. 2012. "Temperature Shocks and Economic Growth: Evidence from the Last Half Century." *American Economic Journal: Macroeconomics* 4 (3): 66–95.

[b] Burke, Marshall, Solomon Hsiang, and Edward Miguel. 2015. "Global Non-linear Effect of Temperature on Economic Production." *Nature* 527 (7577): 235–39.

[c] Cerra, Valerie, and Sweta Chaman Saxena. 2008. "Growth Dynamics: The Myth of Economic Recovery." *American Economic Review* 98 (1): 439–57.

[d] Romer, Christina, and David Romer. 2010. "The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks." *American Economic Review* 100 (3): 763–801.

[e] Reinhart, Carmen, and Kenneth Rogoff. 2009. "The Aftermath of Financial Crises." *American Economic Review* 99 (2): 466–72.

Source: Adapted from Hsiang, Solomon, and Amir Jina. 2014. "The Causal Effect of Environmental Catastrophe on Long Run Economic Growth: Evidence from 6,700 Cyclones." National Bureau of Economic Research Working Paper No. 20352.

Various studies have tackled the disaster–development nexus and generated estimates of global effects on GDP levels and per capita growth. Whereas the majority of these studies used EM-DAT data as instrumental variables in growth regressions, generating some conflicting positive and negative results, more recent panel studies used a combination of EM-DAT data and exogenous variables such as wind speed and pressure for tropical cyclones and precipitation indices for droughts, uncorrelated with income measures such as GDP, to estimate output effects. This recent research also reported more robust results. Table 4 presents some of these studies.[9] While Hsiang and Jina (2014) estimated long-run effects up to 2 decades and projections until 2090, others only provided short-run effects either on the year of impact or after 5 years, further evidence that damage from disaster shocks are not limited to immediate or direct effects.

Using a comprehensive database of disaster events and their physical intensities called GeoMet, Felbermayr and Gröschl (2014) find robust and substantial negative effects of natural disasters on economic growth which is similar to estimates generated by Fomby, Ikeda, and Loayza

[9] Except for Loayza et al. (2012) who used EM-DAT data for the analysis. Other studies with positive results used cross-sectional analysis.

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(2013); however, there was no evidence of a subsequent temporary boom. Their results show that an average storm reduces output growth by 0.16% but a 5% strongest storm by 1.75%. A separate study by Mendelsohn et al. (2012) estimates that tropical cyclones reduce current global output by $26 billion or 0.04% every year which is projected to double to almost $56 billion by the end of this century.

Table 4: Global Estimates of Macroeconomic Impacts of Natural Disaster Shocks

Study	Natural Disaster	Effect on Income (GDP per capita growth) (%)	Observed After
Hsiang and Jina (2014)	1 standard deviation tropical cyclone	−3.6	20 years
	90th percentile cyclone	−7.4	20 years
	99th percentile cyclone	−14.9	20 years
Felbermayr and Gröschl (2014)	average cyclone	−0.16	on impact
	95th percentile cyclone	−1.75	on impact
	95th percentile drought	−0.34	on impact
Loayza et al. (2012)	Droughts	−0.6	1 year
		−3.0	5 years
Mendelsohn et al. (2012)	Tropical cyclones	$26 billion or 0.04% of current global GDP, $56 billion by 2100	annual
Fomby, Ikeda, and Loayza (2009)	Droughts	−1.7	year of the event
	Storms	−0.3	year of impact

GDP = gross domestic product.
Source: Authors' compilation from cited studies.

By performing counterfactuals using their estimates to see what would happen if there were no cyclones from 1950 to 2008, Hsiang and Jina (2014) found that world GDP growth would have been 1.4% higher per year. In selected developing Asian economies, typhoons have resulted in significant "lost growth" for the period from 1970 to 2010 of as high as 7.3% of GDP per capita in the Philippines (Table 5). Together with macroeconomic effects of temperature variation by 2100, the estimated damage from tropical cyclones, which can exacerbate poverty and undermine social welfare (Laframboise and Acevedo 2014), can dampen growth and put considerable economic pressure especially on vulnerable populations in developing Asian economies.

Typhoon Intensity and Damages in Asia

The previous sections discussed the effects of typhoon shocks on macroeconomic growth rates and levels. The "damage functions" or the elasticity of damage to GDP by typhoon intensity (as represented by wind speed) has also been extensively studied and estimated as these are used in climate change research, particularly in integrated assessment models. Using data on hurricanes in the US, various studies estimated elasticity at 3.8 (Schmidt, Kemfert, and Höppe 2010), 5 (Mendelsohn et al. 2012), between 6 and 8 (Bouwer and Botzen 2011), and 9 (Nordhaus 2010). In the Caribbean, Acevedo (2016) estimated it at 2 for nonlandfall and 3.2 for landfall cyclones.

The best-track data for selected Asian economies were taken from the International Best Track Archive for Climate Stewardship (IBTrACS) with information on maximum wind speed as well

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as minimum pressure for the duration of the typhoon.[10] Typhoons which made landfall were identified by overlaying the IBTrACS data within a global grid. Data on damages were taken from the EM-DAT database.[11] GDP-level data were taken from the World Bank's World Development Indicators.

Table 5: Macroeconomic Impacts in Selected Developing Asian Countries: Temperature Variation vis-à-vis Tropical Cyclone Shocks

	Temperature Effects on GDP Per Capita Growth by 2100 (%)		Estimated Loss Using 5% Discount Rate by 2090		Cyclone Climate Growth Penalty ("Lost" Growth), 1970–2010
	RCP8.5	RCP2.6	$ billion, 2010 PPP	% of GDP, 2010 PPP*	GDP per capita growth, %
Philippines	–4.2	–1.0	–299.3	81.5	–7.28
Viet Nam	–4.9	–1.2	–160.1	57.9	…
Thailand	–5.6	–1.3	–140.6	24.0	–2.17
Indonesia	–4.4	–0.9	–10.9	1.1	–1.57
Malaysia	–4.8	–1.1	–9.8	2.4	–0.25
Cambodia	–5.7	–1.4	–9.3	30.6	…
Lao PDR	–4.7	–1.1	–9.2	58.4	…
Developing Asia	–2.5	–0.5	…	…	…

… = data not available, GDP = gross domestic product, Lao PDR = Lao People's Democratic Republic, PPP = purchasing power parity, RCP = Representative Concentration Pathway.
* GDP 2010 PPP from World Development Indicators.
Sources: Authors' compilation from Hsiang, Solomon, and Amir Jina. 2014. "The Causal Effect of Environmental Catastrophe on Long Run Economic Growth: Evidence from 6,700 Cyclones." National Bureau of Economic Research Working Paper No. 20352; Lee, Minsoo, Mai Lin Villaruel, and Raymond Gaspar. 2016. "Effects of Temperature Shocks on Economic Growth and Welfare in Asia." ADB Economics Working Paper Series No. 501. Manila: Asian Development Bank.

This paper uses a modified wind–damage function, a log-log model estimated using panel fixed effects, adopted from Nordhaus (2010) and Acevedo (2016):[12]

$$\ln\left(Damages_{ijt}/GDP_{ijt}\right) = \alpha + \beta ln(Wind_{ijt}) + \sigma Year_t + \mu_j + \epsilon_{ijt}, \quad (1)$$

where *Damages/GDP* for each typhoon *i* in country *j* at year *t* is regressed on the maximum *Wind* speed achieved by each typhoon in the sample and a time trend *Year*. μ_j captures time-invariant country fixed effects and ϵ_{ijt} is the error term. The sample includes data on typhoons that made landfall from 1977 to 2014 for 10 economies with 113 observations.

Results in Table 6 indicate that a 1% increase in typhoon intensity (wind speed in meters per second) results in an approximately 2.3% increase in the damages-to-GDP ratio. Intuitively, it also

[10] Based on Knapp et al. (2010). Includes economies in developing Asia (Cambodia; India; Lao People's Democratic Republic; Myanmar; Philippines; PRC; Solomon Islands; Taipei,China; and Vanuatu) and Japan.

[11] Estimated damages in US dollars, which is the total of insured and noninsured losses from various sources. This include amount of damages to property, crops, and livestock.

[12] Alternatively, using a log-linear model, this paper finds that the semi-elasticity of maximum wind speed to damages is 0.0535. Hsiang and Narita (2012) estimate a semi-elasticity of 0.010 showing that a 1.9 knots per hour (1 meter/second) increase results in a 10% increase in damages.

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shows that both category 1 and 2 hurricanes exhibit increasing damage as the wind speed thresholds intensify.[13] Estimates from this paper show that in Asia, the elasticity is about 2.3. This approximates results from empirical studies that indicate damage as a function of the square or cube of wind speed.

Table 6: Estimates of the Wind Intensity–Damage Function

Variables	(1) Pooled Ln(D)	(2) Pooled Ln(D/GDP)	(3) Damage Ln(D)	(4) Damage/GDP Ln(D/GDP)	(5) Cat 1 Ln(D/GDP)	(6) Cat 2 Ln(D/GDP)
Log(maximum wind speed)	1.7378*	2.3940**	2.4561***	2.3487**	2.4656**	6.9843*
Year	0.0777***	−0.0593***	0.0810**	−0.0260	−0.0367	−0.0142
Constant	−1.5e+02***	98.6914***	−1.5e+02**	32.2594	52.8588	−14.7882
R^2	0.2112	0.1262	0.1981	0.0707	0.0809	0.3629
Observations	113	109	109	109	81	20
Countries	10	10	10	10	10	10
Fixed effects	No	No	Yes	Yes	Yes	Yes

D = damage, GDP = gross domestic product.
* p< 0.1, ** p<0.05, *** p< 0.01.
Source: Authors' calculations.

With global warming, scientists believe that typhoons may further intensify. Emanuel (2005) finds that with warmer sea surface temperatures comes the possibility of stronger storms. This increase in intensity further increases the damages and costs to countries in developing Asia regularly hit by this type of disaster shocks.

To approximate the increase in damages from typhoons due to global warming by 2100, the following parameters were used:[14]

$$\Delta\left({}^{Damages_t}/_{GDP_t}\right) = \left[\left(1+\gamma\theta_t(T_t)^{\beta}-1\right)*100\right], \quad (2)$$

where γ is the semi-elasticity of maximum wind speed relative to changes in the sea surface temperature, ϑ is the elasticity of sea surface temperature to a change in global temperature (T), and β is the wind–damage elasticity estimated above (2.3). This study uses the same γ that Nordhaus (2010) and Acevedo (2016) use, γ = 3.5%, and ϑ assumes a 1:1 change in sea surface temperature with a change in T since the Representative Concentration Pathways (RCPs) do not project decadal changes in sea surface temperature.

Estimation results in Table 7 show that mean damages in Asia will increase by 21% by 2100 using the same sea surface temperature as Nordhaus (2.5°C). Using projected temperature changes (low, mean, and high) under the RCP2.6 scenario, mean damages increase in the range from 5% to 13%. Higher damages as high as 53% result under extreme temperature changes in the RCP8.5 scenario. By performing a sensitivity analysis using a higher γ and lower ϑ, the range of damages is essentially the same as the results from the RCP scenarios, from 5% to 56%.[15]

[13] For easy reference, the Saffir–Simpson scale was used. See NOAA website at http://www.nhc.noaa.gov/aboutsshws.php
[14] Modified equation adopted from Acevedo (2016) and Nordhaus (2010).
[15] Higher γ is from Emanuel (2005) who finds a 5% increase in maximum wind speed with a 1% increase in sea surface temperature.

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Table 7: Estimated Increase in Mean Damages under Climate Change Scenarios

					Increase in Mean Damages (%)	
	θ	γ	ϑ	SST (◦C)	2050	2100
Nordhaus (2010)	9.0	0.035		2.5		112.7
Acevedo (2016)[a]	3.2	0.035		2.5		30.5
This study	2.3	0.035		2.5		21.3
Using RCP2.6 temperature projections						
Mean (T=1.1°C)	2.3	0.035	1.0	1.1	3.7	9.1
Low (T=0.6°C)	2.3	0.035	1.0	0.6	2.0	4.9
High (T=1.6°C)	2.3	0.035	1.0	1.6	5.4	13.4
Mean (T=1.1°C) and higher γ	2.3	0.050	1.0	1.1	5.3	13.1
Mean (T=1.1°C) and lower θ	2.3	0.035	0.6	0.7	2.2	5.4
Using RCP8.5 temperature projections						
Mean (T=4.3°C)	2.3	0.035	1.0	4.3	14.8	38.1
Low (T=2.7°C)	2.3	0.035	1.0	3.0	9.2	23.1
High (T=5.8°C)	2.3	0.035	1.0	5.6	20.3	53.0
Mean (T=4.3°C) and higher γ	2.3	0.050	1.0	4.3	21.5	56.5
Mean (T=4.3°C) and lower ϑ	2.3	0.035	0.6	2.6	8.8	22.2

RCP = Representative Concentration Pathway, SST = sea surface temperature.

[a] Only hurricanes that made landfall in the Caribbean.

Note: The RCP 2.6 and RCP 8.5 temperature projections are adopted from Lee, Minsoo, Mai Lin Villaruel, and Raymond Gaspar. 2016. Effects of Temperature Shocks on Economic Growth and Welfare in Asia. ADB Economics Working Paper Series No. 501. Manila: Asian Development Bank. The former depicts meeting the COP21 target and the latter depicts the extreme projected temperature rise should the world fail to meet the target.

Sources: Authors' calculations based on Nordhaus, William. 2010. "The Economics of Hurricanes and Implications of Global Warming." *Climate Change Economics* 1 (1): 1–20.; Acevedo, Sebastian. 2016. "Gone with the Wind: Estimating Hurricane Climate Change Costs in the Caribbean." IMF Working Paper WP/16/199.

2. Droughts

Compared to tropical cyclones which are "rapid onset" events, droughts are "slow onset" events that affect a wide area and can have significant economic impacts over long periods. Floods, another extreme weather event, are mostly a consequence of heavy rainfall and storm surges due to cyclones. Felbermayr and Gröschl (2014) find that an average drought reduces output by 0.01% while a top 5% strongest drought reduces it by 0.34%. Loayza et al. (2012) document that in developing countries, a typical drought reduces the agricultural and industrial annual growth rate by 1 percentage point, leading to a decline of GDP growth by 0.6 percentage point per year (or 3% over a period of 5 years). A separate study by Fomby, Ikeda, and Loayza (2009, 2013) found that droughts have a negative overall effect on GDP per capita growth, especially in the year of the event. The cumulative effect is 1.7% of GDP growth and 1.6% for agricultural growth. It also has a negative impact on nonagricultural growth, though delayed, up to the third year.

Although there is no consensus yet that global warming has affected the frequency and intensity of El Niño[16] conditions,[17] a study by the Food and Agriculture Organization of the United

[16] El Niño is a band of above-average ocean surface temperatures (warm phase of the El Niño Southern Oscillation or ENSO) that naturally or periodically develops off the Pacific coast of South America and causes weather patterns and other major climatological changes around the world. The cool phase is called La Niña.

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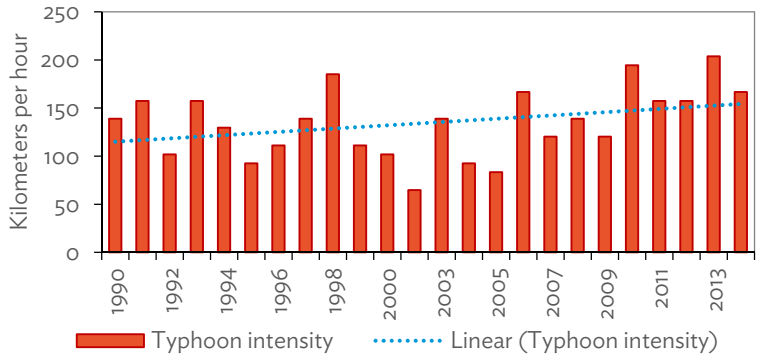
Nations (2014) found that cycles dominated by El Niño were associated with more area affected by drought at the global agricultural level. This cycle in 1989 and 1990 caused extended droughts in 20% and 12% of global agricultural area, respectively. The higher temperatures and droughts brought about by an El Niño event, especially severe in Asia and the Pacific, significantly increase prices of nonfuel commodities (by 5.3% after four quarters), increase energy prices, and reduce output in agriculture, construction, and services, mostly affecting commodity-dependent countries reliant on imported food (Cashin, Mohaddes, and Raissi 2015).

Philippines and Natural Disasters

The Philippines is one of the developing Asian countries regularly hit by storms. Weather-related disasters account for 90% of annual economic damage from all natural disasters in the Philippines, making it one of the countries most exposed to climate change risks.[a] Annually, an average of 19 typhoons enter the country, of which 9 or 10 typhoons make landfall (Cinco et al. 2016; Antilla-Hughes and Hsiang 2013). While there were fewer typhoons (above 115 kilometers per hour), stronger typhoons (above 150 kilometers per hour) affected the country from 1951 to 2013 (Cinco et al. 2016). Since 1990, these typhoons have been getting stronger (see box figure), with the highest maximum wind speed recorded in November 2013 during Typhoon Haiyan.

Typhoon Haiyan, a category 5 cyclone locally known as Yolanda, was the strongest typhoon to ever make landfall in the country. For a country that is used to being battered by typhoons every year, the devastation was staggering. Total damage and loss have been estimated at ₱101.79 billion (equivalent to $2.3 billion)[b] or 0.9% of gross domestic product (NEDA 2013). The economic effects are also region dependent. Relative to the bigger Luzon and National Capital Region/Metro Manila, which account for almost 75% of national output, the regions hit by Haiyan account for about 13% of gross domestic product. When two typhoons hit the Luzon regions in 2009, fourth quarter growth rate was a low 1.4% (Jha, Quising, and Sugiyarto 2014).

Box Figure: Intensity of Typhoons at Landfall in the Philippines, 1990–2014



Source: Authors' calculations using data from IBTrACS version v03r08. http://www.ncdc.noaa.gov/oa/ibtracs

The poor are often the hardest hit. Typhoon Haiyan affected eight provinces, many with high levels of poverty incidence. If about 10% of the estimated 4 million people displaced and 5% of the 12 million directly affected by the typhoon become newly poor, there would be an additional 1 million poor people in the country, increasing poverty incidence by 4% (Jha, Quising, and Sugiyarto 2014).

continued on next page

[17] Based on research by Collins et al. (2010).

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Box continued

The average Filipino household suffers the impacts of typhoons, with a significant decrease in income and expenditures on basic items, as well as increased infant mortality a year after typhoon exposure (see box table). One potential long-term effect is also the low birth weights which may affect later life outcomes like low education level, lower earnings, and adverse health outcomes (Morrow 2014).

Box Table: Average Effects a Year after Typhoon Exposure in the Philippines
(%)

Outcome	Average Rate of Decrease
Household income	−6.6*
Household expenditures	−7.1
Meat	−12.5
Education	−13.3
Medical	−14.3
Female infant mortality	1 death per 1,000 live births

* Compared against average savings rate of 15% in 2009.
Source: Antilla-Hughes, Jesse Keith, and Solomon Hsiang. 2013. "Destruction, Disinvestment, and Death: Economic and Human Losses Following Environmental Disaster." Social Science Research Network. doi:10.2139/ssrn.2220501.

The recent drought intensified by the El Niño phenomenon in 2015 was reported as one of the most powerful El Niño events in modern times. About 42% of the Philippines experienced drought with the United Nations Office for the Coordination of Humanitarian Affairs estimating around 181,687 farmers and 224,834 hectares of agricultural land were severely affected. Data from the Bureau of Fisheries and Aquatic Resources show that fishery production declined due to extreme temperatures and extended drought. Aside from agriculture, Mindanao suffered from power shortages as some of the hydroelectric dams have low water levels. By early 2016, forest fires in some mountain areas and grasslands were reported. Mount Apo, the country's highest mountain and home to forest reserves and breeding ground for the endangered monkey-eating eagle, was damaged due to raging wildfires displacing hundreds of people, including tourists, to flee from the peak on foot.

Due to the vulnerability of the country to natural disasters, especially typhoons, one may ask whether the economy has been resilient. Generally, the Philippines has been able to weather the storms with sufficient fiscal space, strong financial markets, and stable remittances (Jha, Quising, and Sugiyarto 2014). In 2013, economic growth registered at 7.2%, one of the highest in Asia. This growth was underpinned by strong macroeconomic fundamentals such as growth in remittances and in the service sector, and high domestic demand that has shielded the Philippines from persistent disasters (World Bank 2014). However, the country has been unprepared for major disasters. Further research is thus needed to find out the effects of typhoons on the various economic sectors, both in the short and long term, and whether reconstruction efforts had significant effects on gross domestic product growth.

Notes:
[a] Economic damages refer to the monetary value of the negative impact of weather-related disasters on the affected economic and social sectors. Estimates calculated from raw data in IBTrACS.
[b] Based on Bangko Sentral ng Pilipinas (Central Bank of the Philippines) exchange rate of $1 = ₱44.135, as of 12 December 2013.
Source: Authors' compilation from cited studies.

B. Effects on Tourism

Exposure to climate change and related extreme weather events affects tourism, a sector dependent on the weather and geographical location. It is expected to affect tourists' destination choices, creating different patterns of tourism flows at the regional level. Losses are expected for most developing countries while high-latitude advanced economies would gain (Farid et al. 2016; Bigano, Hamilton, and Tol 2007).

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In 28 Caribbean countries, the impact of cyclones on tourism-related income is disproportionately large (Hsiang 2010). Data on total income attributed to tourists, across all industries, are available for a shorter period from 1995 to 2006 and reveal substantial losses that persist up to 4 years relative to a trend and relative to the previous year (Table 8). The effect is large, estimated as high as 3.5% of tourism receipts and 2.8% of visitors the following year. These are driven primarily by reductions in aggregate tourist visits, rather than by reductions of income per visit. In terms of effects on tourism-related industry, cyclones negatively affect the wholesale, retail, restaurants, and hotels sector, with output at −0.9% in the year of impact, and persist in both the second and third years at −0.3%. This contrasts with positive effects on the construction industry at 1.4% from the year of the impact until the following year, due to demand brought by reconstruction and rebuilding efforts.

Table 8: Effect of Tropical Cyclones on Tourism in the Caribbean, 1995–2006

	Deviation from Trend (%)			Change from Prior Year (%)		
	Receipts	Visitors	$ per visit	Receipts	Visitors	$ per visit
Cyclone, *year t*	−1.6	−0.9	−0.6	−1.0	−.5	0.3
Cyclone, *year t+1*	−3.5	−2.8	−0.7	−1.8	−2.0	0.1
Cyclone, *year t+2*	−2.5	−0.9	−1.4	1.1	1.4	−0.3
Cyclone, *year t+3*	−3.0	−2.0	−1.0	...	...	...
Cyclone, *year t+4*	−1.8	−1.2	−0.7	...	...	...
Cyclone, *year t+5*	−0.4	−0.3	−0.2	...	...	...
Cyclone, *year t+6*	0.0	−0.9	0.6	...	...	...

...= data not available.
Source: Hsiang, Solomon. 2010. "Temperatures and Cyclones Strongly Associated with Economic Production in the Caribbean and Central America." *Proceedings of the National Academy of Sciences of the United States of America* 107 (35): 15367–72.

In February 2016, Fiji took a direct hit from Cyclone Winston, the strongest to hit the country and the South Pacific, with damages estimated to exceed $500 million or about 11% of GDP and dealing a serious blow to the tourism industry. Tourist cancellations were as high as 25% immediately following the cyclone (ADB 2016). Fiji, like most Pacific islands, relies heavily on tourism and agriculture. However, with the increasing frequency and intensity of cyclones as well as the effects of El Niño, there are increasing calls for these island states to diversify more into manufacturing and services.

II. ADAPTATION TO NATURAL DISASTER SHOCKS

It is feasible and cost-effective for vulnerable countries to invest heavily in adaptation, as adaptation initiatives can prevent about 3% of GDP loss due to cyclones (Hsiang and Narita 2012). Country-level measures to lessen disaster risks include relocation or migration, climate-resilient infrastructure and improved building and fire codes, preventive measures such as early warning systems and faster emergency response systems, and other safety nets like government transfers and risk-sharing mechanisms such as development aid and disaster insurance. Adaptive capacity increases with income (Bakkensen and Mendelsohn 2016). Rich countries are better equipped because of better public services such as wide access to insurance, financing, as well as stronger institutions that provide safety nets and more resources for enforcing building and safety codes. This is a form of "adaptation deficit" which poorer countries lack and it limits their ability to adapt (Fankhauser and McDermott 2014). In the US, government-funded transfer programs such as unemployment insurance, welfare, and food stamps are some of the safety nets available to affected populations, which explains the relative

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resilience of the country to natural disasters (Deryugina 2011). Richer countries simply have more resources to protect against natural disasters (Fankhauser and McDermott 2014).

A. Migration and Urbanization

Agriculture and tourism, two production sectors that are dependent on the weather and geographical location, are the most affected by tropical cyclones. These are also the sectors that adapt the least to disaster risk. This suggests that nonagricultural and other industries can adapt more quickly through less costly strategies such as relocation (Hsiang 2010). Diversification into manufacturing is also an economic strategy especially for those sectors relying on agriculture, mostly in developing countries.

Natural disaster shocks displace at-risk populations and affect migration patterns, either temporarily or permanently. The Global Estimates Report 2015 puts the annual average number of people displaced by natural disasters at 26.4 million from 2008 to 2015, equivalent to one person displaced every second.[18] During the same period, an average of 22.5 million people are displaced by climate or weather-related disasters, or about 62,000 people per day. The same report further estimates that Asia, with 16.7 million displaced people, accounted for 87% of the global total in 2014, with the People's Republic of China (PRC), India, and the Philippines having the highest levels of displacement in absolute terms. The persistent droughts in Bangladesh illustrate the wide-ranging effects on the country, which resulted in large-scale displacement and migration (Shamsuddoha et al. 2012).

With increasing displacement comes increase in internal migration, primarily to urban areas, especially if economic conditions worsen in the affected areas and rebuilding and reconstruction takes years. The economic development in developing Asia has been characterized by increasing incomes and rapid urbanization. The region is becoming more urban with higher wage opportunities in cities, and more globalized as its share of world output and exports expand. As economic development is shown to lead to fewer fatalities from natural disaster-related events (Kahn 2005; Bakkensen and Mendelsohn 2016; Choi 2016), it can be an important part of adaptation. Higher incomes mean the population can afford resilient housing and greater access to fast emergency response systems and financial instruments such as credit and insurance. However, whether urbanization has led to less damages and losses from disasters is unclear and the effect of migration on mitigating disaster losses is difficult to track. Choi (2016), for instance, shows that urbanization contributed slightly to the increase of disaster damages in countries of the Organisation for Economic Co-operation and Development from 1990 to 2010. On the other hand, Kahn (2014) explores the role of market innovation in cities that may lead to higher quality and cheaper products to cope with disaster risks. He further adds that human ingenuity as well as individual locational and lifestyle choices can help urban populations to adapt.

B. Risk Sharing

Unlike richer countries, poor and developing countries cope through other ways such as overseas development assistance. In one study, Yang (2008) finds that greater hurricane exposure leads to large increases in foreign aid, especially in developing countries. Low-income countries also experienced a spike in migrant remittances but a decline in bank and trade-related lending. Within 3 years after hurricane exposure, total inflows amounted to roughly four-fifths of the estimated damages

[18] Annual report by the International Displacement Monitoring Centre (2015).

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in these poorer subsamples. The opposite happens in richer countries where hurricane exposure leads to inflows of new lending from multilateral institutions but which are offset by a large decline in private financial flows. Said study provides the first evidence of country risk sharing and consumption smoothing during market volatilities and of some types of private financial flows that help buffer countries from negative economic shocks or exogenous shocks such as from hurricanes.

Although international aid can mitigate the effects of natural disasters, it may not be sustainable in the long term relative to the rebuilding costs and may also reduce the incentives to invest in adaptation. These shocks significantly increase the debt-to-GDP ratio as well, putting more pressure on developing economies (Acevedo 2014). Countries with financially developed markets—with greater access to credit and high insurance penetration—are usually high-income economies and can mitigate the economic cost of natural disasters without resorting to deficit financing of expenditures (Melecky and Raddatz 2015). Felbermayr and Gröschl (2014) show that a financially open economy can lessen the negative effects on GDP per capita.[19] On average, output losses for financially less developed countries account for about 2%–10% of GDP. This further reinforces the assumption that adaptive capacity increases with income.

Insurance can also be an important form and substitute to cope with disaster risk, especially for developing countries. It offers a way to reduce the costs of disaster damage without raising taxes or reducing spending (Laframboise and Acevedo 2014). However, poor countries often lack access to disaster insurance. The World Bank's Global Index Insurance Facility is a new and innovative approach that addresses the lack of access to insurance in developing countries (IFC 2016). This index-based (or parametric index) insurance for loss of assets and capital due to natural disaster shocks is based on deviations from the normal values of weather parameters such as wind speed for tropical cyclones, precipitation and rainfall for droughts, and temperature for extreme temperature and heat waves. A multidonor trust fund, it has so far funded private sector insurance initiatives in Indonesia, Sri Lanka, and Papua New Guinea.

Catastrophic risk finance, or disaster risk finance, can also mitigate against natural disaster risks in Asia, as part of a comprehensive disaster risk management in the region. As early as 2008, the Asian Development Bank has been at the forefront of setting up this multilateral risk-sharing mechanism, patterned after the Caribbean Catastrophe Risk Insurance Facility. Opportunities exist for these types of risk sharing in the Asian region and are viable if done through regional public–private partnerships, albeit lacking capacity and resources (ADB 2009). The Pacific Catastrophe Risk Insurance Pilot started in 2013 is an example of an ongoing program that aims to increase the capacity of small Pacific island states for postdisaster financing and reconstruction needs.

In the 1990s, catastrophe bonds were issued to hedge against disaster-related risks. Pension funds and large institutional investors bought about four-fifths of issued catastrophe bonds in 2014, with higher returns than other securities. The outstanding amount is about $25 billion with about $8.8 billion issued in 2014 alone (Farid et al. 2016). However, their long maturity, unwillingness of investors to take on the risks, and difficulties in estimating potential losses have dissuaded investors.

[19] The authors used the Chin–Ito financial openness indicators. A disaster year belonging to the 95th percentile of the weighted disaster index produces a GDP per capita loss of 2.12% if the country is financially closed (Chinn–Ito index of 0.1). With an intermediate openness of 0.4, the damage of the same disaster intensity is 1.43% of GDP per capita, while it is 0.5% for financially open countries (Chinn–Ito index of 0.8). A disaster year in the 75th percentile reduces GDP per capita by 0.47%, 0.32%, and 0.11% for countries with low (0.1), intermediate (0.4), and high (0.8) levels of financial openness, respectively (Felbermayr and Gröschl 2014).

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They do not see the appeal of an investment whose name includes "catastrophe" (Lewis 2007). The huge losses of the insurance industry during Hurricane Katrina also tempered investors' eagerness to invest. One thing they have discovered, however, is that a Katrina-type event went from a 1-in-40-year event to a 1-in-20-year event. The risk from natural disasters has doubled.

III. POLICY RECOMMENDATIONS

Recognizing that climate change compromise development, numerous efforts on climate change adaptation and mitigation have been identified over the past several years. One of the targets of Sustainable Development Goal 13 is "to strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries."[20] Designs and policy measures are country specific and very much dependent on each national circumstances and experiences. These measures must be integrated into national disaster plans as well as in medium- and long-term economic projections. International recommendations and policies on climate change must have proper support from the national government for them to be effectively and efficiently implemented.

International aid played a key role in the construction of disaster-resilient infrastructure in developing countries and development of resilient crop varieties. At the national level, policies and structures for disaster response are in place and preparedness is crucial to prevent large losses from natural disasters. In coordination with the private sector, governments must establish and invest more on early warning systems for natural hazards to warn and prevent large damages. Coordinated policies and mechanisms must be in place in order for the public sector, private sector, and other humanitarian organizations and affected local governments to achieve a proper and faster response and delivery of relief goods and services.

Redirecting investments toward adaptation measures as well as additional financing for climate-resilient initiatives can be done to cope with disasters. Developed and developing economies have to pool resources to better provide assistance both to prevent large damages and losses as well as in faster rebuilding.

Governments must also establish and maintain information management systems to properly identify and prioritize adaptive measures and create their own local adaptation and disaster risk reduction plans. They can further disseminate information and adaptation measures to help improve knowledge on the impact of climate change by mainstreaming climate awareness into the basic education curriculum. Capacity building down to the local level should be conducted especially in disaster-prone areas.

IV. CONCLUSION

Natural disaster shocks, such as typhoons and droughts, have the potential to undo years of development by destroying both human and physical capital. Data from existing studies as well as from global disaster databases point to increasing damages and losses. Using exogenous indicators such as wind speed, temperature, and rainfall patterns, robust estimates point to significant short- and long-

[20] Sustainable Development Goal 13: Take urgent action to combat climate change and its impacts. See UN website at http://www.un.org/sustainabledevelopment/climate-change-2/

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term losses to per capita growth, from as low as 0.1%–14.9% for typhoons and 0.01%–3% for droughts. The extent of output volatility is felt not only in the year of impact but in succeeding years as well, up to 5 years for droughts and 20 years for typhoons. In Asia, the elasticity of damages with respect to maximum wind speed is about 2. This would be higher if further research takes into account other factors such as storm surge and rainfall as well as including socioeconomic factors in future projections.

Current research points to more frequent and stronger weather shocks as the earth gets warmer. Together with temperature variation and sea level rise, the risks from climate-related natural disasters increase. In developing Asia, the macroeconomic impacts from both extreme temperatures and extreme weather events can significantly dampen the region's growth prospects and increase inequality. Vulnerable populations from disaster-prone areas are mostly the poor who have the least access to resilient housing, are most affected by volatile food prices through its effects on agricultural production, and have the least access to financial instruments such as credit and insurance.

Since the poor suffer the most from the effects of natural disaster shocks, adaptation efforts should address needs such as relocation, resilient infrastructure, new resistant crops, and government transfers to more sustainable ex ante strategies and risk-sharing mechanisms like disaster insurance.

Electronic copy available at: https://ssrn.com/abstract=2894778

REFERENCES

Acevedo, Sebastian. 2014. "Debt, Growth and Natural Disasters: A Caribbean Trilogy." IMF Working Paper WP/14/125.

———. 2016. "Gone with the Wind: Estimating Hurricane Climate Change Costs in the Caribbean." IMF Working Paper WP/16/199.

Adedeji, Olumuyiwa, Janna Gieck-Bricco, and Vera Kehayova. 2016. "Natural Disasters and Food Crises in Low Income Countries: Macroeconomic Dimensions." IMF Working Paper WP/16/65.

Antilla-Hughes, Jesse Keith, and Solomon Hsiang. 2013. "Destruction, Disinvestment, and Death: Economic and Human Losses Following Environmental Disaster." *Social Science Research Network*. doi: 10.2139/ssrn.2220501.

Asian Development Bank (ADB). 2009. *Natural Catastrophe: Risk Insurance Mechanisms for Asia and the Pacific—Main Report*. Manila.

———. 2016. *Asian Development Outlook 2014: Asia's Potential Growth*. Manila.

Bakkensen, Laura, and Robert Mendelsohn. 2016. "Risk and Adaptation: Evidence from Global Hurricane Damages and Fatalities." *Journal of the Association of Environmental and Resource Economists* 3 (3): 555–87.

Bigano, Andrea, Jacqueline Hamilton, and Richard Tol. 2007. "The Impact of Climate Change on Domestic and International Tourism: A Simulation Study." *The Integrated Assessment Journal* 7 (1): 25–49.

Bouwer, Laurens, and Wouter Botzen. 2011. "How Sensitive are US Hurricane Damages to Climate? Comment on a Paper by W. D. Nordhaus." *Climate Change Economics* 2 (1): 1–7.

Burke, Marshall, Solomon Hsiang, and Edward Miguel. 2015. "Global Non-linear Effect of Temperature on Economic Production." *Nature* 527 (7577): 235–39.

Cabezon, Ezequiel, Leni Hunter, Patrizia Tumbarello, Kazuaki Washimi, and Yiqun Wu. 2015. "Enhancing Macroeconomic Resilience to Natural Disasters and Climate Change in the Small States of the Pacific." IMF Working Paper WP/15/125.

Cashin, Paul, Kamiar Mohaddes, and Mehdi Raissi. 2015. "Fair Weather or Foul? The Macroeconomic Effects of El Niño." IMF Working Paper WP/15/89.

Cerra, Valerie and Sweta Chaman Saxena. 2008. "Growth Dynamics: The Myth of Economic Recovery." *American Economic Review* 98(1): 439–457.

Choi, Choongik. 2016. "Does Economic Growth Really Reduce Disaster Damages? Index Decomposition Analysis for the Relationship between Disaster Damages, Urbanization and Economic Growth and its Implications." *International Journal of Urban Sciences* 20 (2): 188–205.

Electronic copy available at: https://ssrn.com/abstract=2894778

Cinco, Thelma, Rosalina de Guzman, Andrea Monica Ortiz, Rafaela Jane Delfino, Rodel Lasco, Flaviana Hilario, Edna Juanillo, Rose Barba, and Emma Ares. 2016. "Observed Trends and Impacts of Tropical Cyclones in the Philippines." *International Journal of Climatology* 36 (14): 4638–50. doi:10.1002/joc.4659.

Collins, Mat, S. Soon-Il An, Wenju Cai, Alexandre Ganachaud, Eric Guilyardi, Fei-Fei Jin, Markus Jochum, Matthieu Lengaigne, Scott Power, Axel Timmermann, Gabe Vecchi and Andrew Wittenberg. 2010. "The Impact of Global Warming on the Tropical Pacific Ocean and El Niño." *Nature Geoscience* 3 (6): 391–97.

Dell, Melissa, Benjamin Jones, and Benjamin Olken. 2012. "Temperature Shocks and Economic Growth: Evidence from the Last Half Century." *American Economic Journal: Macroeconomics* 4 (3): 66–95.

Deryugina, Tatyana. 2011. "The Dynamic Effects of Hurricanes in the US: The Role of Non-Disaster Transfer Payments." MIT Center for Energy and Environmental Policy Research CEEPR WP 2011-007.

Emanuel, Kerry. 2005. "Increasing Destructiveness of Tropical Cyclones over the Past 30 Years." *Nature* 436: 686–88.

EM-DAT: The OFDA/CRED International Disaster Database. Brussels, Belgium: Catholic University of Louvain. http://www.emdat.be/

Fankhauser, Samuel, and Thomas McDermott. 2014. "Understanding the Adaptation Deficit: Why Are Poor Countries More Vulnerable to Climate Events than Rich Countries?" *Global Environmental Change* 27 (1): 9–18.

Farid, Mai, Michael Keen, Michael Papaioannou, Ian Parry, Catherine Pattillo, and Anna Ter-Martirosyan. 2016. "After Paris: Fiscal, Macroeconomic, and Financial Implications of Climate Change." IMF Staff Discussion Note SDN/16/01.

Felbermayr, Gabriel, and Jasmin Gröschl. 2014. "Naturally Negative: The Growth Effects of Natural Disasters." *Journal of Development Economics* 111: 92–106.

Fomby, Thomas, Yuki Ikeda, and Norman Loayza. 2009. "The Growth Aftermath of Natural Disasters." The World Bank Development Research Group and Global Facility for Disaster Reduction and Recovery Policy Research Working Paper 5002.

———. 2013. "The Growth Aftermath of Natural Disasters." *Journal of Applied Econometrics* 28 (3): 412–34.

Food and Agriculture Organization of the United Nations. 2014. *Understanding the Drought Impact of El Niño on the Global Agricultural Areas: An Assessment Using FAO's Agricultural Stress Index (ASI)*. Rome.

Hallegatte, Stephane, Mook Bangalore, Laura Bonzanigo, Marianne Fay,Tamaro Kane, Ulf Narloch, Julie Rozenberg, David Treguer, and Adrien Vogt-Schilb. 2015. *Shock Waves: Managing the Impacts of Climate Change on Poverty*. Washington, DC: World Bank.

Electronic copy available at: https://ssrn.com/abstract=2894778

Herring, Stephanie, Martin Hoerling, James Kossin, Thomas Peterson, and Peter Stott. 2015. "Explaining Extreme Events of 2014 from a Climate Perspective." *Special Supplement to the Bulletin of the American Meteorological Society* 96 (12): 1–172.

Hsiang, Solomon. 2010. "Temperatures and Cyclones Strongly Associated with Economic Production in the Caribbean and Central America." *Proceedings of the National Academy of Sciences of the United States of America* 107 (35): 15367–72.

Hsiang, Solomon, and Amir Jina. 2014. "The Causal Effect of Environmental Catastrophe on Long Run Economic Growth: Evidence from 6,700 Cyclones." National Bureau of Economic Research Working Paper No. 20352.

Hsiang, Solomon, and Daiju Narita. 2012. "Adaptation to Cyclone Risk: Evidence from the Global Cross-section." *Climate Change Economics* 3 (2): 1–28.

Intergovernmental Panel on Climate Change (IPCC). 2012. "Summary for Policymakers." In *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, edited by C. B. Field, V. Barros, T. F. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, M. D. Mastrandrea, K. J. Mach, G.-K. Plattner, S. K. Allen, M. Tignor, and P. M. Midgley. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge, UK, and New York, NY: Cambridge University Press.

———. 2014. *Fifth Assessment Report*. Geneva. http://www.ipcc.ch/report/ar5/

International Best Track Archive for Climate Stewardship (IBTrACS). http://www.ncdc.noaa.gov/oa/ibtracs

International Displacement Monitoring Centre. 2015. *Global Estimates 2015: People Displaced by Disasters.* Geneva.

International Federation of Red Cross and Red Crescent Societies (IFRC). 2016. "Philippines: Drought and Dry Spells – Information Bulletin No. 1." April 29. http://www.ifrc.org/docs/Appeals/16/IBPHdr290416.pdf

International Finance Corporation (IFC). 2016. "Global Index Insurance Facility." http://www.ifc.org/wps/wcm/connect/industry_ext_content/ifc_external_corporate_site/industries/financial+markets/retail+finance/insurance/global+index+insurance+facility

Jha, Shikha, Pilipinas Quising, and Guntur Sugiyarto. 2014. "Economic and Poverty Impacts of Typhoon Haiyan: A Policy Note." Unpublished.

Kahn, Matthew. 2005. "The Death Toll from Natural Disasters: The Role of Income, Geography, and Institutions." *The Review of Economics and Statistics* 87 (2): 271–84.

———. 2014. "Climate Change Adaptation: Lessons from Urban Economics." National Bureau of Economic Research Working Paper No. 20716.

Karim, Azreen. 2016. "The Household Response to Persistent Natural Disasters: Evidence from Bangladesh." Victoria Business School SEF Working Paper 05/2016.

Electronic copy available at: https://ssrn.com/abstract=2894778

Klomp, Jeroen, and Kay Valckx. 2014. "Natural Disasters and Economic Growth: A Meta-analysis." *Global Environmental Change* 26: 183–95.

Knapp, Kenneth, Michael Kruk, David Levinson, Howard Diamond, and Charles Neumann. 2010. "The International Best Track Archive for Climate Stewardship (IBTrACS): Unifying Tropical Cyclone Best Track Data." *Bulletin of the American Meteorological Society* 91: 363–76.

Knutson, Thomas, John Mcbride, Johnny Chan, Kerry Emanuel, Greg Holland, Chris Landsea, Isaac Held, James Kossin, A. K. Srivastava, and Masato Sugi. 2010. "Tropical Cyclones and Climate Change." *Nature Geoscience* 3: 157–63.

Laframboise, Nicole, and Sebastian Acevedo. 2014. "Man versus Mother Nature." *Finance & Development* 51 (1): 44–47.

Lee, Minsoo, Mai Lin Villaruel, and Raymond Gaspar. 2016. "Effects of Temperature Shocks on Economic Growth and Welfare in Asia." ADB Economics Working Paper Series No. 501. Manila: Asian Development Bank.

Lewis, Michael. 2007. "In Nature's Casino." The New York Times Magazine, August 26. http://www.nytimes.com/2007/08/26/magazine/26neworleans-t.html?_r=0

Loayza, Norman, Educardo Olaberría, Jamele Rigolini, and Luc Christiaensen. 2012." Natural Disasters and Growth: Going Beyond the Averages." *World Development* 40 (7): 1317–36.

Mei, Wei, Shang-Ping Xie, Francois Primeau, James McWilliams, and Clauia Pasquero. 2015. "Northwestern Pacific Typhoon Intensity Controlled by Changes in Ocean Temperatures." *Science Advances* 1 (4), e1500014. doi:10.1126/sciadv.1500014.

Melecky, Martin, and Claudio Raddatz. 2015. "Fiscal Responses after Catastrophes and the Enabling Role of Financial Development." *The World Bank Economic Review* 29 (1): 129–49.

Mendelsohn, Robert, Kerry Emanuel, Shun Chonabayashi, and Laura Bakkensen. 2012. "The Impact of Climate Change on Global Tropical Cyclone Damage." *Nature Climate Change* 2: 205–209.

Morrow, Sarah. 2014. "Typhoons and Lower Birth Weight in the Philippines." University of San Francisco. http://repository.usfca.edu/thes/89

National Disaster Risk Reduction and Management Council (NDRRMC). 2013. "NDRRMC Update: Final Report re Effects of Typhoon 'Yolanda' (Haiyan)." November 6–9. http://ndrrmc.gov.ph/attachments/article/1329/FINAL_REPORT_re_Effects_of_Typhoon_YOLANDA_(HAIYAN)_06-09NOV2013.pdf

National Economic and Development Authority (NEDA). 2013. "Reconstruction Assistance on Yolanda (RAY): Build-Back-Better." December 16. http://yolanda.neda.gov.ph/reconstruction-assistance-on-yolanda-ray-build-back-better/

National Oceanic and Atmospheric Administration (NOAA). "Saffir-Simpson Hurrican Wind Scale." http://www.nhc.noaa.gov/aboutsshws.php

Electronic copy available at: https://ssrn.com/abstract=2894778

Nordhaus, William. 2010. "The Economics of Hurricanes and Implications of Global Warming." *Climate Change Economics* 1 (1): 1–20.

Raddatz, Claudio. 2007. "Are External Shocks Responsible for the Instability of Output in Low-Income Countries?" *Journal of Development Economics* 84 (1): 155–87.

Reinhart, Carmen, and Kenneth Rogoff. 2009. "The Aftermath of Financial Crises." *American Economic Review* 99 (2): 466–72.

Romer, Christina, and David Romer. 2010. "The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks." *American Economic Review* 100 (3): 763–801.

Schmidt, Silvio, Claudia Kemfert, and Peter Höppe. 2010. "The Impact of Socio-Economics and Climate Change on Tropical Cyclone Losses in the USA." *Regional Environmental Change* 10 (1): 13–26.

Shamsuddoha, Md, SM Munjural Hannan Khan, Sajid Raihan, and Tanjir Hossain. 2012. "Displacement and Migration from Climate Hot-spots in Bangladesh: Causes and Consequences." ActionAid Bangladesh. https://unfccc.int/files/adaptation/groups_committees/loss_and_damage_executive_committee/application/pdf/displacement_and_migration_in_bangladesh.pdf

United Nations. "Goal 13: Take urgent action to combat climate change and its impact." http://www/un.org/sustainabledevelopment/climate-change-2/

United Nations Universtiy, Institute for Environment and Human Security. World Risk Report. http://www.worldriskreport.org/

Victoriano, Danila. 2015. "Safeguarding Development from Natural Disasters." World Bank. February 4. http://www.worldbank.org/en/news/feature/2015/02/04/what-does-it-take-to-bring-resilience-to-scale

World Bank. World Development Indicators. http://data.worldbank.org/data-catalog/world-development-indicators

World Bank. 2014. "Philippine Economic Update 2014: Pursuing Inclusive Growth through Sustainable Reconstruction and Job Creation." March. http://www.worldbank.org/en/country/philippines/publication/philippine-economic-update-2014-pursuing-economic-growth-through-sustainable-reconstruction-and-job-generation

———. 2016. "Extreme Weather Events in a Changing Climate." http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTPROGRAMS/EXTEAER/0,,contentMDK:22858749~pagePK:64168182~piPK:64168060~theSitePK:5991650,00.html#cyclone

Yang, Dean. 2008. "Coping with Disaster: The Impact of Hurricanes on International Financial Flows, 1970–2002." *The B.E. Journal of Economic Analysis & Policy* 8 (1): 1–45.

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Natural Disaster Shocks and Macroeconomic Growth in Asia: Evidence for Typhoons and Droughts

Under a looming threat of climate-related extreme events, estimates of the effects of typhoons and droughts show declines in national incomes compared to predisaster trends persisting up to 2 decades. In Asia, damages from typhoons double relative to a unit increase in wind speed with mean damages projected to rise from 5% to 50%. This could undo development gains in vulnerable developing Asian economies and affect mostly the poor. Relocation, social safety nets, and disaster insurance or similar ex ante mechanisms are needed to cope with increased disaster risks.

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Annex 520

"Disaster insurance in developing Asia: An analysis of market-based schemes", ADB Economics Working Paper Series No. 590, *Asian Development Bank*, September 2019

DISASTER INSURANCE IN DEVELOPING ASIA: AN ANALYSIS OF MARKET-BASED SCHEMES

Swenja Surminski, Architesh Panda, and Peter John Lambert

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Disaster Insurance in Developing Asia: An Analysis of Market-Based Schemes

Swenja Surminski, Architesh Panda, and Peter John Lambert

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ABSTRACT

In recent years, insurance against natural disasters has gained recognition as an important tool for climate risk management that could, if carefully implemented, help increase the resilience of those insured. In response, insurance solutions are increasingly tested and applied in many countries that have no prior experience with insurance or no existing market. This paper analyzes the status, types, and patterns of market-based disaster insurance schemes across emerging and developing countries in Asia. We provide a snapshot of the current use of insurance based on data from Grantham Research Institute on Climate Change and the Environment's Disaster Risk Transfer Scheme Database (2012–2018). Our analysis shows that although the use of insurance is expanding, there are many countries that still don't have any kind of cover available. Where insurance mechanisms exist, they often rely on subsidies or bundling strategies. Although a mix of insurance schemes covering risks for governments (sovereign); or at meso (risk aggregators, cooperatives); and micro level currently operate to address a wide variety of climate and disaster risks, without demand-side support, many markets are likely to collapse or, at the very least, experience far lower penetration rates. We conclude with a discussion of the role of these insurance schemes in increasing resilience, which raises important questions for designing new and measuring and evaluating existing insurance schemes.

Keywords: Asia, climate change, disaster insurance, resilience

JEL codes: G22, G32, Q54

I. INTRODUCTION

Climate change threatens the sustainable development of society, with particularly negative implications for poor and vulnerable communities. Risk reduction and forward-looking climate adaptation are important in building resilience of individuals, businesses, and governments to the impacts of extreme weather and long-term changes. The economic case for proactive management of these risks and for avoidance of further risk creation is strong (Surminski and Tanner 2016). The increasing costs associated with the physical impacts of climate change hamper development efforts in many parts of the world. Low-income countries are at the greatest risk of climate hazards, mainly because of their reliance on climate-sensitive natural resources and agriculture, as well as a lack of adaptive capacity (Intergovernmental Panel on Climate Change 2014). Building climate resilience therefore needs to be an essential component of current and future development planning to ensure that previous gains in poverty reduction and economic prosperity are not wiped out by adverse climatic impacts.

Among the many resilience measures, financial risk transfer as an intervention tool is experiencing growing interest from governments, donors, businesses, and civil society (Surminski Bouwer, and Linnerooth-Bayer 2016; Weingärtner, Simonet, and Caravani 2017). Insurance is considered a possible way to reduce or compensate for economic losses from disasters through ex ante risk management, with agriculture insurance already used in several countries as a safety net to protect farmers and combat food security concerns (Golnarghi, Surminski, and Schanz 2016; Tanner et al. 2015). In this spirit, the InsuResilience Global Partnership for Climate and Disaster Risk Finance and Insurance Solutions was officially launched at the United Nations Climate Conference of the Parties 23 (COP23) in Bonn. At the global level, different multilateral initiatives such as the Sendai Framework for Disaster Risk Reduction include risk transfer and insurance mechanisms (paragraph 30a and 31b, A/conf.224/CR.P.3), while insurance-related approaches are also featured in the Paris Agreement (United Nations Framework Convention on Climate Change COP21, 1/CP.21: Article 3, para. 48; Paris Agreement: Article 8, para. 4). Indeed, insurance instruments can play an important role in managing risks by providing "individuals and businesses with coverage against specified contingencies, by redistributing losses among the pool of policyholders" (Hussels, Ward, and Zurbruegg 2005). This pooling of risks allows for diversification, providing an additional layer of risk absorption capacity. However, beyond the financial dimension, insurance can also affect the behavior of those at risk, either in a moral hazard context, where insurance can induce risky behavior, or as an incentive, where insurance triggers risk reduction investments or the implementation of prevention measures (Surminski 2014).

In low-income countries, typically more than 95% of all losses from weather, climate, and natural hazards remain uninsured (Golnarghi, Surminski, and Schanz 2016). For example, in Asia, Bangladesh is the country with the least insurance penetration at 0.2% of gross domestic product (GDP); in comparison to Japan, where insurance penetration is 2.3% of GDP (Lloyds of London 2018). Where insurance does exist, the insurance market is predominantly concentrated in the agriculture sector. For example, in recent years, both indemnity and index-based agricultural insurance has strongly developed in Asia, from traditional market leaders of India to the People's Republic of China (PRC), to new schemes in Indonesia, the Philippines, Thailand, and Viet Nam.

As climate change progresses, reducing and managing financial impacts from climate-related disasters and extreme events is becoming increasingly important in developing countries. If insurance is to play a role in supporting this quest for resilience, more needs to be done to design and implement

schemes that address current and future risk and increase not only financial resilience but help to reduce risk and avoid further risk creation. This raises many questions about design, scope, and viability of risk transfer schemes, their benefits and costs, and if and how insurance can be supported though government intervention, donor money, or international adaptation assistance (Surminski and Vivid Economics 2018). This also underpins the need for creating necessary preconditions for the use of insurance through public policy and regulation, shaping the operating environment of the industry, and establishing if and how these schemes do meet the needs of those that they seek to cover (Ranger and Surminski 2013).

Although the potential benefits of insurance in the context of climate risks has been recognized for some time now, for example in the context of crop insurance (Di Falco et al. 2014 Panda et al. 2013), there are also clear concerns about possible disincentives or maladaption through insurance (e.g., O'Hare, White, and Connelly 2016). While in theory, well-designed and implemented insurance could help realize the "triple dividend of resilience" in terms of reducing loss and damage in the event of a disaster, managing risk of potential future disasters, and generating development cobenefits (Surminski and Tanner 2016), in reality, this resilience impact remains far from clear.

This paper analyzes the status, types, and patterns of market-based disaster insurance schemes across emerging and developing countries in Asia, and discusses their role in increasing resilience, which raises important questions for measuring and evaluating insurance schemes. We provide a snapshot of the current use of insurance to enhance the knowledge base for donors, insurers, governments, and broader practitioners operating in disaster risk management and insurance in low and lower-middle-income economies. Our analysis is based on an empirical assessment of schemes in Asia—based on data from the Grantham Research Institute on Climate Change and the Environment's Disaster Risk Transfer Scheme Database (2012–2018) (formerly known as the Climate Wise Compendium on Disaster Risk Transfer Schemes in emerging and developing countries).

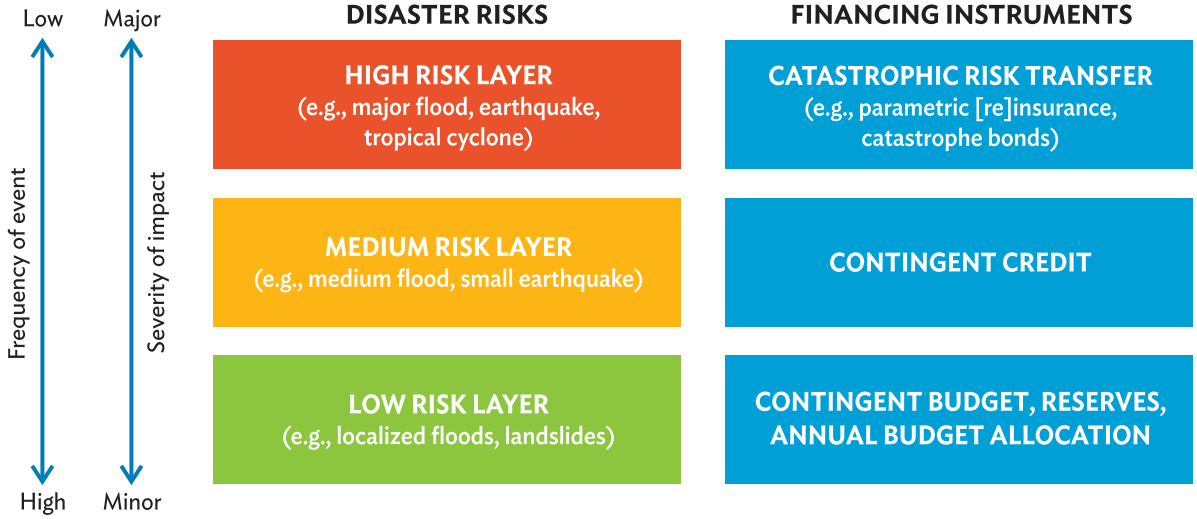
II. CONTEXT: RESILIENCE AND INSURANCE

The concept of resilience has received significant attention recently, becoming a widely recognized part of the sustainable development and climate adaptation movement. There has been substantial discussion on the meaning, nature, and implications of resilience in the literature (Schipper and Langston 2015; Bahadur, Ibrahim, and Tanner 2010; Béné et al. 2012). However, defining and measuring resilience has not been straightforward and involves varied approaches and methodologies in different context. In the most basic sense, resilience can be understood as the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions (Intergovernmental Panel on Climate Change 2012). Risk transfer is understood to be one tool in a holistic climate risk management framework that can increase resilience to climate risks, as highlighted by the InsuResilience initiative launched in 2015 by the Group of Seven leaders, with a unique mandate to extend climate insurance to 400 million highly exposed, uninsured poor and vulnerable people by 2020 to make those individuals, communities, and countries more climate resilient (InsuResilience 2017).[1]

[1] The Group of Seven consists of Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States.

However, while the positive relationship between other types of insurance (e.g., health or life insurance) and economic growth has been explored in detail (see Ghosh 2013, Alhassan and Fiador 2014, Dash et al. 2018), the empirical evidence on the benefits of market-based disaster and climate risk insurance, and in particular their impact on resilience, is still scarce. Recent research on the insurance penetration rate and resilience at the global level finds that the effect of natural disasters depends on access to insurance via private insurance markets and suggests that private insurance penetration and a stable public institutional infrastructure help build resilience to the negative effects of natural disasters (Breckner et al. 2016). However, importantly, insurance is not suitable for all risks nor for all stakeholders, and it does not provide a silver bullet to the challenge of climate risks. As such, it is important to consider aims and objectives behind any type of insurance, types of designs and operations, as well as the needs of those targeted by insurance (Linnerooth-Bayer et al. 2019). This is critical, as the extension of climate insurance to these populations may itself be risky. Poorly designed and/or implemented climate insurance may reduce incentives for risk reduction (Surminski and Oramas-Dorta 2014) increasing moral hazard and potentially lowering resilience. Ensuring that climate insurance is enhancing resilience and well-being requires both appropriate resilience indicators and well-designed studies that can be evaluated with rigor. A recent review, conducted by project partner, the Munich Climate Insurance Initiative, highlighted significant uncertainty around which resilience indicators to use in the monitoring and evaluation of insurance initiatives, and also a shortage of rigorously designed studies to examine how climate insurance influences resilience and measures of well-being such as food security and transitions from poverty (Schaefer and Waters 2016, Hess and Hazell 2016). Questions of type, form, and structure of such markets with respect to their viability in developing countries are now of key importance. More important, any insurance comes at a cost. The ratio of the premium paid versus the coverage obtained is an important consideration, particularly when comparing insurance to other risk financing tools. Ghesquiere and Mahul (2010) investigated this for a range of disaster risk financing instruments, looking at the ratio between the (opportunity) cost of the financial product (e.g., premium of an insurance product, expected net present value of a contingent debt facility) and the expected payout of that financial product. They found that disaster risk transfer is very costly compared to most other instruments, but offers the important advantages of more financing, speed, and certainty of disbursement (Ghesquiere and Mahul 2010, Clarke et al. 2016).

Overall, insurance theory and recent cost–benefit assessments indicate that risk financing is only viable for large and residual risks that cannot be reduced or managed otherwise (Mechler et al. 2014). This suggests that a "risk-layering approach" can be used to identify risk management options that are differentially effective for low-, medium- and high-probability events, as well as tailored to the different risk-bearing capacities of communities, governments, and international organizations. A similar approach has been used by World Bank (2016a) to identify fiscal risk assessment and risk financing options (see figure).



Source: World Bank. 2016a. *Fiscal Disaster Risk Assessment and Risk Financing Options* (English). Washington, DC.

Furthermore, most developing countries face many barriers for implementing climate and disaster insurance as summarized in Table 1. The barriers to implementation of disaster insurance might arise because of demand-side or supply-side constraints. Common demand-side constraints include unaffordability, lack of trust, lack of financial literacy, lack of willingness to pay, and unsupportive regulatory frameworks. The level of insurance demand can be influenced by many factors including legal, social, economic, and political factors (Beck and Webb 2003, Esho et al. 2004). The supply-side constraints include unsuitable insurance risks such as slow onset disasters, lack of data, weak institutional frameworks, problems of asymmetric information (e.g., moral hazard or adverse selection) and lack of technical capacity.

Table 1: Most Common Barriers for Climate and Disaster Insurance in Emerging Markets and Developing Countries

Demand Side	Supply Side
Low income and/or unaffordability Insurance is often considered too expensive for those most vulnerable.	**Risk characteristics** The type of risks and risk trends determine the appetite of those underwriting and the costs of an insurance scheme. For some risks, such as slow-onset sea level rise, insurance is deemed not suitable and not available.
Lack of trust in the insurance mechanism or those running it, often due to lack of experience with insurance.	**Lack of data to accurately price risks** often due to missing data collections, outdated risk information, or lack of standardization or access to risk data
Lack of financial literacy can lead to misunderstanding of risks and the role of insurance, and wrong expectations about payouts.	**"Classic" asymmetric information problems** Moral hazard and adverse selection problems imply that those that are willing to pay for insurance are usually those most at risk and hence costly to insure.
Existence of alternative measures including humanitarian assistance, social safety networks, which may reduce the interest in insurance.	**Lack of technical capacity** Risk financing and insurance require technical skills that are often not present in emerging markets or developing countries.
Limited willingness to pay Particularly for sovereign risk schemes, the lack of political buy-in and political attractiveness of postdisaster aid present challenges.	**High operational or distribution costs** Administrative aspects and lack of distributional networks can put a burden on insurance schemes, particularly in their early phases.
Unsupportive regulatory frameworks Lack of enforcement of customer rights and lack of transparency with regard to insurance policies may create deterrents for (potential) customers to make use of insurance services.	**Unsupportive regulatory frameworks** This may act as a deterrent for private sector involvement and can hamper the scaling up of insurance schemes.

Sources: Authors, based on Ranger, Nicholas, and Swenja Surminski. 2013. "A Preliminary Assessment of the Impact of Climate Change on Non-life Insurance Demand in the BRICS Economies." *International Journal of Disaster Risk Reduction* 3: 14–30. https://doi.org/10.1016/j.ijdrr.2012.11.004; Vivid Economics, Surminski Consulting, and Callund Consulting. 2016. "FINAL REPORT: Understanding the Role of Publicly Funded Premium Subsidies in Disaster Risk Insurance in Developing Countries." United Kingdom Department for International Development.

The following section offers a snapshot of existing disaster and climate risk transfer schemes across Asia. While this data offers little in the way of specific resilience outcomes, it helps one get an overview of the current landscape, as well as answers important questions such as the role of government, the role of demand-side support, and different types of supply-side instruments and how, if at all, these are linked to initiatives to improve resilience.

III. METHODS AND DATA

A. About the Data

This paper utilizes data from the Grantham Research Institute on Climate Change and the Environment's Disaster Risk Transfer Scheme Database (2012–2018, henceforth "database") to describe the landscape of insurance for natural disasters and perils throughout Asia. This data has been developed over many years, with the original version compiled for ClimateWise (2012), and an update for the United Kingdom's Department for International Development in 2016 (Vivid Economics, Surminski Consulting, and Callund Consulting 2016). In this paper, market-based insurance has been defined to distinguish insurance markets from social-safety-net-type measures such as social insurance, which includes, for example, social protection from unemployment and disability. Each scheme in the database is defined by two key properties: (i) the transfer of risk away from entities in low- or middle-income countries, and (ii) the use of one or more ex ante market-based risk transfer instruments.

B. Transfer of Risk

The first dimension of our definition of a scheme pertains to the transfer of risk. The type of risks we focus on are those related to weather, climate, and other natural hazards. These include: droughts, floods, hail, storms, frost, disease, fire, landslides, tsunamis, earthquakes, typhoons, and pest infestations. To limit the scope of research and maintain focus on natural disasters, we do not include insurance for secondary harms that might follow, such as life insurance, health insurance, and income protection, etc.

The entities that each scheme is concerned with (beneficiaries; those who are covered through a scheme) vary, but are largely captured by three groups:

- Groups of individuals / households / smallholder farmers
- Public and private organizations (e.g., businesses, microfinance institutes, nongovernment organizations, public authorities)
- Governments (national, provincial, or local)

Many governments are buying some form of insurance for their own properties, for example public assets against fire; in some cases, this also includes a degree of protection against natural disasters and climate risks. The database is unlikely to capture these, unless the cover is part of a dedicated sovereign risk scheme. Information about any public assets insured is often very difficult to obtain unless a full country case study is conducted—for example as part of the scoping work of the Asian Development Bank (ADB) for city-level insurance schemes in the Philippines and Viet Nam (ADB 2015, 2018). Even within countries, there tends to be no clear overview of which government assets may be protected and to what standard. This is a clear limitation and an area that will require further work to improve understanding of risk transfer and exposure and to avoid possible duplication of coverage.

C. Ex ante Market-Based Risk Transfer Instruments

The second dimension of our definition of a "scheme" (or a single entry in the database) pertains to the use of an ex ante market-based risk transfer instrument. Ex ante refers to the fact that risk is transferred before a hazardous event occurs. "Market-based insurance" in this paper implies a market

for disaster and climate risk insurance, where insurance can be purchased by those seeking protection. This does not necessarily have to be a purely private market—indeed most schemes captured in the database show government involvement—and it also does not imply a voluntary purchasing decision or a market-based pricing approach.[2] For more discussion of how the collection of schemes in the database was compiled (see Data Appendix).

D. Scheme Types and Sectors

While the full list of definitions and data can be seen from the Grantham Research Institute's database, Table 2 gives an overview of some top-level categorizations used in the data.

Table 2: Top Level Categorization of Different Insurance Scheme Types and Sectors

Scheme Type	
Sovereign risk transfer	Schemes that aim to increase the financial response capacity of governments in the aftermath of natural disasters, while protecting their long-term fiscal balances through the use of risk transfer instruments, including insurance
SME and/or private property risk transfer	Schemes aimed at increasing property catastrophe insurance penetration among homeowners, small and medium-sized enterprises, and public entities
Meso-level risk transfer	Schemes that provide cover for "risk aggregators" such as banks, microfinance institutions, agribusinesses, or municipal-level actors (e.g., water authorities)
Microinsurance	Schemes that facilitate access to disaster insurance products for individuals, often aimed to protect the livelihoods of the poor against extreme events
Scheme Sector	
Agricultural	Schemes aimed at farmers, herders, and agricultural financing institutions (e.g., rural banks, microfinance institutions) to increase their financial resilience to adverse natural hazards through insurance
Nonagricultural	Insurance not directly linked to agriculture

SME = small and medium-sized enterprise.
Note: Refer to the definitions in section III.B for further information on micro, SME, meso, and sovereign schemes.
Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

Schemes can also be subclassified as "index based" or "indemnity based," according to the type of insurance instrument used. Index-based insurance involves parametric insurance that covers the probability of a predefined event happening instead of indemnifying actual loss incurred. In the case of indemnity-based insurance, the payout is triggered by actual loss or damage to a physical asset such as crops. For example, consider a specific crop exposed to a risk, for example, drought. Suppose a farmer owns this crop and takes out crop insurance against drought. Indemnity covers the damage

[2] We restrict our attention to "market-based" schemes to ensure consistency and comparability. Many "nonmarket" approaches to risk transfer also exist, such as informal lending networks, precautionary savings, semiliquid buffer capital stocks. These are notoriously difficult to gather data on and are not considered in our analysis.

incurred by the insured party as established by a loss adjuster as soon as the damage occurs. On the other hand, in the case of index insurance, policy holders get a payout based on a predetermined indicator (e.g., the amount of rainfall) which triggers a payment to all insured clients once the indicator crosses the predetermined threshold.

E. Limitations of the Database

The database pools information on as many disaster insurance schemes in developing and emerging countries across Asia as possible. It offers a comprehensive but not complete picture, due to some data limitations relating to available information in English versus other languages and a lack of data about the scale of the scheme. There are also higher chances that the collected information for the database is biased toward available sources from public schemes, since for purely private schemes information may not be available publicly (see Data Appendix D for details).

IV. CURRENT LANDSCAPE OF INSURANCE FOR DISASTER AND CLIMATE RISKS IN ASIA

A. Overview

Asia and the Pacific region comprise 45 developing economies and three developed economies (ADB 2018). Since the 1980s, these economies across Asia have become hotspots of economic growth and lead the charge in reducing global poverty. However, these economies face high exposure to disaster and climate risks, making them vulnerable to the ongoing impact of global climate change. Recently, the United Nations Economic and Social Commission for Asia and the Pacific (2018) stressed that only about 8% of catastrophe losses in Asia and the Pacific are insured, despite the region having suffered almost $1.3 trillion in losses over the last 50 years. In the latest revision of the database, we identified a total of 53 schemes that aimed at providing disaster or climate risk insurance to developing economies in Asia.

B. Comparing Past and Present Landscape of Risk Transfer Schemes in Asia

Comparing the 2018 database to the data collected in 2012, we observe an overall increase in schemes operating across Asia.

In 2012, there were 35 schemes actively transferring risk, compared to 53 operating today. Table 3 breaks this down by region, showing the expansion in the number of schemes, which also appears to correlate with increasing levels of penetration and coverage (Microinsurance Network 2018).[3]

Looking across economies, we see from Table 4 that the majority of new schemes come from expansion at the extensive margin (where economies with zero schemes in 2012 now have one or two schemes in operation). The biggest expansions along the intensive margin have occurred in the PRC, the Philippines, and Bangladesh. None of the economies have seen a reduction in the number of risk transfer schemes in operation.

[3] Recall that "schemes" do not accurately reflect coverage or penetration, since they include both very small and very large entries. In this case, we anecdotally observe that coverage has also increased substantially between 2012 and 2018, but our data does not allow for this comparison.

Table 3: Comparison of Number of Active Risk Transfer Schemes by Region, 2012–2018

Asian Region	2012	2018
Central	0	1
East	7	8
Pacific	0	2
South	20	24
Southeast	8	18

Note: See Table 6 for the breakdown of each country by region.
Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

Table 4: Comparison of Number of Active Risk Transfer Schemes by Economy, 2012–2018

Economy	2012	2018
Bangladesh	2	5
Cambodia, Lao People's Democratic Republic, and Myanmar	0	1
Cambodia and Myanmar	0	1
China, People's Republic of	5	6
Cook Islands, Marshall Islands, Samoa, Tonga, and Vanuatu	0	1
Fiji	0	1
India	14	15
Indonesia	2	4
Kazakhstan	0	1
Mongolia	1	1
Myanmar	0	2
Nepal	2	3
Philippines	3	7
Sri Lanka	0	1
Taipei,China	1	1
Thailand	1	1
Viet Nam	2	2

Note: Economies are in alphabetical order and are grouped according to their participation in the same scheme. Some economies appear twice because they might belong to two or more different schemes, for example, Myanmar.
Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

In the next section, we leave behind the 2012 data and focus on deconstructing the information from the 2018 database, exploring different aspects of the landscape of risk transfer schemes across low- and middle-income countries in Asia.

C. Risk Transfer Schemes Operating across Asia

Looking at all the disaster risk transfer schemes from the database provides a snapshot of how the region is currently using insurance for addressing natural hazards. This section further unpacks different features of the schemes in operation and offers insights about the types of ex ante market-based risk transfer instruments operating to transfer these risks.

Table 5 describes the current landscape of insurance schemes operating (or soon to be operational) across developing Asian economies. We see that the majority of schemes (71%) deliver microinsurance. The prevalence of these schemes is unsurprising, since they are small (as few as 400 policies, as in a pilot program for rice paddy farmers in Myanmar), and are also easily linked to existing microfinance schemes. Microinsurance schemes across Asia typically operate at the local or state level or apply to a small subgroup (e.g., PepsiCo's index weather insurance scheme for potato farmers in India). We also see that 14% of all schemes in operation are larger sovereign risk schemes. These schemes range from single country (e.g., earthquake insurance bonds held by the government of the PRC) to regional (e.g., the Pacific Catastrophe Risk Assessment and Financing Initiative, which pools together sovereign disaster risks across 15 Pacific nations). A small number (5%) of schemes operate to cover risks to private property held by small and medium-sized enterprises. Finally, 10% of schemes insure institutions at the meso level (e.g., VisionFund's scheme insures microfinance institutes across Cambodia and Myanmar).

Table 5: Number of Disaster Insurance Schemes in Asia by Region and Type, 2018

Asian Region	Micro	SME	Meso	Sovereign
Central	1	–	–	–
East	5	2	2	2
Pacific	1	–	–	1
South	22	–	1	2
Southeast	13	1	3	3
Total	42	3	6	8
%	71	5	10	14

meso = scheme that provides cover for "risk aggregators" such as banks, microfinance institutions, agribusinesses, or municipal-level actors (e.g., water authorities); micro = microenterprise; SME = small and medium-sized enterprise.
Notes: Six schemes span two insurance types and were thus "double counted" (e.g., microinsurance and meso insurance for farmers and microfinance institutions). See Table 6 for the breakdown of each country by region.
Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

Drilling down to the economy level, Table 6 further illuminates how the types of insurance schemes vary across specific economies.

Table 6: Number of Disaster Insurance Schemes in Asia by Economy and Type

Economy	Micro	SME	Meso	Sovereign
Central:	1	–	–	–
Kazakhstan	1	–	–	–
East:	5	2	2	2
China, People's Republic of	4	2	1	1
Mongolia	1	–	1	–
Taipei,China	–	–	–	1
Pacific:	1	–	–	1
Cook Islands, Marshall Islands, Samoa, Tonga, and Vanuatu	–	–	–	1
Fiji	1	–	–	–
South:	22	–	1	2
Bangladesh	5	–	1	–
India	13	–	–	2
Nepal	3	–	–	–
Sri Lanka	1	–	–	–
Southeast:	13	1	3	3
Cambodia, Lao People's Democratic Republic, and Myanmar	–	–	–	1
Cambodia and Myanmar	–	–	1	–
Indonesia	2	1	1	1
Myanmar	2	–	–	–
Philippines	6	–	1	1
Thailand	1	–	–	–
Viet Nam	2	–	–	–
Grand Total	**42**	**3**	**6**	**8**

meso = scheme that provides cover for "risk aggregators" such as banks, microfinance institutions, agribusinesses, or municipal-level actors (e.g., water authorities); micro = microenterprise; SME = small and medium-sized enterprise.
Note: Table shows the number of schemes and illustrates regional spread. Economies are grouped according to region; some economies have been grouped together and some economies reappear at different groupings as they participate in different schemes at the same time.
Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

Table 6 shows that the database is weighted toward India, the Philippines, and the PRC as the top three countries in terms of number of disaster insurance schemes. These three countries represent the most mature markets (excluding developed countries) for disaster risk insurance across Asia. The PRC's agricultural insurance market is the second largest globally (Aon Benfield 2016) after the United States. In India, a long history of heavily subsidized agricultural insurance programs has led to high levels of uptake among smallholder farmers throughout most regions and across most crop types (e.g., The Modified National Agricultural Insurance Scheme). A key driver of uptake for the Philippines

appears to be government mandate (such as compulsory multiperil crop insurance, MPCI). Along with subsidies, making MPCI compulsory (or bundling it with financial services) has helped develop the market over a relatively short period.

Table 7 shows that the majority of insurance contracts introduced as part of the schemes listed in the database have a slight bias toward multiperil coverage (60%) compared to the 40% of schemes that promote single-peril insurance contracts.

Table 7: Number of Single-Peril or Multiperil Schemes

	Count	%
Multi	31	60
Single	21	40

Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Grantham Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

We see from Table 8 that the losses covered by the majority of schemes in our database are agricultural losses (62%). This is as expected, since our focus is on the risks from climate, weather, and other natural hazards, which are heavily linked to agricultural losses. Further, discussion of risk transfer schemes in the agriculture sector is given in section IV.F.

Table 8: Number of Schemes that Covers Agricultural Losses Explicitly

	Count	%
Agricultural	32	62
Nonagricultural	18	35
Both	2	4

Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Grantham Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

D. Delivery of Disaster Risk Transfer Schemes

As has been discussed in section II, disaster risk transfer through the use of market-based instruments remains heavily underdeveloped, suggesting that certain roadblocks (e.g., low-income levels, weak institutional framework, and a lack of transparency or trust) still must be overcome. This section focuses on information available from the database that sheds light on how existing schemes have been able to deliver, support, and incentivize the uptake of risk transfer across low- and middle-income countries in Asia.

The ability to provide access to risk transfer instruments and ensure reach and delivery to those at risk is an important ingredient. Table 9 shows the breakdown of "final delivery channels,"

defined as beneficiary-facing entities. We see that more than half of schemes in the database offer risk transfer through private final delivery channels. These include insurance and credit retail outlets, as well as larger private or state-owned private entities.

Table 9: Final Delivery Channel by Type

	%
International public entity	11
National public entity	30
NGO	5
Private (including SOE)	54
	100

NGO = nongovernment organization, SOE = state-owned enterprise.
Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Grantham Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

E. Incentives for Disaster Risk Transfer Schemes

The database provides some information about strategies to increase uptake of market-based risk transfer instruments. Two approaches were widely used to incentivize uptake: (i) premium subsidies (to reduce or eliminate the out-of-pocket cost for beneficiaries) and (ii) compulsory acquisition and/or bundling (i.e., making the product compulsory for a group of individuals, or a compulsory add-on to other products like access to finance).

(1) Premium Subsidies and Financial Support

Table 10 shows that, of the schemes listed in the database, 57% had some kind of partial subsidy to bolster demand. A further 13% of schemes offered a full subsidy (making the product free of charge to those covered).

Table 10: Number of Schemes with Financial Support

	Count	%
None	16	30
Premium subsidy - partial	30	57
Premium subsidy - full	7	13

Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Grantham Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

Table 11 shows how subsidies were used by the type of insurance provided. For example, it shows that only around one-third (31%) of microinsurance schemes listed had no subsidy on offer. Importantly, climate risk insurance can be expensive and have high transactions costs, often making subsidies essential for uptake.

Table 11: Schemes with Financial Support by Scheme Type

	Micro	SME	Meso	Sovereign
None / no info	13	1	2	2
	31%	33%	33%	29%
Premium subsidy - partial	24	2	2	5
	57%	67%	33%	71%
Premium subsidy - full	5	–	2	1
	12%	–	33%	14%

meso = scheme that provides cover for "risk aggregators" such as banks, microfinance institutions, agribusinesses, or municipal-level actors (e.g., water authorities); micro = microenterprise; SME = small and medium-sized enterprise.
Notes: Six schemes span two insurance types and were thus "double counted" (e.g., one scheme might be classified as "micro" and "meso") thus, horizontal summation may appear different to "total" in Table 10.
Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Grantham Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

The choice of support measures for insurance can have implications for uptake, operations, and behavioral influence (Vivid Economics, Surminski Consulting, and Callund Consulting 2016). One example that has been investigated in greater detail is the Pacific Catastrophe Risk Insurance Pilot (PCRIP). Introduced in 2013, PCRIP was designed to increase the financial resilience of Pacific Island countries (PICs) against natural disasters by improving their capacity to meet postdisaster funding needs. Initial assessment indicated that countries in this region unanimously wished to purchase catastrophe insurance but would have been unable to afford it without premium subsidies because a full premium would impose significant strain on their national budgets (Narube 2015b). The Government of Japan's grant helped finance a majority of the PCRIP premium payments, but participants contributed approximately 5% of the total premium cost in 2014 and 16% in 2015 (Global Facility for Disaster Reduction and Recovery 2015). The World Bank (2015) suggests that these contributions from the PICs through the PCRIP reflect demand for sovereign insurance in the region. But Narube (2015b) observed that it seemed as though the decision to join the PCRIP was influenced heavily by the availability of insurance at no or little cost. This observation was validated by the PICs when it was indicated that they would "seriously evaluate their ongoing participation if premium ceases to be subsidised." In the same consultation report, Narube also mentions that countries believed the operational cost of maintaining the PCRIP would be significant and participants believed they would be unable to pay it from their national budgets. The quest for a more permanent premium support mechanism led to the creation of the Pacific Resilience Program using International Development Association grants and credits worth $32.29 million (World Bank 2016c). The Pacific Resilience Program initiative allocated approximately $8 million for investments in risk reduction and early warning initiatives, and the remaining to "disaster risk financing" activities, which include premium support (World Bank 2016b).

(2) Compulsory Uptake and/or Bundling

Moving to the mechanism of compulsory uptake and/or bundling of insurance, Table 12 shows that a third of schemes used this to increase demand for insurance.

Table 12: Count of Schemes where Insurance was Compulsory or Bundled

	Count	%
Compulsory and/or credit linked	18	34
Noncompulsory	35	66

Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

Table 12 shows that the use of compulsory uptake and/or bundling is utilized across all insurance types, with roughly a third of schemes being compulsory. The major benefit of credit-linked insurance is the reduced possibility of default, which also improves the business case for providing credit to poorer, more vulnerable households. The literature also discusses other benefits and possible drawbacks, as well as challenges with credit linking, such as problems arising from basis risk for farmers for index insurance, liquidity problems for the farmers, and high cost to the insurer in administering the insurance (Meyer, Hazell, and Varangis 2017; Clarke and Dercon 2009; Farrin and Miranda 2015; Giné and Yang 2009).

In the Philippines, the three most prominent microinsurance schemes are all credit linked. The Philippine Crop Insurance Corporation offers a number of credit products with compulsory insurance, such as through the Area Based Yield Crop Insurance program covering 17 rice farming municipalities. This has allowed the government to leverage existing microcredit delivery infrastructure and allowed rapid expansion of microinsurance coverage.

F. Agricultural Insurance

Agriculture continues to be extremely important in many of the low- and middle-income countries in Asia and the Pacific region considered for this study. These countries range in size of GDP from $14 trillion for the PRC (International Monetary Fund 1980–2018) to $16.85 billion for the Lao People's Democratic Republic (Lao PDR) (World Bank 1960–2018). The share of agriculture in the GDP varies from 27% of total GDP in Nepal to only 3% of total GDP in the Lao PDR. According to the recent study by the Food and Agriculture Organization (FAO) (2016), developing countries' agriculture sectors absorb an average of 22% of the total damage and losses caused by natural hazards. Building disaster resilience of agriculture thus assumes significance beyond the economic impacts; it is also critical for improving livelihoods and reducing poverty in the region.

Looking specifically at developing countries, Table 13 identifies those schemes from the database directly involved in agriculture sector insurance. Results shows that South Asian, Southeast Asian, and Pacific countries have higher numbers of agricultural insurance schemes as compared to the East Asian economies. However, this does not provide insights into insurance coverage and penetration, which are very difficult to measure.

Table 13: Count of Agricultural Insurance Schemes in the Database

Asian Region	Count	%
Central	1	100
East	5	71
Pacific	0	0
South	15	63
Southeast	13	72
Grand Total	**31**	**58**

Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

The spread and penetration of the agricultural insurance market in Asia is still small compared to developed countries, and mostly dominated by high government intervention and subsidy programs. For example, in 2005 only 13.4% of global agricultural insurance premiums were from emerging markets, which had increased to 22% in 2011, driven largely by major growth in Brazil, the PRC, and India (Swiss Re 2013). The agricultural insurance market in developing countries and specifically in Asia and the Pacific region have grown rapidly over the last decade. The global agricultural insurance premium volume jumped from $8 billion in 2004 to $20 billion in 2007, and of the 80% of global premium volume covered by the survey, 91% came from crop insurance (Mahul and Stutley 2010).

In the context of agricultural insurance, the most common (74%) payout mechanism structure is index based (Table 14), with risk transfer based either on weather indices or other indices such as average area crop yield. This is a result of recent trends toward these parametric solutions, in response to well-known issues with indemnity insurance products (transaction costs, verifiability etc.) associated with developing country insurance markets. It is also the result of the advances in technology aiding the implementation of index-based insurance schemes (e.g., use of satellite data, advances in modeling methods, etc.).

Table 14: Count of Agricultural Insurance Scheme by Payout Mechanisms

	Count	%
Indemnity	8	24
Index	25	74
Both	1	3

Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

Asia has a long of history of introduction and growth of agricultural schemes. However, during the 1970s, many of the major public sector MPCI initiatives were introduced and piloted in Bangladesh, the PRC, India, the Philippines, and Thailand. However, these schemes did not achieve much coverage until the early years of the 21st century when the new schemes were introduced and revised, led by countries such as India and the PRC. Since then, there has been major expansion in public–private

partnerships for crop and livestock insurance in Asia. There also have been introductions of new products, such as weather-index-based insurance schemes in a few countries. The first micro level or individual farmer weather-index-based insurance program was launched in India in Andhra Pradesh in 2003 by ICICI Lombard Insurance Company in conjunction with Bhartiya Samruddhi Investments and Consulting Services (BASIX), a local microfinance institution, for small and marginal farmers growing castor and groundnuts. There is, however, a major gap in agricultural insurance provision in the mainly small island economies of the Pacific region (FAO 2011) and also there are many challenges for other countries. For example, FAO (2011) points out the many roadblocks to well-functioning agricultural insurance markets in developing countries. These include the following.

- Government endorsement has remained essential to scaling up agricultural insurance in developing countries.
- People's understandings of insurance and its products are substantially lower among farmers in developing countries.
- The insurance market is challenged by the existence of a large number of small and marginal farmers in Asian countries.
- Index insurance is still being implemented on a pilot basis in many countries of Asia, and the market is dominated by indemnity-based crop insurance.
- Domestic insurers have less access to reinsurance markets and lack the capacity to deal with systemic risks.

Table 15 summarizes some of the key properties of agriculture insurance usage across Asia.

Table 15: Overview of Agricultural Insurance Markets across Asia

Country	Income Grp (2018)	Crop Insurance	Voluntary/ Credit Linked	Subsidy	Index Based	Major Crops	First Scheme
Bangladesh	LMI	✓	Voluntary	✓	×	Rice	1977
Bhutan	LMI	×	NA	×	×	NA	NA
Cambodia	LMI	×	NA	✓	✓ (Pilot)	NA	2019
China, People's Republic of	UMI	✓	Voluntary	✓	✓	Crops and livestock	1982
India	LMI	✓	Credit linked	✓	✓	All major crops and livestock	1985
Indonesia	LMI	✓	Voluntary	✓	✓ (Pilot)	Rice	2011
Lao People's Democratic Republic	LMI	×	NA	✓	✓ (Pilot)	NA	NA
Malaysia	UMI	×	NA	×	×	NA	NA
Myanmar	LMI	×	NA	✓	✓ (Pilot)	NA	2018
Nepal	LI	✓	Voluntary	✓	×	NA	2013
Pakistan	LMI	✓	Credit linked	✓	×	Crops and livestock	2008
Philippines	LMI	✓	Credit linked	✓	✓ (Pilot)	Rice; corn; high-value commercial crops (HVCC); livestock; fishery	1980
Sri Lanka	LMI	✓	Voluntary	✓	✓	Rice, vegetables	1961
Thailand	UMI	✓	Voluntary	✓	✓ (Pilot)	Rice, cotton, maize, sorghum	1978
Viet Nam	LMI	✓	Voluntary	✓	×	All crops and livestock	1982

LMI = lower-middle income, NA = not applicable, UMI = upper-middle income, LI = lower income.
Note: Where multiple schemes operate in a single market, we provide the best reflection of that single market.
Source: Authors' own based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

This overview provides a snapshot of some of the key features of disaster and climate risk insurance schemes (and the markets they exist in). We have seen that there is still substantial room for market development and expansion across Asia. A mix of sovereign, meso, small and medium-sized enterprises, and microinsurance schemes operate currently to address a wide variety of risks (catastrophe, multiperil, and named peril). Finally, without subsidies and bundling and/or compulsion many markets are likely to collapse or, at the very least, would experience far lower penetration rates.

V. INSURANCE AND RESILIENCE

The previous section has described the current state of risk transfer schemes across Asia using the updated database. As their core function, all the schemes offer financial support to those who take out or receive the cover, either once they have experienced a loss or when a preset event is occurring, such as a lack of rainfall. Insurance can play a significant role in society's ability to recover from disasters through its risk transfer role by spreading and smoothing risks, providing faster and more efficient recovery, offering certainty about postdisaster support, helping to reduce immediate welfare losses and consumption reduction, and reducing the need for budgetary changes (see Hallegatte 2014, Clarke and Dercon 2009). If and how the schemes in the database fulfill this ambition is often less than clear; and insurers, governments, and the insured may have different views on this.

This section examines how the schemes in the database instruments can also influence risk reduction efforts, increase resilience, and support adaptation to climate change. Importantly, in times of changing climate, and rising exposure and vulnerability, it is essential to consider what role insurance schemes can play for climate risk management and adaptation efforts, at the very least to ensure that schemes can continue to be viable in the future. Many analysts have argued that insurance can play a role in ex ante risk reduction measures apart from its role in recovery and reconstruction (Schäfer, Warner, and Kreft 2018). However, such a notion has also been contested. In the context of the United Nations Framework Convention on Climate Change's Loss and Damage discourse, a recent study (Linnerooth-Bayer et al. 2019) argues that the preventive role of insurance through incentives is not well established and insurance might lead to disincentives through moral hazard. In an early investigation of the 2012 database, Surminski and Oramas-Dorta (2014) found very few schemes show any link between risk transfer and risk reduction in the case of flood insurance schemes, while the large majority appear not to formally or informally address risk reduction. Following the same methodology and looking at publicly available information, the analysis established three different degrees of linkages between risk transfer and risk reduction across schemes in Asia. These are

- **no association:** schemes where there is no documented link to any risk reduction measures;
- **indirect association:** where risk transfer is considered one element within an overall policy framework or strategy for disaster risk reduction or adaptation; and
- **direct association:** where a risk transfer scheme explicitly supports risk reduction efforts as part of its operation.

According to the 2012 database, just over one-third of schemes offered explicit support for risk reduction. In the current data, we see that this number has gone up to around two-thirds. This could be an indication of growing acceptance from those designing or operating the schemes of the need for more holistic measures—recognizing that insurance is no silver bullet in response to rising risk levels.

However, the database is limited in its ability to inform if and how risk transfer is changing risk behavior and influencing future risk creation. This remains difficult to judge. Table 16 attempts to capture the landscape of risk reduction activities as they relate directly to insurance schemes for disaster and climate risks.

While this overview provides some high-level pointers, further details on the nature of the risk reduction elements and how they are used can only be gained through detailed case study analysis. Measuring the impact of insurance, including on resilience and risk levels, remains difficult and no accepted methodology exists. One example of a detailed impact assessment study is the index-based livestock insurance scheme in Mongolia. The scheme provided subsidized insurance to Mongolian herders, up to 2016. Bertram-Huemmer and Kraehnert (2015) recorded increased survival rates for the herder's livestock as a result of index-based livestock insurance during 2009–2010.

The Munich Climate Insurance Initiative has proposed a different methodology for assessing the resilience impact of insurance, based on the resilience concept of Bahadur et al. (2015), which describes resilience as the ability to do the following:

- Anticipate: estimate weather event impacts and the measures and costs required to address them.
- Absorb: cope with the impacts of shocks and absorb the effects of the event.
- Adapt: adjust to potential damage, take advantage of opportunities or respond to consequences.
- Transform: alter the fundamental attributes of a system to improve resilience to weather events.

Table 16: Resilience and Disaster Risk Transfer Schemes

Country	Income (2018)	Risk Reduction/ Preparedness Activities	Risk Awareness Raising	Risk Management Capacity Building	Physical Risk Reduction
Afghanistan	LI	×	×	×	×
Bangladesh	LMI	✓	×	✓	×
Bhutan	LMI	×	×	×	×
Cambodia	LMI	×	×	×	×
China, People's Republic of	UMI	✓	×	✓	✓
India	LMI	✓	✓	✓	✓
Indonesia	LMI	✓	×	×	×
Lao People's Democratic Republic	LMI	×	×	×	×
Malaysia	UMI	×	×	✓	×
Myanmar	LMI	×	×	×	×
Nepal	LI	✓	×	✓	×
Pacific nations	LI/LMI	✓	×	✓	×
Pakistan	LMI	✓	✓	×	×
Philippines	LMI	✓	✓	✓	✓
Sri Lanka	LMI	✓	×	✓	×
Thailand	UMI	×	×	×	×
Viet Nam	LMI	✓	×	×	×

LI = lower income, LMI = lower-middle income, UMI = upper-middle income.
Note: Where possible, we relied on outcomes rather than stated intentions.
Source: Authors' own, using various case studies, author knowledge, and, where information was available based on data from Grantham Research Institute on Climate Change and the Environment. 2012–2018. Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

However, evidence for the impact of climate insurance on these elements is relatively sparse. A recent review by InsuResilience identified positive changes in some indicators of resilience as a result of climate insurance (Table 17).

Table 17: Evidence from Munich Climate Insurance Initiative's InsuResilience Review on Climate Insurance for the Poor

Resilience element	Indicators that show improvement in this element as a result of access to climate insurance
Anticipate	Promote risk assessment
Absorb	Improve financial liquidity after disaster, reduce distress asset sales, increase food security, enable rapid recovery
Adapt	Increase savings, increase investment in higher risk activities, increase productivity, improve conditions to take up credits, promote risk reduction behavior
Transform	Meeting the aforementioned attributes is a precondition for transformation, for example, establishing a culture of prevention

Source: Schaefer, Laura, and Eleanor Waters. 2016. *Climate Risk Insurance for the Poor & Vulnerable: How to Effectively Implement the Pro-poor Focus of InsuResilience*. Munich Climate Insurance Initiative: Bonn, Germany. http://www.climate-insurance.org/fileadmin/mcii/documents/MCII_2016_CRI_for_the_Poor_and_Vulnerable_full_study_lo-res.pdf.

To address this limitation in understanding how insurance can support the resilience and adaptation of its beneficaries, we are currently testing a new methodology with several insurance schemes, including agricultural insurance in India, as part of the Evaluating the Resilience Impacts of Climate Insurance Project. Using a set of survey questions, we are investigating subjective resilience among farmers in the disaster-prone Western Indian state of Maharashtra. Using an in-depth household-structured questionnaire, focus group discussions, and expert elicitation over a 2-year period, the study aims to measure and examine subjective resilience to disasters in the context of crop insurance. This work builds upon the expertise of existing resilience frameworks from FAO and Food Security Information Network groups (FAO 2014, 2015; Constas et al. 2014) and proposes the use of subjective resilience indicators to gain a better understanding of what role insurance can play for well-being in the face of shocks and stressors (Clare et al. 2017). Subjective indicators specifically consider how respondents view their own resilience and ask about their views on the impact that instruments such as insurance have on their life. This approach also investigates the complementarities and differences between the knowledge we gain through more commonly used objective, metrics such as calculating risk levels, compared to the knowledge gained through the use of subjective metrics. At the same time, this methodology can be used to create awareness and the understanding of resilience drivers among those involved in designing and implementing insurance schemes. The work in Maharashtra is based on close interactions across stakeholders, and initial findings from the survey are already being fed back to decision makers.

VI. DISCUSSION AND CONCLUSION

This paper provides a snapshot of the current use of insurance across emerging and developing countries in Asia. Our analysis shows that although the insurance sector is expanding, there are many countries that still have not started any kind of disaster or agricultural insurance schemes, such as Afghanistan, Bhutan, Cambodia, the Lao PDR, Malaysia, and Myanmar. In terms of the agricultural insurance market, the scenario has not changed much in the last decade. The agricultural insurance market is still largely dominated by the government-led subsidized crop insurance schemes. Further, many of the countries do not have any agricultural insurance schemes except pilot programs recently launched. Additionally, there appears to be lack of insurance for natural disasters such as landslides, volcanic eruptions, and earthquakes in many Asian countries. The database also reveals the importance of support mechanisms for insurance schemes.

One of the ambitions of the paper was to dig deeper into the question of market-based insurance and its link with resilience. At this point, the analysis is still limited, and the data and evidence about actual impact on the ground seem weak. One important consideration when comparing insurance schemes and considering resilience impacts are the aims and objectives of the different stakeholders involved. Under the overarching goals of reducing poverty and supporting sustainable development, there can be different nuances of what the specific objectives of insurance are. For example, the design and development of insurance schemes can be guided by different aims such as:[4]

- protecting the livelihoods of the poor through insurance solutions against income reduction and loss of assets due to climate and disaster risk;
- promoting insurance market development as an essential element of financial risk management within the private sector; and/or
- supporting reliant and fast relief through ex ante climate and disaster risk financing (faster disaster relief).

It is obvious that there can be trade-offs between these different success criteria. Importantly, the timing of expected impacts from support measures can also vary, for example, in the context of market development, solvency, and support for those most vulnerable. There are also some ethical questions that need to be considered; for example, there may be concerns about private insurance companies standing to gain by receiving aid money via public premium support (e.g., direct commercial gain and opportunities to open new businesses), requiring robust evidence, monitoring and evaluation (Vivid Economics, Surminski Consulting, and Callund Consulting 2016). It is therefore important to establish priorities and conduct transparent discussions among partners to clarify aim and objectives. This also needs to include an agreement on the necessary monitoring indicators for those designing and supporting insurance schemes prior to design and implementation of any support measures.

Add to this, the notion of using insurance to increase resilience. We note that terminologies appear to have shifted and that more schemes refer to "resilience" and risk reduction than in 2012. This is likely the result of the shifting international discourse, led by InsuResilience and donors publicly committing to risk reduction and adaptation. What this actually means for success criteria, design, and implementation remains less clear, but current work on methodologies and new surveys on resilience impact are expected to shed further light on this.

[4] See also Surminski and Vivid Economics 2018.

For those wishing to support insurance schemes, it would be important to consider if and how any support measures, such as premium subsidy or capacity building, can influence the role that insurance plays for resilience. One example would be investment in risk reduction as a way to keep insurance viable and affordable. This was investigated by Vivid Economics, Surminski Consulting, and Callund Consulting (2016) for the United Kingdom's Department for International Development and for KfW (Surminski and Vivid Economics 2018). The studies find that determining the right mix in line with local conditions, needs, and capacity is therefore an important consideration. This also relates to the sequencing of support measures, where several support measures with cobenefits beyond insurance, such as risk reduction, capacity building, and technical assistance may be chosen first, to pave the way for an eventual insurance purchase. Depending on the level of preparedness and capacity for risk transfer within a country, the intervention may start relatively broad, with measures to improve risk understanding and institutional development. These efforts can be beneficial far beyond risk transfer. Technical capacity building for risk financing is another step, after which the eventual design and implementation of a risk pool (or indeed other risk transfer or financing instruments) can follow, if deemed suitable and relevant for the country (Vivid Economics, Surminski Consulting, and Callund Consulting 2016).

On the flip side, there may be further unintended consequences that would not feature in any standard cost-effectiveness assessment. This can occur when support measures create the expectation that donor financing will take care of the problem, creating an overdependency. Another unforeseen consequence is, if support measures come with a range of instructions and conditions that lead governments to avoid ownership and buy-in, they may end up implementing projects, but not creating their own internal technical capacity to evaluate them nor critically reflect on whether or not the sovereign risk pool meets their needs and requirements. Furthermore, providing concessional insurance may have the perverse or unintended behavioral effect of inducing excessive risk-taking or less consideration of disaster risk when making development decisions. For example, infrastructure planning can generate a false sense of security and if this effect is strong, the cost effectiveness of an intervention may be sharply reduced. This could be averted by linking concessional insurance with risk mitigation measures, for example, through conditionality of cover. Some support measures are more prone to these distortions than others. Some may also negatively impact existing social safety net structures or crowd out other disaster risk management efforts. Using the database to assess the current application of insurance is a useful starting point for more in-depth assessment of the implementation and impacts of insurance. As highlighted above, much of this data is not available at a global level or in a standard format. Indeed, there is no common methodology for impact assessments and many schemes lack transparency about monitoring and evaluation. This is a key area that will require capacity building efforts and collaboration between donors—those who provide insurance schemes and other partners such as civil society—to ensure that the use of insurance can support climate adaptation and resilience, and to avoid costly maladaptation or unintended consequences.

DATA APPENDIX

A. Introduction

This document seeks to give the reader an insight into how the database was put together. The Grantham Risk Transfer Scheme Database documents existing schemes in middle- and low-income countries that seek to transfer risks associated with weather, climate, or other natural hazards.[5]

B. What Constitutes a "Scheme"?

Each entry in the database is called a "scheme." A scheme is defined by

- the transfer of risk away from entities in low- or middle-income countries, and
- the use of one or more ex ante market-based risk transfer instruments.

The most common types of "entities" are:

- groups of individuals and/or households and/or smallholder farmers;
- public and private organizations (e.g., businesses, microfinance institutes, nongovernment organizations, public authorities); and
- governments (national, provincial and/or local)

The entity from whom risk is transferred is called the beneficiary. This is usually, but not always, party to the transaction of a risk transfer instrument

By "*ex ante* risk transfer instrument," we mean that the risk is transferred before the occurrence of an event that might trigger a payout, such as an earthquake or heavy rainfall. By "*market-based* risk transfer instrument," we mean that the risk transfer instrument was priced, and that the risk was transferred through free, mutually agreeable exchange.[6]

Each scheme might cover a large or small number of beneficiaries. For example, a scheme might detail the provision of a pilot program to provide indemnity-based insurance to 200 cattle herders in Mongolia. Another scheme might detail the provision or multiperil index-based insurance that is sold to tens of thousands of crop farmers across India.

A large number of schemes in the database are also uniquely identified because of some form of central management, branding, or natural grouping. For example, in India, the government runs the "Modified National Agricultural Insurance Scheme." This program heavily subsidizes index-based insurance for smallholder crop farmers. Here, this enters the database as a single scheme that transfers risk from "small crop farmers," using a "multiperil, index-based insurance instrument." Another example might be the PRC's earthquake insurance program, which sells index-based insurance to "residential property owners."

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[5] Grantham Research Institute on Climate Change and the Environment. 2012–2018. Grantham Disaster Risk Transfer Scheme Database. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

[6] We restrict our attention to "market-based" schemes to ensure consistency and comparability. Many "nonmarket" approaches to risk transfer also exist—such as informal lending networks, precautionary savings, and semiliquid buffer capital stocks.

C. Purpose and History of the Database

The purpose of the database is to identify the features of each scheme and analyze these features both across time and space. The first edition of the database was published in 2012 under the name ClimateWise Compendium of Disaster Risk Transfer Initiatives in the Developing World. It is a "living document," and was revised in 2016 and 2018. Since its conception, the database has been heavily revised both in terms of its content and its structure.

Data sources consulted for the current version of the database are mainly secondary in nature, consisting of public sector and private sector reports and publications by international research organizations and partnerships.

Further information has been provided by primary sources including, ClimateWise insurers; dedicated scheme and/or insurer websites; risk transfer web portals; and websites of international organizations, development banks, national governments, research institutions, nongovernment organizations, microfinance institutions, agricultural banks, etc.

D. Sample Bias and Limitations

Despite the care taken, we would expect that our sample of schemes in the database to have certain bias. These were unavoidable given the scope of our project and the methods used to collect the data. We briefly list these here, as any research conclusions must first consider such bias:

(i) Our researchers looked only at information written in English.
(ii) We were collecting secondary sources primarily from web-based resources. As such, less developed countries in terms of their information and communication networks will be underrepresented.
(iii) The larger the scheme, the more likely it is that information pertaining to this scheme was available. All else equal, the likelihood that smaller schemes were overlooked is higher.
(iv) Some countries might have been overrepresented, such as India, which is large and has put much information on the Internet, in contrast to countries such as Myanmar.
(v) The database might have some public sector bias, as information on many of the privately operated insurance schemes might not have been available in the public domain as compared to government schemes.

REFERENCES

Alhassan, Abdul Latif, and Vera Fiador. 2014. "Insurance-Growth Nexus in Ghana: An Autoregressive Distributed Lag Bounds Cointegration Approach." *Review of Development Finance* 4 (2): 83–96. doi:doi.org/10.1016/j.rdf.2014.05.003.

Aon Benfield. 2016. Global Insurance Market Opportunities, Insurance Risk Study, 11th edition. http://thoughtleadership.aonbenfield.com/Documents/20160911-ab-analytics-gimo.pdf.

Asian Development Bank (ADB). 2015. *Strengthening City Disaster Risk Financing in Viet Nam*. Manila. https://think-asia.org/handle/11540/5275.

———. 2018. *Philippine City Disaster Insurance Pool: Rationale and Design*. Manila. https://www.adb.org/publications/philippine-city-disaster-insurance-pool.

Bahadur, Aditya V., Maggie Ibrahim, and Thomas Tanner. 2010. *The Resilience Renaissance? Unpacking of Resilience for Tackling Climate Change and Disasters*. Sussex: Institute of Development Studies. https://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/2368/The%20resilience%20renaissance.pdf?sequence=1&isAllowed=y.

Bahadur, Aditya, Katie Peters, Emily Wilkinson, Florence Pichon, Kirsty Gray, and Thomas Tanner. 2015. "The 3As: Tracking Resilience across BRACED." BRACED Working Paper. London: Overseas Development Institute.

Beck, Thorsten, and Ian Webb. 2003. "Economic, Demographic, and Institutional Determinants of Life Insurance Consumption across Countries." *World Bank Economic Review* 17 (1): 51–87. doi:10.1093/wber/lhg011.

Béné, Christophe, Rachel Godfrey Wood, Andrew Newsham, and Mark Davies. 2012. "Resilience: New Utopia or New Tyranny? Reflection about the Potentials and Limits of the Concept of Resilience in Relation to Vulnerability Reduction Programmes." Institute of Development Studies Working Papers Volume 2012, Number 405, 1–61. Sussex: Institute of Development Studies. doi:10.1111/j.2040-0209.2012.00405.x.

Bertram-Huemmer, Veronika, and Kati Kraehnert. 2015. "Does Index Insurance Help Households Recover from Disaster? Evidence from IBLI Mongolia." Discussion Paper No. 1515. Berlin: German Institute for Economic Research, DIW. https://ideas.repec.org/p/diw/diwwpp/dp1515.html.

Breckner, Miriam, Florian Englmaier, Till Stowasser, and Uwe Sunde. 2016. "Resilience to Natural Disasters—Insurance Penetration, Institutions, and Disaster Types." *Economics Letters* 148: 106–10.

Clare, Abbie, Rebecca Graber, Lindsey Jones, and Declan Conway. 2017. "Subjective Measures of Climate Resilience: What is the Added Value for Policy and Programming?" *Global Environmental Change* 46: 17–22.

Clarke, Daniel, and Stefan Dercon. 2009. "Insurance, Credit, and Safety Nets for the Poor in a World of Risk." United Nations Department of Economic and Social Affairs Working Paper No. 81.

Clarke, Daniel, Olivier Mahul, Richard Poulter, Tse Ling Teh. 2016. "Evaluating Sovereign Disaster Risk Finance Strategies: A Framework." World Bank Policy Research Working Paper No. 7721. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/430111468184437717/pdf/WPS7721.pdf.

ClimateWise. 2012. Compendium of Disaster Risk Transfer Initiatives in the Developing World. Cambridge: Cambridge Institute for Sustainability Leadership. https://www.cisl.cam.ac.uk/business-action/sustainable-finance/climatewise/pdfs/climatewise-compendium-of-disaster-risk-transfer.xlsm/view.

Constas, Mark A., Timothy R. Frankenberger, John Hoddinott, Nancy Mock, Donato Romano, Chris Bene, and Dan Maxwell. 2014. "A Common Analytical Model for Resilience Measurement: Causal Framework and Methodological Options." *Food Security Information Network Technical Series No. 2*. Food Security Information Network published by Rome: Food and Agriculture Organization, Rome: World Food Programme, and Washington DC: International Food Policy Research Institute. https://www.fsnnetwork.org/common-analytical-model-resilience-measurement-causal-framework-and-methodological-options.

Dash, Saurav, Rudra P. Pradhan, Rana P. Maradana, Kunal Gaurav, Danish B. Zaki, and Manju Jayakumar. 2018. "Insurance Market Penetration and Economic Growth in Eurozone Countries: Time Series Evidence on Causality." *Future Business Journal* 4 (1): 50–67.

Di Falco, Salvatore, Felice Adinolfi, Martina Bozzola, and Fabian Capitanio. 2014. "Crop Insurance as a Strategy for Adapting to Climate Change." *Journal of Agricultural Economics* 65 (2): 485–504. doi:10.1111/1477-9552.12053.

Esho, Neil, Anatoly Kirievsky, Damian Ward, and Ralf Zurbruegg. 2004. "Law and the Determinants of Property-Casualty Insurance." *Journal of Risk and Insurance* 71 (2): 265–83. doi:10.1111/j.0022-4367.2004.00089.x.

Farrin, Kathleen, and Mario J. Miranda. 2015. "A Heterogeneous Agent Model of Credit-Linked Index Insurance and Farm Technology Adoption." *Journal of Development Economics* 116: 199–211.

Food and Agriculture Organization of the United Nations (FAO). 2011. "Agricultural Insurance in the Asia Pacific Region, Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific Bangkok, 2011." Rome. http://www.fao.org/3/i2344e/i2344e00.pdf.

———. 2014. "Resilience Index Measurement and Analysis Model." Rome.

———. 2015. "SHARP: A Participatory Tool to Assess Climate Resilience." Rome.

———. 2016. *The Impact of Disasters on Agriculture and Food Security*. Rome. http://www.fao.org/3/a-i5128e.pdf.

Ghesquiere, Francis, and Mahul Olivier. 2010. "Financial Protection of the State against Natural Disasters: A Primer." World Bank Policy Research Working Paper No. WPS 5429. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/227011468175734792/Financial-protection-of-the-state-against-natural-disasters-a-primer.

Ghosh, Amlan. 2013. "Does Life Insurance Activity Promote Economic Development in India: An Empirical Analysis." *Journal of Asia Business Studies* 7 (1): 31–43. doi:10.1108/15587891311301007.

Giné, Xavier, and Dean Yang. 2009. "Insurance, credit, and technology adoption: Field experimental evidence from Malawi." *Journal of Development Economics* 89 (1): 1–11.

Global Facility for Disaster Reduction and Recovery. 2015. *Pacific Catastrophe Risk Insurance Pilot: From Design to Implementation: Some Lessons Learned.* Washington DC: International Bank for Reconstruction and Development, International Development Association or The World Bank. https://www.gfdrr.org/sites/default/files/publication/Pacific_Catastrophe_Risk_Insurance-Pilot_Report_140715(1).pdf.

Golnaraghi Maryam, Swenja Surminski, and Kai-Uwe Schanz. 2016. *An Integrated Approach to Managing Extreme Events and Climate Risks: Towards a Concerted Public–Private Approach.* Zurich: The Geneva Association. https://www.genevaassociation.org/sites/default/files/research-topics-document-type/pdf_public/20160908_ecoben20_final.pdf. Grantham Research Institute on Climate Change and the Environment. 2012–2018. Disaster Risk Transfer Scheme Database. Grantham Research Institute on Climate Change and the Environment. http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/ (accessed April 2019).

Hallegatte, Stephane. 2014. "Economic Resilience: Definition and Measurement." World Bank Policy Research Working Paper No. 6852. Washington, DC: World Bank. https://openknowledge.worldbank.org/ handle/10986/18341.

Hess, Ulrich, and Peter Hazell. 2016. *Innovations and Emerging Trends in Agricultural Insurance. How Can We Transfer Natural Risks Out of Rural Livelihoods to Empower and Protect People?* Eschborn, Germany: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

Hussels, Stephanie, Damian Ward, and Ralf Zurbruegg. 2005. "Stimulating the Demand for Insurance." *Risk Management and Insurance Review* 8 (2): 257–78.

InsuResilience. 2017. https://www.insuresilience.org/about/.

Intergovernmental Panel on Climate Change. 2012. "Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation." In *A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change,* 555–564, 582, edited by C.B. Field, V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley. Cambridge, UK, and New York, USA: Cambridge University Press.

———. 2014. "Summary for Policymakers." In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,* 1–32, edited by C.B. Field, V.R. Barros, Dokken D, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White. Cambridge, UK, and New York, USA: Cambridge University Press.

International Monetary Fund. 1980–2018. Data Mapper. https://www.imf.org/external/datamapper/NGDPD@WEO/OEMDC/ADVEC/WEOWORLD.

Linnerooth-Bayer JoAnne, Swenja Surminski, Laurens M. Bouwer, Ilan Noy, and Reinhard Mechler. 2019. "Insurance as a Response to Loss and Damage?" In *Loss and Damage from Climate Change. Climate Risk Management, Policy and Governance,* edited by R. Mechler, L.M. Bouwer, T. Schinko, S. Surminski, and J. Linnerooth-Bayer. Cham, Switzerland: Springer.

Lloyds of London. 2018. *A World at Risk: Closing the Insurance Gap*. https://www.lloyds.com/news-and-risk-insight/risk-reports/library/understanding-risk/a-world-at-risk.

Mahul, Olivier, and Charles J. Stutley. 2010. *Government Support to Agricultural Insurance: Challenges and Options for Developing Countries*. Washington DC: The World Bank. https://openknowledge.worldbank.org/handle/10986/2432.

Mechler, Reinhard, Laurens M. Bouwer, JoAnne Linnerooth-Bayer, Stefan Hochrainer-Stigler, Jeroen C. J. H. Aerts, Swenja Surminski, and Keith Williges. 2014. "Managing Unnatural Disaster Risk from Climate Extremes." *Nature Climate Change* 4: 235–37. doi:10.1038/nclimate2137.

Meyer, Richard L., Peter B. Hazell, and Panos Varangis. 2017. *Unlocking Smallholder Credit: Does Credit-Linked Agricultural Insurance Work?* Washington, DC: World Bank. http://documents.worldbank.org/curated/en/515371511848930976/Unlocking-Smallholder-Credit-Does-Credit-Linked-Agricultural-Insurance-Work.

Microinsurance Network. 2018. The World Map of Microinsurance Network. http://worldmapofmicroinsurance.org/.

Narube, Savenaca. 2015a. *Pacific Disaster Risk Financing and Insurance Program. Pacific Catastrophe Risk Insurance Pilot (PCRIP) Country Consultation Report.* Secretariat of the Pacific Community: New Caledonia.

———. 2015b. *Pacific Catastrophe Risk Insurance Pilot (PCRIP): Establishment of a Management Entity, Secretariat of the Pacific Community*.

O'Hare, Paul, Iain White, and Angela Connelly. 2016. "Insurance as Maladaptation: Resilience and the 'Business as Usual' Paradox." *Environment and Planning C-Government and Policy* 34 (6): 1175–93. doi:10.1177/0263774x15602022.

Panda, Architesh, Upasna Sharma, K.N. Ninan, and Anthony Patt. 2013. "Adaptive Capacity Contributing to Improved Agricultural Productivity at the Household Level: Empirical Findings Highlighting the Importance of Crop Insurance." *Global Environmental Change* 23 (4): 782–90.

Ranger, Nicholas, and Swenja Surminski. 2013. "A Preliminary Assessment of the Impact of Climate Change on Non-life Insurance Demand in the BRICS Economies." *International Journal of Disaster Risk Reduction* 3: 14–30. https://doi.org/10.1016/j.ijdrr.2012.11.004.

Schaefer, Laura, and Eleanor Waters. 2016. *Climate Risk Insurance for the Poor & Vulnerable: How to Effectively Implement the Pro-poor Focus of Insuresilience*. Bonn, Germany: Munich Climate Insurance Initiative. http://www.climate-insurance.org/fileadmin/mcii/documents/MCII_2016_CRI_for_the_Poor_and_Vulnerable_full_study_lo-res.pdf.

Schäfer, Laura, Koko Warner, and Sönke Kreft. 2018. "Exploring and Managing Adaptation Frontiers with Climate Risk Insurance." In *Loss and Damage from Climate Change. Concepts, Methods and Policy Options,* 317–341, edited by R. Mechler, L.M. Bouwer, T. Schinko, S. Surminski, J. Linnerooth-Bayer. Cham, Switzerland: Springer.

Schipper, Lisa, and Lara Langston. 2015. *A Comparative Overview of Resilience Measurement Frameworks: Analysing Indicators and Approaches*. London: Overseas Development Institute.

Surminski, Swenja. 2014. "The Role of Insurance in Reducing Direct Risk - The Case of Flood Insurance." *International Review of Environmental and Resource Economics* 7 (3–4): 241–78. http://doi:10.1561/101.00000062.

Surminski, Swenja, Laurens M. Bouwer, and JoAnne Linnerooth-Bayer. 2016. "How Insurance Can Support Climate Resilience." Nature Climate Change 6 (4): 332–33.

Surminski, Swenja, and Delioma Oramas-Dorta. 2014. "Flood Insurance Schemes and Climate Adaptation in Developing Countries." *International Journal of Disaster Risk Reduction* 7: 154–64. http://doi:10.1016/j.ijdrr.2013.10.005.

Surminski, Swenja, and Thomas Tanner, eds. 2016. *Realising the 'Triple Dividend of Resilience' A New Business Case for Disaster Risk Management.* Cham, Switzerland: Springer International Publishing.

Surminski, Swenja, and Vivid Economics. 2018. "Study on the Assessment of Tools to Support Climate and Disaster Risk Insurance." KfW Development Bank Materials on Development Finance No. 5. Frankfurt: KfW Development Bank.

Swiss Re. 2013. "Partnering for Food Security in the Emerging Markets." Sigma No. 1/2013. Zurich: Swiss Reinsurance Company.

Tanner, Thomas, Swenja Surminski, Emily Wilkinson, Robert Reid, Jun Rentschler, and Sumati Rajput. 2015. *The Triple Dividend of Resilience: Realising Development Goals through the Multiple Benefits of Disaster Risk Management.* London, UK: Overseas Development Institute and Washington, DC: International Bank for Reconstruction and Development/International Development Association or World Bank. https://www.gfdrr.org/sites/default/files/publication/The_Triple_Dividend_of_Resilience.pdf.

United Nations Economic and Social Commission for Asia and the Pacific. 2018. Opening Statement at Innovative Financing for Disaster Risk Reduction in Asia-Pacific, delivered at the Innovative Financing for Disaster Risk Reduction in Asia-Pacific, United Nations Headquarters, New York. https://www.unescap.org/speeches/opening-statement-innovative-financing-disaster-risk-reduction-asia-pacific.

Vivid Economics, Surminski Consulting, and Callund Consulting. 2016. "FINAL REPORT: Understanding the Role of Publicly Funded Premium Subsidies in Disaster Risk Insurance in Developing Countries." London: United Kingdom Department for International Development. https://www.gov.uk/dfid-research-outputs/final-report-understanding-the-role-of-publicly-funded-premium-subsidies-in-disaster-risk-insurance-in-developing-countries.

Weingärtner, Lena, Catherine Simonet, and Alice Caravani. 2017. "Disaster risk insurance and the triple dividend of resilience." Working paper 515. Overseas Development Institute: London.

World Bank. 1960–2018. GDP (Current US$). World Bank Data. Washington, DC. https://data.worldbank.org/indicator/ny.gdp.mktp.cd?end=2018&start=1960 (accessed April 2019).

———. 2015. "World Bank Group Offers Support to Aid Vanuatu's Recovery." Washington, DC: https://www.worldbank.org/en/news/press-release/2015/03/30/world-bank-group-offers-support-to-aid-vanuatu-recovery.

———. 2016a. *Fiscal Disaster Risk Assessment and Risk Financing Options* (English). Washington, DC.

———. 2016b. "Pacific Resilience Program" (P147839). Washington, DC.

———. 2016c. "Pacific Islands Prepare for a More Disaster Resilient Future." Washington, DC: https://www.worldbank.org/en/news/press-release/2015/06/19/pacific-islands-prepare-for-a-more-disaster-resilient-future.

Disaster Insurance in Developing Asia

An Analysis of Market-Based Schemes

Well-designed insurance schemes can play an important role in increasing resilience to climate and disaster risks. This paper analyzes the status, types, and evolution of market-based disaster insurance schemes across developing Asia. The analysis shows that although the use of insurance is expanding, many countries still have no cover available. Where insurance coverage does exist, there is often a reliance on premium subsidies and means to compel uptake, such as mandatory coverage and credit-linked products. The paper discusses how this "carrot or stick" approach affects the sustainability and penetration of climate and disaster risk insurance schemes and efforts to increase resilience.

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Annex 521

"Small States' Resilience to Natural Disasters And Climate Change—Role For The IMF", *International Monetary Fund*, December 2016

INTERNATIONAL MONETARY FUND

IMF POLICY PAPER

SMALL STATES' RESILIENCE TO NATURAL DISASTERS AND CLIMATE CHANGE—ROLE FOR THE IMF

December 2016

IMF staff regularly produces papers proposing new IMF policies, exploring options for reform, or reviewing existing IMF policies and operations. The following documents have been released and are included in this package:

- The **Staff Report**, prepared by IMF staff and completed on November 7, 2016 for the Executive Board's consideration on December 1, 2016.

The IMF's transparency policy allows for the deletion of market-sensitive information and premature disclosure of the authorities' policy intentions in published staff reports and other documents.

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International Monetary Fund
Washington, D.C.

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INTERNATIONAL MONETARY FUND

SMALL STATES' RESILIENCE TO NATURAL DISASTERS AND CLIMATE CHANGE—ROLE FOR THE IMF

November 4, 2016

EXECUTIVE SUMMARY

Small developing states are disproportionately vulnerable to natural disasters. On average, the annual cost of disasters for small states is nearly 2 percent of GDP—more than four times that for larger countries. This reflects a higher frequency of disasters, adjusted for land area, as well as greater vulnerability to severe disasters. About 9 percent of disasters in small states involve damage of more than 30 percent of GDP, compared to less than 1 percent for larger states. Greater exposure to disasters has important macroeconomic effects on small states, resulting in lower investment, lower GDP per capita, higher poverty, and a more volatile revenue base.

One-third of small developing states are also highly or extremely vulnerable to climate change in the lifetime of the current generation. Climate change is projected to affect small states disproportionately, partly by exacerbating natural disasters and partly through more gradual effects such as rising sea level. Small states will thus face much larger economic costs from climate change than larger peers. The impact on important economic sectors (agriculture, tourism, fishing) and pressures on ecosystems could exacerbate poverty and emigration.

Well-designed domestic policies can reduce the direct human and economic costs of climate change and natural disasters. A range of macroeconomic policy approaches will be needed—including not only better disaster response but much more focus on risk reduction and preparedness. These policies should be developed on a proactive basis (not only after disasters have hit), and integrated into core PFM, investment, and debt management frameworks. Risks to the financial sector should similarly be assessed and crisis management frameworks adopted. Risk reduction efforts will improve the business climate, encourage new investments, and help sustain stronger medium-term growth. Capacity building support from the Fund and other development partners will remain critical.

Financing is needed for risk reduction and response to natural disasters and climate change. Advance planning should provide for a combination of fiscal buffers, contingent financing plans, and risk transfer arrangements. Too often, however, disaster financing is largely identified "after the event". Partly as a result, larger disasters appear

to be under-financed for small states, despite their relatively small cost by global standards.

On climate change, financing has been oriented toward mitigating greenhouse gas emissions rather than helping small states adapt to global warming. While small states have begun to access global climate funds, their adjustment needs are under-funded by as much as $1 billion annually. Complex and administratively cumbersome procedures for establishing eligibility for climate change financing are hampering access by small states with weak capacity.

The Fund plays a niche-but-important role in meeting member's post-disaster financing needs. Small developing states are active users of the Fund's emergency financing facilities and instruments (RCF and RFI) which have been important sources of rapid liquid support. That said, small states benefitted much less than larger countries from the 2015-16 reforms to access under PRGT facilities and the RFI, and they find current access limits constraining in relation to their large balance of payments needs for the most severe disasters. To address this gap in the financial safety net, an increase in RCF and RFI access limits is proposed for members facing severe disasters. Small states should also be encouraged to consider more active use of Fund arrangements, including on a precautionary basis, as a vehicle for resilience-building policy reforms and associated capacity building support. Given the role for the Fund in helping countries to develop macro-critical policies for climate change mitigation and adaptation (carbon pricing and energy subsidies; fiscal, investment and debt management frameworks for climate-related spending, etc.), consideration could be given to tailored assessments of policies in these areas to help countries develop strong climate change policy frameworks and qualify for access to global climate funding.

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CONTENTS

Abbreviations and Acronyms

CAT bond	Catastrophe bond
CAT DDO	Catastrophe Deferred Drawdown Option
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CCR Trust	Catastrophe Containment and Relief Trust
CO_2	Carbon dioxide
COP	Conference of the Parties (of the UN Framework Convention on Climate Change)
DIG	Debt, Investment and Growth model
DSA	Debt Sustainability Analysis
EBF	Extra-Budgetary Fund
ECF	Extended Credit Facility
EM-DAT	Natural disasters database maintained by Université Catholique de Louvain
ENDA	Emergency Natural Disaster Assistance
FSAP	Financial Sector Assessment Program
GHG	Greenhouse gases
IPCC	Intergovernmental Panel on Climate Change
LAC	Latin America and Caribbean
LIDC	Low-income developing country
MENA	Middle Eastern and North African countries
PDNA	Post-Disaster Needs Assessment
PFM	Public Financial Management
PIMA	Public Investment Management Assessment
PPP	Public-private partnership
RCF	Rapid Credit Facility
RFI	Rapid Financing Instrument
SBA	Stand-By Arrangement
SCF	Stand-by Credit Facility
SEA	South East Asia
SIDS	Small Island Developing States
SLR	Sea-level rise
SSA	Sub-Saharan Africa

INTRODUCTION

1. **This paper explores the burden on small developing states as a result of natural disasters and climate change**.[1] Many small island states are highly vulnerable to storm damage and some face a perilous future as a result of sea level rise. To minimize the human and economic cost of disasters and climate change, a more proactive policy approach is needed, with a shift by both domestic policymakers and the global community toward advance planning rather than "after the event" disaster response. Small states should integrate risk reduction and disaster response programs into their core budget and debt management frameworks. To smooth the impact of shocks, they need access to external financing and risk transfer options. The paper builds on a range of earlier Fund work on the risks from climate change and natural disasters, including small states country reports and the cross-country analysis cited in Box 1.

Box 1. Definition and Vulnerabilities of Small States

The IMF membership includes 34 small developing states, comprising countries with a population below 1.5 million that are not advanced market economies (according to the World Economic Outlook's classification) or high-income oil exporting countries (following the World Bank's categorization).[2] About half of the group are lower or lower-middle income states. The vast majority of small states are defined as small island developing states (SIDS) by the UN, a group comprising 52 low-lying coastal countries sharing similar challenges to sustainable development, and many are members of the Alliance of Small Island States.[3]

"Smallness" reduces scope for economies of scale in production, distribution, and public administration, undermining competitiveness, hampering the delivery of public goods, and hindering diversification against external shocks. Where small states have not adopted strong and sustained policy responses, including structural reforms, these factors have contributed to weak growth, macroeconomic volatility, and, for some, higher debt levels since the 2000s. The challenges associated with diseconomies of scale were discussed in recent Board papers (IMF, 2013a, 2013b, 2013c, 2014b, and 2015c).

2. **Coverage of this paper**. The opening two sections review the impact on small developing states of natural disasters and climate change. These sections discuss the outlook for and impact of disasters and climate change, and the key transmission channels within the economy. The third section of the paper looks at how public policies can help build resilience to natural disasters and climate change. It looks at key elements of a holistic disaster management framework, and explores the implications for fiscal, financial, and external policies. This section emphasizes, in particular, the role of the Fund in advising on policy frameworks. A fourth section

[1] For simplicity, the group of small developing states (Box 1) is referred to as "small states" throughout the paper.

[2] The countries comprise: in the Caribbean, Antigua and Barbuda, the Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago; in Asia-Pacific, Bhutan, Fiji, Kiribati, Maldives, Marshall Islands, Micronesia, Nauru, Palau, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, and Vanuatu; and in other regions, Cabo Verde, Comoros, Djibouti, Mauritius, Montenegro, Sao Tomé and Principe, Seychelles, and Swaziland.

[3] The exceptions are Bhutan, Djibouti, Montenegro, and Swaziland.

examines approaches for financing natural disasters and climate change, outlining an optimal approach and explaining what factors lead practice to fall short. This section concludes with a detailed discussion of the different elements of the financing "toolkit" and explores how access to finance could be further strengthened. The paper concludes with a discussion of the particular role played by the Fund in financing natural disasters and supporting countries as they seek to access climate change financing.

3. **Fund engagement**. With progressive climate change, the economic challenges faced by small states are likely to rise, including as a result of more frequent and more damaging natural disasters. Given this, it will be important that the Fund respond to members' needs using all available instruments—economic analysis and policy advice, Fund financing, and capacity building. Moreover, policies for managing natural disasters and climate change should be integrated into the Fund's tool kit on a sustained basis, applied routinely, and updated as new policy challenges emerge. In these areas, the Fund also has an important role to play in facilitating the sharing of cross-country experience.

4. **Collaboration with other institutions will remain critical**. Where preparedness for natural disasters and climate change requires expertise on policies and institutional frameworks outside the competence of Fund staff, close collaboration with other institutions, such as the World Bank, will be needed.

IMPACT OF NATURAL DISASTERS

The cost of natural disasters for small developing states is more than four times that for larger countries, relative to the size of their economies. A key factor is the larger tail-risk of extremely damaging disasters for small states. Greater vulnerability to disasters is associated with lower investment, lower GDP per capita, higher poverty, and a more volatile revenue base.[4]

A. Impact and Frequency of Natural Disasters in Small States

5. **Small states are proportionately more vulnerable to natural disasters**. According to the most widely used database on natural disasters (EM-DAT, Box 2), the economic cost of the average natural disaster during 1950-2014 was equivalent to nearly 13 percent of GDP for small states compared to less than 1 percent of GDP for larger states (Table 1).[5] Similarly, the average natural disaster affects 10 percent of the population in small states, compared to 1 percent for other countries.[6]

[4] Drafted by Mai Farid and Sebastian Acevedo, based on a background study by a team also comprising Ricardo Marto, Dan Nyberg, and Vimal Thakoor, led by Prakash Loungani.

[5] Though, given the greater size of large states, the absolute magnitude of disaster damage averaged nearly $850 million, compared to under $90 million for small states.

[6] The comparator group covers all countries with population above 1.5 million, at all income levels.

Table 1. Average Effects of Disasters by Region and Income, 1950–2014

	Damages (US$) 1/		Damages / GDP (%)		Affected / Pop (%)	
	Non-SS	SS	Non-SS	SS	Non-SS	SS
Region						
Latin America & Caribbean	429	118	2.5	16.1	1.0	10.8
North America	1,978		0.1		0.0	
Europe & Central Asia	753		0.6		0.7	0.4
Middle East & North Africa	532	4	0.8	0.3	0.5	15.6
Sub-Saharan Africa	91	91	1.1	5.2	2.3	10.3
South Asia	591	148	0.6	13.9	1.0	3.4
East Asia & Pacific	871	45	0.3	11.9	0.7	9.0
Income						
Low income	318	16	2.9	6.3	1.9	5.6
Lower middle income	275	55	0.9	12.7	1.2	11.1
Upper middle income	762	112	0.4	18.3	0.8	10.3
High income: nonOECD	379	165	0.5	2.6	0.4	0.8
High income: OECD	1,541		0.1		0.2	
Total	**849**	**87**	**0.7**	**12.9**	**1.1**	**9.8**

Sources: EM-DAT; WEO; WDI; and IMF staff calculations.

1/ In 2010 constant US dollars.

6. **The greater vulnerability of small states applies to almost all categories of natural disaster**. Across a wide range of disasters (except extreme temperatures), an occurrence in a small state is proportionately more damaging than an equivalent event in a larger state, making the recovery in the aftermath of a disaster more challenging. For example, a disaster-level storm is 23 times more damaging than for large states, measured as a share of GDP (Table 2). This partly reflects the large number of small developing states that are islands, so that when a storm makes landfall it affects a larger proportion of the population. Greater damage may also reflect the more constrained fiscal space of small states which can preclude adequate advance investments in risk reduction.

Table 2. Average Effects of Disasters by Type, 1950–2014

	Damages (US$) 1/		Damages / GDP (%)		Affected / Pop (%)	
	Non-SS	SS	Non-SS	SS	Non-SS	SS
Drought	1,071	67	1.2	2.0	12.2	35.4
Earthquake	2,231	128	1.4	12.3	0.5	2.0
Extreme temperature	1,357	3	0.8	0.5	1.3	0.7
Flood	577	37	0.4	3.1	0.7	5.5
Storm	756	100	0.7	16.1	0.7	11.2
Volcanic activity	173		0.8		0.2	6.7
Wildfire	575	32	1.1	14.5	0.3	0.4
Other	178		0.8		0.1	1.0
Total	**849**	**87**	**0.7**	**12.9**	**1.1**	**9.8**

Sources: EM-DAT; WEO; WDI; and IMF staff calculations.

1/ In 2010 constant US dollars.

Box 2. Data on Natural Disasters

Coverage. The analysis in this section draws on the EM-DAT database, the most comprehensive global source on natural disasters and most widely used in the literature. The database covers 13,000 natural disasters for the period 1950-2014, with information on the date, location, and type of disaster, and their human and economic cost. It covers disasters that meet at least one of the following criteria: (i) 10 or more people reported killed; (ii) 100 or more people reported affected; (iii) a declaration of a state of emergency, or (iv) a call for international assistance.[1/] More detailed evaluations on the impact of selected disasters are also available through UNDP Post-Disaster Needs Assessments (PDNAs).

Limitations. A key challenge is how to measure the impact of natural disasters, which not only damage property but also lead to the loss of current and future incomes (some key concepts are outlined in the table below). The EM-DAT database, in principle, covers both property damage and income losses, but does not differentiate between the two. Moreover, while EM-DAT reports the human impact for about 90 percent of disasters, economic damage is reported for only 32 percent of disasters (36 percent for small states). Estimates for economic damage are more readily available for some types of disasters, such as storms, but rarely for epidemics.[2/] Also, in general, richer countries tend to have a better records of economic damages than low income countries, while the latter tend to have a better reporting of people affected or killed. Separate estimates of property damage and income losses are available through PDNAs, but for only a limited number of disasters.

Term	Definition	Example
Direct losses	Conventionally measured as property damage.	Houses, buildings, and structures damaged; crops or forests destroyed.
Damage (economic costs)	Includes property damage (above) plus incomes foregone as a result of the disaster.	Lower tourism receipts or disruptions to export shipments.
Non-market costs	These are costs that are not captured in the standard national income accounts.	Time spent by unremunerated family workers on rebuilding after a disaster impact.

[1/]EM-DAT is maintained by the Centre for Research on the Epidemiology of Disasters at the School of Public Health of the Université Catholique de Louvain, Belgium (see Guha-Sapir et al., 2015). Other data on natural disasters are available from the NATCAT service by Munich Re and through the World Bank's Pacific Risk Assessment and Financing Initiative (PCRAFI) and Caribbean Catastrophe Risk Insurance Facility (CCRIF).

[2/]The classification of natural disasters includes: geophysical (earthquake, mass movement, volcanic activity), metrological (extreme temperature, fog, and storms), hydrological (flood, landslide, wave action), climatological (drought, wildfire) and biological (epidemic, insect infestation).

7. **Disasters not only cost more in small states, but are also more frequent (adjusting for land area)** (Table 3).[7] Ranked by frequency of disasters in relation to land area, 21 of 33 small states are in the global top-50. Small states, as a consolidated group, experienced 460 disasters between 1950-2014, an average of 7 disasters within the group each year. By contrast, eight countries with roughly similar overall land area to the combined small states experienced only 66 disasters over the same period, or roughly one each year.[8] The higher frequency of disasters partly reflects the unfavorable location of many small island states in the cyclone and hurricane belts each side of the equator.

8. **Reflecting frequency and impact, the cost of disasters over time is higher for small states**. Over the last 25 years, the annual damage (including both disaster and non-disaster years) averaged 1.8 percent of GDP for small states compared to 0.4 percent of GDP for other countries (Table 3).[9] The cost estimate for small states may also be an underestimate. Adjusting for under-reporting, Acevedo (2016) suggest that damages for the Caribbean could be 1.6 to 3.6 times larger than reported in the EM-DAT database.

Table 3. Average Annual Effects of Disasters

	1950-2014		1990-2014	
	Small states	Other states	Small states	Other states
Damages (percent of GDP)	1.2	0.3	1.8	0.4
Damages (US$m)[1]	8.5	314.0	17.0	698.4
Affected population (percent of total)	1.5	0.9	2.0	1.4
Disaster frequency[2]	0.3	0.1	0.4	0.2

Sources: EM-DAT; WEO; WDI; IMF staff calculations.
1/ In 2010 constant US dollars.
2/ Average annual disasters per 1,000km^2.

[7] Without controlling for land area, the countries with more natural disasters tend to be the largest countries in the world (China, the US, Russia, India, etc.). However, the average land area of small states is 17,700 km^2 while the average non-small state is more than 35 times larger.

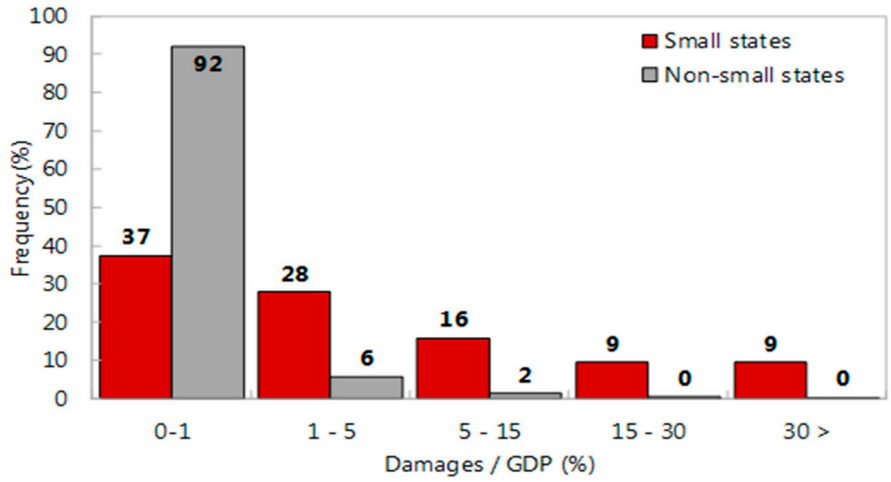
[8] Eight countries have a land area comparable (+/-10 percent) to the small states group: Botswana, Central African Republic, France, Kenya, Madagascar, Somalia, Ukraine, and Yemen.

[9] The choice of time period reflects the better reporting of disasters in small states since 1970. Data for the period 1950–2014 show a smaller annual average cost of 1.2 percent of GDP, which probably represents under-recording.

9. **Large disasters are a "fatter tail risk" for small states**. Given their much smaller economic base, disasters resulting in damages equivalent to large shares of GDP are much more common in small states. EM-DAT data suggest that about 9 percent of disasters impacting small states create damages equivalent to 30 percent or more of GDP, compared to less than 1 percent for larger states (Figure 1).

10. **The 2000s saw a record number of global disasters, as well as rising intensity**. Data show an increasing trend in the frequency of disasters (both globally and for small states) that partly reflects better reporting (Figure 2). EM-DAT started to systematically record disasters only in 1988; prior to that date, information was collected from historical sources such as newspapers and official reports. The earlier information may be less accurate and comprehensive, particularly for small- and medium-scale disasters.[10] Since the late-2000s, the frequency of disasters has declined throughout regions, income levels and disaster types, likely due to cyclical climatic factors. The trend in disaster frequency does not take into account the intensity of disasters, which is continuing to rise.[11]

Figure 1. Disaster Distribution for Small and Larger States



Sources: EM-DAT; WEO; WDI; and IMF staff calculations.

11. **Relative vulnerability across small states to natural disasters is summarized in Annex 1**. Over one-third of small states (13 countries) are assessed by staff to be at extreme risk of natural disasters, comprising five Pacific countries (Kiribati, Palau, Samoa, Tonga, Vanuatu), six

[10] Supportive evidence for under-reporting in the Caribbean is provided by Acevedo (2016). He contrasts firm evidence of higher tropical cyclone activity in the 1950s and 1960s than in the 1990s and early 2000s with lower reporting of storm disasters in EM-DAT for the earlier periods. This suggests that a significant portion of earlier cyclone disasters went unreported.

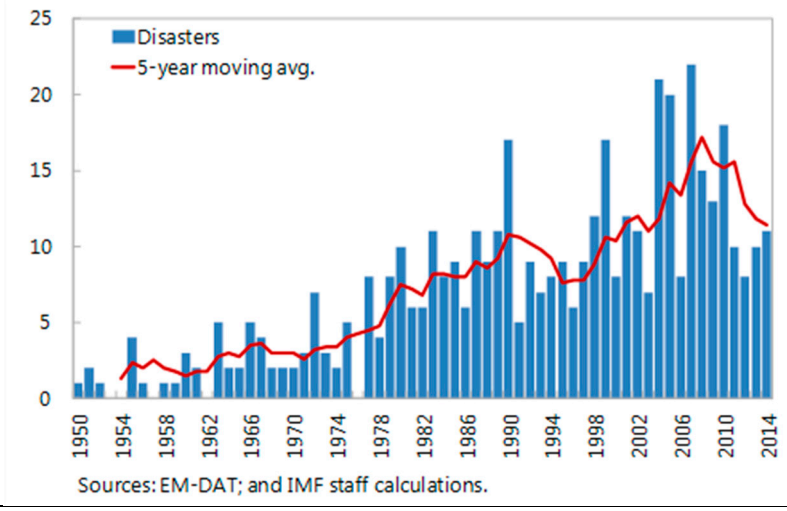
[11] At a global level, the average yearly number of extreme hurricanes and cyclones—defined as having a pressure of 900 mbar or lower—was 2.1 in the 1980s, 3.0 in the 1990s, 4.0 in the 2000s, and 4.3 for the years 2010-2015 (source: Wikipedia).

Caribbean countries (Antigua and Barbuda, Belize, Dominica, Grenada, St. Lucia, St. Vincent and the Grenadines) and two other small states (Comoros and Maldives).

B. Transmission Channels

12. **This section discusses the macroeconomic impact of natural disasters.** These represent an extreme form of a supply shock and can have macroeconomic effects that are both large and long-lasting. The literature describes the cycle of loss and recovery as a three-stage process. The first stage involves *direct losses* from the destruction of infrastructure and property. In the second stage, *indirect losses* accumulate from foregone output and incomes, and *costs* are incurred as individuals and business work around disruptions. Finally, as the recovery starts, rebuilding of infrastructures and replacement of damaged goods leads to a temporary boost in activity and employment in the affected area (although there may be a leakage if outside contractors are brought in). It also opens up the opportunity to upgrade infrastructures. Apart from the cycle of impact and recovery from individual disasters, the periodic destruction of part of a country's productive assets is an implicit tax on capital which tends to deter investments and lower productivity and living standards on a sustained basis.

Figure 2. Small States: Number of Natural Disasters per Year



Sources: EM-DAT; and IMF staff calculations.

13. **Natural disasters vary in impact depending on their type as well as with the population and economic characteristics of the affected country.** For earthquakes, there is large up-front damage at the time of the shock, and also heavy rebuilding costs. Persistent droughts, by contrast, can be associated with more drawn-out damages and costs. The same type of disaster can have different impacts in different countries. The 2010 earthquake in Chile was stronger and hit a more densely populated area than the same year's earthquake in Haiti. But because of lower construction standards, the human and economic cost in Haiti was far higher, with 200,000 people killed (1,000 in Chile) and destruction equivalent to 120 percent of GDP (14 percent of GDP in Chile) (see Cavallo and Noy (2010)).

14. **There is a substantial literature documenting the macroeconomic impact of natural disasters.** The findings are mixed in some cases, likely reflecting differences in country characteristics as noted above. Accordingly, assessments regarding country disaster vulnerabilities need to blend insights from the literature with specific information on country risks. The findings below are broadly supported by new Fund analysis exploring how macroeconomic outcomes are related to exposure to natural disaster risks (Annex II).

- ***Natural disasters have a clear temporary impact on growth.*** A number of studies point to negative short-term growth effects as damage to physical assets and to commercial and financial infrastructures result in foregone production in the immediate aftermath of the disaster (Raddatz, 2007; Noy, 2009; Acevedo, 2014; Cabezon et al. 2015). Looking at a slightly longer period, reconstruction spending can lead to a positive growth impact for small disasters (Loayza et al, 2009). Hochrainer (2009) finds a significant negative medium-term impact on growth only for large shocks. Event studies confirm that hurricanes result in an initial jump in unemployment in the short term, followed by reversal to the baseline (Ewing and Kruse, 2002).

- ***Evidence on the impact of natural disasters on underlying long-run growth is more mixed.*** Cavallo and Noy (2010) finds no significant long-run impact, while Cabezon et al. (2015) find that for the Pacific islands, trend growth over 1980–2014 was 0.7 percentage point lower than it would have been without natural disasters.

- ***Fiscal balances tend to be adversely affected***. The adverse impact on short-run activity tends to weaken the tax base: thus, Cabezon et al. (2015) find higher tax revenue volatility in disaster-prone Pacific small states. Spending also tends to rise on account of relief and recovery programs. Fiscal imbalances can lead to higher borrowing. Acevedo (2014) finds that floods in the Caribbean result in higher public debt burdens, while Lee et al. (2016) find that natural disasters increase public indebtedness for Pacific islands. In other cases, fiscal needs are met through grants. In some cases, the fiscal impact of disasters may be understated, to the extent that aggregate spending data conceal a shift of resources toward disaster programs from other priorities.

- ***Natural disasters also tend to worsen the external trade balance.*** Damage to production and transportation capacity tends to reduce exports. Over the short term, imports could decline with the dislocation to economic activity, but would tend to rise thereafter, buoyed by disaster relief and recovery programs (Rasmussen, 2004, Cabezon et al., 2015). The deterioration tends to be larger for agricultural exporters. Other elements of the balance of payments may improve. Bluedorn (2005) finds that hurricanes lead to an increase in international aid and remittances in the short-term. Also, where countries have insured or reinsured abroad, disasters can result in balance of payments inflows as insurance companies make payments for damages (Laframboise and Loko, 2012).

- ***Natural disasters can have a disproportionate impact on the poor.*** Low-income communities tend to be located in the most vulnerable areas with weak housing standards (World Bank, 2003, 2016a, 2016b) and disasters can exacerbate social conditions. Low-income communities also commonly do not have access to credit or insurance to help weather shocks (IMF, 2003). There is also a gender element, with natural disasters having their largest impact on life expectancy for women and girls (Neumayer and Plumper, 2007).

15. **Differences in the cost of natural disasters have been attributed to institutions as well as initial economic and financial conditions.** Noy (2009) asserts that institutions affect the direct efficiency of the public intervention following disasters or the indirect impact by shaping the private sector response. He finds that higher literacy rates, higher degree of openness to trade, and higher levels of government spending increase the ability of governments to mobilize resources for reconstruction, mitigate the impact of the shock, and contain the spillovers on the macro economy. Economic diversification and fiscal space to conduct counter-cyclical policy can also impact the response and overall economic cost. Regarding financial conditions, countries with better reserve buffers and access to domestic credit, but with less open capital accounts, are better able to cope with disasters.

CLIMATE CHANGE

Climate change is expected to exacerbate the impact of natural disasters and worsen other vulnerabilities of small states. About one-third of small states are highly or extremely vulnerable to climate change in the lifespan of the current generation. Key risks are from sea level rise and declining agricultural productivity, with expected spillovers for tourism. Stressed ecosystems could boost poverty and further encourage emigration.[12]

16. **Climate change is likely to increase disaster vulnerabilities globally and particularly for small states.** Acevedo (2016) finds that climate changes increases the probability of large natural disasters (tropical storms) and raises mean damages. Specifically, by 2100, tropical storms making landfall could inflict damages up to 77 percent higher than today (with an impact up to 42 percent higher even when storms do not make landfall).[13]

17. **Climate change is also expected to impose broader persistent costs on economies.** Depending on climate change outcomes (Box 3), several transmission channels are particularly relevant:

[12] This section was drafted by Mai Farid and Sebastian Acevedo, based on a background study by a team also comprising Ricardo Marto, Dan Nyberg, and Vimal Thakoor, led by Prakash Loungani.

[13]This estimate is based on a high CO2 climate change scenario, with higher sea surface temperatures causing more intense storms as the main transmission channel (see below). It is however lower than the estimate in Nordhaus's (2010) seminal exercise, which estimates that mean damages for the US could more than double (rise by 113 percent) by 2100.

- **Sea-level rise (SLR)**. SLR is projected to be directly related to the degree of global warming and proximity to the equator. SLR of 50cm by the 2050s is expected based on existing carbon emissions. This could reach 70cm with 2°C global warming (the central goal of the Paris Agreement) and over 1m with 4°C global warming. SLR close to the tropics could be 10-15 percent higher (World Bank, 2013). SLR raises the risk of storm surges, tropical cyclones, and tsunamis, as well as persistent flooding and coastal erosion. The Maldives is at risk of disappearing entirely with SLR of 1m, while other small states also face significant risks (Dominica, Grenada, Kiribati, the Marshall Islands, St. Vincent and the Grenadines, and Tuvalu).[14]

- **Extreme temperatures**. Global warming is projected to result in more frequent and more intense episodes of extreme heat. While the marginal impact is projected to be smaller for countries closer to the equator, this comes on top of already high average temperatures for small states in the Caribbean, Pacific, and Africa.[15]

- **Water stress**. SLR can lead to salt water contamination of freshwater aquifers, reducing access to water for drinking and crop irrigation.[16] Use of alternative, less healthy water brings risk of water-borne disease. With more volatility in rainfall as a result of climate change, droughts also pose risks to water supplies.[17]

[14] Recent research suggests that sea level rise could impact island atolls more quickly than earlier projected, because with SLR, reefs will provide less protection against wave-induced run-up and flooding (Storlazzi et al., 2015).

[15] According to the World Bank (2014a), under a 2°C scenario, the share of land affected by unusual extreme heat at the end of the century is projected to be 70 percent in South East Asia (SEA), 30 percent in the Middle East and North Africa (MENA) region, 30–40 percent in Latin America and the Caribbean (LAC), and 45 percent in Sub-Saharan Africa (SSA), compared, for example to 10–15 percent of land in Europe and Central Asia. Under a 4°C scenario, these shares would more than double.

[16] Countries such as the Bahamas and Barbados are almost entirely dependent on ground water for fresh water, while in Mauritius ground water meets 60 percent of domestic water supply needs (UNFCCC, 2007).

[17] Under a 2°C scenario (for the 2040s), water runoff available for drinking and irrigation could decline by as much as 30 percent in Latin America and the Caribbean and 50 percent in sub-Saharan Africa (see World Bank (2013 and 2014a), Schlosser and others (2014), Kochhar and others (2015)).

Box 3. Climate Change Basics

Definition and drivers. Climate change refers here to the gradual change or variability in global mean temperature and related developments such as increased frequency of extreme weather events, variability in precipitation, and rising sea levels (up to several meters if ice sheets melt). There is a broad scientific consensus that manmade emissions of greenhouse gases (GHG) are a key driver of ongoing climate change and their continued trend will cause further warming and long-lasting damage to the climate system (IPCC, 2014).

Warming impact. Global mean temperature has increased progressively since 1900, and is now about 0.8°C higher, mostly from rising GHG concentrations. If carbon dioxide (CO2) equivalent concentrations were stabilized at 450, 550, and 650 parts per million (ppm), mean projected warming over pre-industrial levels would be 2, 3, and 4°C, respectively. Absent mitigation and adaptation, indications are that the global mean temperature increase could reach about 3-4°C or more by the end of this century—producing severe and irreversible change in climate conditions in many parts of the world. The central goal of the Paris Agreement is to limit global warming to 2°C.

18. **Small developing states are estimated to be at greater risk than developed countries**.[18] Projections of climate parameters by IPCC and Maplecroft's 2016 climate change vulnerability index suggest that countries closer to the equator and low-lying coastal countries (including many small states) are extremely or highly vulnerable to climate change. Roughly three-quarters of low-income countries and one-third of small developing states are assessed as extremely or highly vulnerable to climate change, compared to one-quarter of the rest of the world. The 2016 Maplecroft exposure index assesses risks for 24 small states, of which three are at extreme risk (Fiji, Mauritius, and Montenegro) and a further four at high risk (Belize, Djibouti, Timor Leste, and Vanuatu). This likely understates risks to small states, as a number of vulnerable states are not covered by the assessment (e.g., the low-lying Kiribati and Tuvalu, and tourism-based Maldives) (Annex I).

19. **The economic impact on small developing states will be seen in several sectors**. Roson and van der Mensbrugghe (2012) identify the main channels of impact as sea-level rise and agriculture for Southeast Asia, Latin America and the Caribbean; water scarcity for MENA; and labor productivity and health for sub-Saharan Africa. Key sectors at risk are the following:

- **Coastal ecosystems**. Damage to coastal areas and infrastructure from SLR will have a broader impact on livelihoods (e.g., fishing) and habitability in these areas. Over the long term, climate change will make some ecosystems completely uninhabitable.[19]

[18] See Farid et al. (2016) for a full discussion.

[19] See Burkett (2011) and Barnett and Adger (2003).

- **Tourism**. Climate change can undermine tourist-based economies through erosion of beaches, reduced freshwater supplies, and extreme climate events (floods, storms, and tsunami) which damage critical infrastructure (airports, roads and hotels). The loss of tourism competitiveness will likely reflect overall stress from climate change, being greatest for developing countries, particularly small developing states vulnerable to SLR.[20] This is a major source of risk for the most tourism-dependent small states.[21]
- **Agricultural productivity**. A number of studies have found that the combination of rising temperatures and greater rainfall volatility (including periods of drought), reduce agricultural productivity and GDP growth (e.g., Reilly and Schimmelpfennig, 1999). With 97 percent of crop land being rain-fed rather than irrigated, countries in sub-Saharan Africa and Southeast Asia are particularly vulnerable (World Bank, 2013). One study projects that output in poor countries could fall by 1.3 percent on average from baseline levels for each 1°C rise in global mean temperatures, largely due to reduced agricultural and industrial output (Dell et al., 2012). Lower crop yields from unfavorable growing conditions are also projected to boost food prices, with implications for low-income groups (Hallegatte et al., 2015).

20. **The economic costs of climate change for small states are projected at 15 percent of GDP or more**. For Caribbean small states, a one-meter sea-level rise by 2080 is projected to result in losses and damages of about 8 percent of projected GDP (Simpson et al., 2010). For Pacific island small states, a sea level rise of between 1 and 1.7 meters is projected to result in an economic impact of between 3 and 15 percent of GDP due to lost agricultural production, tourism and fisheries and infrastructure damage (Asia Development Bank, 2013). These figures compare with projections for market and nonmarket losses and damages for the global economy ranging from 1 to 4 percent of output for a 4°C increase in global mean temperature.[22]

21. **Climate change-related stress is projected to boost poverty and emigration**. Low-income communities are particularly vulnerable to climate change because of heavy reliance on agricultural incomes, a high proportion of incomes devoted to food items, and limited access to savings or credit to weather climate-related shocks. Economic vulnerability is matched by risks to health and other social indicators. Globally, climate change could push more than 100 million people into poverty by 2030 (Hallegatte et al., 2015). As climate change has a progressive impact on incomes, job opportunities, and living conditions (Khonje, 2015), emigration is likely to increase further—already twice that for larger countries and rising since the early-2000s (Figure 3).

[20] See Roson and van der Mensbrugghe (2012), and Simpson and others (2010).

[21] Tourism receipts are equivalent to more than 25 percent of GDP for Antigua and Barbuda, the Bahamas, Maldives, Palau, Seychelles, St. Lucia, and Vanuatu. They also exceed 15 percent of GDP for Barbados, Belize, Cabo Verde, Dominica, Fiji, Mauritius, Montenegro, Samoa, and St. Kitts and Nevis (see World Development Indicators).

[22] Studies such as Roson and van der Mensbrugghe (2012), Tol (2014), and Dellink and others (2014) adopt different assumptions and projections for climate parameters including the channels of market and non-market impact of climate change. There is considerable variation across studies and uncertainty as to the potential damages from extreme temperature and related catastrophic weather events.

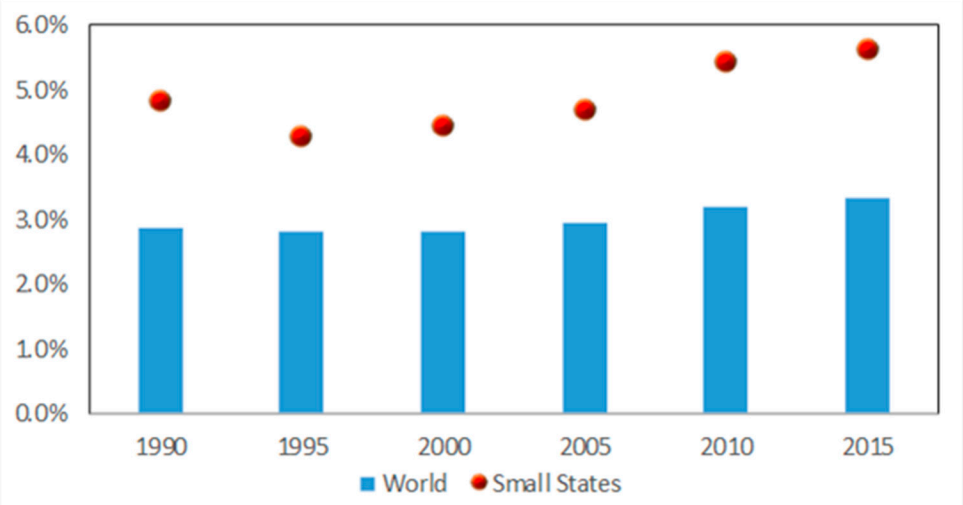
POLICY RESPONSES TO NATURAL DISASTERS AND CLIMATE CHANGE

Much can be done to reduce the human and economic costs of climate change and natural disasters, alleviate output losses, and ultimately improve growth potential for small states. This section focuses on the need to extend macroeconomic policy advice and analytical frameworks to address the specific challenges associated with natural disasters and climate change.[23]

A. Introduction

22. **Public policies can play an important role in building resilience to natural disasters and climate change**. While weather events may be unavoidable, human and economic damages can be reduced by policies to improve preparedness and strengthen countries' ability to bounce back from disasters and withstand global warming. A well-developed literature on policy frameworks for preparedness and resilience-building is actively promoted by the World Bank, UN, and other organizations. The frameworks emphasize readiness and contingency planning, risk reduction investments (both to strengthen physical infrastructure and to make financial risks tolerable), and appropriate regulations (for instance, for safe zoning and a supportive business climate) within a coherent long-term plan for economic resilience. However, the success of such plans will depend on their consistency with macro-stability and sustainability.

Figure 3. Migration from Small Developing States



Source: United Nations.

[23] Prepared by Nicole Laframboise, Xavier Maret, and Patrizia Tumbarello, drawing on an earlier background study prepared by a team also including Jihad Alwazir, George Anayiotos, Jan Gottschalk, Kevin Greenidge, Ermal Hitaj, Keiichiro Inui, Ricardo Marto, Mario Pessoa, and Michael Tharkur.

23. **The immediate issue for Fund advice is how best to align macro, fiscal, and financial policies to support resilience-building while maintaining stability and sustainability**. In the coming years, a more fundamental reassessment of macroeconomic policies as part of a national survival strategy will be necessary for small states facing an existential threat from climate change and sea level rise. This challenge goes beyond the scope of this paper, but the Fund will in future need to play a central role in helping at-risk countries explore their long-term macro-options.

24. **Planning for disasters and a more difficult physical environment should be mainstreamed**. Countries should explicitly build disaster and climate change into fiscal and other policy frameworks—including into budget design, public investment planning, and debt and asset management. This integration process should span the following elements:[24]

- **Identification and quantification**. Steps are needed to identify and quantify the main disaster or climate change risks, their likelihood of realization, potential impacts, and key vulnerabilities (infrastructures at risk, vulnerable communities and populations).

- **Invest in risk reduction**. Guided by risk assessments, decisions should be taken on whether and how to invest in risk reduction.

- **Develop contingency plans**. Where risks cannot be mitigated, contingency plans for disaster response are needed.

- **Arrange contingency financing**. Contingency plans for financing disaster relief and recovery should include self-insurance (fiscal reserves and contingency funds), contingent plans for disaster response using borrowed or grant resources, and risk-transfer arrangements using insurance or other capital market options.

25. **Typically, considerable progress is needed to strengthen disaster risk management planning**. While the above elements are intuitively straightforward, implementation tends to fall short. Analytical studies point to underinvestment in risk reduction across different countries despite calculated high rates of return on marginal projects.[25] Clarke and Dercon (2016) cite multiple examples of flawed disaster response in both advanced and developing countries attributed to inadequate contingency planning, problems in coordinating responses across multiple partners (local and national governments, disaster relief agencies, foreign governments, etc.), and lack of access to necessary financing.

26. **Political and other obstacles may need to be addressed**. Clarke and Dercon (2016) highlight key challenges for disaster risk planning. Some relate to the professional requirements

[24] For approaches to defining disaster risk management frameworks see, for example, Clarke and Dercon (2016) or the Global Disaster Risk Framework (World Bank and UN).

[25] One dollar of US federal investment in preparedness is estimated to yield a reduction in damage of approximately $15 (Healy and Mulhotra, 2009).

for good planning, e.g., scientific expertise in forecasting and modelling disasters or administrative skill in policy coordination. Important obstacles also relate to the politics of disaster risk management. Studies ranging from India to the United States suggest that politicians receive higher electoral rewards for responding to disasters "after the event" than for investing in risk reduction before disasters strike. This is partly because disaster response is more newsworthy than risk reduction, and partly because a program of preventive investments may span multiple administrations with "ownership" that is difficult to attribute. Experience also points to strong administrative and political preferences to retain discretion in responding to events, rather than to commit to ex ante plans—even if discretion is at the cost of speedy and effective response. Clarke and Dercon (2016) argue that a combination of sound professional advice, including from international organizations such as the Fund, and strong domestic leadership are needed to overcome these obstacles. Financing can also be a major hurdle, especially for small states, where spending on disaster risk reduction has to compete for scarce resources with other public services and with the need to maintain cash buffers for responding to disasters and other shocks.

27. **Disaster risk management approaches will differ across countries**. Steps to implement the disaster risk management framework are explored in more detail below, along with the respective role of the Fund. Since each country faces different risks and vulnerabilities, national preferences will dictate different social and economic priorities and institutional arrangements.[26] Accordingly, policy advice should be tailored to country circumstances. The approaches outlined below have been developed specifically with a view to the needs of small states, but will apply in most cases also to larger countries facing risks from natural disasters and climate change. Annex III provides a case study of Vanuatu, exploring the impact of the highly destructive cyclone Pam in 2015 and the resultant policy lessons.

28. **Fund engagement should be within its areas of macroeconomic competence**. As discussed below, macroeconomic policies and institutions within the Fund's areas of expertise play an important role in preparing for and responding to natural disasters and climate change. At the same time, many policies also important for reducing the macroeconomic impact of disasters and climate change are outside the Fund's areas of competence, and Fund staff should collaborate closely with other organizations, such as the World Bank, to develop a full assessment of the adequacy of country policies.

29. **The Fund's tools for assessing risks and vulnerabilities need to be adjusted to incorporate natural disasters**. Approaches for integrating natural disasters and climate change risks into standard Fund analysis are discussed in Annex IV with key messages summarized in Box 4. This advice builds on past work on small states, where staff have often explicitly integrated

[26] In the Marshall Islands, the government has developed several disaster risk management frameworks at the sub-regional, national, and international level in coordination with UNDP and other partners. Micronesia held a nation-wide forum on disaster risk management involving state and national leaders and other organizations. Tonga has developed specialized hazard maps and is providing stakeholders with training in disaster risk management. In Tuvalu, the government has a national climate change action plan and disaster risk management plan.

risks and vulnerabilities from natural disasters into projections and policy advice. That said, there has been considerable variance in approaches across countries and there appears to be scope to draw on good practice approaches in a more standardized manner.

B. Identifying Risks and Vulnerabilities

30. **The Fund should identify risks and vulnerabilities and ensure they are appropriately reflected in macroeconomic policy frameworks**. Disaster planning rests on a clear understanding of risks and vulnerabilities, the latter typically identified by national experts or international partners such as the World Bank and UNDP.[27] Based on the specific risks facing particular countries, the Fund can advise on relevant policy responses. Transparent communication is important.

Box 4. Integrating Natural Disasters and Climate Change into IMF Macro-frameworks and Risk Analysis

- **Macro criticality**. In countries where natural disasters and climate change significantly affect economic performance, Fund analysis (of the macro framework, debt sustainability, external imbalances, etc.) should make specific allowance, whether in the short- or medium- to long-term.
- **Data sources and perspectives**. Staff will usually need to combine EM-DAT data, country economic data, and perspectives from country experts to develop a full picture of the potential scale, frequency, and macro transmission channels of natural disasters and climate change. The assumptions adopted for analytical purposes should be clearly documented.
- **Macro baselines**. Medium- to long-term baselines used for assessing policy sustainability (e.g., DSAs) should reflect economic performance not just in good years, but also factoring in the economic impact of future natural disasters. A range of approaches can be used to reflect the "average impact" of disasters, including using historic averages for key variables to develop tailored adjustments based on assumed risks and transmission channels.
- **Alternative shocks scenarios**. The policy implications of adverse scenarios should be assessed. Risks around the baseline and the adequacy of fiscal and external buffers should be evaluated using alternative scenarios calibrated to reflect "average" and/or "tail risk" natural disasters.
- **Financial risks, reserve adequacy, and GE modeling**. Tailored approaches can be used to explore financial sector risks, following practices applied in recent FSAPs. The current reserve adequacy tool can be readily adjusted to reflect the impact of natural disasters. And the Debt, Investment, and Growth (DIG) model could be used to explore the dynamic adjustment path following a disaster (see Annex V).

[27] In general, advanced economies will have the expertise and resources to conduct more detailed risk and vulnerability assessments than lower-income countries and small states. The latter will likely focus on a more narrowly-defined range of risks and transmission mechanisms.

31. **Preparation of a fiscal risk statement is a key element of Fund guidance on macro risk management**. For countries where natural disasters are important, the risk statement should cover associated risks; this should be presented together with the budget to guide budget discussions.[28] The Fund gives TA to countries to develop fiscal risk statements and has also created a fiscal transparency code and evaluation that covers risks from natural disasters.[29] More broadly, the Fund recommends that risk management be undertaken within a comprehensive PFM framework covering risk assessment, self-insurance, and risk reduction and transfer (Box 5).

32. **Sound macroeconomic data are key for assessing risks and developing policy responses.** Given the limited capacity of many small states' statistical agencies, Fund capacity building will be important across a broad range of sectors (national accounts, fiscal and external accounts, financial sector) and would span issues of methodology, data collection, and compilation. Regional collaboration on macroeconomic data compilation may be an option for some small states.

Box 5. Fiscal Risk Management and Fiscal Risk Statements

Risk identification is important for fiscal transparency. The IMF's Fiscal Transparency Code defines twelve major risks including natural disasters, and specifies that countries should analyze, disclose, and manage their potential fiscal exposure to such disasters. It indicates that management of these risks should be based in a published strategy.

Fiscal risks statements (FRS). These are reports prepared by the government at the time of budget preparation to inform the legislature and civil society about the most relevant fiscal risks and how the government plans to address them. The report, usually prepared by the ministry of finance in coordination with other agencies, should describe and quantify the main fiscal risks, discuss their likelihood, and propose fiscal measures to mitigate and manage them. Countries such as the Philippines, Indonesia, and New Zealand have detailed FRS that cover disasters. For example, the Philippines created a pre-disaster risk assessment, developed a catastrophe risk insurance facility for local governments, and incentivized local governments to pool calamity funds.

Framework for managing fiscal risks. Fiscal risk management should follow the broad policy approach in paragraph 24. Fiscal exposure to disaster risks should be *identified and quantified* in the fiscal risk statement. The statement should guide policymakers and the public toward risk-management priorities by detailing quantifiable and unquantifiable contingent liabilities and whether these are considered probable, possible or remote. Then, *mitigation steps* should be taken to reduce fiscal exposure, either as part of the budget or during the fiscal year (e.g., public infrastructure investment, tax incentives to encourage resilience-building behavior, or regulatory intervention—see Box 6). *Contingency plans* should be specified for risks that cannot be mitigated. For example, procedures to allow rapid release of funds in the wake of a natural disaster should be put in place in advance. *Contingency financing* should be identified in advance to the extent possible, as discussed in more detail in the section on financing (see IMF, 2016a for further details).

[28] The identification and disclosure of fiscal risks is a central component of the Fund's advice on managing fiscal risks. For general guidance, see IMF (2008) and IMF (2012a).

[29] For the Fiscal Transparency Code and published Fiscal Transparency Evaluations, see

http://www.imf.org/external/np/fad/trans/index.htm.

C. Investing in Risk Reduction

33. **A risk reduction program to address identified vulnerabilities should be developed**. Besides the development of information campaigns to increase preparedness, early warning systems, and contingency planning, risk reduction steps could involve public infrastructure projects, incentives to encourage private sector investments in risk reduction, and financial investment to offset risk. Some relevant options are enumerated in Box 6.

34. **The Fund can help determine whether public investment is financeable and part of a coherent medium-term development plan**. As discussed later in the paper, public spending on risk reduction needs to be consistent with fiscal space, debt sustainability, and macroeconomic absorptive capacity. This assessment depends, in part, on the projected economic returns from risk reduction programs. Staff are extending debt sustainability analysis on a case-by-case basis to reflect such returns.[30] General equilibrium models such as the Fund's Debt, Investment, and Growth (DIG) model provide a more comprehensive approach for exploring the impact of scaled-up investment on the macro-economy (see Annex V).

Box 6. Risk Reduction Approaches

Public infrastructure programs. Stronger infrastructure could offer better protection against disasters. Examples include more effective seawalls along urban coastlines; maintenance or reinforcement of bridges; and investments in urban resilience (resilient construction and building back better).[31]

Public information provision. Accurate information about risks can influence decisions on where to locate and how to construct private commercial and residential properties.[32] For example, risk maps on flood zones, areas at risk from coastal erosion, and landslide areas can provide valuable information to property investors. Where there is a developed insurance industry, this can help in setting terms and conditions for property cover. Information on disaster risk areas can also be used to tailor possible public insurance subsidies, with lower public contributions for high-risk areas. Adequate funding for public early warning systems is also important (e.g., hydro-meteorological and communication systems).

Property rights and regulation. Land use and zoning rules can reduce property exposed to disasters (e.g., by limiting building in flood plains) and building codes can ensure property strong enough to withstand disasters. Well-defined rights to own and lease properties create incentives to maintain property values. These can be fostered through affordable and effective land titling procedures and market-friendly rent controls.

Fiscal policies and pricing incentives. Targeted incentives could subsidize retrofitting properties to strengthen resilience (less costly to the tax base than a broad-based tax holiday to attract investors to a vulnerable country). Accelerated capital depreciation provisions also offer targeted incentives for investing in property. Fiscal incentives and appropriate pricing could also support more drought resilient crops, protect and expand forest coverage, and preserve scarce water resources.

[30] See McIntyre and others (2016).

[31] For example, Botswana, the Marshall Islands, Micronesia, St. Lucia, St. Vincent and the Grenadines, and Vanuatu have enhanced disaster resilience through infrastructure projects.

[32] World Bank research suggests that information provided by hazard-location maps and data on building quality can be capitalized into property values.

35. **Physical and financial investment in risk reduction (resilience-building) should be part of a well-prioritized public financial management (PFM) strategy**.

- All resilience-building public investments should be undertaken within the framework of each country's comprehensive public investment program. While the Fund does not typically advise on specific investment priorities, it can help countries assess and build the strength of their public investment management framework using the Public Investment Management Assessment (PIMA). This provides a comprehensive diagnostic of a country's current public investment practices and, based on this diagnostic, derives recommendations on how to raise efficiency (Box 7).[33]

- Fiscal buffers should be accumulated via a saving strategy consistent with medium-term fiscal objectives (e.g., through the gradual accumulation of a rainy-day fund). The Fund should seek to ensure that spending and contingency allowances are integrated into a multi-year budget process. A consistent multi-year process may permit, for instance, contingency funds for emergency needs that remain unspent within a given year to be used for risk reduction measures the following year (as in Mexico and Vietnam). For small states, limited administrative skills and weak PFM systems may hamper the effectiveness of risk reduction efforts.[34] In such cases, the Fund can play an important role in capacity building.

36. **Regional approaches can be developed for risk reduction**. Administrative economies of scale can be achieved by adopting regional regulatory standards or by establishing regional administrative bodies. Thus, in the Caribbean, the Caribbean Disaster Emergency Management Agency (CDEMA) coordinates regional disaster responses and establish codes of good practice, including for building construction. [35]

37. **More diverse income sources can contribute to reducing risks from natural disasters and climate change**. Where small states have a highly-concentrated economic base (relying on agriculture, or tourism, say), it may be possible to develop new sources of income that are more resilient. For example, many small states have very large territorial waters, and Seychelles has pioneered the importance of the "blue economy" as a potential source of incomes and livelihood. The role of the Fund is less to identify potential new growth models than to advise on macroeconomic policies that may be needed for an effective transition (see IMF, 2014d).

[33] See IMF (2015b), pp. 19.

[34] For low-income developing countries, IMF (2015a), estimates a public investment efficiency gap of 40 percent.

[35] Similarly, in the Pacific, regional approaches to strengthen public financial management include shared training facilities and courses (University of the South Pacific, Pacific Islands Center for Public Administration); pools of skilled and specialist resources can be shared across countries (Pacific Financial Technical Assistance Center, Pacific Islands Forum Secretariat); and networks for information sharing (Pacific Islands Financial Managers' Association, Pacific Islands Tax Administrators Association). The World Bank's Pacific Resilience Program (PREP) also seeks to foster regional approaches (see Annex VI).

D. Disaster Contingency Plans

38. **Risk reduction activities should be combined with contingency plans for disaster response**. Failure to plan ahead can seriously hamper the effectiveness of post-disaster intervention. Clarke and Dercon (2016) highlight the frequency with which public responses fall short because of delays in agreeing intervention priorities, time taken to resolve leadership and coordination issues across multiple levels of government and with foreign counterparts, and lack of short-term financing. They recommend establishing contingency plans for post-disaster action aligned with key risks and vulnerabilities. Thus, if droughts are a key risk, contingency plans could revolve around issues of food security and income support for farmers and pastoralists; if hurricanes are the main risk, plans could focus on emergency housing, compensation for the homeless, and restoration of key public infrastructures.

Box 7. Improving Public Investment Efficiency with PIMA

The IMF's Public Investment Management Assessment (PIMA) provides a comprehensive diagnostic of a country's institutional capacity under 15 categories at three key stages of the public investment cycle: (i) investment planning, which covers, *inter alia,* fiscal rules, the management of PPPs, and regulation; (ii) investment allocation, examining the budgeting process (comprehensiveness, whether allocations are made multi-year) and project selection; and (iii) investment implementation, considering investment protection, the transparency of execution, and the availability of funding.

Following a 2015 report identifying average inefficiencies in public investment processes at around 30 percent, the Fund has been deploying this assessment tool across several countries. In partnership with the World Bank, the diagnostic has been conducted in more than 15 pilot countries (see IMF, 2014a and 2015a).

39. **To ensure rapid disaster response, discretion should be kept to a minimum**. Rules for public intervention should be clearly defined (such as the size of payments to affected households), leadership responsibilities should be explicit, and programs should be triggered by clearly-defined criteria (e.g., hurricanes at or above a certain category). The contingency plan should also be aligned with incentives for the private sector to adopt risk reduction behaviors.

40. **Social safety nets provide important contingency coverage**. Disasters can lead to permanent harm for victims, especially children, where malnutrition can impair cognition, productivity, and lifetime earnings, and so timely assistance is critical. For effective disaster intervention, contingent plans should be in place to scale up existing safety nets (World Bank, 2016c). The design of new programs after a disaster is declared may not allow for sufficiently prompt intervention.[36] Cash transfers or vouchers are increasingly preferred where local markets can meet needs, because, unlike food aid, they offer greater choice and flexibility and stimulate

[36] In many small states, the core elements of social protection systems are characterized by weak design and inefficient processes that do not lend themselves to fast response in post-disaster contexts. These would need to be addressed if safety nets are to be used effectively to mitigate risks and respond to shocks. The World Bank's ongoing operations in Jamaica, Grenada, St. Lucia, and St. Vincent and the Grenadines are aimed at addressing some of these issues.

domestic supply (Box 8). By contrast, research shows that large inflows of food and clothing aid can disrupt the value chain and undermine the livelihoods of merchants and other local businesses, especially in very small economies. These effects can be worsened by the monetization of aid, or corruption in distribution. Public works programs can also play an important role in providing post-disaster income support, while helping with disaster recovery and rebuilding. In some countries, such programs may be more politically amenable than cash transfers. The scale of relief should, in general, be calibrated to immediate needs, without undermining incentives for a return to more normal labor market participation as part of economic recovery.

41. **The Fund can support members by sharing country experience with safety nets**. In general, policy choices about the goals of contingency financing plans would be nationally determined, while the Fund has experience in helping countries adopt and strengthen safety nets and create the necessary fiscal space. For additional technical advice on how to design schemes that are well-targeted and efficient, countries should draw on expertise in the World Bank and other relevant institutions. Given that budget constraints are a factor in safety net design, governments should explore with development partners the scope to use contingent financing arrangements to support disaster-related safety net programs.

42. **Caution is needed in drawing on pension or provident funds to finance a safety net.** Following cyclone Pam, the Vanuatu National Provident Fund (VNPF) allowed its 40,000 active members (mostly civil servants) to withdraw up to 30 percent of their pension fund to cover cyclone-related expenses. Although this successfully provided financing equivalent to 2 percent of GDP over a three-month period, most members were located on less-affected islands and a significant fraction of the withdrawals was likely used for non-disaster purposes (there was no monitoring of funds usage). The drawdown left the VNPF illiquid and less able to finance pension needs. In Fiji, similar concerns arose when public pension fund assets were used to cover disaster recovery needs.

43. **The Fund can also advise on the design of budget laws to ensure that budget systems continue to function after a disaster.** The legal framework should ensure sufficient spending flexibility to cope with natural disasters, including by: (i) provisions in organic budget laws allowing the government to exceed spending limits up to a defined amount in the event of a formally declared natural disaster; (ii) escape clause provisions in any fiscal responsibility laws to allow the government to break the numerical or procedural targets in case of a major natural disaster; (iii) provision in the annual budget law giving the necessary flexibility to the government to shift resources in case of a major natural disaster; and (iv) establishment of contingency space in the budget to cope with emergency needs (IMF, 2012b). The appropriate approach will depend on the PFM legal tradition in any given country.

E. Fiscal Policies and Debt Sustainability

A range of fiscal institutions and policies are relevant for managing the macroeconomic vulnerabilities posed by natural disasters and climate change. These span PFM and debt management practices, carbon taxation and energy pricing reform, and approaches for achieving fiscal and debt sustainability.

Box 8. Examples of Disaster-Related Safety Nets

Fiji. In the immediate aftermath of 2016 Tropical Cyclone Winston, the government focused on humanitarian and in-kind support (food, water, tents). After about one month, local markets became functional again, and the government made cash payments to vulnerable groups through the existing social welfare scheme benefitting about 22,800 households and 17,800 pensioners. An impact evaluation found that beneficiaries were faster to recover than non-beneficiaries and that the majority of assistance was spent on essential items. A final stage of support comprised the provision of housing vouchers (around 3-4 months after the cyclone).

Jamaica. Following Hurricane Dean in 2007, Jamaica made a supplemental transfer of around $28 to 90,000 beneficiaries under its established safety net scheme (PATH). In addition, based on assessments of property damage, it provided vouchers to households valued from US$280 to US$850 to purchase hardware supplies from local stores for home repair.

Maldives. A cash transfer system was developed after the 2004 tsunami and delivered to some 53,000 people—about a fifth of the population—within one month. Teams visited all the affected islands, confirmed the damage to houses, and on the next day paid the victims in cash (the equivalent of $40-$115, depending on the damage).

Mauritius. To ensure transparency, post-disaster transfers were distributed in public meetings after assessing housing damage.

Pakistan. After a major earthquake, individuals and families were given a fixed amount for relief and to help rebuild their destroyed houses. Payments were channeled through bank accounts opened by beneficiaries.

Vanuatu. To support rebuilding, the government suspended VAT on building materials for 3 months in the aftermath of cyclone Pam.

Public finance and debt management

44. **Policies for disaster risk management should be integrated into a sound budget framework**. A sound PFM system is essential to enhancing risk management by incorporating disaster risks into fiscal planning. From a public financial management (PFM) perspective, risk reduction investments, contingency financing plans, and disaster financing approaches discussed above should be part of a top-down approach to budgeting under a transparent and sustainable medium-term fiscal framework (see IMF, 2009 and 2014b). The Fund should continue to play a leading role as provider of technical assistance on PFM practices in small developing states and other disaster-vulnerable countries (Box 9).

Box 9. A Case Study on IMF Capacity Building on PFM Practices—Pacific Islands

PFM capacity building, designed to improve budget planning and enhance the transparency of public funds, helps the Pacific Islands (PICs) make a strong case for external assistance related to natural disasters and climate change.

Public financial management reform and more transparent aid management policies enhance the effectiveness and quality of public expenditure, thus offering benefits that extend beyond climate change and natural disaster risk management. A recent report by the Pacific Islands Forum (PIFS, 2013, Nauru case study) offers several lessons. These include the benefits of integrating climate change into national plans, policies and budgets, and of tracking spending through budget systems. The report also cites the difficulties in quantifying the extent of external financing available for climate change and distinguishing this financing from existing development assistance. These challenges are likely to divert capacity from other aspects of core policy management.

The Pacific Financial Technical Assistance Centre (PFTAC) also provided training to enhance Pacific islands' disaster risk management capacity. PFTAC, in coordination with the World Bank's Disaster Risk Financing and Insurance (DRFI) Program, delivered a March 2015 regional workshop hosted by the Pacific Islands Forum Secretariat on incorporating natural disaster risks into the fiscal planning process. The workshop addressed special budgetary procedures for providing rapid access to emergency funding; the macroeconomic and fiscal impact of natural disasters; how to incorporate disasters risks into the fiscal planning process, and elements of disaster risk financing.

45. **Fund capacity building can also help small states strengthen public debt management in the aftermath of natural disasters**. Thus, Vanuatu recently established a public debt management office as part of an emphasis on "building back better" following cyclone Pam. Specific liquidity management innovations could be introduced into domestic and external debt instruments to provide temporary cash flow relief (triggering deferral of debt service for qualifying natural disasters).

Carbon taxes and energy pricing

46. **The Fund can advise small states on carbon taxation and energy pricing reform**. Small states contribute little to global CO_2 emissions and other greenhouse gases. Nonetheless, carbon taxes can help these countries make progress on their emissions commitments and provide an attractive source of revenue. For the 2015 Paris Agreement on climate change, 195 countries submitted emission reduction pledges—independently determined national contributions (INDCs). For example, Mauritius and Seychelles pledged to reduce their emissions by 30 and 20 percent, respectively, relative to business as usual emissions in 2030. Carbon taxes (or tax-like instruments) are the most efficient instruments for reducing emissions. They can also raise substantial new revenues and can be implemented through a straightforward extension of fuel taxes which are well established in most countries and amongst the easiest of taxes to administer. The Fiscal Affairs Department of the IMF has developed spreadsheet tools to quantify the level of carbon pricing needed in different countries, the environmental, fiscal, economic, and incidence impacts of these policies, and their trade-offs with other instruments. The IMF also

provides country-level guidance on the broader reform of energy prices to reflect the full range of environmental impacts (e.g., air pollution, road congestion).

Fiscal and debt sustainability

47. **Adequate fiscal buffers are a critical part of disaster contingency planning**. As discussed in the next section, domestic resources represent the first "layer" of potential disaster financing, providing immediate liquidity for disaster relief. Indeed, for small disasters, domestic deposit buffers may provide the only necessary financing. Once the appropriate size of the fiscal buffer has been established (see below), a first challenge for fiscal policy may be to accumulate additional savings if the current buffer falls short. This will require an assessment of how savings can be increased (additional revenue measures, savings on expenditures) and a timeline for the policy adjustment. The pace of accumulation of buffers should be considered from a cost-benefit assessment. Where priority spending would need to be cut to boost savings and build buffers, a more gradual accumulation of buffers could be considered drawing on new revenue measures. One option for building buffers is to include a sizeable provision for future natural disasters in the annual budget. In the event that a disaster does not occur, this allocation could be saved, thereby strengthening the fiscal buffer.

48. **The fiscal stance should be set taking into account the need to build and maintain contingency buffers**. In general, it may be necessary to "look through the cycle", running a stronger fiscal stance in non-disaster years to accumulate buffers (in the form of savings or debt reduction) that can offset the adverse impact on public finances in future disaster events. The appropriate fiscal stance in non-disaster years will also depend on starting conditions. For example, the fiscal stance calibrated to provision adequately for the costs of future disasters may come on top of primary surpluses necessary to reduce a historically high debt burden. Care is needed to distinguish disaster-related and other random shocks from more permanent changes in fiscal conditions. The Fund can help countries disentangle the temporary disaster element which merits financing from more permanent fiscal shocks for which macroeconomic adjustment would be more appropriate.

49. **Fiscal rules can provide the discipline needed to sustain buffers**. For countries facing disaster risks, an appropriate rule could target an underlying fiscal balance during normal times that builds buffers and borrowing space. This could be accompanied by an escape clause that allows for larger fiscal deficits as part of the response to shocks such as natural disasters. The rule could also include a "debt brake" that requires fiscal adjustment in case of large *ex-post* slippages in fiscal balances and associated debt buildup. Where initial fiscal consolidation to reduce debt burdens is necessary, this should precede the introduction of a fiscal rule, thereby making the rule more credible, with the rule serving to lock-in these gains.

50. **Debt sustainability assessments take on additional importance in disaster-vulnerable countries**. Post-disaster recovery and rebuilding programs typically include a debt-financed element, and the amount and terms of such financing should be carefully reviewed. Experience suggests that rapid debt accumulation is not uncommon in countries experiencing a

series of disasters. This may reflect a weak underlying fiscal stance, with disaster-related borrowing exacerbating already weak debt dynamics. It may also reflect looser scrutiny of borrowing plans in a post-disaster setting. DSAs should be based on assumptions about trend economic growth and the future fiscal stance that incorporate the risks of adverse shocks from further disasters over the projection period (Box 4 and Annex IV).

51. **More adept debt management may also help strengthen fiscal buffers.** The stock of existing debt and associated financing requirements may constrain the scale and terms of access to new financing for disaster response. In some cases, debt management approaches may improve credit access—for example, refinancing existing short-term obligations at longer maturities may provide potential for new short-term borrowing. In other cases, the overall debt burden (relative to GDP or revenues) may be excessive, and improved market access will require a sustained period of strengthened fiscal performance to reduce debt ratios and steps to deepen the domestic debt market.

F. Monetary Policy and Financial Sector Issues

Financial sector risks should be identified, and contingency plans adopted and communicated. Deep and well-regulated banking systems and developed capital markets are better able to withstand shocks and provide credit to aid post-disaster recovery.

52. **The impact of natural disasters on inflation should be considered in setting monetary conditions**. While natural disasters have a negligible impact on inflation in advanced economies, they can have an impact lasting several years in developing countries (Parker, 2016). For the latter, storms can boost food price inflation for up to a year, while earthquakes tend to reduce CPI inflation excluding food, housing, and energy. A good understanding of these effects can help in setting policy in the immediate aftermath of a disaster.

53. **The financial sector should be incentivized to support economies through disasters and develop risk-management instruments.** For small states, this requires, first, identifying financial sector risks and adopting and communicating contingency plans. Over time, reforms to improve regulations and financial deepening will leave the sector better able to withstand shocks and provide credit to aid post-disaster recovery. Ideally, the financial system would also provide insurance and hedging instruments, as well as financing for investment in risk reduction. However, scale inefficiencies in small states make it likely that these needs will continue to be provided externally.

54. **FSAPs and FSSRs can help assess disaster risks**. While only a limited number of Financial Sector Assessment Program (FSAP) reviews have been conducted by Bank-Fund teams for small states, they provide illustrative examples of how stress tests can be used to identify the financial risks associated with natural disasters, both for the banking system as well as for the

insurance sector.[37] The recently introduced Financial Sector Stability Reviews (FSSRs) have been developed as a new technical assistance instrument to help countries pursue financial inclusion and deepening in a manner complementary to financial stability. FSSRs have the potential to boost financial sector resilience to natural disasters through support for long-term financial sector development as well as short-term risk management frameworks (see below).

55. **Crisis management strategies and contingency plans should be tailored to identified risks**. Disaster risk management strategies can draw on Fund FSAPs and other capacity building on financial crisis preparedness and safety nets. The strategy should be tested in crisis simulations, and financial institutions and the public should be informed about the plans and tools available to handle a crisis.

- *Infrastructure*. Key immediate goals are to ensure continued access to the banking system, continuity of the payment system, and ability to conduct cash transfers. Continued access to microfinance and mobile banking can also help in conducting financial transactions after a disaster.[38] Where there is a developed local insurance sector, it should have infrastructure in place to allow prompt response in the event of a disaster.

- *Institutions*. The strategy should define the responsibilities and actions of key institutions (usually the central bank, ministry of finance, regulatory authorities, and parliament) and establish plans for contingency financial sector response and recovery. Public lending institutions may be expected to play a role in financing the recovery, though risks should be carefully considered.[39]

[37] The 2015 Samoa FSAP included two stress tests on a category 4 tropical cyclone, modeling the damage on physical property and production, with consequences for bank solvency.

[38] In the West Bank and Gaza, the Palestine Monetary Authority issued banking regulations in preparations for natural disasters that included implementation of business continuity, disaster recovery, and crisis management plans adopted by all banks. These plans identified and insured critical information backups, alternative operational sites 50km away from each HQ, and emergency operation procedures and evacuation plans.

[39] In Samoa, public development bank lending following natural disasters has been a key part of the government's recovery strategy. The Samoa FSAP stressed the importance of sound supervision of the development bank, reform of its governance (drawing on World Bank expertise), and full accounting for any public costs of such credit in the budget and DSA.

56. **Longer-term planning should target financial deepening and building financial resilience.**

- Steps to improve financial access can help countries weather disasters, as can longer term efforts to develop insurance and capital markets. Resilient mobile banking and microfinance networks should also be developed to supplement the traditional banking system for cash transfer after a disaster, and to support remittances, which are always an important source of incomes in small states and can be augmented when there is an urgent need.[40] The development of private insurance should be a priority, either domestically or through regional or international arrangements. More developed financial systems may also be able to finance public interventions or restructure obligations more easily in a post-disaster setting.

- Strong regulatory and supervisory frameworks can make banking systems more resilient to shocks. Disasters can undermine loan performance, resulting in financial stress. Financial crisis preparedness/safety nets, including a solid bank resolution framework and a deposit insurance scheme, should be strengthened in advance of natural disasters. For small states with limited supervisory capacity, the focus should be on the basics (such as access to financial data, and conducting off- and on-site supervision).

57. **Higher prudential capital and liquidity ratios may be appropriate for disaster-vulnerable countries**. Developing and running stress tests would help determine suitable macro-prudential measures to address liquidity stresses, which may be more acute for smaller countries. The regulator would need to balance various factors such as profitability, capital adequacy, non-performing loans (NPLs), deposit growth, and overall growth in the economy with the potential impact of disaster risks on the economy and the financial sector.

G. External Sector Policies

58. **The assessment of appropriate external buffers should take account of key features of small states.** The impact of disasters on the balance of payments of small states is proportionately higher as a share of GDP. In addition, most small states have fixed exchange rate arrangements. These two factors suggest that the optimal level of reserve cover is likely to be higher than for other economies. A natural disaster will likely increase demand for foreign currency that will require substantial intervention to support the pegs. Even in states with flexible exchange rate rates, a higher level of reserves will help prevent disorderly foreign exchange market developments.

[40]Considering the loss of correspondent banking relationships by some small states and the off-shore nature of many small island banking systems, the ex-ante adoption and implementation of a robust AML/CFT regime consistent with FATF international standards will contribute to their ability to receive needed remittances in a timely and efficient manner.

59. **Standard reserve adequacy metrics often do not factor in the risk/ impact of disasters and underestimate reserve needs for countries susceptible to natural disasters.** The metric for reserve adequacy developed by Mwase (2012) for small states takes into account countries' susceptibility to natural disasters.[41] The metric places a greater weight on short-term debt and exports than for other countries, reflecting the higher vulnerability of small islands to terms-of-trade shocks and the limited financial structures that could lead to accelerated deleveraging for countries without short-term market debt. Thus, the metric requires higher reserve holdings than would normally be assessed to reduce the probability of a crisis (i.e., minimizing the probability that a shock leads to a crisis). This framework could be applied, tailored to the specific circumstances of different small states.[42] Further analysis is also warranted regarding the appropriate reserve buffers for disaster-affected countries. Based on a sample of countries, small states do not appear to significantly draw on reserves following disasters to finance balance of payments needs (Annex VII, Figure 2). One possibility is, that with limited reserve buffers, imports are delayed until external financing can be mobilized.

60. **Pooling of reserves at the regional level may help reduce the costs of preparing for natural disasters.** It allows members to share risk, thereby lowering the level of reserves that each country needs to maintain. Such pooling of reserves--as in the case of the Latin American International Reserve Fund (FLAR) and the Chiang Mai Initiative (CMI) in East Asia--offers a way to deal with idiosyncratic shocks, such as with natural disasters.[43] Pooling international reserves allow members to benefit from economies of scale, thereby reducing the cost of natural disaster insurance premiums.[44] It also reduces the need for excessive reserves hoarding owing to incentives to avoid resort to official financing. Transfers from the regional reserve pool following a natural disaster would also allow for a faster recovery, a cushion to the balance of payments, and can even mitigate capital outflows by instilling confidence. The main drawback to such a mechanism is moral hazard and sovereign risk concerns associated with risk sharing across countries.

[41]This metric is not yet reflected in the IMF's current toolkit for assessing reserves adequacy.

[42] In Swaziland, staff's policy advice on reserve adequacy in the 2014 and 2015 Article IV consultations was based on an analysis that took into account large exogenous shocks where the probability of a large shock (e.g., natural disaster) is based on a cross-country sample average. Staff recommended boosting reserve cover to 5-7 months of imports.

[43] FLAR provides balance of payments assistance to member countries by granting credits or guaranteeing loans to third parties. It helps harmonize the exchange, monetary and financial policies of member countries (Bolivia, Colombia, Costa Rica, Ecuador, Paraguay, Peru, Uruguay, and Venezuela) and improves the terms of investment of international reserves made by the Andean countries. CMI is a multilateral currency swap arrangement among the 10 members of the ASEAN plus the "A three" countries: China, Japan, and South Korea. CMI seeks to provide an efficient and credible mechanism for offering emergency liquidity to ASEAN +3 economies experiencing currency crises.

[44] Under the World Bank-supported PCRAFI, consideration is being given to establishing a mutual fund that could meet country needs in the event of smaller disasters that do not trigger a sovereign insurance payout.

FINANCING APPROACHES

61. This section discusses financing needs related to natural disasters and climate change.[45] It opens by exploring current practices for financing natural disasters, optimal approaches, and obstacles to the latter. This is followed by a detailed discussion of several key financing options, with specific recommendations for usage. The section concludes with a discussion of access to climate change financing for small states.

A. Financing Natural Disasters

Countries should develop advance plans for financing natural disasters, rather than looking at options only "after the event". Advance plans should comprise a mix of fiscal buffers, contingent grant and loan arrangements, and risk transfer options. Limited progress has been made in this direction, and large disasters tend to be under-financed for small states, despite the relatively small cost by global standards.

62. **Natural disasters give rise to several financing needs**. Prior to disasters, financing should be allocated to a program of risk reduction investments. When disasters strike, financing is needed for relief and recovery. Then, longer-term financing is needed for rebuilding. Each of these elements of financing should be integrated into the fiscal and debt management frameworks.

63. **Uncertainty is the biggest challenge, so ex-ante risk reduction should be a priority**. The main challenge is how to provision for urgent post-disaster relief and recovery costs that are, by their nature, unpredictable and require financing that was not envisaged in the budget process. Rebuilding needs in the aftermath of a disaster are similarly difficult to predict. Risk reduction investments, on the other hand, are predictable and can be integrated in a straightforward manner into the medium-term fiscal framework. There is a strong case for expanding ex ante risk reduction investment to a far greater extent than currently, since not only can this type of financing be managed with more predictability, but—more fundamentally—the greater a country's success with risk reduction, the lower its expected damages that will need ex-post financing.

64. **Currently, however, small states' disaster financing is almost exclusively focused on ex-post recovery rather than on ex-ante risk reduction**. Governments face constraints on domestic and external resources, and difficulties in accessing financial instruments at costs that seem affordable. Hence they continue to rely on ex-post borrowing and support from the international community to pay for rebuilding. The result is underinvestment in adaptation and

[45] Drafted by Leo Bonato, drawing on a background study prepared by a team comprising Mai Farid, Burcu Hacibedel, Sarwat Jahan, Marshall Mills, Andrea Salerno, Wendell Samuel, Nobuyasu Sugimoto, Eriko Togo, and Marilyn Whan-Kan, led by Adrienne Cheasty and Cathy Pattillo.

risk reduction as well as a slow, fragmented, and unreliable response to natural disasters (Clarke, 2016). Data on overseas development assistance (ODA) point to a clear ex-post emphasis. During 1990-2010, emergency response and reconstruction accounted for 86 percent of disaster-related ODA disbursements, with disaster prevention and preparedness representing only 14 percent.[46] For small developing states, the latter proportion was only slightly higher (24 percent). ODA financing is also less than fully additional. There is also evidence that, in the aftermath of a disaster, external development partners reassign previously allocated funding, implying a reprogramming of spending priorities.[47] While this may be an efficient use of resources, it can overstate the country's access to net new financing. Moreover, it implies a tradeoff between disaster recovery and the developmental goals that would otherwise have been financed.

65. **The World Bank has developed a risk-layered framework for optimizing disaster financing.** Given a country's disaster risk, policy makers should choose a mix of financial instruments that finances their contingent liability at the lowest economic opportunity cost (Clarke et al. 2016). The model balances the speed of access to post-disaster resources with the cost and potential availability of financing (Figure 4).

- *Small disasters*. Small but unpredictable financing needs can be met using self-insurance—either by reallocating spending or drawing down available government deposits. This can provide resources quickly and at a lower cost than via sovereign insurance.

- *Moderate sized disasters*. Financing needs will typically exceed buffers available from self-insurance, and will require access to external resources. Since external grants and loans are often difficult to mobilize at short notice, efforts should be made to establish contingent arrangements that provide access to resources in the event of a disaster. For moderate and large disasters, risk transfer options should also be developed, whereby a third party takes over a portion of disaster-related financial risks in exchange for a fee or premium.

- *Largest disasters*. In these cases, large-scale insurance is not cost-effective, but catastrophe adjusters in sovereign bonds can allow some risk transfer in the form of debt service savings.[48] Debt sustainability considerations may prevent large scale use of borrowed resources, and there may be little alternative but to depend on grants and humanitarian assistance, where available, though financing flows are often slow and unpredictable.

[46] Based on the Disaster Aid Tracking Database compiled by the Global Facility for Disaster Reduction and Recovery. During 1990-2010, just two percent of overall ODA was devoted to disaster-related activities (US$92 billion, of which $1.2 billion to small developing states).

[47] For instance, after Hurricane Ivan, where damages to Grenada amounted to more than US$800 million, donors pledged about US$150 million in aid, but one third of this took the form of reallocated commitments.

[48] For an extensive discussion of disaster financing approaches, see World Bank, 2014b.

Figure 4. Disaster Financing Risk Layering Model

Probability of Frequency of Event (size of shock)	Ex-ante Financing	Ex-post Financing
5 percent or ≤ 20 years (≤ 3 percent of GDP)	Budgetary reserves	Emergency budget allocations
3.33 percent or 20-30 years (≤ 5 percent of GDP)	Contingent loans	Emergency loans
1 percent or 30-100 years (≥ 5 percent of GDP)	Insurance and reinsurance	…
0.5 percent or 100-200 years (≥ 5 percent of GDP)	Catastrophe bonds	Grants and humanitarian aid
Below 0.5 percent or ≥ 200 years (≥ 5 percent of GDP)	Global partnerships, exogenous shocks and pandemics	

Source: IMF, based on Clarke and Dercon, 2016.

66. **Actual practice suggests some degree of optimization of disaster financing**. For this paper, sources of financing were examined for 24 disasters of different sizes affecting small developing states in 1995-2015 (Table 4 and Annex VII). Data were compiled on the amount of disaster damages (EM-DAT database) as well as the estimated sources of fiscal and balance of payments financing.[49] The results suggest some degree of risk layering of financing. For the smallest disasters, financing appears to come from internal resources, as recommended by the risk layering model, since there is no identified increase in external financing.[50] For medium-sized disasters, there is a clearer diversification of financing sources—involving both domestic bank credits as well as external grant and loan financing. For the largest disasters, there is less use of domestic bank financing, and more exclusive reliance on external resources—including the use of remittances by the private sector.[51] This country survey suggests that small states have access to sufficient external financing to cover mid-sized but not the largest disasters. In the latter case, new external financing over a three-year period covered less than half of the estimated disaster losses. This suggests that recovery from the largest disasters is either typically incomplete, or a process that stretches well beyond three years, implying extended costs from sub-par infrastructure.

[49] The data do not explicitly identify insurance receipts, but these are believed to be small relative to other flows, with some exceptions.

[50] With no evident drawdown of international reserve cover, it appears that any additional need for foreign exchange was covered by increased inflows.

[51] The results do not change when the size of disasters is measured by the number of people affected, for a which a larger sample is available.

B. Risk Financing Toolkit

67. **The Fund can assist countries to identify disaster-related financing needs**. This could involve quantifying financing needs, based on an analysis of disaster risks and vulnerabilities and their possible fiscal impact. Financing needs could be segmented by date, distinguishing urgent financing needs (under 3 months), short term needs (under 1 year), and medium term needs (over 1 year). This would help to identify the necessary scale of fiscal buffers, access to financing, and/or risk transfer arrangements. The following paragraphs explore the different elements of the disaster risk financing tool kit in more detail.

Domestic financing and deposit buffers

Government deposits and access to domestic bank financing provide buffers for shocks, but have financial sector liquidity implications that need to be managed. They are best suited for less costly disasters.

Table 4. Sources of Post-Disaster Fiscal and BOP Financing

Disaster scale	Large Disasters (more than 35 percent of GDP)	Middle-range Disasters (2 to 35 percent of GDP)	Small Disasters (1 percent of GDP or less)
Sources of financing: 1/			
Reserve drawdown	No	No	No
Domestic bank financing	No	Yes	No
External grant financing	Yes	Yes	No
External loan financing	Yes	Yes	No
Remittances	Yes	No	No
Adequacy of BoP financing to cover losses			
Number of disaster events	8	8	8
Average losses (percent of GDP)	48	3	0.6
Additional ext. financing (percent of GDP) 2/	22	4.5	-1.8

Sources: IMF and EM-DAT data.
1/ Balance of payments data provided information on reserve drawdown and remittances; fiscal data provided information on domestic bank financing; and fiscal and BOP data provided information on external grant and loan financing.
2/ Cumulative change in annual average financing for disaster year and three following years compared to the annual average financing three years prior to the disaster. The over-financing of middle-range disasters is due to one outlier (Seychelles).

68. **Central and commercial bank financing may provide a limited buffer against shocks**. Where small states have a central bank with authority to provide budgetary financing, this may represent one option, albeit limited, for disaster-related financing. In general, central bank financing of the budget should be strictly limited on account of risks of fiscal dominance that could undermine monetary policy effectiveness. Disaster-related spending should also compete on an even-footing for fiscal resources, and should not have "special" access to central bank financing. Scope to borrow from domestic commercial banks is also likely to be limited, as

liquidity in the system may not be adequate to provide additional fiscal financing at a time when the banking system faces other financing and liquidity needs on account of the disaster. Overall, domestic borrowing is likely to be most useful in the context of small-scale disasters.

69. **Government deposit buffers provide an alternative to domestic borrowing.** In principle, such buffers are designed to cover early disaster response needs without compressing other priority spending until other sources can be mobilized. In some disaster-vulnerable countries in the Pacific, governments aim to maintain a deposit buffer equivalent to 3 months of recurrent spending. This buffer could, in principle, take the form of deposits in the government's general fund, a "virtual" contingency fund within the general fund, or a dedicated fund for natural disasters. The Fund can advise on the design and management of deposit buffers and the use of dedicated contingency funds (Annex VIII). An important general consideration is that the drawdown of deposit buffers within the banking system will have similar liquidity implications as government borrowing that will need to be managed. Where current deposit buffers are inadequate, the Fund can advise on strategies for accumulating assets.[52] As noted in the fiscal policy discussion, the timeline for building adequate buffers may depend on broader fiscal constraints, and would need to be specified consistently with the country's public investment and debt and asset management strategies, given the trade-off between building buffers, capital spending, and reducing debt burdens.

External borrowing and insurance

Contingent lines of credit help reduce ex ante disaster financing uncertainty, while insurance products allow for risk transfer, at a cost.

70. **Contingent lines of credit reduce external financing uncertainties**. Financing can be slow to arrange, particularly if markets perceive the disaster as having increased credit risks.[53] For these reasons, Clarke and Dercon (2016) argue for ex ante financing agreements that can be mobilized in the event of a disaster. Contingent financing arrangements can be arranged with bilateral, multilateral, and commercial creditors. At a bilateral level, for example, the Marshall Islands, Micronesia, and Palau benefit from compact agreements with the United States offering access to emergency support from relevant U.S. agencies, notably the Federal Emergency Management Agency (FEMA) and the United States Agency for International Development (USAID).[54] At the multilateral level, the World Bank's CAT DDO offers a pre-approved line of credit for countries experiencing disasters. Currently, this instrument is available only for middle

[52] For example, unspent amounts in a contingency fund could be accumulated as a fiscal buffer.

[53] For example, hurricane Ivan in the 2004 contributed to the debt default by Grenada in 2005.

[54] In February 2016, the government of the Marshall Islands declared a state of emergency, citing severe drought conditions, resulting from a protracted El Niño system. A subsequent declaration of emergency by the U.S. administration activated support from FEMA.

income countries, and the Seychelles is the only small state that has negotiated coverage.[55] The World Bank, with G20 financing, also recently established a Pandemic Emergency Financing Facility which could serve as a good model for natural disaster financing. The facility protects poor countries against pandemics using catastrophe bonds, reinsurance, and a cash window. Financing under the IMF's RCF and RFI are not fully contingent, in that they are subject to conditions for access;[56] however, the fact that these do not entail a Fund-supported program helps facilitate rapid disbursement. One downside to contingent credit is that the ex-ante fiscal costs of disaster relief remain uncertain and, even on an ex post basis, the fiscal impact is deferred until debt service falls due.

71. **More clarity in budgeting can be provided through insurance and other risk transfer arrangements**. By insuring public assets, governments can reduce uncertainties associated with direct exposure to disaster risks. Similarly, encouraging insurance of private property reduces the risk that the public sector will be called on to cover private losses. Empirical research has shown that countries with more private and public insurance penetration experience far lower output and income losses from disasters.[57] Prompt insurance compensation reduces downtime for productive assets, reduces disruption of infrastructure, and indemnifies producers for income losses. The research suggests that countries with relatively low insurance penetration stand to benefit the most because they have relatively more unprotected earning assets compared to countries nearing saturation. However, uptake of insurance coverage should reflect cost-benefit considerations. For disaster financing in Ethiopia, Clarke and Dercon (2016) show that a financing strategy that includes insurance is far less costly than other options when disasters are large (i.e., 1-in-30 year events), but this advantage declines with smaller, more common events. Similarly, Bevan and Adam (2016) show that insurance is less costly than tax increases and expenditure reallocation for some disasters.

72. **Traditional indemnity insurance of physical assets is not widespread in small states.** The cost of indemnity insurance is high, especially where markets are underdeveloped and competition is limited.[58] High premiums can also reflect the high probability and cost of disasters in small states. As a result, uptake is low, with premium payments for non-life cover averaging just 1 percent of GDP for typical small states. That said, Belize and Grenada rely on traditional insurance against severe natural disasters. In Grenada this covered about 4.5 percent of total

[55] Discussions are underway as part of the IDA 18 replenishment to make the CAT DDO available to IDA countries, including small island states.

[56] For example, that the country faces an urgent balance of payments need, and that this is expected to be resolved within one year and that no major policy adjustments are necessary to address underlying balance of payments difficulties.

[57] See for example Melecky and Raddatz (2011), von Peter and Saxena. (2012), and Munich Re (2013).

[58] Market development is not the full explanation, since use of disaster insurance is low even in advanced economies facing lower disaster probabilities. Japanese insurance coverage is one of the highest in the world at more than 10 percent of GDP. But earthquake insurance covers less than 30 percent of property, and covered only about 15 percent of the losses in the 2011 earthquake.

damages (9.2 percent of GDP) in a recent large disaster. There is some evidence from developing countries that traditional insurance for disasters has been more successful and sustainable under public-private partnerships than under exclusively private or public options. In considering this option, contingent risks to the budget would need to be carefully monitored. At the same time, the private market can be supported through better regulation and supervision, and there may be a role for some level of mandatory catastrophe insurance.[59]

73. **Innovative approaches for sharing natural disaster risks have emerged over the past decade**. Parametric insurance has emerged as a complement to regular indemnity insurance. Rather than covering specific physical assets, it is effectively an options contract that pays out in the event of a disaster that exceeds a pre-specified severity. Triggers for payout can be specified, for example, in terms of storm, flood, or earthquake intensity (measured according to third party data). Parametric insurance is quick-disbursing, but costs can be high because the market for cover is still developing. In some cases, economies of scale have been achieved by pooling cover at a regional level. A second innovation has been the development of catastrophe (CAT) bonds, which are issued as financing instruments by disaster-vulnerable countries. In exchange for a generous coupon payment, investors agree to forgive the bond principal in the event of a disaster (as measured by a parametric trigger). This releases resources from debt service to finance disaster response. Further details on these approaches are provided in Annex IX.

74. **The Fund can support insurance development in several ways**. Technical assistance on debt management strategies could be extended to include approaches for assessing the optimal mix of debt and insurance instruments. Since insurance is an alternative to debt-financing of disaster relief, countries need to understand how to balance debt against insurance (i.e., risk retention against risk transfer). This involves adopting a framework that weighs the costs of borrowing (debt service costs, market access risks) against the costs of insurance (insurance premia, basis risk). By helping countries better understand these tradeoffs, Fund expertise would help countries decide on what type and level of insurance coverage to purchase. The Fund can also help identify approaches to promote sustainable development and oversight of private insurance markets, including through FSAPs and FSSRs. A deeper dialogue with the insurance industry would make the Fund contribution more effective in this area.

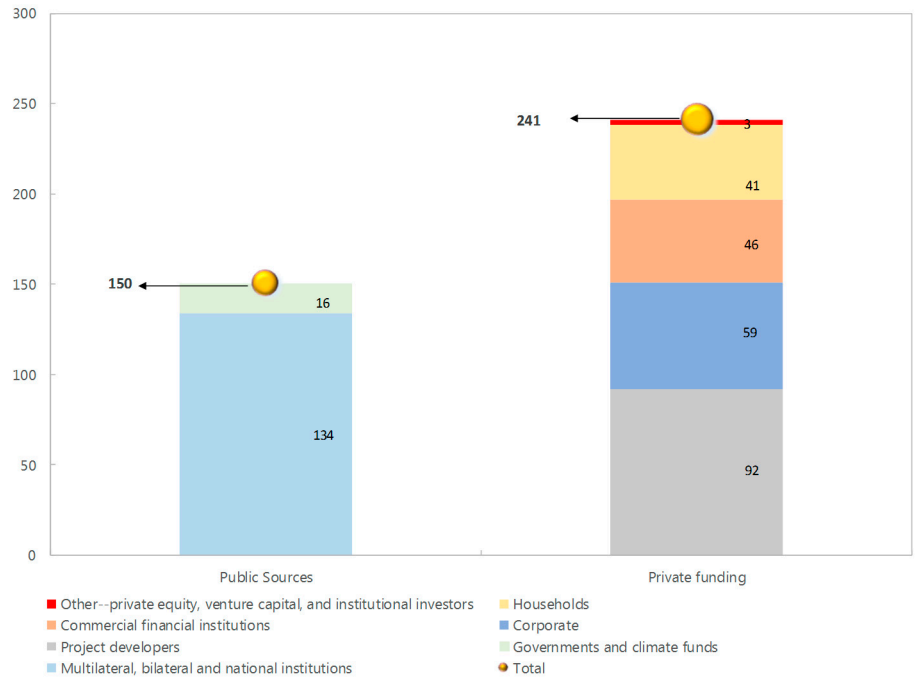
C. Climate Change Financing

Small states have begun to access global climate funds, but their needs remain under-funded by as much as $1 billion annually. Moreover, available financing is biased toward mitigation (reducing greenhouse gas emissions) rather than adaptation needs (adjusting to the impact of climate change). Access to climate change financing is complex and administratively cumbersome, hampering access by small states with weak capacity.

[59]New Zealand increased its coverage against earthquakes to about 90 percent of all residential buildings following the introduction of mandatory insurance**.**

75. **Estimated global financing for climate change currently approaches $400 billion annually**. According to the most comprehensive source, cumulative financing (public and private) reached US$391 billion in 2014 (Figure 5). The private sector accounts for the largest share, with investments predominantly in carbon emissions mitigation in advanced and emerging countries. However, data on climate change financing are subject to a large degree of uncertainty. The architecture of climate finance is complex and evolving rapidly with a multiplicity of initiatives. International financial institutions, multilateral mechanisms, and climate funds operate side by side with national development assistance agencies, bilateral and national funds. The fragmentation of financing sources hampers the consistency and quality of data as different entities report according to their own definition, level of detail, frequency, and with different quality control procedures.[60] Despite recent efforts to improve the situation, significant data gaps remain, particularly for private financing and public financing that is not channeled through multilateral or national development banks.[61]

Figure 5. Global Climate Finance Flows (2014, US$ billions)



Source: Climate Policy Initiative (2016)

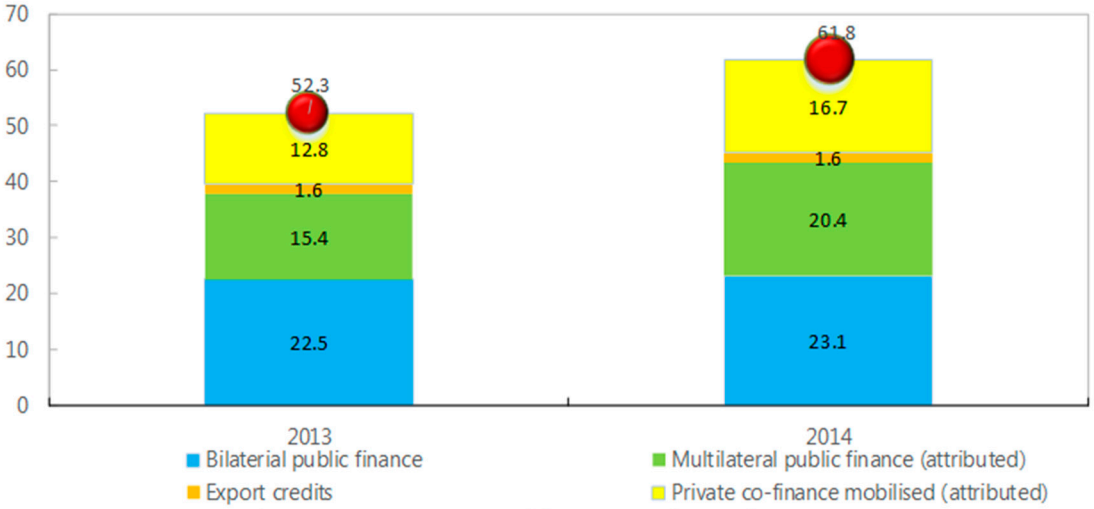
[60] The operational definition of climate finance recommended by the UNFCCC states that "*Climate finance aims at reducing emissions, and enhancing sinks of greenhouse gases and aims at reducing vulnerability of, and maintaining and increasing the resilience of human and ecological systems to negative climate change impacts.*" (UNFCCC, 2014).

[61] Including estimates of private investment in energy efficiency and domestic public financing, global climate finance would reach US$933 billion in 2014, which is still small compared, for example, with the US$1.6 trillion invested in fossil energy (UNFCCC, 2016).

76. **Developed countries have committed to jointly mobilizing US$100 billion of climate change financing for developing countries by 2020.** In the 2009 Copenhagen Conference of Parties (COP15) to the United Nations Framework Convention on Climate Change (UNFCCC), developed countries agreed that this amount should be raised each year from both public and private sources with a balanced allocation between *mitigation* (reducing greenhouse gas emissions) and *adaptation* (adjusting to the impact of climate change). The 2010 Cancun Conference (COP16) affirmed a clear priority for adaptation finance to the most vulnerable developing countries. The commitment to the US$100 billion goal was strengthened at the 2015 Paris conference (COP21), with a concrete roadmap agreed upon by 38 advanced countries to help developing countries to develop and implement mitigation contributions and adaptation plans, scale-up climate finance and significantly increase finance for adaptation.[62]

77. **A rough estimate suggests that financing for low-income countries has reached the $50-60 billion range**. Based on data compiled by the OECD and Climate Policy Initiative, financing flows increased from $52 billion in 2013 to $62 billion in 2014 (Figure 6). Official bilateral and multilateral sources comprise around 70 percent of the total, the majority in the form of grants and concessional loans. Based on current commitments, OECD projections suggest that financing flows could approach $100 billion by 2020.[63]

Figure 6: Progress Toward the S$100 Billion Goal, 2013–14 (US$ billion)



Source: OECD-CPI, 2015, *Climate Finance in 2013-14 and the USD 100 Billion Goal.*

78. **Climate change financing for small developing states is also growing, but from a low base**. Climate finance increased significantly after COP15, but the overall amount remains

[62] Roadmap to US$100 Billion.

[63] OECD, 2016b.

small, reaching less than US$1 billion in 2014 (Table 5). Multilateral development banks play a key role, having channeled $444 million to small states in 2014.[64] In the same year, direct assistance from bilateral donors amounted to US$368 million while US$140 were provided by dedicated multilateral and bilateral climate funds.[65]

Table 5. Climate Change Financing to Small Developing States – 2014
(US$ millions)

Multilateral development banks 1/	444
Bilateral officials sources	368
Climate funds	140
Total	**952**

1/ Data for the 39 members of the Alliance of Small Island States (AOSIS).

Source: IMF staff elaborations on OECD DAC and ODI-Climate Finance Update databases and AfDB, ADB, EBRD, IDB, IFC, and WB (2016a).

79. **A majority of small states financing is for climate change mitigation, falling short of adaptation needs**. Although COP16 placed increased emphasis on adaptation for low-income and small developing countries, mitigation still accounts for some 58 percent of total climate change financing for small developing states. According to the most recent estimates, global adaptation costs are 2 to 3 times higher than international public finance available for this purpose and to close this gap adaptation finance would have to be between 6 to 13 times larger by 2030 (United Nations, 2016). For small states, in 2010 the World Bank estimated a shortfall in annual adaptation financing relative to their needs of about $800 million (Margulis and Narain, 2010). Of this shortfall, 66 percent was for Caribbean states, 27 percent for Pacific states, and 7 percent for Africa and the Indian Ocean. Adaptation priorities vary across small states, with the infrastructure representing the largest cost, and expected to increase over time with

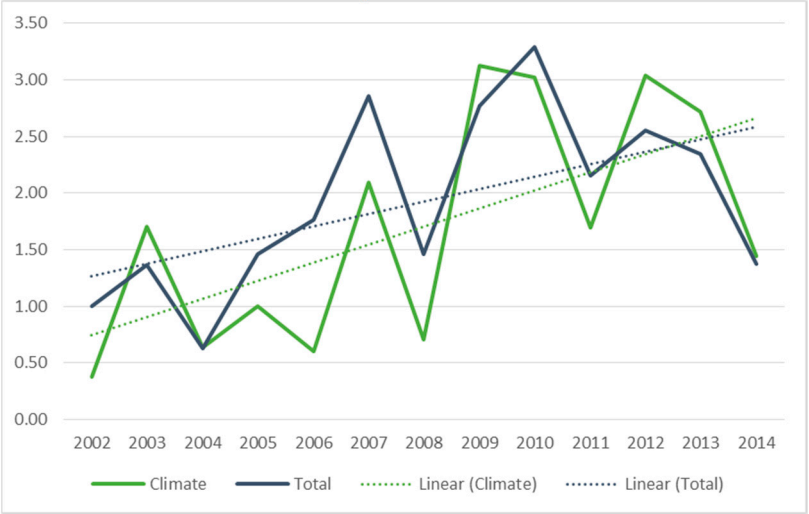
[64] Figures for multilateral development banks (MDBs) are based on data on MDBs' own resources included in African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, European Investment Bank, Inter-American Development Bank, International Finance Corporation, and World Bank (2015a). These data are only available for the 39 members of the Alliance of Small Island States (AOSIS) (list available at http://aosis.org/about/members/.) which likely overestimates the amount directed to the sample of 34 small developing states.

[65] Among the various programs, the most active are the *Pilot Program for Climate Resilience* (PCCR) under the *Strategic Climate Fund* (SCF), which is part of *Climate Investment Funds* (CIFs) hosted and administered by the World Bank; the *Least Developed Countries Fund* (LDCF), which is part of the *Global Environment Fund* (GEF) under the UNFCCC, but also hosted by the World Bank; the *Global Climate Change Alliance* (GCCA), established by the European Union to target LDCs and SIDS; the *Adaptation Fund* (AF) under the UNFCC. The new *Green Climate Fund* (GCF) under the UNFCCC has already approved several projects for small developing states.

urbanization. Other priorities include investments in coastal zones, water supplies, agriculture, human health, and preparedness for extreme weather events.

80. **Additionality of climate change financing is a concern for small developing states**. Bilateral and multilateral climate finance may crowd out pre-existing commitments. Indeed, over the last decade, bilateral climate finance to small developing states has increased more rapidly than overall official development assistance (Figure 7). Projections suggest that aid to these countries will stagnate at current levels going forward. Moreover, in addition to the data issues mentioned above, tracking progress toward the US$100 billion goal is complicated by the difficulty to distinguish between resources made available by donors under previous commitments and new and additional resources.

Figure 7. Small developing states' share of ODA flows
(percent)



Source: IMF staff elaborations on OECD CRS database

81. **Eligibility criteria for financing are complex and administratively cumbersome for small developing states**. The multiplicity of funding sources and intermediaries has given origin to an equally fragmented set of criteria that regulate the flow of climate funds. While multilateral development banks have adopted broadly harmonized principles to guide eligibility and disbursement for climate-related projects, criteria for climate funds and bilateral initiatives vary markedly. Eligibility criteria for the main existing funds include: (i) being a party to the UNFCCC eligibility/Kyoto Protocol; (ii) eligibility for general financing/technical assistance from the institution (IFAD, World Bank, UNDP), including debt sustainability and macroeconomic context; (iii) consistency with the funding institution's strategic objectives or themes/ specialization; (iv) consistency with national plans/strategies; and (v) recipient government's commitment, etc. In many cases, applicants are required to have coherent national climate plans already in place. Fulfilling the conditions for access to available funds can be a challenge for small developing

states with low capacity.[66] While most governments and financing partners recognize the need for more effective coordination and partnership in climate change financing, efforts are at an early stage. A particular challenge is to adjust administrative procedures to the scale of small states' funding needs.[67]

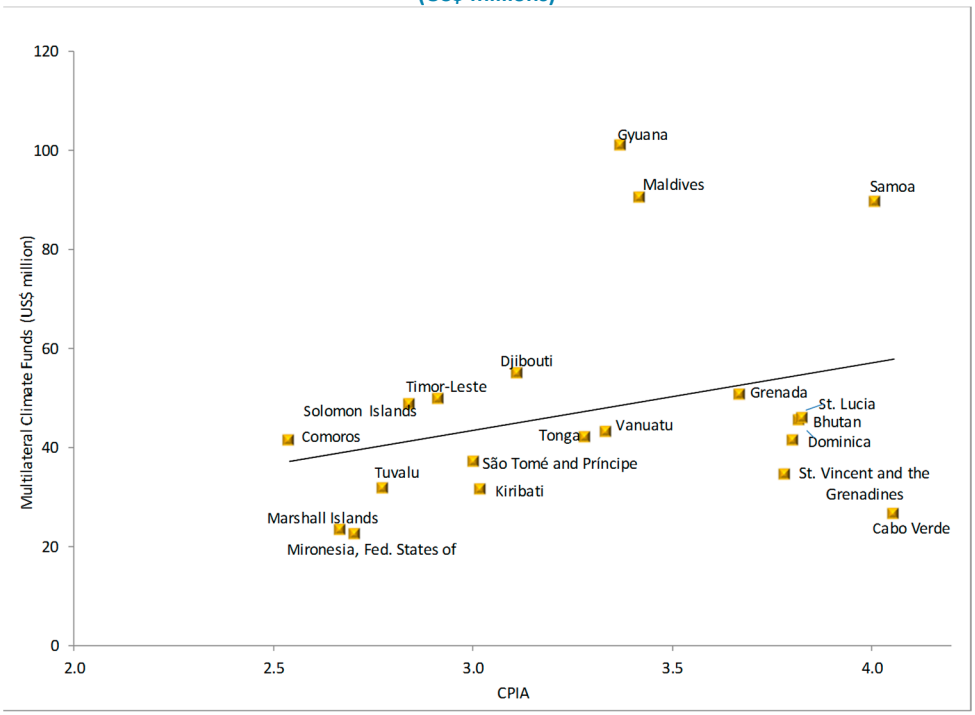
82. **Strengthening administrative capacity will be critical for helping small developing states access climate change financing**. Adequate administrative capacity is essential to coordinate domestic institutions to access, manage, and use climate finance in an effective manner. Indeed, small developing states with lower institutional capacity have less access to multilateral climate finance (Figure 8).[68] Also, supporting policies may be necessary to promote adaptation efforts and governments can play an important role. Policy intervention can help overcome market failures and promote private sector adaptation. Key factors for an enabling domestic environment are stable domestic policies and consistent legal and regulatory frameworks. These factors can help attract and absorb international climate finance while ensuring the effective and accountable use of the funds.

[66] Recognizing the need to bolster small states' access to climate change funding, a Commonwealth Climate Finance Access Hub was launched in 2016. Located in Mauritius and co-financed by Australia and the Commonwealth Secretariat, the hub will place climate finance advisors in small states for periods of 1-2 years to help host ministries identify and apply for climate change funding.

[67] A forthcoming OECD/World Bank report finds that over half of the climate and disaster resilience projects in SIDS are smaller than $200,000, and that the combined total of SIDS projects represents just 2 percent of global projects.

[68] This result holds even when controlling for the level of per capita income.

Figure 8. Institutional Capacity and Access to Multilateral Climate Finance, 2003-2015
(US$ millions)



Source: IMF staff calculations on ODI-Climate Funds Update database and World Bank CPIA database. Based on 20 out of 34 small developing states with reported CPIA scores.

THE FUND'S ROLE IN FINANCING[69]

A. IMF Financing for Natural Disasters

The Fund plays an important niche role in meeting member's post-disaster financing needs. RCF and RFI financing is disbursed rapidly and has a valuable catalytic impact.

83. **IMF financing is a valuable component of the disaster risk financing tool kit for small developing states** (Annex X). The Fund's comparative advantage is fast disbursement of resources to meet urgent balance of payment and fiscal financing needs. For large-scale funding for rebuilding, development institutions take the lead.[70] While Fund resources are not automatically available following disasters, financing is typically approved within three months across the Fund's instruments and facilities. Disaster financing is available on concessional terms for PRGT-eligible members, among them a number of small islands and micro states with per

[69] Prepared by Peter Allum, Mai Farid and Dan Nyberg.

[70] For instance, the World Bank typically concentrates on infrastructure and housing during the reconstruction (Annex VI); the United Nations Development Program (UNDP) focuses more on the social aspects of recovery.

capita incomes above the normal threshold for PRGT eligibility.[71] Fund financing is expected to play a catalytic role in mobilizing other external financing, with early engagement in assessing the member's post-disaster fiscal and balance of payments financing needs and its macroeconomic policy framework providing a basis for others to step in.

84. **Small states are disproportionate users of disaster-related financing**. Of the 49 instances of disaster-related Fund lending since 2000, small states accounted for a little over one-third, roughly double their proportion of the Fund's membership (Annex Table 2). This reflected disproportionate use of the Fund's emergency financing facilities and instruments (Emergency Natural Disaster Assistance facility (ENDA), ESF-RAC, and subsequently RCF and RFI), where small states accounted for 60 percent of the number of disbursements since 2000. By contrast, small states were much less likely to obtain disaster-related financing through augmentation of existing Fund arrangements. Fund support for small states covered a range of disasters, spanning storms, floods, drought, earthquakes, and tsunamis (Annex Tables 1-2).

85. **Not all small states experiencing disasters have sought Fund financing.** Of the 53 natural disasters reported by EM-DAT for small states since 2000, the Fund provided financial assistance in only 16 cases. These cases did not include two disasters with damages of more than 30 percent of GDP and 3 other disasters with damages in the range 20-30 percent of GDP.[72] This likely reflects an ability to meet urgent BOP needs on favorable terms without Fund financing, a situation that will likely continue to apply in some cases in the future.

Merits of expanded program engagement

A broader pattern of program engagement with small states could help build disaster resilience.

86. **Greater use of the Fund's arrangements and Fund-supported programs would offer several advantages.** Consistent with the thrust of this paper, it would support an ex ante approach to developing institutions and policies for responding to natural disasters. In particular, it would provide a structured framework for the design, implementation, and monitoring of resilience-building policies, and could help coordinate the delivery of capacity building. Program reporting on disaster preparedness could also help countries access other sources of external financing on better terms, including on a contingent basis. In this connection, program engagement could help structure collaboration between the Fund and other financing partners, including the World Bank. From the perspective of Fund financing, an arrangement can be

[71] Currently there are 13 countries benefitting from this higher income threshold: Cabo Verde, Dominica, Grenada, Kiribati, Maldives, Marshall Islands, Micronesia, St. Lucia, St. Vincent and the Grenadines, Samoa, Tonga, Tuvalu, and Vanuatu.

[72] Belize (2000) and Guyana (2005) for damages exceeding 30 percent of GDP; Belize (2001), Tonga (2001), and The Bahamas (2004) for damages between 20 and 30 percent of GDP.

quickly augmented in the event that a new natural disaster exacerbates balance of payments need.[73]

87. **Program engagement should meet small states' specific needs**. The low interest in program engagement in the past likely reflects both capacity and policy considerations.[74] With limited administrative capacity, small states are taxed by the resources needed for program design and implementation. At the same time, small states may perceive the Fund's program conditionality as mismatched to their country priorities. These concerns could be addressed by ensuring that, where potential balance of payments needs relate primarily to disaster risks, policies under a Fund-supported program would be streamlined and focused squarely on building resilience.

88. **A range of options for program engagement are available**. Depending on balance of payments needs and the timeframe for strengthening policy frameworks, this could be through multi-year disbursing arrangements under the ECF or EFF, or through precautionary arrangements (SBA or SCF). A subset of small states would also qualify for the support through the Policy Support Instrument (PSI). Precautionary arrangements would accumulate access rights that could be exercised (and potentially augmented) in the event that a balance of payments need arises during the arrangement period, while qualification for an SCF would be presumed for an on-track PSI if a balance of payments need emerges as a result of natural disaster. The goal of program engagement would be to help countries transition to a level of preparedness and resilience for which ongoing program engagement would not be needed, with Fund financing potentially available as part of the safety net for shocks financing.

Use of the Fund's emergency financing facilities and instruments

Access limits under the RCF and the RFI were increased in 2015, albeit with uneven implications across small states, depending on quota increases under the 14th General Review. Access remains low in relation to the largest natural disasters, where small states are most vulnerable.

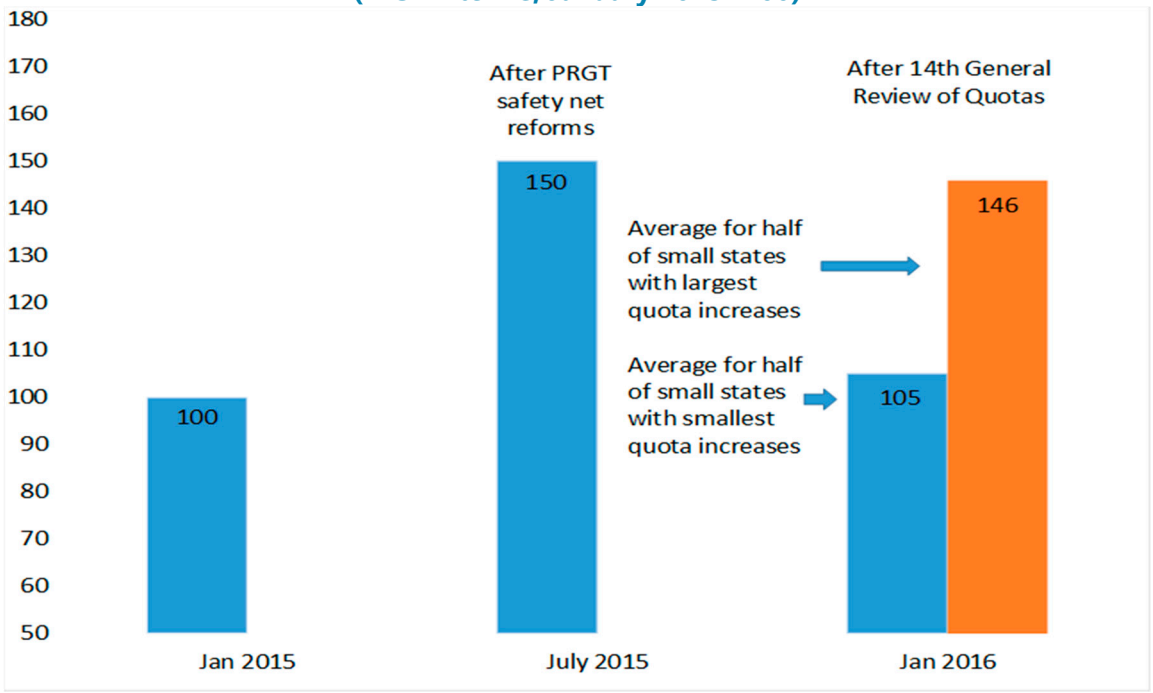
89. **In the July 2015 Board discussion of the financial safety net for developing countries, access limits under the RCF and RFI were increased by 50 percent**. This step, taken with a broader increase in access limits under the PRGT, was designed to redress an erosion of access norms relative to GDP, trade, and gross financing needs (see IMF, 2015b). The increase in access under the RCF and RFI was seen as particularly important to support small states hit by natural disasters and other shocks. The increase in access did not, however, fully reverse the two-thirds cumulative erosion of RCF access since 2004 measured vis-à-vis standard economic metrics. Moreover, when access limits under the PRGT facilities and RFI were halved in 2016 with the doubling of Fund quotas under the 14th General Review, this was to the relative disadvantage

[73] For example, ECF augmentation provided Djibouti with resources after the 2012 drought.

[74] While small states represent 18 percent of the Fund's membership and 29 percent of PRGT-eligible countries, they accounted for just 12 percent of PRGT-supported programs approved since 2000 and only 8 percent of new GRA arrangements (with the latter figures including a few cases of blended PRGT/GRA arrangements).

of the majority of small states, whose quotas rose by less than 100 percent. As a result, the half of small states that received the smallest quota increases saw only a minor increase in the SDR value of access to RCF and RFI financing as a result of the 2015-2016 reforms (Figure 9).

Figure 9. Annual Access Ceilings under RCF and RFI (in SDR terms, January 2015=100)



Source: IMF Staff.

90. **The RCF/RFI safety net is small in relation to the largest natural disasters**. Severe disasters are likely to result in larger immediate balance of payments needs, and while Fund financing is typically higher in such cases, the increase is not fully in proportion to disaster costs. Thus, for smaller disasters (defined as involving costs of less than 30 percent of GDP), Fund emergency financing was equivalent to 11.6 percent of disaster impact, while the equivalent figure was 2.4 percent for larger disasters (with costs in excess of 30 percent of GDP) (see Annex Table 2). Some decline in the Fund's relative role might be expected, to the extent that larger disasters involve larger reconstruction efforts financed by bilateral creditors, regional development banks, and commercial creditors. However, there is evidence that, for the most severe disasters, the need for Fund financing can exceed the current annual RFI financing limit and the corresponding RCF limit under the shock window (37.5 percent of quota). For example, in 2015, following hurricane damage to Dominica and cyclone damage in Vanuatu, Fund financing under the RCF and RCF/RFI blends were approved in amounts equivalent to 53.5 and 71.4 percent of current quotas.

91. **Fund arrangements are not seen as a good substitute for the RCF/RFI safety net for severe disaster cases**. In principle, where the RCF and RFI cannot meet immediate disaster-related BOP needs, members can request a Fund arrangement—which, as discussed above, could support resilience-building policies. However, in the immediate aftermath of a severe disaster countries find it difficult to free up policy-making resources for discussions with the Fund on medium-term policy frameworks.[75] Given this, and with the prospect that disasters could become progressively more severe with climate change, greater access appears warranted for the RCF and RFI to meet the immediate balance of payments needs of members facing severe natural disasters.

92. **To round-off the 2015 financial safety net reforms, consideration could be given to higher RCF/RFI access limits for countries impacted by severe disasters**. Indeed, this approach was suggested by a few Directors in 2015. Reforms could be framed as outlined below. In the event of Board support, a formal proposal could be developed for Board consideration.

- **Annual access**. For countries impacted by severe disasters, defined as causing damage of 30 percent of GDP or higher, the annual access limit under the RCF and RFI would be set at 60 percent of quota. In all other cases, the current annual access limit would apply (37.5 percent of quota). As at present, access would be determined on a case-by-case basis, based on balance of payments need, capacity to repay, and the catalytic role of Fund financing. The augmented access limit would apply to the full Fund membership—though, as discussed below, countries experiencing disasters of this scale tend to be smaller states.[76]

- **Cumulative access limits** would remain unchanged at 75 percent of quota. Where countries benefit from higher RCF/RFI access under the severe disaster window, this would reduce remaining cumulative access below 37.5 percent of quota.

- **Measurement**. Damages, for above purposes, would comprise the value of destruction of physical assets plus foregone output, measured relative to pre-disaster GDP projections. In measuring disaster damages, the Fund would draw on assessments by the national authorities, UNDP, World Bank, and other relevant agencies.

- **Letter of intent**. For countries seeking financing within the augmented RCF or RFI window, an expectation could be established that the authorities' letter of intent should document existing and planned practices in regard to the adoption and implementation of disaster risk reduction approaches. This documentation requirement would not slow access to Fund financing and would not establish conditionality. However, it would allow the Board to assess the adequacy of policy efforts to manage disaster risks, including the potential need for

[75] Indeed, good practice suggests that the design of a disaster risk management framework involve a wide group of counterparts, including other development partners, different levels of government, the private sector, and non-governmental organizations. Thus, a Fund arrangement designed to promote resilience-building would normally involve a broad and potentially time-intensive consultative process.

[76] RFI assistance would continue to count toward the applicable RCF annual and cumulative access limits, but not vice versa.

capacity building support for such efforts in the post-disaster period. Moreover, consistent with current policy, higher access under the RCF shocks window would only be expected in cases where the member's existing and prospective policies are sufficiently strong to address the shock.

93. **Eligibility for the augmented access window for severe disasters would be relatively rare**. Historically, fewer than one-in-ten disasters in small states resulted in damages of 30 percent of GDP or higher, a ratio that falls below one-in-one hundred for larger states (Text Figure 1). Over the period 2000-2015, eleven countries would have met the proposed threshold (Table 6).[77] Of this group, ten were PRGT eligible, nine were small states, and nine sought Fund financing, generally through the Fund's emergency facilities and instruments.

94. **An augmented access limit for the RCF and RFI would result in only modest additional demand for Fund resources**. On the assumption that the augmented access limit is used, on average, roughly once each year, and given the typical size of countries that may prove eligible, the additional demand on PRGT and GRA resources is projected to be limited.[78] Importantly, the proposed reform would preserve the financial sustainability of the PRGT.[79]

[77]A further country, Kenya, would have come very close, with a drought causing damages equivalent to 28.8 percent of GDP.

[78]Based on the historic occurrence of natural disasters across countries, their scale in relation to GDP, and country quotas, projections for additional RCF loan demand would under most scenarios remain within less than 5 percent of the annual average lending capacity of the PRGT, and well within the observed swings in loan demand the PRGT is equipped to cope with (IMF, 2016c).

[79]Ring-fencing access to countries facing disaster damages of more than 30 percent of GDP reduces potential loan demand considerably compared to the option of an across-the-board increase in RCF and RFI access limits. The potential impact on PRGT and GRA loan demand would likely remain modest with other relatively high thresholds (e.g., 20 or 40 percent of GDP). However, raising the threshold above 30 percent of GDP could make use of the new access window unnecessarily rare. Given inevitable uncertainties around the costing of disaster impacts, a much lower threshold could also result in some smaller disasters being overstated to access the new financing window. After several years' experience, use of the higher access window and the associated disaster damage threshold could be reviewed.

Table 6. Countries Experiencing Severe Natural Disasters, 2000—15

Country	Year	Disaster	Damage (% of GDP)	Small state	PRGT-eligible [1/]	Request for Fund financing
Belize	2000	Storm	33	Y	…	…
Grenada	2004	Hurricane	200	Y	Y	ENDA
Maldives	2004	Tsunami	50	Y	Y (B)	ENDA
Guyana	2005	Flood	36	Y	Y (B)	…
Dominica	2009	Hurricane	35	Y	Y	ECF augmentation
Haiti	2010	Earthquake	121	…	Y	ESF-RAC
St. Lucia	2011	Hurricane	34	Y	Y	RCF/ENDA
Samoa	2013	Cyclone	30	Y	Y	RCF
Nepal	2015	Earthquake	33	…	Y	RCF
Vanuatu	2015	Cyclone	60	Y	Y (B)	RCF/RFI
Dominica	2015	Flood	96	Y	Y	RCF

Source: Damage estimates from EM-DAT, IMF staff reports, and World Bank PDNAs.

1/ The "B" signifies countries presumed to blend RCF and RFI access.

95. **The narrowly-targeted nature of the reform would limit moral hazard considerations**. While the additional Fund access would provide important balance of payments support, at the margin, for the most severe disasters, it would be available only rarely. Further, Fund financing would remain small in relation to total damages. As a result, members would retain strong incentives to develop other contingent financing arrangements and to adopt policies that foster risk reduction. The expectation that such policies would be discussed in the authorities' letter of intent would help identify cases where preparedness falls short. This could help inform discussions on a possible successor arrangement in support of resilience building.

96. **The reform would not encourage facilities shopping**. Countries typically seek stand-alone shocks financing under the RCF/RFI, rather than requesting Fund arrangements (either on a stand-alone or parallel basis). As such, the proposal for augmented access would have no material impact on facilities shopping.[80] The unchanged cumulative access limit for the RCF and RFI would maintain incentives for countries to shift toward financing under Fund arrangements in the event of repeated large disasters.

97. **The impact of Fund financing will inevitably depend on a very large catalytic role**. Even with scope for higher access under the RCF and RFI, the proportion of disaster costs to be

[80] The recent issued Board paper on "Financing for Development: Enhancing the Financial Safety Net for Developing Countries—Further Considerations" discusses the repeated use of the RCF, and finds no evidence of misuse of the RCF in terms of facilities shopping (see IMF, 2016d).

met from other financing sources would remain very large.[81] The Fund would continue to play an important catalytic role in identifying balance of payments needs, providing quick-disbursing funds for immediate needs, and confirming a sound macroeconomic framework for disaster relief and recovery. In the case of severe disasters, the ability of members to access a rarely-used higher access window could send a strong message of the Fund's support, helping trigger comparable exceptional support from other development partners, which will likely involve large scale grants to maintain sustainable debt positions.

B. Role of the Fund in Climate Change Financing

The Fund's role in helping countries develop policies for climate change mitigation and adaptation suggests that tailored assessments of progress in these areas could help countries access global climate funding.

98. **The Fund could support global efforts to combat climate change by assessing and advising on countries' macroeconomic policies as they relate to climate change preparedness**. These assessments could be conducted in collaboration with the World Bank, with the Fund covering macroeconomic policy goals and implementation in its areas of competence. The latter include the adoption of energy taxes and subsidy reforms that appropriately price carbon emissions; the quality of frameworks for managing public infrastructure investments, including in climate change mitigation and adaptation; the strength of public finance management systems and their capacity to effectively intermediate budget resources dedicated to climate change programs; and the consistency of climate change spending programs with goals for fiscal and debt sustainability and macroeconomic absorption capacities.

99. **Climate change policy advice could help countries develop coherent macro policy frameworks**. Under the UN Framework Convention on Climate Change, countries have communicated Intended Nationally Determined Contributions (INDCs), specifying steps to be taken in the context of their own national circumstances, capabilities and priorities to help reduce global greenhouse gas emissions. Over the period through 2020, these INDCs will be formalized as national climate change programs which, in turn, should be aligned with overall national development strategies. To support this process, the Fund can advise countries on how to create sustainable fiscal space for climate change programs, PFM and investment management tools, and good international practices as regards energy taxation and carbon pricing. Fund engagement would be particularly important where domestic policy capacity is limited—for example in small states and fragile states.

[81] Annex table 2 suggests that average shocks facility financing of 36 percent of quota met just 2.4 percent of disaster damages for small states. Even with access of 60 percent of quota, Fund financing would remain only 4 percent of overall damages.

100. **Assessments could also help catalyze climate change financing**. Official bilateral and multilateral agencies have a strong interest in providing climate change financing to countries maintaining sound macroeconomic policy frameworks. In principle, a favorable Bank-Fund assessment of a country's climate change policy framework could simplify the process of qualifying for financing.[82] Staff have discussed the climate change financing process with the Green Climate Fund (GCF), World Bank, and UN agencies. These exchanges suggested that IMF macroeconomic policy assessments would be welcome, though further work would be needed to establish the specific role that Fund assessments could play in catalyzing financing. Given the current climate change financing architecture with fragmented responsibilities across multiple funds and agencies, the Fund's assessments would likely remain one of many factors determining funding decisions.

101. **Climate change policy assessments would have resource implications which would be funded through prioritization of existing resources**. Article IV surveillance would normally cover macroeconomic policies relating to climate change where these are macro-critical, but coverage would not typically be comprehensive across the areas identified above. A full assessment would typically require additional Fund resources, either to complement the Article IV consultation process or to staff a separate staff visit. This would involve additional effort of the country teams and drawing on technical assistance expertise, the sum of which would depend on the number and type of countries covered by the assessments. Given the Fund's budget ceiling, this would require prioritization of the work of the country teams and within the overall technical assistance resource envelope.

102. **Consideration could be given to IMF climate change policy assessments on a pilot basis**. Small and fragile states would be priorities for Fund engagement, given their more limited administrative depth. Given potential resource costs and the as yet uncertain catalytic impact of such assessments, a pilot approach would provide implementation lessons that could adapted more widely, depending on the Fund's evolving role in supporting members as they confront the macroeconomic challenges of climate change. A future review of the Fund's role in supporting climate change, including through such pilots, would be useful to help refine and guide policies.

ISSUES FOR DISCUSSION

103. **Directors may wish to discuss the following issues:**

- **Policy approaches**. Do Directors agree that strengthened domestic policy frameworks should play an important role in mitigating disaster vulnerabilities, and that a greater emphasis is needed on developing ex ante disaster risk management frameworks and integrating the macroeconomic elements into core public fiscal, debt, and financial management practices?

[82] Consideration could be given to providing climate change policy assessments as a form of technical assistance, with the expectation that the country assessment would be published.

- **Financing for natural disasters**. Do Directors agree that small states should seek to develop more ex ante financing arrangements, including insurance and other options for risk transfer? Do Directors see scope for the international community to better support small states by developing contingent financing arrangements and supporting regional insurance pooling arrangements?
- **Climate change financing**. Do Directors agree that enhanced access to financing for climate change adjustment is a priority for small states? Do Directors agree on the importance of developing less complex and administratively cumbersome application procedures to enhance financing access for small states?
- **IMF arrangements**. Do Directors agree that use of Fund arrangements by small states could help in developing policies and institutions necessary for resilience to natural disasters? Where natural disasters are the main factor giving rise to potential balance of payments need, do Directors agree that program design could be streamlined and focused on resilience building policies?
- **RCF and RFI financing**. Do Directors see merit in an increase in the annual access limits under the RCF and RFI to better meet the needs of members facing urgent balance of payments needs following severe natural disasters?
- **IMF climate change assessments**. Do Directors see value in IMF assessments of macroeconomic policies related to climate change mitigation and adaptation? Do they favor exploring such assessments, on a pilot basis, for small states in partnership with the World Bank?
- **Capacity building**. Do Directors agree that, with strained administrative capacity in small states, sustained Fund support will be critical across the full range of its activities, with a particular emphasis on capacity building?

References

Acevedo, Sebastian, 2014. "Debt, Growth and Natural Disasters: A Caribbean Trilogy," IMF Working Paper No. 14/125, (Washington: International Monetary Fund).

Acevedo, Sebastian, 2016. "Gone with the Wind: Estimating Hurricane and Climate Change Costs in the Caribbean," IMF Working Paper 16/199.

Asia Development Bank, 2013, "The Economics of Climate Change in the Pacific," (Manila: Asia Development Bank).

Barnett, J. and W. Adger, 2003, "Climate Dangers and Atoll Countries." Climatic Change, Vol. 61, pp. 321-337.

Bevan, David and Christopher Adam. 2016. "Financing the Reconstruction of Public Capital after a Natural Disaster." The World Bank Group, Washington, DC.

Bluedorn, J. C., 2005. "Hurricanes: Intertemporal Trade and Capital Shocks." Nuffield College Economics Paper, No. W22.

Buffie, E., A. Berg, C. Pattillo, R. Portillo, and L.F. Zanna, 2012, "Public Investment, Growth, and Debt Sustainability: Putting Together the Pieces," IMF Working Paper 12/144.

Burkett, M., 2011. "The Nation Ex-Situ: On Climate Change, Deteritorialized Nationhood, and the Post-Climate Era," Climate Law, Vol. 2, pp. 345-374.

Cabezon, E., L. Hunter, P. Tumbarello, K. Washimi, and Y. Wu, 2015. "Enhancing Macroeconomic Resilience to Natural Disasters and Climate Change in the Small States of the Pacific." IMF Working Paper No. 15/125, (Washington: International Monetary Fund).

Cavallo, E., and Noy, I., 2010, "The Economics of Natural Disasters: A Survey," IDB Working Paper Series No. 124, (Washington: International Development Bank).

Clarke, Daniel. 2016, "Disaster Risk Finance as a Tool for Development — A Summary of Findings from the Disaster Risk Finance Impact Analytics Project", The World Bank Group, Washington, DC.

Clarke, Daniel Jonathan and Stefan Dercon. 2016. "Dull Disasters? How Planning Ahead Will Make a Difference", Oxford University Press, Oxford; The World Bank Group, Washington, DC.

Clarke, Daniel, Mahul, Olivier, Poulter, Richard, and Tse Ling Teh, 2016. "Evaluating Sovereign Disaster Risk Finance — A Framework", Policy Research Working Paper No. 7721, Finance and Markets Global Practice Group, The World Bank Group, June.

Climate Policy Initiative, 2016, "Global Landscape of Climate Finance 2015".

Dell, M., B. Jones, and B. Olken, 2012. "Temperature Shocks and Economic Growth: Evidence from the Last Half Century." American Economic Journal: Macroeconomics 4(3): 66–95.

Dellink, R., E. Lanzi, J. Château, F. Bosello, R. Parrado, and K. Bruin, 2014, "Consequences of Climate Change Damages for Economic Growth: A Dynamic Quantitative Assessment," OECD Economics Department Working Paper No. 1135, (Paris: Organization for Economic Co-operation and Development).

Ewing, B. and Kruse, J., 2002. "The Impact of Project Impact on The Wilmington, North Carolina, Labor Market," Public Finance Review, Vol. 30(4), pp. 296-309.

Farid, M., M. Keen, M. Papaioannou, I. Parry, C. Pattillo, and A. Ter-Martirosyan and others, 2016. "After Paris, Fiscal, Macroeconomic and Financial Implications of Climate Change," Staff Discussion Note No. 16/01, (Washington: International Monetary Fund).

Guerson, A., 2016, "Assessing Government Self-Insurance Needs against Natural Disasters—An Application to the ECCU", ECCU Article IV Staff Report, Appendix, 2016.

Guha-Sapir, Debarati; Below, Regina; and Hoyois, Philippe (2015). EM-DAT: The CRED/OFDA International Disaster Database, (Brussels, Belgium: Université Catholique de Louvain). Available: www.emdat.be

Hallegatte S., B. Bangalore, L. Bonzanigo, M. Fay, T. Kane, U. Narloch, J. Rozenberg, D. Treguer, and A. Vogt-Schilb, 2015, "Shock Waves: Managing the Impacts of Climate Change on Poverty," Climate Change and Development Series, (Washington: The World Bank).

Healy, A., and N. Mulhotra, 2009, "Myopic Voters and Natural Disaster Policy," American Political Science Review, Vol. 103(3), pp. 387-406.

Hochrainer, S., 2009, "Assessing the Macroeconomic Impacts of Natural Disasters – Are there Any?" World Bank Policy Research, Working Paper No. 4968, (Washington: The World Bank).

IMF, 2003, "Fund Assistance for Countries Facing Exogenous Shocks," http://www.imf.org/external/np/pdr/sustain/2003/080803.pdf.

IMF, 2008, "Fiscal Risks—Sources, Disclosure, and Management", SM/08/154.

IMF, 2009, "Fiscal Rules—Anchoring Expectations for Sustainable Public Finances".

IMF, 2012a, "Fiscal Transparency, Accountability and Risk", FO/DIS/12/151.

_____, 2012b, "Natural Disasters: Mitigating Impact, Managing Risks" IMF Working Paper 12/45, 2012.

IMF, 2013a, Macroeconomic Issues in Small States and Implications for Fund Engagement, (February 20, 2013).

_____, 2013b, Asia and Pacific Small States— Raising Potential Growth and Enhancing Resilience to Shocks.

_____, 2013c, Caribbean Small States—Challenges of High Debt and Low Growth.

IMF, 2014a, "Making Public Investment More Efficient," FO/DIS/15/64, 2014.

_____, 2014b, "Staff Guidance Note on the Fund's Engagement with Small Developing States", 2014.

_____, 2014c, "Update on the Fiscal Transparency Initiative", August 2014.

_____, 2014d, "Sustaining Long-Run Growth and Macroeconomic Stability in Low-Income Countries—The Role of Structural Transformation and Diversification", FO/DIS/14/33, March 2014.

IMF, 2015a, "Making Public Investment More Efficient", IMF Policy Paper, June 2015.

_____, 2015b, "Financing for Development—Enhancing the Financial Safety Net for Developing Countries", June 2015.

_____, 2015c, "Macroeconomic Developments and Selected issues in Small Developing States", March 2015.

IMF, 2016a, "Analyzing and Managing Fiscal Risks: Best Practices", June 2016.

_____, 2016b, "Guidance Note on the Assessment of Reserve Adequacy and Related Considerations", June 2016.

_____, 2016c, "Update on the Financing of the Fund's Concessional Assistance and Debt Relief to Low-Income Countries", April 2016.

_____, 2016d, "Financing for Development: Enhancing the Financial Safety Net for Developing Countries—Further Considerations", October 2016.

Intergovernmental Panel on Climate Change, 2014. "Climate Change 2014: Synthesis Report Summary for Policymakers," Geneva.

Khonje, W., 2015, "Migration and Development: Perspectives from Small States". The Commonwealth Secretariat.

Kochhar, K., C. Pattillo, Y. Sun, and others, 2015, "Is the Glass Half Empty or Half Full? Issues in Managing Water Challenges and Policy Instruments." Staff Discussion Note No. 15/11, (Washington: International Monetary Fund).

Laframboise, N., and B. Loko, 2012, "Natural Disasters: Mitigating Impact, Managing Risks." IMF Working Paper No. 12/245, (Washington: International Monetary Fund).

Loayza, N., E. Olaberría, J. Rigolini, and L. Christiansen, 2009. "Natural Disasters and Growth—Going Beyond the Averages." World Bank Policy Research Working Paper 4980, (Washington: The World Bank).

Lee, D., P. Tumbarello, K. Washimi and T. Zeinullayev (forthcoming), "Mind the Gap: Public Investment, Growth and Natural Disaster Risk in the Small States of the Pacific," Working Paper, (Washington: International Monetary Fund).

Margulis, Sergio and Urvashi Narain, 2010, "The Cost to Developing Countries of Adapting to Climate Change: New Methods and Estimates — The Global Report on the Economics of Adaptation to Climate Change Study", The World Bank Group, Washington, DC.

McIntyre, Arnold, and others, 2016, "Caribbean Energy: Macro-Related Challenges", IMF Working Paper, WP/16/53, March 2016.

Melecky, Martin and Raddatz, Claudio E., 2011, "How do Governments Respond? Natural-Disaster Shocks and the Fiscal Stance, *World Bank Policy Research Working Paper No. 5564*.

Melina, G., S. Yang, and L.F. Zanna, 2014, "Debt Sustainability, Public Investment, and Natural Resources in Developing Countries: The DIGNAR Model," IMF Working Paper No. 14/50, forthcoming in *Economic Modelling*.

Munich Re, 2013, "Economic consequences of natural catastrophes: Emerging and developing economies particularly affected – Insurance cover is essential'. Position Paper, October 2013

Mwase, 2012, *"How Much Should I hold? Reserve Adequacy in Emerging Markets and Small Islands",* IMF Working Paper, WP/12/205.

Neumayer, E. and T. Plümper, 2007. "The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy, 1981–2002," Annals of the Association of American Geographers, Vol. 97(3), 551–566.

Noy, I., 2009, "The Macroeconomic Consequences of Disasters." Journal of Development Economics Vol. 88(2), pp. 221-231.

OECD, 2016a, "Climate Finance in 2013-14 and the US$100 Billion Goal", in collaboration with the Climate Policy Initiative (CPI), Venice.

_____, 2016b, "2020 Projections of Climate Finance Towards the USD 100 Billion Goal: Technical Note", OECD publishing.

Pacific Islands Forum Secretariat (PIFS), 2013, "Pacific Climate Change Finance Assessment: Nauru Case Study", in collaboration with Australian Aid and United Nation Development Program.

Parker, Miles, 2016, "The Impact of Natural Disasters on Inflation", Reserve Bank of New Zealand, DP2016/06.

Raddatz, C., 2007, "Are External Shocks Responsible for the Instability of Output in Low-Income Countries?" *Journal of Development Economics* Vol. 84(1), pp. 155-187.

Rasmussen, T., 2004, "Macroeconomic Implications of Natural Disasters in the Caribbean." IMF Working Paper No. 4/224, (Washington: International Monetary Fund).

Roadmap to US$100 Billion.

http://dfat.gov.au/international-relations/themes/climate-change/Pages/climate-finance-roadmap-to-us100-billion.aspx

Roson, R., and D. van der Mensbrugghe, 2012, "Climate Change and Economic Growth: Impacts and Interactions," International Journal of Sustainable Economy, Vol. 4(3), pp. 270-85.

Reilly, J., and D. Schimmelpfennig, 1999. "Agricultural Impact Assessment, Vulnerability, and the Scope for Adaptation." Climate Change, *Vol.* 40, pp. 745–88.

Schlosser, C., K. Strzepek, X. Gao, and others, 2014. "The Future of Global Water Stress: An Integrated Assessment." Report No. 254, MIT Joint Program on the Science and Policy of Global Change, (Cambridge: Massachusetts Institute of Technology).

Simpson, M., D. Scott, and M. Harrison, and others, 2010, "Quantification and Magnitude of Losses and Damages Resulting from the Impacts of Climate Change: Modeling the Transformational Impacts and Costs of Sea Level Rise in the Caribbean," United Nations Development Programme.

Storlazzi, Curt, Edwin Alias, and Paul Berkowitz, 2015, "Many Atolls May be Uninhabitable within Decades due to Climate Change", Nature.com, Scientific Reports, Article 14546, September 2015.

Tol, R., 2014. "Correction and Update: The Economic Effects of Climate Change," *Journal of Economic Perspectives* Vol. 28 (November), pp. 221–26.

UNFCCC, 2007, "Impacts, Vulnerabilities and Adaptation in Developing Countries", Bonn, Germany.

UNFCCC, 2014, "Biennial Assessment and Overview of Climate Finance Flows Report", UNFCCC Standing Committee on Finance, New York, 2014

UNFCCC, 2016. " Fourteenth Meeting of the Standing Committee on Finance."

United Nations, 2016, "The Adaptation Finance Gap Report", UN Environment Program, New York, 2016

von Peter, von Dahlen and Saxena, 2012, „Unmitigated disasters? New evidence on the macroeconomic cost of natural catastrophes", BIS Working Papers.

World Bank, 2003, "Caribbean Economic Overview 2002: Macroeconomic Volatility, Household Vulnerability, and Institutional and Policy Responses," Report No. 24165, LAC (Washington: World Bank).

World Bank, 2013, "Turn Down the Heat: Climate Extremes, Regional Impact and the Case for Resilience," (Washington: The World Bank Group)

World Bank, 2014a, "Turn Down the Heat: Confronting the New Climate Normal", (p15, footnote, p40)

_____, 2014b, "Financial Protection Against Natural Disasters: An Operational Framework for Disaster Risk Financing and Insurance". Washington, DC.

World Bank, 2015a, "*2014 Joint Report on Multilateral Development Banks' Climate Finance*"

_____, 2015b, "IDA's crisis response window", IDA17 mid-term review, Washington, D.C.

World Bank, 2016a, "Shock Waves: Managing the Impacts of Climate Change on Poverty", Washington, DC: World Bank.

_____, 2016b, "World Bank Group Engagement with Small States: Taking Stock", World Bank Operations Policy and Country Services, August 2016.

_____, 2016c, "Building Resilience through Social Protection", SISRI Knowledge Note No. 2. Small Island States Resilience Initiative, The World Bank and Global Facility for Disaster Reduction and Recovery (GFDRR), authors Williams, A, F. Lamanna and N. Jones.

Annex Table 1. IMF Financing to Small States Hit by Natural Disasters, 2000-2015

Country	Year [1]	Event	Damage (% of GDP) [2]	IMF Financing (% of Quota) [3]	IMF Financing (% of GDP)	IMF Financing (% of Damage)	Instrument Used [4]	PRGT-eligible [5]
Small States								
RCF/RFI/ENDA								
Dominica	2015	Floods	96	53.5	1.7	1.7	RCF	Y
Vanuatu	2015	Cyclone	60	71.4	3.1	5.1	RFI/RCF blend	Y
St. Vincent and Grenadines	2014	Floods	15	35.5	0.9	5.9	RFI/RCF blend	Y
Samoa	2013	Cyclone	30	35.8	1.1	3.6	RCF	Y
Dominica	2012	Floods	7	17.8	0.7	10.1	RCF	Y
St. Vincent and Grenadines	2011	Floods	3.6	10.6	0.3	8.2	RCF	Y
St. Vincent and Grenadines	2011	Hurricane	5	17.7	0.5	9.5	RCF	Y
St. Lucia	2011	Hurricane	34	25.0	0.6	1.9	RCF/ENDA blend	Y
St. Kitts and Nevis	2009	Hurricane	NA	17.8	0.5	NA	ENDA	
Dominica [6]	2009	Hurricane	35	28.5	1.1	3.0	ESF-RAC	Y
Samoa	2009	Earthquake and Tsunami	15	35.8	1.4	10.2	ESF-RAC	Y
Belize	2009	Hurricane	4.8	17.6	0.6	11.5	ENDA	
Dominica	2008	Hurricane	20	17.8	0.7	3.5	ENDA	Y
Maldives	2005	Tsunami	50	19.3	0.6	1.1	ENDA	Y
Grenada	2004	Hurricane	200	17.8	0.7	0.4	ENDA	Y
Grenada	2003	Hurricane	2	17.9	0.7	33.8	ENDA	Y
ECF-augmentation								
Djibouti	2012	Drought	NA	30.0	1.0	NA	ECF-augmentation	Y

Source: IMF staff reports, WB post-disaster needs assessment reports, EM-DAT, WEO, and staff calculations.

1/ Reflects the year when Board approved the arrangement or the augmentation.

2/ Source: EM-DAT, IMF Staff Reports and WB post-disaster needs assessment reports.

3/ Reflects the fourteenth quota review of January 26, 2016.

4/ RCF stands for Rapid Credit Facility; RFI - Rapid Financing Instrument; EPCA - Emergency Post Conflict Assistance; ENDA - Emergency Post Natural Disaster Assistance; ESF - Exogenous Shock Facility; ECF - Extended Credit Facility.

5/ Eligibility to Use the Fund's Concessional Facilities for Concessional Financing (SM/15/158).

6/ The damage of 35 percent of GDP indicates the cummulative damage from 2007 and 2008 hurricanes.

Annex Table 1. IMF Financing to Small States Hit by Natural Disasters, 2000-2015 (cont.)

Country	Year [1]	Event	Damage (% of GDP) [2]	IMF Financing (% of Quota)[3]	IMF Financing (% of GDP)	IMF Financing (% of damage)	Instrument Used [4]	PRGT-eligible [5]
Larger States								
RCF/ENDA								
Nepal	2015	Earthquake	32.8	22.7	0.2	0.7	RCF	Y
Gambia, The	2015	Ebola	4.5	12.5	1.2	27.2	RCF	Y
Liberia	2015	Ebola	18.4	12.5	2.2	12.1	RCF	Y
Guinea	2014	Ebola	NA	12.5	0.6	NA	RCF	Y
Mali	2013	Drought	NA	6.4	0.1	NA	RCF	Y
Pakistan	2010	Floods	5.7	14.6	0.3	4.5	ENDA	
Bangladesh	2008	Cyclone	1.7	12.5	0.2	12.6	ENDA	Y
Kyrgyz Republic	2008	Earthquake	0.3	37.5	2.1	701.6	ESF-HAC	Y
Sri Lanka	2005	Tsunami	5.4	17.9	0.6	11.5	ENDA	
Malawi	2002	Food Crisis	NA	12.5	0.6	NA	ENDA	Y
Haiti	2010	Earthquake	120.8	108.7	4.0	3.4	PCDR	Y
ECF/SBA-augmentation								
Malawi	2016	Drought	NA	25.0	0.9	NA	ECF-augmentation	Y
Sierra Leone	2014/2015	Ebola	21.6	60.2	4.2	19.4	ECF-augmentation	Y
Guinea	2015	Ebola	7.5	21.1	0.9	12.6	ECF-augmentation	Y
Liberia	2014	Ebola	NA	12.5	2.4	NA	ECF-augmentation	Y
Bosnia and Herzegovina [7]	2014	Floods	2.4	31.9	0.7	29.4	SBA-augmentation	
Côte d'Ivoire	2014	Ebola	NA	20.0	0.6	NA	ECF-augmentation	Y
Lesotho	2012	Flood	2.6	12.5	0.6	20.2	ECF-augmentation	Y
Kenya	2011	Drought	28.8	30.0	0.6	2.1	ECF-augmentation	Y
Haiti	2010	Earthquake	120.8	40.0	1.5	1.2	ECF-augmentation	Y
Burkina Faso [8]	2009	Flood	1.8	27.5	0.6	34.0	ECF-augmentation	Y
Haiti	2009	Hurricanes, Floods	13.7	15.0	0.6	4.2	ECF-augmentation	Y
Togo	2008	Flood	NA	12.5	0.9	NA	ECF-augmentation	Y
Nicaragua	2008	Hurricane, Flood	8.4	2.5	0.1	1.4	ECF-augmentation	Y
Niger	2005	Drought	NA	15.0	0.9	NA	ECF-augmentation	Y
Kenya	2004	Drought	NA	9.2	0.4	Na	ECF-augmentation	Y
Zambia	2002	Drought	NA	2.5	0.8	NA	ECF-augmentation	Y
Chad [9]	2001	Food Emergencies	0.1	4.0	0.4	712.9	ECF-augmentation	Y
Malawi [10]	2001	Food Crisis	0.2	3.4	0.2	89.3	ECF-augmentation	Y
Kenya	2000	Drought	NA	7.4	0.4	NA	ECF-augmentation	Y
Mozambique	2000	Floods	9.0	12.5	0.8	8.9	ECF-augmentation	Y
Madagascar [11]	2000	Cyclones	0.2	10.0	0.8	357.5	ECF-augmentation	Y

Source: IMF staff reports, WB post-disaster needs assessment reports, EM-DAT, WEO, and staff calculations.

1/ Reflects the year when Board approved the arrangement or the augmentation.

2/ Source: EM-DAT, IMF Staff Reports and WB post-disaster needs assessment reports.

3/ Reflects the fourteenth quota review of January 26, 2016.

4/ RCF stands for Rapid Credit Facility, RFI - Rapid Financing Instrument, EPCA - Emergency Post Conflict Assistance, ENDA - Emergency Post Natural Disaster Assistance, ESF - Exogenous Shock Facility, ECF - Extended Credit Facility.

5/ Eligibility to Use the Fund's Concessional Facilities for Concessional Financing (SM/15/158).

6/ The damage of 35 percent of GDP indicates the cummulative damage from 2007 and 2008 hurricanes.

7/ Three flood events occurred in 2014. The number only covers the damages of the one that took place in May.

8/ Two flood events occurred in 2009. The number only covers the damages of the one that took place in September.

9/ Food emergencies arose from three events - epidemic, flood, and drought. EM-DAT does not classify events as food emergency. Only the flood has damages information of $1 million.

10/ Food crisis arose from five events - two floods and 3 epidemics. EM-DAT does not classify events as food emergency. Only the January flood has damages information of $6.7 million.

11/ Two cyclone events occurred in 2000. The number only covers the damages of the one that took place in February.

Annex Table 2. IMF Financing for Natural Disasters, 2000—June 2016

	Number of Disaster Events[1/]	Damage (% of GDP)	IMF Financing [2/]		
			(% of quota)[3/]	(% of GDP)	(% of damage)
Small states					
Emergency facilities (ENDA, RCF, RFI)	16				
No EM-DAT damage estimates	1	...	17.8	0.5	...
Damage under 30% of GDP	8	9.0	21.4	0.7	11.6
Damage 30% of GDP or higher	7	72.1	35.9	1.3	2.4
ECF augmentation[4/]	1	...	30.0	1.0	...
Total	17				
Larger states					
Emergency facilities (ENDA, RCF)	10				
No EM-DAT damage estimate	3	...	10.5	0.5	...
Damage under 30% of GDP	6	4.3	17.9	1.1	13.7 [6/]
Damage 30% of GDP or higher [5/]	1	32.8	22.7	0.2	0.7
ECF/SBA augmentation	21	16.7	17.8	0.9	6.4 [8/]
PCDR [7/]	1	120.8	108.7	4.0	3.4
Total	31				

Source: IMF and EM-DAT (see Annex Table 1).

1/ Includes a few cases of double-counting. Specifically, Ebola support in 2014-15 for Guinea and Liberia is included as both RCF disbursements and ECF augmentation, and support following Haiti's 2010 earthquake is included as both ECF augmentation and under the PCDR.
2/ Includes purchases under the RCF, RFI, ENDA, Exogenous Shock Facility - Rapid Access Component, augmentations of existing ECF and SBA arrangements, and debt relief under the PCDR.
3/ Disbursements measured in percentage of current (2016) quota.
4/ Support for Djibouti following a drought in 2012; no damage estimates available.
5/ The RCF request followed Nepal's 2015 earthquake which resulted in damage of 33 percent of GDP.
6/ The ratio of IMF financing to damage excludes one outlier (2008 Kyrgyz Republic earthquake) where disaster damages appear to be under-reported, leading to a high ratio of Fund financing relative to reported damages.
7/ Following Haiti's 2010 earthquake, the Fund provided financing equivalent to 0.9 percent of GDP through ECF augmentation plus PCDR debt relief equivalent to 4 percent of GDP.
8/ This ratio excludes three outliers (2001 Malawi food crisis, 2001 Chad food emergencies, and 2000 Madagascar cyclone) where disaster damages appear to be under-reported, leading to a high ratio of Fund financing relative to reported damages.

Annex I. Relative Vulnerabilities of Small States to Natural Disasters and Climate Change[1]

Vulnerabilities to natural disasters and climate change vary across small developing states. While climate change may make natural disasters more destructive, the two risks are often quite distinct. Thus, Mauritius is more at risk from climate change than natural disasters, and vice versa for Samoa. The Fund's engagement with small states should take these differential vulnerabilities into account, as summarized in Table 1. Based on a range of indicators, about two-thirds of small developing states are estimated to be extremely or highly vulnerable to natural disasters. About one-third of small states are similarly assessed as vulnerable to climate change within the current generation (next 30 years) based on risks calculated by the IPCC and Maplecroft.[2] The specific rankings in this table are sensitive to the underlying methodologies on the definition and aggregation of risk measures. Accordingly, the rankings should be regarded as indicative, and be complemented by specific measures of the vulnerabilities of individual countries.

For climate change, country coverage of vulnerability ratings is more limited. Several countries for which ratings are not available are identified from other sources as being at high risk from sea level rise (i.e., Kiribati, Maldives, Marshall Islands, Micronesia, and Tuvalu).

[1] Drafted by Mai Farid and Sebastian Acevedo, based on a background study by a team also comprising Ricardo Marto, Dan Nyberg, and Vimal Thakoor, led by Prakash Loungani.

[2] Climate Change Vulnerability Index assesses the combined risk of *exposure* to extreme climate-related weather events and changes in major climate parameters (temperature, precipitation, sea-level), and *sensitivity* to exposure in life-supporting sectors of food, water, health, infrastructure, and ecosystems services. Darker red indicates more extreme vulnerability. Other indices to assess vulnerability to climate change include Center for Global Development—Quantifying Climate change, DARA Climate Vulnerability Monitor, University of Notre Dame—Global Adaptation Index (ND-Gain), World Food Programme, and the Food Insecurity and Climate Change Vulnerability.

Table 1. Ranking of Small Developing States by Vulnerability to Natural Disasters and Climate Change

	Ranking by vulnerability to natural disaters 1/
Samoa	1
Grenada	2
Belize	3
Vanuatu	4
St. Lucia	5
Dominica	6
Kiribati	7
St Vincent and the Grenadines	8
Palau	9
Maldives	10
Tonga	11
Comoros	12
Antigua and Barbuda	13
Solomon Islands	14
São Tomé and Príncipe	15
St Kitts and Nevis	16
Tuvalu	17
Swaziland	18
Fiji	19
Micronesia, Federated States of	20
Marshall Islands	21
Cabo Verde	22
Mauritius	23
Djibouti	24
Guyana	25
Seychelles	26
Bahamas	27
Bhutan	28
Barbados	29
Trinidad and Tobago	30
Timore-Leste	31
Montenegro	32
Suriname	33

1/ IMF staff calcualtions for the period 1950-2014.

Note: The colors indicate the level of risk among small states, where the risks are extreme (red), high (amber), medium (yellow) and low (green).

The vulnerability to natural disasters ranking is a combination of the rankings on the frequency of disasters, and effects of those disasters over the period 1950-2014.

	Ranking by vulnerability to climate change 2/
Fiji	1
Mauritius	2
Montenegro	3
Timor-Leste	4
Belize	5
Vanuatu	6
Djibouti	7
Solomon Islands	8
Bhutan	9
Swaziland	10
Guyana	11
Bahamas	12
Trinidad and Tobago	13
Suriname	14
Dominica	15
São Tomé and Príncipe	16
Antigua and Barbuda***	17
St. Kitts and Nevis***	18
Samoa	19
Comoros	20
Saint Lucia	21
Tonga***	22
Barbados	23
Cabo Verde	24
Grenada	NA
Kiribati***	NA
Maldives***	NA
Marshall Islands***	NA
Micronesia, Federated States***	NA
Nauru	NA
Palau	NA
Saint Vincent and The Grenadines	NA
Seychelles	NA
Tuvalu***	NA

2/ Maplecroft 2016 exposure index.

***Indicates the most vulnerable small states to sea-level rise based on IPCC projections.

Small states' vulnerability to climate change is assessed using the exposure index which evaluates the frequency and intensity of climate events to changes in baseline climate parameters over the next 30 years as estimated by the IPCC. The index Index values are divided into four risk categories: extreme (0.0-2.5), high (>2.5-5.0), medium (>5.0-7.5) and low (>7.5-10.0). Countries are assigned a rank in the table, based on their relative position in the index, where the country ranked 1 is the highest risk.

Annex II. Macroeconomic Impacts of Natural Disasters

This annex explores the impact of natural disasters on small states by comparing vulnerability to natural disasters to key macro outcomes.[1] The study used EM-DAT data for 1990-2014, measuring vulnerability from three dimensions: frequency of disasters; economic cost (damages as percent of GDP); and social cost (percentage of population affected). Vulnerability is compared to long-term averages for macro outcomes, with small states compared to larger countries. To ensure comparability, outliers are excluded: disasters are included only where economic and social cost data are available, where the economic cost is at most 3 percent of GDP, and where at most 8 percent of the population are affected. A few countries with large land areas and a large total number of recorded disasters are excluded (China, India, Philippines, US), as they would otherwise dominate the results.

The results confirm that disasters have an adverse impact on some key macro outcomes, with small states disproportionately impacted. More frequent exposure to disasters tends to result in long-run economic and social costs, with small states most affected. The results are strongest for GDP per capita, agricultural activity, and poverty. Specific findings are summarized below.

GDP per capita. Countries hit more frequently by disasters tend to have a lower GDP per capita, with the largest impact for small states. Where countries frequently experience disasters with a high social cost, GDP per capita also tends to be lower. The reverse is the case for economic cost—which is positively related to GDP per capita. However, the causality may run in the opposite direction here, with more advanced economies standing to lose more from disasters.

Poverty (% of population). The findings echo those above, with poverty tending to be higher for countries impacted most frequently by disasters and facing the highest social cost.

Agricultural contribution to GDP (% share). Countries more reliant on agriculture tend to face higher social costs from natural disasters, notably in the case of small states. Agriculture-based economies also tend to experience more frequent disasters, though the causality is unclear.

Tax revenue (% of GDP). Tax ratios tend to be lower for countries most frequently impacted by natural disasters and for countries where disasters have the highest economic cost.

Government consumption (% of GDP). For small states, spending tends to be highest for countries impacted most frequently by disasters and those experiencing disasters with a higher social cost.

Trade balance (% of GDP). Countries vulnerable to disasters tend to have less favorable trade balances, though this effect is found only for large countries, not small states.

[1] Drafted by Mai Farid and Sebastian Acevedo, based on a background study by a team also comprising Ricardo Marto, Dan Nyberg, and Vimal Thakoor, led by Prakash Loungani.

Overall and private gross capital formation (% of GDP). Countries facing frequent and economically costly disasters tend to have lower overall and private sector capital formation, with the largest impact for small states. This may be one channel, operating through capital stocks, that influences GDP per capita and living standards.

External development assistance (% of budget financing). There is no evidence for greater access to long-term external development assistance for countries more vulnerable to disasters.

Annex III. Vanuatu: Coping with the Damages of Cyclone Pam—Policy Lessons[1]

The 2016 Article IV consultation with Vanuatu focused on assessing the extent of the recovery from the 2015 cyclone and drawing lessons for IMF support. Fifteen months after Cyclone Pam struck Vanuatu, the economy continues to recover from extensive damage. Reconstruction efforts have begun to yield positive results, with the reopening of damaged hotels and refurbishment of Port Vila's international airport supporting the return of tourists to the islands. With the benefit of hindsight, this annex explores lessons for helping achieve post-disaster macroeconomic stability.

Cyclone Pam was one of the most damaging natural disasters in Vanuatu's history. The cyclone struck Vanuatu in March 2015, causing overall damages amounting to more than 60 percent of GDP. It affected almost 72 percent of the population (more than 188,000 inhabitants). The main productive sectors were highly affected, with particular damages to tourism and transport infrastructure and production losses in agriculture and tourism. The damages exceeded that of any other natural disaster experienced in the region in recent memory.

In the aftermath of Cyclone Pam, development partners contributed significant amounts of aid-in-kind, grants, and loans. In addition to the IMF's financial assistance under the RCF and RFI (about USD23.8 million), more than USD210 million (28 percent of GDP) was committed by bilateral and multilateral partners, with about USD72 million in grants received in 2015. Although donor responses were swift and generous (in particular from bilateral partners), financing disbursements have been slow on account of delays to the reconstruction program.

The immediate response was quite effective in alleviating human suffering and restoring economic activity, and despite substantial delays there are encouraging developments. The authorities' and partners' response ensured prompt access to food and shelter. The medium- to long-term recovery was more sluggish. A Recovery Committee was established in August 2015 to coordinate reconstruction efforts, but some recovery procedures proved burdensome and delayed key initiatives. Schools are still being held in tents and health centers are still partially destroyed in the most-affected islands. However, major infrastructure projects (including roads, the building of international wharfs and inter-island shipping facilities) have started and the reconstruction of social infrastructure is in the pipeline.

Vanuatu's experience suggests several lessons:

Institutions matter. Disaster response can be delayed without institutions and contingency plans for quick and smooth disaster response. Vanuatu had established in 2013 a Ministry dealing exclusively with climate change issues, making the National Disaster Management Office (NDMO) central to coordinating preparedness and recovery initiatives. The NDMO responded adequately to the population's basic needs

[1]Prepared by Ricardo Marto (RES).

following Cyclone Pam, and although the Recovery Committee was quickly established, advance attention to avoiding bureaucratic obstacles in its operations would have been useful.

- ***Domestic buffers need to be in place.*** Fiscal buffers in Vanuatu were limited. The Response Fund, triggered in case of a major emergency, could provide up to 1.5 percent of the government's budget for that fiscal year (0.3 percent of GDP), falling short of the expenses needed to restore basic services. A permanent mechanism that could help face immediate recovery concerns should be considered to expedite the response to average-size natural disasters.

- ***External buffers need to be actionable.*** External buffers, including donors' financial support, should be more predictable and partners should ensure disbursements are timely and at concessional terms. Although Vanuatu's partners promptly committed considerable resources, disbursements have been slow. The sovereign insurance payout through the PCRFI initiative was limited, covering less than 1 percent of damages. The authorities should therefore contemplate instruments that commit pre-approved resources that can be drawn down in the event of a major disaster and ensure greater donor contributions for sovereign insurance mechanisms.

- ***Resilient infrastructure includes better maintenance.*** Given Vanuatu's high risk from natural disasters and climate change, the budget should include an explicit allocation for disaster risk reduction and climate change adaptation. In addition to investing in new infrastructures and programs, the authorities should ensure adequate funding for infrastructure maintenance.

- ***Social safety nets should be well-targeted***. While post-disaster relief programs should ideally leverage existing safety nets, this was not an option for Vanuatu. Accordingly, the government needed to resort to ad hoc interventions (temporary suspension of VAT and import duties on construction materials; deferred payment of vehicle registration fees and VAT payments; subsidies for agricultural seedlings to affected households). The National Provident Fund also allowed members to withdraw part of their retirement savings to cover expenses related to damages. While these programs provided welcome relief, they raise questions about effective targeting and the appropriate use of scarce resources.

- ***Monetary policy can help alleviate liquidity constraints and foster the continuity of the payments system***. IMF financial support helped consolidate RBV's comfortable level of reserves, which smoothed the impact of the cyclone. RBV also provided effective liquidity support by reducing its monetary policy rate by about 340 basis points, and cutting the statutory reserve deposit requirement for commercial banks from 7 to 5 percent. Supervisory authorities should ensure banks have adequate business continuity plans. In Vanuatu, banks were able to provide enough physical currency to proceed with daily activities when banks were closed, ATM machines down, and the only mean of payment available were notes and coins. They also provided waivers on retail customers' loan repayments for 2 to 3 months and delayed loan repayments for 6 to 12 months to some corporate customers pending an insurance payout.

Annex IV. Tailoring Macroeconomic Frameworks and Risk Analysis for Natural Disasters and Climate Change[1]

A. Introduction

1. **This annex explores how the Fund's macro frameworks and risk analysis should be designed to appropriately reflect the impact of natural disasters and climate change on small states' economies**. It identifies macro-financial frameworks and risk analysis approaches that can be used when developing policy recommendations for managing natural disasters and climate change.

2. **The next section provides general guidance on integrating natural disasters into macro frameworks and risk analysis**. It outlines approaches for disaster risk analysis. Subsequent sections cover the practicalities of this work in more detail, discuss existing approaches, and provide recommendations for future good practice techniques. In many cases, country teams are already adopting many of these proposals, and the intention is to define options and establish norms to help ensure consistently strong analysis.

3. **Fund analysis should focus on countries for which natural disasters are projected to have a significant macro-financial impact**. These countries are typically, though not exclusively, small states. The earlier discussion of relative natural disaster risks across small states (paragraph 11 of the main paper and Annex I) can help guide decisions on whether to include these risks in Fund analysis. Approaches should be flexible, based on country interest and staff's assessment of risks and policy priorities.

B. Data sources and Reporting of Assumptions

4. **Analysis starts with the potential size, frequency, and transmission channels of disasters**. A first source is provided by EM-DAT data which can be used to identify the timing of past disasters for a given country as well as their economic and social impact. One downside of this database is the limited coverage of economic losses. In addition, it does not measure the impact of disasters on GDP, budgets, or the balance of payments, and ignores the dynamic pattern of the economic impact. Accordingly, staff should also draw on country-level data on economic developments at the time of past disasters. Careful examination of movements in the national accounts, fiscal accounts, and balance of payments may help identify the size and transmission channels for past disasters.[2] Staff can further strengthen their assessment through discussions with government officials, business leaders, and the relevant experts and other stakeholders.

[1] Prepared by a team comprising Ms. Gold (WHD) and Messrs. Allum (SPR), Atolia (RES), Cihak (MCM), Ding (APD), Geiregat (FIN), Guerson (WHD), Mooney (FIN), and Takizawa (SPR).

[2] The main paper highlighted some of the key transmission channels. Care is needed to allow for lagged effects: for example, GDP growth could fall at the time of the disaster but rise above trend as reconstruction projects are implemented.

5. **In some cases, perspectives can be gained from the World Bank's Post-Disaster Needs Assessments (PDNAs)**. For a limited number of disasters, the Bank has compiled detailed estimates of physical damage and production losses.[3] While PDNA estimates of production losses may be a starting point for analyzing the GDP impact of disasters, there is no one-to-one relationship between estimated production losses and measured GDP.[4] This may be because the PDNA includes non-marketed production excluded from measured GDP (as cited in the case of Vanuatu) or because the production losses are measured before taking into account the positive offsetting effects from post-disaster reconstruction activities in the public and private sectors. Physical damage estimates may be useful for purposes of general equilibrium modeling of destruction to the capital stock, but do not typically feature in Fund macro-frameworks given the general absence of balance sheet data.[5]

6. **The assumptions underpinning disaster risk analysis should be transparently documented**. Where Fund documents include an analysis of natural disaster risks, the relevant assumptions on size and frequency of disasters, macro impact, and policy responses should be detailed. This would represent an improvement in regard to current practices (Box 1). Where staff has developed a dynamic model of the impact of natural disasters for scenario purposes, this could also be documented (see example in Annex Table 1).

C. Developing Macroeconomic Baselines

7. **This section addresses how to develop medium- to long-term macroeconomic baselines for assessing economic sustainability**. Vulnerability to disasters can accumulate over many years and through a series of disasters, as fiscal shocks lead to higher borrowing and as infrastructures damage saps private investment and growth. Economic performance for these countries may be episodic. For a number of years, trends may look favorable as post-disaster recovery buoys growth and budget outcomes; but then a new disaster marks a period of much less favorable outcomes. For such countries, it is important that long-term projections be based not just on the more favorable outlook in non-disaster years, but also factor in the down-cycles that come with disasters, as well as any benefits from investing in resilience to disasters. For projections such as those used for the LIC DSA that can cover a period as long as 20 years, these adjustments to reflect potential disaster effects are critical.

[3] This work is conducted through the World Bank-managed Global facility for Disaster reduction and Recovery (GFDRR).

[4] Thus, in Vanuatu's 2015 cyclone, production losses were estimated in the PDNA at 24 percent of GDP, while Fund staff estimated that measured GDP growth in 2015 would be reduced by only 5½ percent of GDP as a result of the cyclone. Similarly, the PDNA for Samoa estimated production losses at over 12 percent of GDP, while the staff report requesting RCF financing estimated the GDP impact at 1.1 percent of GDP.

[5] For modeling and other purposes, a distinction should be made between damage to productive capital assets and damage to social assets (e.g., housing).

Box 1. Past Practice in Analyzing Natural Disaster Risks

A survey of recent IMF country reports for small states has been conducted with a view to assessing the treatment of natural disaster risks in macro frameworks and risk analysis.

A large number of country reports cover the impact of actual disaster events. Discussions typically focus on overall damage, lost production, and consequences for the budget. The latter include lost revenues, outlays on post-disaster relief and reconstruction, and budget financing. Risk analysis is sometimes provided for countries subject to frequent disasters. In these cases, country reports sometimes include a discussion of forward-looking disaster risks and the appropriate policy response.

Macro-financial baselines do not explicitly reflect the long-term impact of periodic natural disasters. Country reports are not typically explicit about whether or how the macro-financial impacts of future natural disasters are reflected in medium- and long-term macro projections, such as those prepared for the LIC DSA. In general, teams do not appear to systematically consider disaster impacts when making baseline projections, with a few noteworthy exceptions.[6]

There is also no standard practice for modeling or reporting risks associated with natural disasters. In many cases, a qualitative discussion is presented in the Risk Assessment Matrix (RAM). In other cases, quantitative disaster scenarios are explored, either in the staff report, or more often in the DSA. Country reports are generally opaque as to how prospective natural disaster risks would impact the economy, and what policies are in place to address such risks. The degree of detail in these areas varies significantly, even for neighboring countries within the same area department.

Disaster risks are most comprehensively analyzed for small states in the Caribbean and Pacific. This country group is subject to the most frequent and destructive hurricanes/cyclones. Outside these regions, country reports typically cover the impact of ongoing disasters (such as drought in sub-Saharan Africa) with less emphasis on the potential impact of future disasters. This may reflect the lower macro criticality of natural disasters for larger, more diversified economies.

8. **A number of approaches can be adopted for building realistic long-term macro baselines**. In general, these seek to "look through the cycle", adopting projections for key variables that are realistic long-term averages, taking disaster and non-disaster years together. The resulting baseline will tend to be smooth, rather than including periodic disaster-related disturbances. However, by adjusting average growth downwards (say) to allow for the future impact of disasters, the level of GDP would be the same at the end of the smooth baseline as it would be under a stochastic alternative. Moreover, this approach helps separate analysis of long-term policy sustainability from questions of the adequacy of policy buffers in the presence of shocks (the second issue being covered in detail later in this annex).

9. **In some cases, variables can be projected based on long-term historic averages**. Where disasters are relatively common, a long average of past performance (e.g., 20 years) could capture the

[6] For example, recent reports for Dominica and St. Kitts and Nevis.

impact of disasters. For example, growth projections could be based on a long-term historic average, rather than the more recent average for non-disaster years.[7] This approach represents a relatively straightforward and transparent way to include natural disaster effects in the baseline. It has the drawback, however, of not explicitly distinguishing between underlying (non-disaster) performance and the separate impact of natural disasters. In addition, it does not take into account potential structural factors that, for some countries, may make past averages not representative of future prospects. Thus, this approach is unlikely to be useful for projecting revenue- and expenditure-GDP ratios, which are subject to important structural shifts. For such variables, other approaches will be needed, as discussed below.

10. **A second approach is to adjust non-disaster projections using the estimated or modeled impact of disasters**. A starting point would be to identify the likely path of an economic variable in the absence of disasters. For example, a projection for the public expenditure-GDP ratio could be based on recent outcomes in non-disaster years, taking into account policies likely to impact on future spending. This projection would then be adjusted to include the annual average impact of prospective disasters. The adjustment could vary in sophistication, and in principle could take into account: (a) the anticipated frequency of disasters; (b) their likely magnitude; (c) the impact of disasters on the macro variable in question; and (d) the expected policy response. For example, if past disasters have occurred, on average, once every 10 years, this implies a 0.1 probability of a future disaster in any given year. In this case, the baseline for a given variable could be adjusted by the product of this probability and impact of an average disaster.[8]

11. **Where data are of poor quality, other approaches may be needed to identify disaster effects**. For some small states, EM-DAT may not provide country coverage and national data sources may be unreliable for purposes of identifying national disaster effects. A mix of approaches can be adopted in such cases. Using long run historical trends may capture average disaster effects. And approximate estimates of the impact of disasters might be derived using a "synthetic control" approach from comparisons with peer countries that are similar, except with respect to exposure to disasters. Under this approach, outcomes for a particular variable (e.g., growth) in a disaster-prone country are compared to those for a control group of countries with similar characteristics other than exposure to natural disasters.[9] The resulting difference can be attributed to the impact of natural disasters and can be used for purposes of constructing the macro baseline. It should be recognized, however, that estimates are subject to a margin of error, reflecting the difficulty of identifying counterpart countries that differ only on account of disaster vulnerability.

[7] This approach was adopted for projecting underlying GDP growth in the St. Kitts and Nevis staff report since past trends were viewed as a good indicator of future growth in the absence of evident structural breaks. For this report, revenues and expenditures and other key macro variables were appropriately based on recent performance and policies, rather than past averages.

[8] To allow for the dynamics of disaster responses, the impact should be calculated on a cumulative multi-year basis. Thus, if the average disaster worsens the overall fiscal balance by 2 percentage point in the immediate year and by 1 percentage point in each of the following two years, the cumulative impact of 4 percentage points would be used with the disaster probability (0.1 in this example), to produce a natural disaster fiscal adjustment factor of 0.4 percentage points.

[9] This approach was adopted in the 2015 Samoa staff report.

12. **Adjustments should, in principle, include "second round effects", as the public and private sectors adjust to the impact of disasters**. Macro baselines should not only reflect the first-round impact of natural disasters but also seek to include the most important reactions by governments, households, and corporations. For example, governments may undertake fiscal adjustment to offset part of the costs of a natural disaster or may gain access to new grant financing to pay for disaster recovery. These policy reactions should be included only where there are good reasons to expect that such measures would be adopted—based on past practices or an established policy framework. There should be no presumption that policy reactions will fully address the costs of natural disaster, ensuring sustainability of the adjusted macro baseline.[10]

13. **Adjustments to macro baselines should ideally allow the fiscal impact of disasters to be separately identified**. Fiscal projections could be adjusted in two ways: either by adjusting budget lines individually (revenues adjusted downwards, public expenditure and grant receipts adjusted upwards), or by introducing a new line into the fiscal accounts showing the net impact of disasters. This could be shown above-the-line, after the unadjusted overall balance including grants. In general, the second approach (showing a "net disaster impact" line) is recommended for presentational clarity.[11] Because detailed analysis is less important for the presentation of the balance of payments, disaster effects could be integrated into variables separately (exports, grant inflows, etc.) rather than by introducing a separate line item for disaster impacts.

14. **Care is needed that disaster adjustments do not complicate near-term policy discussions**. For the current year and possibly one year ahead, baseline macroeconomic projections could be "clean", excluding any adjustment for natural disaster impacts. This would allow staff reports to show macro projections aligned to the authorities' growth assumptions, planned budgets, etc. This could result in some variables "deteriorating" between the clean baseline (years 0-1) and the baseline including annual average disaster effects (years 2 and beyond). The basis for any such shift would need to be explained in the country report.[12] Staff should also be clear in discussions that this presentational approach does not imply a view that there is a lower probability of a natural disaster in the near term, or a corresponding lower need for contingency planning.

15. **Where countries invest to become more resilient to natural disasters, this should be reflected in long-term macro frameworks**. The beneficial impact can be recognized by reducing the negative disaster adjustments in the outer years of the macro framework. A key question is the return on investments, and how much is captured by the public sector. For example, do debt-financed investments in resilience-building generate sufficient additional future fiscal savings and growth-related tax collections to be self-financing? Or do taxes need to rise in parallel to ensure fiscal sustainability? To lay the foundations for this analysis, teams should be cautious in projecting future savings from resilience-

[10] The significant historic debt accumulation by several Caribbean countries at high risk of natural disasters suggests that policy reactions have not fully offset disaster costs in the past.

[11] This could be labeled, for example, as the "disaster cost contingency spending". This approach was adopted in the Dominica report [provide references].

[12] This shift in the presentation is another reason why showing a net disaster impact line in the fiscal accounts would help presentational clarity.

building investments. Where possible, independent evidence of the likely rate of return on such investments would be valuable.

D. Constructing Alternative Shocks Scenarios

16. **This section discusses how to prepare alternative scenarios to model risks around the baseline**. While a disaster-adjusted baseline helps to assess long-term policy sustainability, risks to the baseline are important when considering the appropriate size of fiscal and external buffers. Even where policies are sustainable based on the annual average impact of disasters, fiscal and external buffers may be inadequate to weather the impact of a natural disaster. These risks and the corresponding need for contingency plans can be assessed using an alternative scenario or stress test that models a single large disaster event. For example, debt sustainability analysis (DSAs) should typically include an alternative scenario featuring an appropriately scaled disaster event. Discussions of reserve adequacy in the context of the external sector assessment (ESA) should also look at potential reserve drains arising from disasters. Such risk analysis should be standard practice for all DSAs and ESAs for countries at high risk of natural disasters, and would help inform Risk Assessment Matrices (RAMs) for these countries.

17. **The alternative scenarios would chart the dynamic response to a large shock**. A standard scenario would involve an "average" disaster, while tail risks could be explored by modelling the sort of disaster that might occur once every 50 or 100 years.[13] The scenario would trace the immediate and subsequent response of key macro variables, typically spanning several years of post-disaster reconstruction. This type of alternative scenario has already been used by some country teams, and implications for debt can easily be studied using the LIC DSA toolkit.

18. **Stochastic simulation offers an alternative, more sophisticated approach to exploring risks**. This approach—for example using Monte Carlo experiments—could be run drawing random shocks calibrated to the statistical distribution of historical natural disasters, measured by size and frequency. Under each simulation, the randomly-produced shocks would impact on key macro variables according to the estimated dynamic pass-through relationship. This will produce a probabilistic distribution of the main economic variables required to assess fiscal and debt sustainability incorporating the risks from natural disasters. It could be used, for example, to inform policy decisions on the amount of savings required to reliably achieve fiscal sustainability in scenarios consistent with the recurrent occurrence of natural disasters. It could also be used to assess the adequacy of buffers or contingency plans. Thus, for example, scenario outcomes could be used to calculate the probability that disaster-related public spending would exceed a particular level in a given year (or group of years). Similar results could be developed for other variables (growth, external balance, etc.).[14]

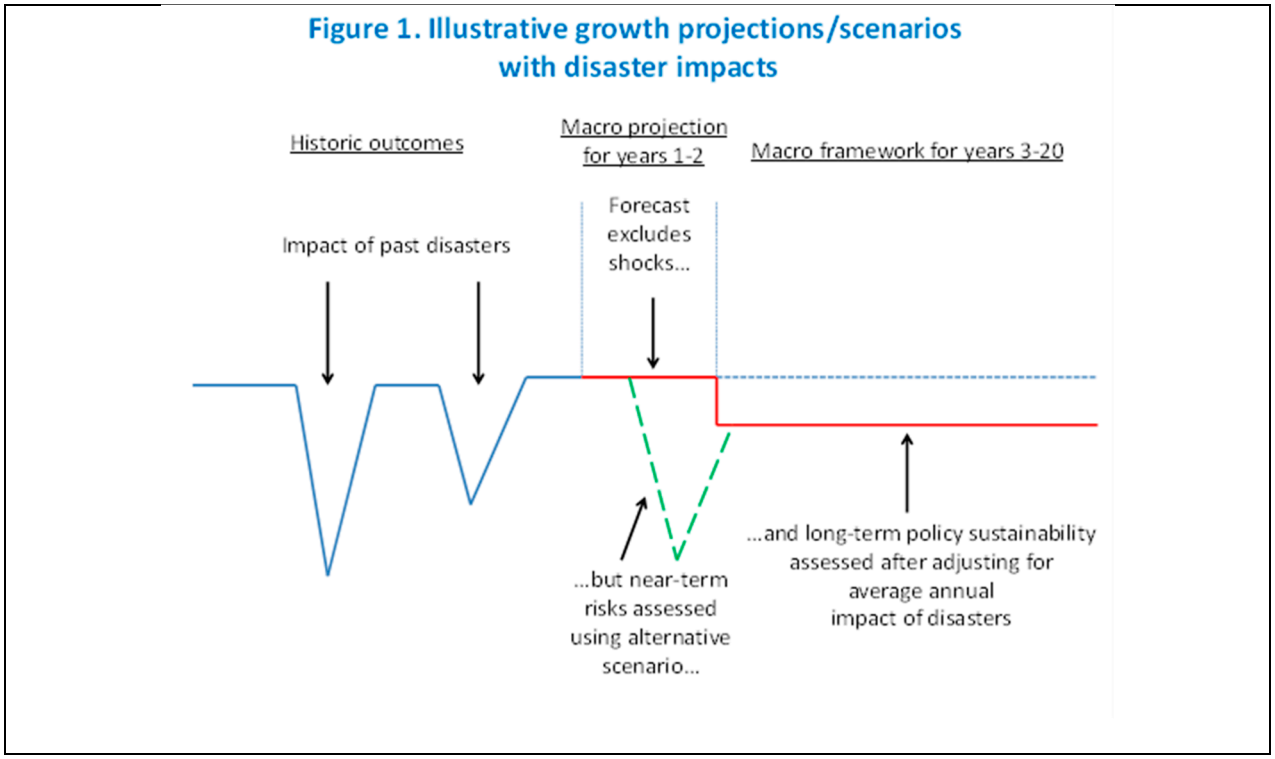
[13] Since individual country data are not available to clearly define the scale of "a once in 50 years" disaster, these estimates would typically be informed by data across a range of countries and periods.

[14] The Monte Carlo approach has been used in an innovative manner in the case of Dominica, tailored to the specific circumstances following a somewhat different approach than that described above.

19. **Stochastic simulation analysis produces valuable information but at a cost**. The results depend critically on the assumed probability distribution of disasters, which is uncertain. Data on country disasters are available only for 60 years at best, which provides only an approximate measure of the underlying probability distribution.[15] At the same time, probabilistic simulation approaches are not part of the standard Fund modeling tool kit, and it would be resource-intensive to develop skills on a team-by-team basis. If this approach were to be widely adopted, it would likely require a computational tool allowing teams to run simulations using country-specific parameters.

20. **The core analytical approaches recommended above are summarized in Figure 1**. The near-term macro forecast baseline (years 1-2) would not include the impact of prospective natural disasters and these risks would be covered instead by alternative scenario analysis. Looking further ahead (years 3 onwards), macro baselines would be adjusted to reflect the annual average impact of disasters, as calculated using historical data.

Figure 1. Illustrative growth projections/scenarios with disaster impacts



E. Other Macro Modeling Considerations

Financial sector risk analysis

21. **For vulnerable states, FSAPs are likely to cover disaster risks**. While only a limited number of FSAPs have been conducted for small states, a wider review of FSAPs finds that stress tests have

[15] Likely, a simplified probability distribution would need to be used: for example, assuming that a "peak" disaster occurs only once every 50 years while a more typical disaster occurs more frequently, say every 10 years (depending on country circumstances).

sometimes sought to identify the financial risks associated with natural disasters. Recent FSAP reports commonly refer to natural disaster risks, and stress tests for the insurance sector often consider the projected impact of sizeable disaster events.[16] Modeling disaster shocks is less straightforward for the banking sector, where the possibility of disasters is associated with operational risk. To assess the latter, consideration would need to be given to the impact of natural disasters on different elements of banks' income statements. This is a complex task in practice, and disaster risks are instead typically assessed from the perspective of solvency, tracing a causal link running from disasters to lower GDP to decline in asset quality. Following this approach, the 2015 Samoa FSAP based two stress tests on a category 4 tropical cyclone, modeling the damage on physical property and production, with consequences for bank solvency.

22. **Macro-financial linkages should also be considered.** In principle, savings in the banking system provide an important buffer for the private sector to weather disasters. The quality of bank assets could suffer a serious blow if the natural disaster impacts their clients. For example, crop destruction may make it difficult for farmers to repay agricultural credits, leading to an increase in non-performing loans. Severe disasters may also undermine the normal functioning of the financial system in the short run, acting to delay the recovery process.[17]

Reserve adequacy

23. **External sector assessments should take into account buffers needed to cope with vulnerability to natural disasters**. As noted earlier, the balance of payments would typically deteriorate following a natural disaster reflecting lost exports and additional import needs, and its financing would rely on remittances, external grants and borrowing, and possible reserve drawdowns. To the extent that financing is not readily available at reasonable cost, countries vulnerable to natural disasters may need to build higher external buffers.

24. **The Fund's existing reserve adequacy assessment tools can be tailored to countries prone to natural disasters**. Of the Excel-based templates available for assessing reserve adequacy (ARA), the ARA-CC methodology for credit-constrained economies is likely to be the most relevant to small developing states. The guidance note discusses how the tool and approach can take into account country-specific risk and other factors which are also relevant to natural disasters.[18] These include: (i) expected shocks (e.g., future disasters); (ii) structural changes (e.g., investing in resilience); (iii) alternative scenarios (e.g., a natural disaster in the next year); and (iv) risk aversion (e.g., precautionary incentives because of higher vulnerability to natural disasters).

[16] For example, in the Portugal FSAP, the impact was considered of an earthquake equivalent to that in 1755, and in the France FSAP, the impact was considered of a similar storm to that in 1999. The recent United States FSAP considered the effects of hurricanes, earthquakes, and tornadoes, in combination with adverse macro scenarios.

[17] The staff report for Vanuatu's 2015 Article IV and RCF/RFI requests was exemplary in discussing financial linkages and policy reactions to Cyclone Pam. In this case, commercial banks allowed for voluntary suspension of debt service over 2-3 months, and an emergency borrowing facility (along with other liquidity measures) was activated by the central bank.

[18] See IMF (2016b) and additional background and analysis in Mwase (2012).

F. General Equilibrium Modeling

25. **Teams looking to explore the general equilibrium impact of natural disasters could do so using the Debt, Investment, and Growth (DIG) model**. This would allow teams to provide policy advice based on a coherent framework. The impact of natural disasters could be introduced into the DIG model in three ways. First, the disaster can be assumed to wipe out a part of the current output and second, destroy a portion of the existing productive capital, constraining production until these assets are replaced through new investments. Disasters can also be viewed as having a third, temporary impact on the productivity of capital while business activities are disrupted by the after-effects of the disaster.

26. **The DIG model can be used to explore the adjustment path following a disaster**. Using different parametric assumptions, this model can explore how rapidly the public and private sectors can rebuild lost productive capacity, the impact of policy responses, the importance of access to credit or insurance, and the importance of labor and product market flexibility for post-disaster recovery. Further discussion and illustrative charts are provided in Annex IV.

27. **There are, however, constraints to the existing DIG model**. For example, disaster-prone countries are distinct in having a more uncertain investment environment. Investors will seek a higher rate of return to compensate for risks to capital. This distinction relative to non-disaster prone countries is not currently a feature of the DIG model.

G. Climate Change

28. **Over the coming 50 years, climate change is expected to have major macroeconomic consequences**. Rising sea levels, desertification, and excessive heat levels are just some of the changes that will affect current patterns of production and employment, even after costly outlays on adaptation. The challenge for the Fund is how to integrate these changes into standard long-term macro baselines for assessing policy sustainability. One problem is the high degree of uncertainty about the path of climate change and how this will influence economic activity in countries. A further consideration is that climate change will build up only gradually, and the macro impact may only start to be significant toward the end, or even beyond the standard 20-year period adopted for long-term baseline analysis.

29. **Given these considerations, the primary focus of the Fund's near-term risk analysis is likely to be on natural disasters, rather than climate change**. While climate change is anticipated to contribute, over time, to larger and more destructive natural disasters, this trend is not sufficiently well-defined as to allow macro baselines to be developed with a gradation of disaster effects, rising over time. Instead, risks analysis using alternative scenarios that model peak disaster events (one-in-a-century disasters, say) can be used as a proxy for the risks that could emerge with climate change.

30. **For the near term, adjustments to macro baselines are most relevant for adjustment and mitigation investments**. Countries may be undertaking or considering public outlays that would either mitigate carbon emissions (e.g., by shifting to renewable energy sources) or that would help the country adjust to the effects of climate change (e.g., by investing in infrastructures that are resilient to rising sea levels or to more frequent droughts). These investments may be launched, in many cases, within the

period covered by Fund macro baselines, and could be significant in scale. Thus, in developing fiscal baselines, teams should ensure that consideration is given to the level of public spending and whether this adequately reflects likely outlays relating to climate change. While some substitution may be possible within public investment programs to cover climate change needs, in many cases it will require a higher overall level of spending. Where country authorities have not yet considered the impact of climate change on fiscal and debt sustainability, the Fund's analysis of potentially necessary climate change-related investments would be an important contribution to macro surveillance. In this work, teams will need to seek independent information on likely costs and recognize the associated uncertainties.

Table 1. Atlantis: Potential Economic Impact of Natural Disasters

1.	**Estimated/assumed disaster impact** (first-year impact, percent of GDP)				Tail-event	Average	1/
	Lost production (GDP impact)				15.0	5.0	
	Damage to physical assets/infrastructures				85.0	15.0	
	Total losses				100.0	20.0	
	Memorandum item:						
	Average losses in small states (1950-2014)					12.9	

2.	**Disaster impact and recovery scenario**	Year 0	Year +1	Year +2	Year +3	Year +4	Total	Notes
	Real GDP							
	GDP growth (deviation from trend)	-5.0	1.0	2.5	1.7	0.0	0.0	
	GDP level (deviation from trend)	-5.0	-4.1	-1.7	0.0	0.0	-10.7	2/
	Fiscal impact (% of GDP)							
	Revenues	-0.5	-0.3	-0.1	0.0	0.0	-0.9	
	Expenditures	1.5	2.0	2.0	1.0	0.0	6.5	3/
	Overall balance (before grants)	-2.0	-2.3	-2.1	-1.0	0.0	-7.4	
	Grant financing	0.5	2.0	1.0	0.0	0.0	3.5	
	External borrowing	0.5	0.3	1.0	1.0	0.0	2.8	
	Other identified financing	0.2	0.0	0.0	0.0	0.0	0.2	4/
	Fiscal financing gap	**0.8**	**0.0**	**0.1**	**0.0**	**0.0**	**0.9**	
	Balance of payments impact (dev. from trend, % of GDP)							
	Net exports of goods/services	-3.0	-4.0	-3.0	-2.0	-0.5	-12.5	
	Exports of goods/services	-3.0	-2.0	0.0	0.0	0.0	-5.0	
	Imports, including for reconstruction	0.0	2.0	3.0	2.0	0.5	7.5	5/
	Remittances	0.5	1.0	0.5	0.5	0.3	2.8	
	Grants	0.5	2.0	1.0	0.0	0.0	3.5	
	Capital/financial account	0.7	0.5	1.0	1.0	0.0	3.2	
	Public	0.5	0.3	1.0	1.0	0.0	2.8	
	Private	0.2	0.2	0.0	0.0	0.0	0.4	
	Overall balance	**-1.3**	**-0.5**	**-0.5**	**-0.5**	**-0.2**	**-3.0**	
	Reserve drawdown	0.5	-0.5	0.0	0.0	0.0	0.0	
	BOP financing gap	**0.8**	**1.0**	**0.5**	**0.5**	**0.2**	**3.0**	6/
	Financial sector impact (dev. From trend, %of GDP)							
	Credit/GDP ratio	-0.1	-0.4	-0.4	-0.1	0.0		

3.	**Long-run public cost of natural disasters and climate change** (% of GDP)	(Annual avg.)	
	Disaster-related public spending (relief and reconstruction)	1.3	7/
	Investments to mitigate future climate change impact	1.0	8/

1/ Data could refer to an actual recent disaster, or a typical large disaster.
2/ Despite a post-disaster bounce-back in growth, the level of activity may remain temporarily depressed by infrastructure damage.
3/ Includes relief transfers and reconstruction spending.
4/ Includes domestic financing, insurance payouts, and any draw-down of government assets.
5/ Includes both private and publicly-financed imports for reconstruction.
6/ Includes possible financing by IMF.
7/ In this case, assumes that disasters occur, on average, every 5 years, each requiring cumulative public spending of 6.5% of GDP.
8/ Based on country-specific risks from climate change and opportunities for infrastructure and other mitigation investments.

Annex V. Exploring the Use of Model-Based Approaches to Assess the Economic Impact of Natural Disasters[1]

Introduction

This annex assesses the feasibility and the value of model-based approaches for assessing the economic impact of natural disasters in a typical low-income developing country. The focus is on the Debt, Investment, and Growth (DIG) model of RES and SPR, and its variants. The annex describes the merits of a model-based approach; summarizes the DIG model and its recent use in country analysis; outlines how a natural disaster can be modeled in the DIG framework; and provides an example of how the model could be applied to a stylized low-income developing country. The annex concludes by providing examples of policy questions relating to natural disasters that the DIG framework could address.

The model-based approach explored here provides a coherent framework for a consistent and more informed policy analysis. This advantage of model-based approach in policy analysis is the result of (1) incorporating in the model, in a systematic matter, reasonable economic behavior (such as, quantity demanded goes down when price goes up) and the constraints on economic choices (the budget constraints); (2) making explicit the relationship between underlying assumptions and the resulting outcomes; and (3) moreover, considering the costs and benefits of policy choices, the policy trade-offs, in an internally consistent manner, in particular, taking into account inter-temporal dimension through appropriate discounting.

Using the DIG and DIGNAR models

Fund staff developed a model-based framework to analyze the effects of public investment scaling-up on growth and debt sustainability. The DIG model, developed in Buffie et al. (2012), is a dynamic low-income developing country (LIDC)-specific open-economy model that incorporates the nexus between public investment and growth, different financing strategies (external concessional, external commercial, and domestic), and fiscal reaction rules. It also captures high rates of return on public capital as well as significant inefficiencies in public investment and absorptive capacity constraints, which are pervasive in LIDCs. The link between public investment and growth in the model arises from the fact that the outputs of the two production sectors producing traded and non-traded good depend not only labor and private capital used, but also on the stock of public infrastructure, as it determines the productivity of the production process.

The model has been widely used for analyzing the macroeconomy and informing the policy discussion with authorities in LIDCs. Fund staff have applied the model and extensions to 14 countries and a custom and economic union in the context of Article IV consultations, program reviews, and donor meetings (Afghanistan, Benin, Burkina Faso, Cabo Verde, CEMAC, Cote d'Ivoire, Ethiopia, Ghana, Lesotho,

[1] This annex was prepared by Manoj Atolia (RES).

Liberia, Rwanda, Senegal, Togo, and Yemen). This work has complemented the IMF-World Bank DSF by helping country teams and authorities assess the growth, debt, and fiscal implications of ambitious, front-loaded infrastructure investment plans contained in national development plans or PRSPs. These plans are not fully funded by aid, resulting in a financing gap that could be covered by fiscal adjustment, external commercial or domestic borrowing. Extensions of the model have analyzed the implications of investing not only in infrastructure, but also in energy (e.g., Ethiopia and Senegal) or security (e.g. Afghanistan). On-going applications include Cambodia, Maldives, Nigeria and Sri Lanka. These applications have formed the basis of policy dialogue with authorities regarding the trade-offs of different financing strategies, as well as the role of key structural characteristics for growth and debt sustainability effects of public investment.

The DIG model's framework is quite flexible and has been extended by Fund staff to incorporate special features of natural resource-rich developing countries. This extended model, termed the Debt, public Investment, Growth and Natural Resources model (DIGNAR), was developed in Melina et al. (2014). It has been used to assess the macroeconomic implications of investment surges, including for debt sustainability. The DIGNAR model has been applied to 12 countries in Article IV consultations and TA missions (Angola, Côte d'Ivoire, Chad, Guinea, Kazakhstan, Liberia, Mauritania, Mongolia, Mozambique, Myanmar, Niger, and Sierra Leone). On-going applications include Botswana and Iran. The analysis underscored the role of the volatility of resource prices, the uncertainty of resource output, and the exhaustibility of resource reserves in strategies to avoid excessive and unsustainable borrowing. A sustainable investing approach that combined a gradual investment scaling-up with a resource fund—a fiscal buffer mechanism that saves additional resource revenues in boom times and can be drawn down to support investment spending during low resource revenues—could help protect the economy from boom-bust cycles and therefore support macroeconomic stability—e.g., Angola.

Extending the DIG approach to natural disasters

The DIG model's framework can be used to assess the economic impact of natural disasters and evaluate the policy responses to these disasters. For the purpose of the analysis of natural disasters, it would be necessary to capture in this framework at least three important (negative) effects of these disasters. First is the loss of current output. Second is the loss of productive assets. Third is the disruptions in the functioning of the critical infrastructure that reduce the productivity of the remaining, surviving assets. These effects of a natural disaster can be modeled in a DIG model in a very natural way as a loss of current output, a (permanent) loss of public and private capital, and a (temporary) decline of productivity. As demonstrated by this modeling strategy, the current models are flexible enough to partly address some of the questions related to the impact of and policy responses to natural disasters.

These current breed of models, however, may not be able to fully address all the implications of the natural disasters. The reason is that recurrent and severe natural disasters not only affect economic decisions due to repeated dislocation of productive activity, but, more importantly, they are also likely to create tremendous uncertainty about the outcomes of the economic activity. A proper analysis of these adverse effects of frequent natural disasters, thus, may require a stochastic model which explicitly takes

such uncertainties about the future into account. Current breed of DIG models, however, have perfect foresight. Steps are afoot to incorporate uncertainty, but many challenges remain.

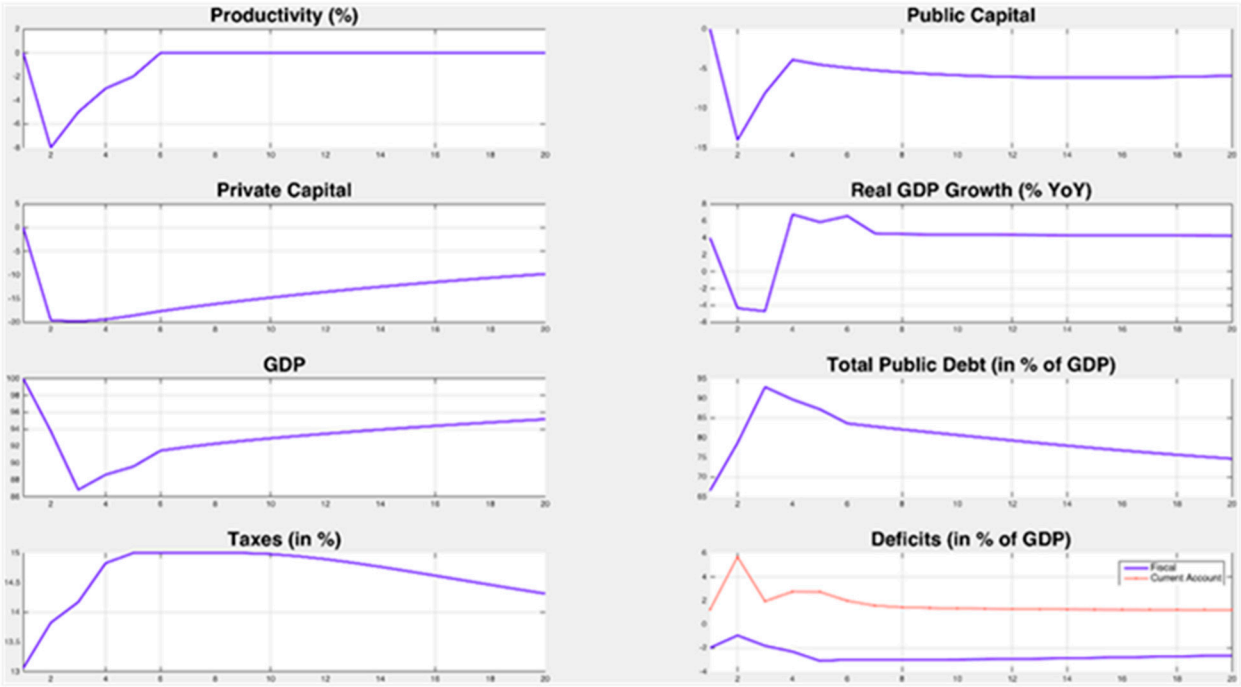
Applying the DIG model: a stylized example

The model, in its present form, can be easily dovetailed to do scenario analysis for natural disasters. Such an exercise will be a useful starting point for policy analysis as it provides a comprehensive assessment of the economic impact of a natural disaster hitting the economy, including its impact not only growth and debt sustainability, but also on private investment and consumption.

The scenario analysis done here is for an extreme disaster in a typical stylized developing country. The economy is assumed to grow at a rate of 4 percent per year in the long run. The government can borrow in international market at interest rate of 9.55 percent per annum. In this analysis, it is assumed that the disaster strikes towards the end of the year and destroys 8 percent of current year output (modeled as a decrease in current year productivity of 8 percent). It is also assumed to wipe out 20 percent of country's capital stock which amounts to a loss of 56.8 percent in terms of GDP, bringing total loss from the disaster to 64.8 percent of GDP. Finally, the disruption in functioning of the economic infrastructure, is assumed to result in persistent decrease in productivity which reduces productivity in next three years by 5, 3, and 2 percent respectively. However, it is also assumed that the loss of public capital from the natural disaster is (approximately) fully offset by grants inflows, which amount to 12 percent (5, 4, and 3 percent in first three years) of GDP.

The simulated extreme natural disaster results in a large, immediate and persistent adverse effect of growth, debt, and fiscal balance. The response of the macro and fiscal variables of interest is shown in Figure 1. The loss of output in the period of disaster reduces growth in the first period from 4 to -4 percent per year. The effects of lower productivity and loss of capital are felt in subsequent periods. Their combined effect lowers output again in the next period and the growth rate remains negative, falling further to -5 percent per year. Subsequently, the growth reverts back closer to the long-run trend. However, the adverse effects on the level of GDP persist for a long period of time. In the meantime, the fiscal side of the economy is strained with tax rate hitting the ceiling of 15 percent and debt shooting from close to 65 percent of GDP to over 90 percent of GDP.

Annex Figure 1. Response of Macro and Fiscal Variables to a Severe Natural Disaster



Potential extensions and applications of the DIG framework to natural disasters

The following list provides some examples of other questions which existing model(s) could modified to address to some extent:

- **The model can be used to address the cost and benefits of building ex ante resilience against natural disasters.** Building resilience would require an initial investment, but would reduce the losses from future disasters. This trade-off can be analyzed in the model by feeding into the model the effectiveness of the investment in resilience-building in reducing the economic impact of the future disasters.

- **The model can be used to study and compare various financial and insurance policies to mitigate the economic impact of natural disasters.** For example, the model may be usefully employed to study various tradeoffs between carrying the risk of disasters versus off-loading it in financial markets through various options such as insurance with a broad coverage or just a catastrophic one. The model incorporates a very elaborate setup for the government and thus can be used to study various policy tradeoffs, for example, between paying-when-disaster-strikes and self-insurance, e.g., through fiscal and foreign exchange buffers, built up during good times to draw down during the times of a natural disaster.

- **Moreover, it can be put to use to understand the best way of organizing and financing post-disaster reconstruction.** During post-disaster times, many regular development activities are suspended and effort is directed towards reconstruction. In addition, government may borrow and/or increase taxes to raise additional resources for reconstruction. The growth and macroeconomic impact of such, alternative policies can be assessed in these models.

- **The effect of natural disasters on investment and FDI can be analyzed as well.** Natural disasters affect investment by lowering the return on such investment. The model can be employed to address this issue. However, the other very important channel through which such disasters may dissuade investors is the uncertainty that they generate. A proper analysis of these adverse effects of frequent natural disasters on investment would require a stochastic model.

- **There are other questions that the model may find hard to address or require extending it in significant ways.** For example, consider the effect of natural disasters on sustained, long-run growth. The determinants of long-run growth are not well understood. Lack of investment is considered to be one reason for poor growth performance. To the extent, natural disasters deter investment that would affect economic growth. However, the trend, long-run growth is exogenous in the DIG model. Thus, in its present form, the DIG is not set up to address this issue. Another such example would be the effect of natural disasters on migration and brain drain. The model as such will be hard to adapt to answer questions of migration. The current set up assumes that labor is not mobile across countries and including margins needed for agents to make a choice may require a significant change in the set up.

Annex VI. World Bank Financing for Natural Disasters

The World Bank has had a central role in ex-post natural disaster support complementary to that of the Fund. A majority of Bank member countries have turned to it for emergency assistance after a natural disaster. Prior to 2008, its crisis support was mainly ad hoc and primarily relied on restructuring of, or diversion of resources away from, existing projects. Until 2008, the *Emergency Recovery Loan (ERL)* was the lending instrument of choice for natural disasters but it averaged almost as long as other lending instruments to begin disbursements, leaving the Bank with no true emergency lending mechanism other than reallocations (World Bank, 2006).

The World Bank has a key role in the global framework for disaster risk reduction. In 2005, in the wake of the Indian Ocean tsunami, UN member countries adopted the Hyogo Framework for Action, the first action plan to reduce mortality and economic losses from disasters. In 2006, to operationalize the framework, the World Bank, the UN, and donors launched the *Global Facility for Disaster Reduction and Recovery (GFDRR*), a global partnership program housed and managed by the World Bank. Its total portfolio consisted of 226 grants at the end of FY2014 for a total of US$156 million, and 85 new grants worth US$60 million have subsequently been approved. In 2013, over 70 percent of the World Bank's Country Partnership Strategies recognized natural disasters as a risk to sustainable development, and disaster risk reduction has been integrated into the institutional scorecard to monitor progress (United Nations, 2013). The Sendai Framework, which replaced the Hyogo Framework in 2015, introduced a significant shift from disaster management to disaster risk management and an increased focus on coordination with other relevant frameworks, including that on climate change.

Starting in 2008, the World Bank has developed three new mechanisms to provide additional resources more rapidly in response to natural disasters. The Bank created the *IDA Crisis Response Window (CRW)*, *Immediate Response Mechanism (IRM)* and Development Policy Finance with a *Catastrophic Risk Deferred Drawdown Option (CAT DDO)*. The CRW, established in 2009, provides low-income countries expedited access to funding following severe natural shocks. The IRM, approved in 2011, can provide access to a portion of the member's undisbursed IDA balances within weeks rather than months of an emergency. The CAT DDO is a contingent credit line that serves as quick-disbursing bridge financing in the event of a natural disaster. Although six small states have started to use the CRW, no small state has an IRM and only one – Seychelles – has a CAT DDO.[1]

In parallel, the World Bank is working with its members to reduce disaster risks. Its efforts focus on integrating disaster risk management and climate change adaptation into the Bank's development assistance programs and promoting resilient development and policy reforms. For example, under the Pacific Resilience Program (PREP), approved in June 2015, the Bank will offer support through 2020 to strengthen early warning, resilient investments and financial protection of participating countries. Working with multiple countries, PREP will encourage regional approaches, including multi-hazard early warning systems, impact forecasts, and response coordination. For climate change, the World Bank's Climate Change Action Plan 2016-2020 commits that by FY19, 20 percent of new health, nutrition, and population projects will consider climate in their design.

[1] For more details, see World Bank, 2006 and 2015b.

Annex VII. Financing Practices for Past Natural Disasters[1]

This annex explores data on countries' access to financing following past disasters. Information on financing has been examined for 24 disasters of different sizes affecting small developing states over the period 1995-2015. Disasters were differentiated between small, middle-range, and large, based on estimates of disaster damage reported in the EM-DAT database. Specifically, small disasters represent damages of up to 1 percent of GDP, middle-range disasters 2-35 percent of GDP, and large disasters more than 35 percent of GDP. Each category covers one-third of the disasters included in the exercise (8 each).

Financing sources and amounts are identified using fiscal and balance of payments data. Fiscal data provided information on domestic bank financing and external grant and loan financing of the budget, while balance of payments data provided parallel information on grant and loan financing as well as information on drawdowns of international reserves and inflows of private remittances. Neither data source provided information on insurance receipts, but these are believed to be small relative to other flows. Averages of each source of financing flow across the 8 countries in each sample are shown in Annex Figures 1 and 2 below.

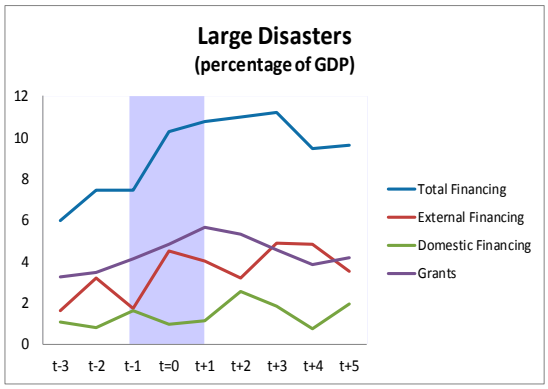
Patterns of financing are compared for pre- and post-disaster periods. For each series, estimates of annual financing flows are volatile, likely reflecting a range of factors in addition to the impact of natural disasters. Accordingly, an averaging process was adopted in an attempt to isolate the impact of disasters on financing flows. Specifically, a comparison was made between average annual financing flows in the three years prior to a natural disaster and the annual average for the disaster year and three subsequent years. This takes into account the variable phasing of disaster financing, some of which is provided up front for disaster relief, and some of which is provided in subsequent years to finance recovery activities. Summary findings are reported in Text Table 5 of the main report, and results for several individual disasters are reported in the figures below.

Access to external loan and grant financing differs significantly across countries. Cabo Verde (2009) and Guyana (2005) were hit by heavy rainfall, which caused floods and landslides. Despite the different intensity of the disasters, the overall financing was substantial in both cases (respectively 13 and 9 percent of GDP in the two years after the disaster), the mobilization of external financing and grants was sizable and timely, and domestic financing very limited. The experiences of Swaziland, hit by a drought in 2001, and St. Lucia, struck by Hurricane Tomas in 2010, were quite different. In both cases, the intensity of the disaster was high, although overall financing was much smaller for Swaziland relative to the size of the economy (about 2 percent of GDP in the two years after the disaster as opposed to 8 percent of GDP in St. Lucia). External financing, however, was not as forthcoming as in Cabo Verde and Guyana, and the use of domestic sources was correspondingly more intense.

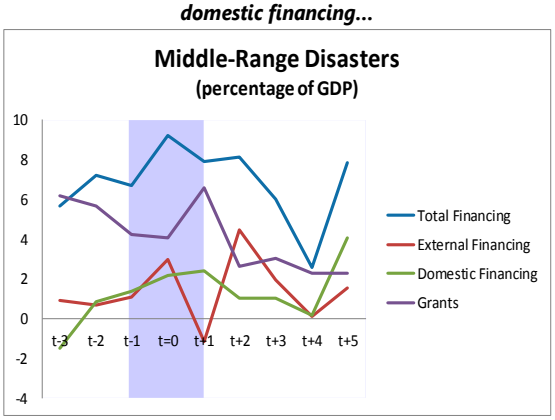
[1]Prepared by Sarwat Jahan, based on a background study by a team also comprising Mounir Bari and Tania Mohd Nor led by Adrienne Cheasty, Marshall Mills, and Cathy Pattillo.

Annex Figure 1. Government Financing following Natural Disasters

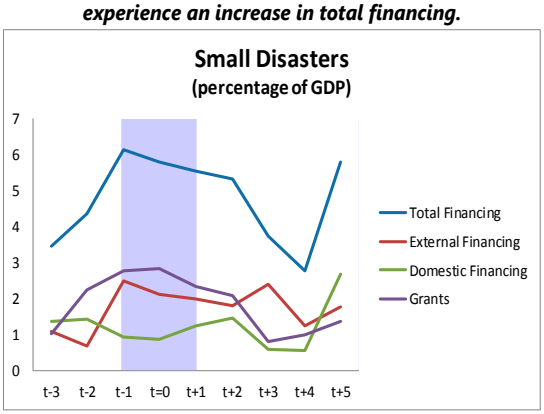
For large-damage disasters, total financing jumps by over 3% GDP between t-1 and t+1, mostly driven by grants and external financing ...



... for middle range disasters, the rise in total financing is mainly driven by grants although external financing may have come in between t-1 and t. In the face of volatile external financing, countries were somewhat cushioned by domestic financing...



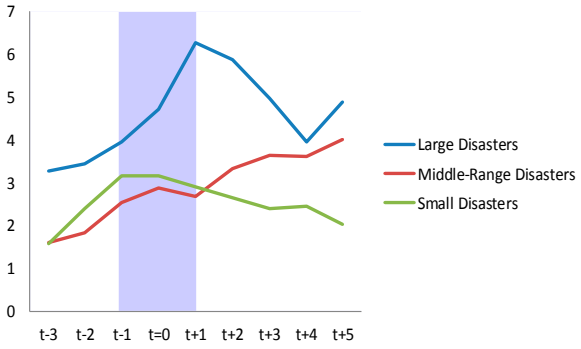
... the countries with the least amount of damages did not experience an increase in total financing.



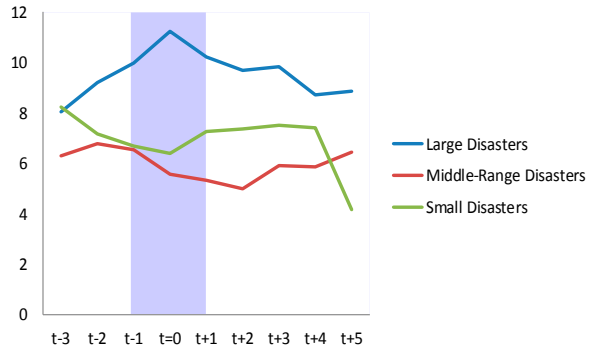
Sources: EM-DAT and IMF.

Annex Figure 2. External Financing Following Natural Disasters

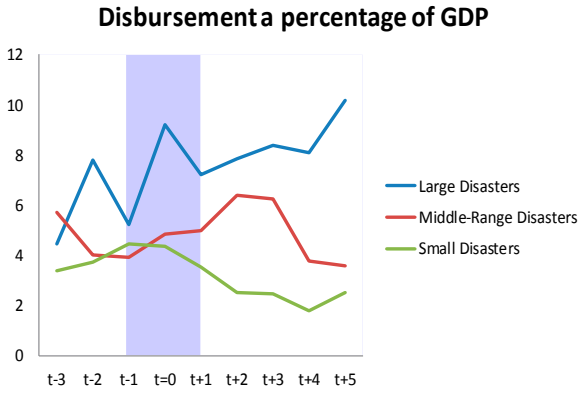
There is an increase in grants for the large natural disasters although it may come with a lag...



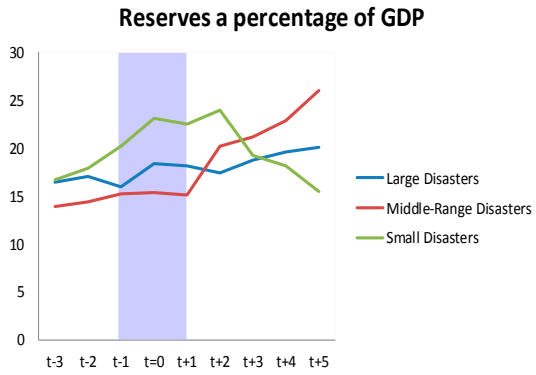
....while large disasters also see a discernible increase in remittances.



Disbursements increase for both large and mid-range natural disasters, but more so for large disasters.

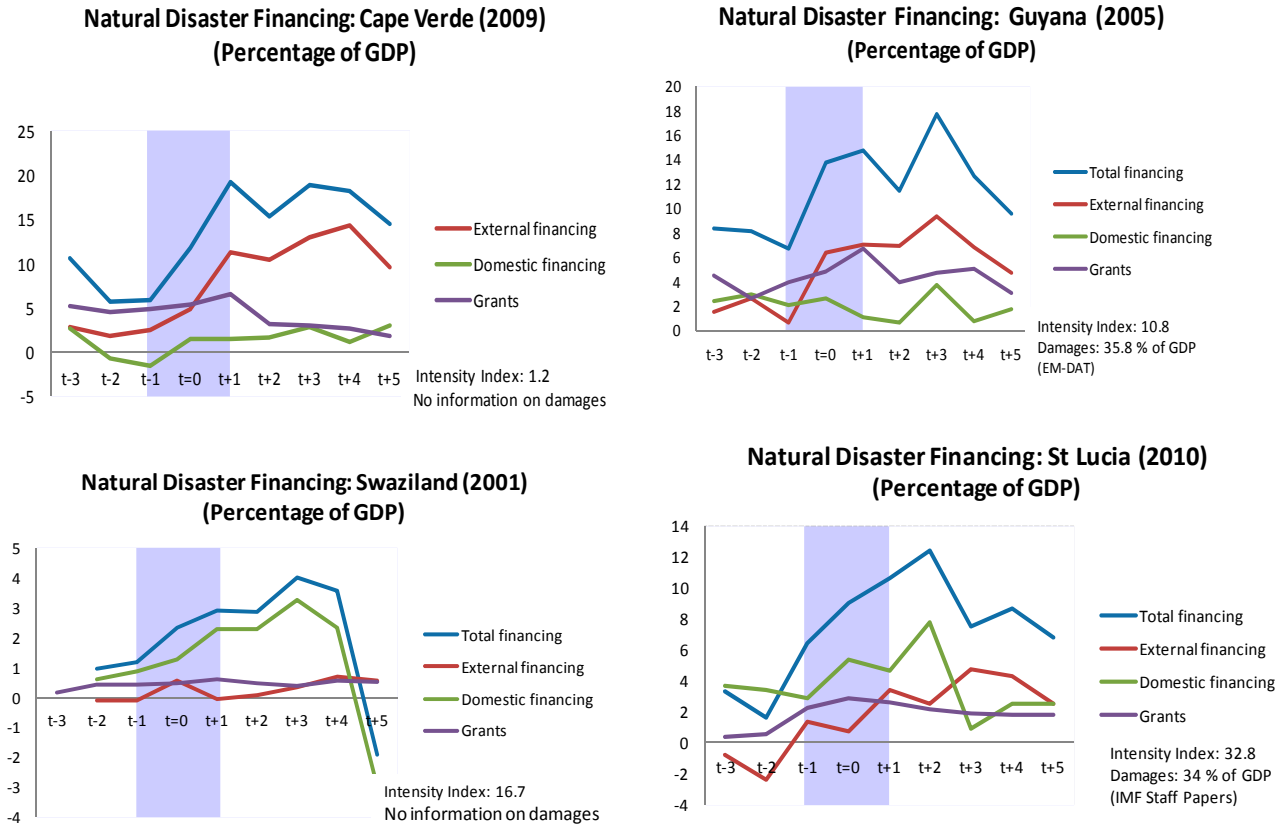


And international reserves are not drawn down.



Sources: EM-DAT, IMF, and the World Bank.

Annex Figure 3. Country Case Studies of Disaster Financing



Note: The timing of disasters affects how much of the financing can be mobilized in t=0. Cabo Verde disaster hit in September; Guyana in February; the drought in Swaziland started in 2000 and continued through 2001; Hurricane Tomas struck St. Lucia in October 2010.

Annex VIII. Design and Use of Government Deposit Buffers

Design of deposit buffers

Size of buffers. The appropriate size for a deposit buffer depends on the projected probability of natural disasters and their associated financing needs (loss of revenues, new spending pressures).[1] It also depends on the expected timeline for accessing alternative financing sources (external grants, loans, insurance payouts), the capacity of the government to preserve the buffer against other spending pressures, and the scope to reduce disaster risks through mitigation measures. Where countries have ready access to borrowed resources, the optimal deposit buffer would also depend on the relative costs of holding buffers rather than taking on new post-disaster debts. (As most small states face constrained short-run borrowing opportunities, this issue of relative costs would not typically be a major consideration.) Given these considerations, the appropriate size of buffers should be determined on a case-by-case basis, rather than using a standardized metric.

Using deposit buffers. The use of deposit buffers after a natural disaster can have macroeconomic consequences that are similar to domestic borrowing. A drawdown of deposits at the central bank has the same effect as borrowing from the central bank in that it generates liquidity that could jeopardize goals for inflation or the exchange rate. Scope to draw on deposits held with domestic commercial banks may also be constrained by disaster-related stress affecting the banking system. In the extreme, a weak bank could face deposit runs following a disaster, impeding use of the government's deposit buffer. Credit and liquidity risk to the government from deposits held with commercial banks could be addressed, in part, through higher capital ratios, liquidity ratios specific to government deposit buffers, separation of buffer-related assets from other investments, other investment restrictions, or an emergency liquidity assistance facility operated by the central bank in the event of a natural disaster. These safeguards would be burdensome, however, for banks to apply and for the government to monitor. Overall, deposit buffers held with domestic banks are best suited for financing modest post-disaster spending needs.

Overseas buffers. Larger deposit buffers would be more readily usable if invested abroad. This could be in the form of central bank international reserves or government deposits with foreign commercial banks. The drawdown of funds would not, in the first instance, impact domestic liquidity conditions.[2] That said, the repatriation and use of foreign funds could have implications for exchange rate management. The latter impact could be beneficial, to the extent that the supply of foreign currency helps meet balance of payments needs arising from the disaster. As a contingency measure, holding foreign currency buffers in today's interest rate environment would also have opportunity costs that should be weighed.

Use of dedicated contingency funds

Countries building up budgetary reserves to address natural disaster risks may choose to utilize a dedicated fund for this purpose. The main characteristics of such funds are that they have a dedicated

[1] The size of saving funds and the annual budget contributions needed to self-insure against natural disasters can be estimated, for example, by simulating natural disasters and their impact on macroeconomic variables (see Guerson, 2016).

[2] Where the government sells foreign exchange domestically to finance its disaster-related spending, this acts to sterilize any creation of domestic liquidity.

financing source, specific governance and investment rules, and very restrictive rules regarding the way the resources are to be utilized. They are attractive for building up reserves because they provide considerable flexibility in timing expenditures across years, and can hold money in reserve, away from the demands placed on the general budget funds, until it is needed.

However, many of these funds are extra-budgetary (EBFs), meaning that they are kept outside of the usual budget process and follow different allocation rules. EBFs are less transparent and, by not being part of the regular budget process, allocate resources without taking account of alternative budget needs. To mitigate these disadvantages, a well-designed framework should have the following characteristics:

- The fund should be consolidated with budget information to allow assessment of the overall fiscal situation; at a minimum, the fund balance should appear in financial statements, and drawdowns from the fund should appear in budget execution reports.
- There should be a standing appropriation that allows for spending immediately after certain trigger event (such as a declaration of a disaster emergency by the executive).
- It should have clear rules governing the use of the resources; follow normal government accounting standards; prepare and publish audited financial statements; define governance rules; and adopt prudent and transparent investment policies. In general, normal PFM rules should apply, but procurement rules for immediate disaster response should be adjusted to allow for quicker procurement.
- It should be limited to respond to disasters with large fiscal impacts: hence, drawdowns should only start above a threshold size, or a minimum total cost estimate. Smaller expenditure needs should be covered through budget contingencies.
- The size of the fund should be determined by taking into account (i) expected damages, (ii) likely available support from the international community (incl. IMF support), (iii) ability to borrow in an emergency, and (iv) opportunity costs for building up buffers. The fund should not get too large because (i) its primary purpose is to "buy time" by covering immediate expenses during which time longer-term financing can be arranged, and (ii) a large fund will generate pressures to tap it for other purposes.
- The fund is a funding source, not an implementing agency. Hence, spending authority should rest with implementing agencies who decide and execute post-disaster spending. The fund typically should not have staff dedicated to it.

Dedicated funds are useful as a funding source for expenditures that cannot be included in the budget because of their inherent unpredictability; however, they should not be used for predictable medium- to long-term expenditures such as climate change adaptation or resiliency investment. These should be included in medium-term budget frameworks or as standing legislation within the annual budget processes, and executed through the budget.

Annex IX. Innovative Risk Transfer Approaches

Innovative approaches for sharing natural disaster risks have emerged over the past decade. This annex covers two important developments—parametric insurance and catastrophe (CAT) bonds. In line with the risk layering approach described in the main paper, a blend of traditional insurance, parametric insurance, and CAT bonds can reduce the overall cost of coverage against risks that vary in probability and severity. Access to such insurance may depend on maintaining incentives for risk reduction in the public and private sectors, and risk transfer arrangements should be conditional on efforts to reduce disaster risks, or should include financial incentives to take such actions.

Parametric insurance

Whereas payments under regular indemnity insurance rely on case-by-case damage assessments, parametric insurance pays out as soon as third party data confirms a disaster event based on pre-defined parameters. Insurance contracts can be tailored to key risks and vulnerabilities in each country, such as hurricane wind speed, or earthquake intensity.

Parametric insurance has the key advantage of being quick-disbursing and its use is growing, albeit from a low base.[1] Costs of cover tend to be high, reflecting several factors. Where disasters are common, the costs of risk transfer will be high, and parametric insurance is best used as cover for the most severe, uncommon disasters. Uncertainties about the distribution of disaster risks can also raise cost of coverage, at least until insurers develop accurate models of parametric distributions. Basis risk can also reduce the cost-effectiveness of parametric insurance, and research to better understand disaster transmission channels can help improve the design of risk cover.[2] Similar to the sovereign bond markets, initial participation by the sovereign can help foster price discovery and reduce the cost of subsequent sovereign participation. Given these various considerations, payouts have typically covered just 1 percent at most of total losses, reflecting limited coverage offered or bought by the authorities as well as basis risk.

Regional pooling of parametric insurance can also help exploit economies of scale. Regional risk pooling is a natural extension of parametric insurance that relies on participation of multiple parties including governments and IFIs for both initial capitalization and policy coordination. With initial capitalization provided by donors and IFIs, the regional pool transfers part of its risk to international reinsurance and capital markets. The World Bank (2014b) estimates that risk pooling reduces the ex-ante financial costs of insurance by up to 50 percent, reflecting partial sharing of capital, administrative and operating economies,[3] and improved access to reinsurance markets. Accordingly, support for regional risk pooling

[1] Derivatives market transactions also offer scope for "insurance-like" risk transfer. Financial instruments meeting such needs will increasingly be available, though the challenge will be to achieve cost-effective economies of scale for issuers and to reduce basis risk for purchasers.

[2] Basis risk arises where model parameters are only loosely related to losses (e.g., wind-speed fails to fully capture the destructive power of a hurricane).

[3] For example, the extension of the CCRIF from the Caribbean to Central American countries provided economies of scale by distributing administrative and risk modelling research costs across a larger client base.

may be a cost-effective way for global partners to promote risk transfer by small states. Several regional risk pooling arrangements are in place:

- **Caribbean**. The Caribbean Catastrophe Risk Insurance Facility (CCRIF), supported by the World Bank and international donor community was launched in 2007. The expansion of the CCRIF to include Central America is projected to reduce premiums for the Caribbean countries by 25 percent and 36 percent for Central America. Caribbean countries already enjoy a 50 percent reduction in premiums from what they would have paid individually.

- **Pacific**. In 2013, a similar facility was created for Pacific countries—the Pacific Catastrophe Risk Insurance Pilot. This program was made possible through the collective efforts of the Government of Japan, the World Bank, and the Global Facility for Disaster Reduction and Recovery.

- **Africa**. African Risk Capacity, an Africa insurance pool for droughts (flood risks to be added at a later date) issued its first policies in May 2014 to cover events with a frequency of I in 5 years. It has a current membership of 32 countries including three small states—Comoros, Djibouti, and Sao Tome and Principe.

Parametric Insurance Payouts and Estimated Total Losses

			Insurance Payout ($million)	Total losses ($million)	Payout (in percent of losses)
Anguilla	CCRIF	2010	4.2	13	32.3
Barbados	CCRIF	2010	8.5	741	1.1
St. Lucia	CCRIF	2010	3.2	588	0.5
St. Vincent and the Grenadines	CCRIF	2010	1.1	288	0.4
Haiti	CCRIF	2010	8	14000	0.1
Dominica	CCRIF	2015	2.4	244	1.0
Vanuatu	PCRIP	2015	1.9	268	0.7

Source: CCRIF, PCRIP, and various media reports.

Catastrophe bonds

Catastrophe (CAT) bonds and other state contingent financial instruments provide for a degree of risk transfer. CAT bonds offer institutional investors high coupons, but in the event of a disaster, bond principal is forgiven, freeing the resources from the issue for disaster management. Principal forgiveness depends on a parametric trigger, based on scientifically measurable characteristics of a hazard. This facilitates quick action in the event of a disaster, while at the same time protecting investors from moral hazard arising from asymmetric information.

Mexico is, to date, the only sovereign to issue a CAT bond, with a 2012 issue providing coverage against earthquakes and hurricanes. The World Bank has also issued a CAT bond to finance CCRIF, the parametric insurance facility for Caribbean countries. In the case of Grenada, debt restructurings during 2014/15 have also included hurricane clauses, developed with Fund advice. Specifically, in a debt exchange with commercial bondholders, new bonds featured a haircut as well as a "hurricane clause" that will defer up to 2 semi-annual payments for all debt service in the event of qualifying hurricane. Depending on the timing of the event, the debt service deferment could provide as much as 5 percent of GDP in cash flow relief. A similar clause was included in Grenada's debt restructuring with the export-Import Bank of Taiwan, and a hurricane clause, though much weaker, was included in Grenada's November 2015 Paris Club rescheduling agreement.

Annex X. Fund Financing for Natural Disasters

Rapid Credit Facility (RCF). Established in 2009, the RCF provides rapid financial support in a single, up-front loan disbursement. Access is available to low-income countries eligible for concessional borrowing through the Poverty Reduction and Growth Trust (PRGT). RCF financing carries a zero interest rate, has a grace period of 5½ years, and a final maturity of 10 years. The RCF replaced the earlier subsidized Emergency Natural Disaster Assistance (ENDA).

Rapid Financing Instrument (RFI). Established in 2011, the RFI is available on non-concessional GRA terms, and is repayable within 3¼ to 5 years. Both the RCF and RFI are designed for members that do not require a full-fledged economic reform program (e.g., because of the transitory and limited nature of the shock), or where such a program is not feasible because the need is urgent or policy implementation capacity is limited.

Access limits under the RCF and RFI. The annual access limit under the RCF and RFI was increased from 50 to 75 percent of quota in July 2015 as part of a financial safety net package for developing countries. (The same package eliminated the scope to use the RCF and RFI in parallel to obtain financing of up to 100 percent of quota.) With the increase in quotas in 2016, annual access limits were halved to 37.5 percent of quota.

Augmentation of an existing program. When a country with an IMF-supported program is hit by a natural disaster, augmented financing under the existing program can provide additional financial support. Also, an IMF program can play a catalytic role in mobilizing international assistance even when an augmentation of resources under the existing program does not take place (e.g., Solomon Islands, 2014).

Catastrophe Containment and Relief (CCR) Trust. Established in 2015, the CCR Trust replaced the earlier Post-Catastrophe Debt Relief (PCDR) Trust.[1] It allows the Fund to join international debt relief efforts when poor countries are hit by catastrophic natural and/or public health disasters. The IMF can provide debt relief to free up resources to meet exceptional balance of payments needs created by the disaster, rather than having to assign those resources to debt service. The post-catastrophe relief assistance under the CCR Trust is available to 38 low-income countries eligible for concessional borrowing through the PRGT and which also have either a per capita income below US$1,215—or, for small states, a population below 1.5 million and a per capita income below US$2,430.[2] A country qualifies for post-catastrophe relief under the CCR Trust if it is hit by a disaster that directly affects at least one third of the population and affects a large portion of the economy evidenced by either destruction of more than a quarter of the country's productive capacity (as estimated by such early indications as destroyed structures and the impact on key economic sectors and public institutions) or caused by damage exceeding 100 percent of GDP.

[1] Following the 2010 Haiti earthquake, the PCDR trust was established to permit the Fund to provide debt relief on IMF repayments when poor countries are hit by the most catastrophic natural disasters.

[2] Among the Pacific islands, only *Solomon Islands* meet these criteria.

Annex 522

"Building Resilience in Developing Countries Vulnerable to Large Natural Disasters", *International Monetary Fund*, June 2019

INTERNATIONAL MONETARY FUND

IMF POLICY PAPER

BUILDING RESILIENCE IN DEVELOPING COUNTRIES VULNERABLE TO LARGE NATURAL DISASTERS

June 2019

IMF staff regularly produces papers proposing new IMF policies, exploring options for reform, or reviewing existing IMF policies and operations. The following documents have been released and are included in this package:

- A **Press Release** summarizing the views of the Executive Board as expressed during its May 1, 2019 consideration of the staff report.
- The **Staff Report**, prepared by IMF staff and completed on April 4, 2019 for the Executive Board's consideration on May 1, 2019.

The IMF's transparency policy allows for the deletion of market-sensitive information and premature disclosure of the authorities' policy intentions in published staff reports and other documents.

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June 26, 2019

International Monetary Fund
700 19th Street, NW
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IMF Executive Board Discusses Building Resilience in Developing Countries Vulnerable to Large Natural Disasters

On May 1, 2019, the Executive Board of the International Monetary Fund (IMF) discussed an IMF staff paper on building resilience to large natural disasters and options for managing associated risks in vulnerable developing countries.

Background

Many developing countries, particularly small states, are vulnerable to natural disasters that can have large human, economic, and social costs. Recent examples of major disasters include Cyclone Idai (March 2019), which caused significant loss of life and widespread economic disruption in Mozambique and neighboring countries, and Hurricane Maria (September 2017), which caused damage to property and infrastructure estimated at some 200 percent of GDP in Dominica. As the frequency and intensity of natural disasters is projected to increase over time with climate change, the economic and social impact of disasters can also be expected to increase.

Given these costs, there are many benefits to taking actions now to enhance preparedness for natural disasters, in terms of lowering the economic and social impact, speeding up recovery, and providing greater continuity in public services. However, in many disaster-vulnerable countries, there is substantial underinvestment in resilience-building efforts, reflecting capacity constraints, large upfront costs, and limited fiscal space. International financial institutions and other development partners make available various forms of support for resilience-building, but domestic institutional capacity constraints often limit the ability of small and poorer countries to fully leverage the resources available to them.

Drawing on a substantial body of existing work by the World Bank and other agencies, the IMF staff paper recommends that vulnerable countries develop comprehensive disaster resilience strategies (DRS) in consultation with development partners and other stakeholders. The DRS should be grounded in a clear diagnostic of disaster vulnerabilities and rest on three pillars: building structural, financial, and post-disaster/social resilience. Such a strategy would support ex-ante planning, provide a framework for coordinating the work of development partners before and after disasters, and help catalyze donor support. Given its expertise in designing macroeconomic policies and frameworks, the IMF can play an important role in supporting resilience building in

disaster-vulnerable countries in the context of its operational work with countries and its support for domestic capacity development.

Executive Board Assessment[1]

Executive Directors welcomed the opportunity to take stock of ongoing staff work on building resilience to natural disasters in vulnerable countries, including the efforts being made to incorporate disaster risks into macroeconomic frameworks and into Fund surveillance more generally.

Directors agreed that natural disasters can have significant and long-lasting effects on economic well-being in many developing countries, particularly small, fragile, and low-income states, and that the frequency and intensity of weather-related shocks are expected to further increase as climate change evolves. They underscored that the social and economic impact of natural disasters can be mitigated through policies to build resilience, including targeted investments in infrastructure and the effective use of available financial instruments.

Directors agreed that incorporating disaster risk is an important component of sound macroeconomic management in countries where risks of large-scale natural disasters are significant. They agreed that the Fund, in collaboration with the World Bank and other development partners, can help vulnerable countries assess the trade-offs between development needs, rising debt vulnerabilities, and the benefits of ex ante resilience building. Most Directors agreed that the Fund's approach to resilience building should extend to slower-onset disasters, which can also have a detrimental impact on countries.

Directors welcomed the suggested three-pillar approach to resilience-building as a useful framework for analyzing policy options in a systematic fashion and for identifying key priorities. They noted that the approach was informed by the Sendai Framework for Disaster Risk Reduction and the work of the World Bank on disaster risk management and insurance strategies. They agreed that many small, fragile, and low-income countries face significant capacity constraints in developing a full strategy for building resilience, which can severely impair the ability of governments to make effective use of external support, and noted that the Fund and the World Bank are well placed to assist countries in overcoming these capacity gaps. While noting the important role of development partners in supporting national efforts, Directors emphasized that government ownership is crucial in building resilience to natural disasters.

Directors saw merit in governments in vulnerable countries developing a national disaster resilience strategy (DRS), drawing on support from the international financial institutions. The Fund could take a lead role in helping countries develop a macroeconomic policy framework that adequately reflects both disaster costs and returns from resilient investment and that identifies the fiscal actions to support the policy framework. The World Bank and other development

[1]An explanation of any qualifiers used in summings up can be found here: http://www.imf.org/external/np/sec/misc/qualifiers.htm.

banks could take a lead role in helping countries identify and assess disaster vulnerabilities and in prioritizing investment needs. Directors highlighted the need for Fund staff to collaborate closely with the World Bank in supporting country efforts, with a few Directors underscoring the core expertise of the Bank in key areas where support would be needed.

Overall, a DRS would provide a roadmap for policy design and sequencing, and facilitate coordination of donor support for national plans. Directors remarked that the DRS would focus national attention on active preparation for disasters while providing an anchor for support from development partners. Directors noted scope for further clarifying the details of coordination, sequencing, and responsibilities of different stakeholders in developing an effective country-owned DRS. They also highlighted that the development of a DRS would benefit from peer learning and experience-sharing among countries and agencies. Directors agreed that a credible DRS could help catalyze higher levels of financial support from bilateral donors, climate funds, and other sources, and welcomed the interest expressed by some Caribbean authorities in developing such strategies.

Directors emphasized that the use of risk-transfer instruments should figure more prominently in government measures to improve financial resilience to disasters, while recognizing the challenges involved in developing insurance markets that provide reasonable premium levels relative to expected annual payouts. They welcomed the efforts of donor countries to support insurance market development and strengthen risk pooling. Directors broadly supported additional work by the Fund, in collaboration with the World Bank, to analyze the role and potential contribution of state-contingent debt instruments in helping countries build resilience to natural disasters.

Directors noted that the Fund has a valuable role to play in supporting country efforts to build resilience to natural disasters, as part of its surveillance and capacity building activities. A coherent resilience strategy should fit within a medium-term macroeconomic policy framework that is consistent with maintaining debt sustainability, including under adverse shocks—an area of core Fund expertise. Staff could also contribute through analysis of the economic impact of disasters and of trade-offs between public investment and debt accumulation. Directors agreed that the Fund's lending toolkit was sufficiently flexible to provide support for disaster-vulnerable countries that face a BoP need, but most saw scope to increase access limits as well as to use the toolkit in non-traditional ways to support resilience-building. Directors encouraged giving special attention to countries prone to natural disasters in the upcoming FSAP Review and Comprehensive Surveillance Review.

Directors agreed that disaster resilience strategies need to be based on a robust diagnostic of risks and vulnerabilities and encouraged a pragmatic approach, in coordination with the World Bank. They asked for a full assessment of the Climate Change Policy Assessments being piloted in a handful of small countries, in collaboration with the World Bank, which could provide a valuable diagnostic for national authorities.

Directors noted that building resilience to natural disasters extends to areas in which the Fund does not have relevant in-house expertise. They underscored that providing effective support to governments would require close collaboration and coordination with other institutions that have the relevant expertise, including in developing disaster resilience strategies, and called for a clear division of labor, based on respective mandates, between the Fund, the multilateral development banks, and other agencies.

INTERNATIONAL MONETARY FUND

April 4, 2019

BUILDING RESILIENCE IN DEVELOPING COUNTRIES VULNERABLE TO LARGE NATURAL DISASTERS

EXECUTIVE SUMMARY

Focus and Motivation: Many developing countries are vulnerable to natural disasters that can have large human and economic costs: disaster risk management for these countries is a macro-critical challenge. In recent years, the IMF has been underscoring the macroeconomic risks of climate change and natural disasters for many countries (typically either small or poor), including their limited capacity to develop, finance, and implement a full disaster risk-management strategy. This paper discusses the components of such a strategy—drawing on consultations with other international organizations and on discussions at recent high-level conferences on building disaster resilience in the Caribbean and in the Pacific regions—and looks at how support for national resilience-building from international financial institutions (IFIs) and other development partners might be better coordinated.

A Roadmap for Resilience: The paper views disaster risk management through the lens of a three-pillar strategy for building structural, financial, and post-disaster resilience. Enhancing *structural resilience* requires infrastructure and other investments to limit the impact of disasters (Pillar I); building *financial resilience* involves creating fiscal buffers and using pre-arranged financial instruments to protect fiscal sustainability and manage recovery costs (Pillar II); and *post-disaster (including social) resilience* requires contingency planning and related investments ensuring a speedy response to a disaster (Pillar III). A full national disaster resilience strategy (DRS) requires actions on all three pillars, grounded on a clear diagnostic.

In many small or low-income countries, there is substantial underinvestment in building structural resilience, reflecting sizable up-front costs and limited fiscal space, as well as limited use of ex-ante financing instruments such as insurance, reflecting both cost concerns and underdeveloped markets. While steps are being taken in many countries to facilitate speedy recovery and reconstruction following a disaster, there is still substantial room to strengthen response mechanisms to improve post-disaster resilience. The benefits of investing in resilience building include lower expected losses from disasters, higher returns to private investment, improved employment and output performance, and better continuity in public services after a disaster.

International financial institutions and other development partners offer various forms of support to disaster-vulnerable countries, but many countries have limited capacity to take full advantage of such support, which can be fragmented and poorly coordinated across providers. This paper argues that a fleshed out nationally-owned DRS could act as the anchor or platform for coordinated support from development partners, which would be needed both to develop

and implement the DRS. Such a strategy, if endorsed by the various stakeholders, including Fund endorsement of the associated macroeconomic framework, could also have a strong catalytic effect in mobilizing concessional donor support.

IMF Role: Within its mandate, the Fund can play a valuable role in supporting resilience building in disaster-vulnerable countries. In particular, Fund surveillance can analyze the macroeconomic impact of disasters and of resilience-building; Fund arrangements could be used to support implementation of a DRS, including providing financing to address associated balance of payments problems; and targeted capacity-building support in areas of Fund expertise can help strengthen national capacity. The Fund, collaborating with the World Bank and others, can also bring together stakeholders—private insurers, governments, donors, climate funds—to tackle issues such as impediments to market-based risk transfer (e.g., exploring the financial viability of debt instruments with disaster clauses) or better connecting small states with the climate funds.

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INTRODUCTION

1. Natural disasters take a large human toll and disrupt economic activity in many developing countries, particularly small states. Climate-related disasters, including hurricanes/cyclones and droughts, have been increasing in intensity and frequency over time against the backdrop of global climate change, while geological events, such as volcanic eruptions, earthquakes, and tsunamis, represent a perennial hazard.

2. The macroeconomic significance of natural disasters depends on country conditions. In larger countries with more diversified or affluent economies, the impact is typically local in nature, with some combination of private insurance markets and central budgetary resources providing support to disaster-hit regions; the macroeconomic impact on the national economy is usually modest. By contrast, in countries that are geographically or economically small, where key sectors are dependent on weather conditions, and/or where private insurance markets are underdeveloped, the effects of such shocks on national economic activity and production capacity can be large.

3. This paper focuses on the second group: countries where natural disasters can have a large macroeconomic impact and, hence, where building resilience to natural disasters is a macro-critical challenge. Countries that fall into this grouping are typically either small or poor or both, with limited administrative capacity to develop a disaster risk management strategy to contain the impact of adverse shocks. This paper uses the term *disaster-vulnerable countries* to refer to such countries.

4. The difficulty of building resilience to natural disasters in disaster-vulnerable states was examined in a recent Board paper (IMF, 2016a). The paper examined the specific vulnerability of small developing states to natural disasters and climate change; noted that disaster management preparations typically fall well short of what is needed; and explored how Fund policy advice and capacity-building could help countries improve disaster resilience, including via financing strategies.[1] A subsequent paper (IMF, 2017a) led to the creation of a "large natural disasters" window in the Fund's emergency financing facilities, with higher access levels than for other exogenous shocks.

5. This paper builds on these earlier works, viewing disaster risk management through the lens of a three-pillar strategy for building structural, financial, and post-disaster (including social) resilience. It draws on the substantial body of work produced by the World Bank and other agencies on preparing for, and managing, large natural disasters (Annex I). The focus is on how best to support disaster-vulnerable countries, including both small states and larger low-income countries, in building resilience to disasters, taking account of the significant fiscal and institutional capacity constraints. A comprehensive approach to building resilience requires a combination of inputs that collectively underpin

[1] IMF (2016b) explored the effects of natural disasters in sub-Saharan Africa (SSA): it found that, while short-term economic effects were often muted, these shocks yielded a marked rise in malnutrition and poverty levels and had a significant adverse impact on longer-term development.

a national Disaster Resilience Strategy (DRS),[2] including a well-grounded diagnostic upon which the component parts of the three-pillar strategy can be built. Countries with significant capacity constraints will require assistance from development partners both to develop a sound DRS and then to implement it; the DRS can provide a platform for organizing effective collaboration across international financial institutions (IFIs) and other development partners.

6. The remainder of the paper is organized as follows. Section II reviews stylized facts regarding disaster-vulnerable countries—the scale of disasters and the challenges to building resilience. Section III discusses the main elements of a DRS, drawing upon analytical work by Fund staff, the World Bank, and other agencies, and ongoing engagement with country authorities. Section IV examines how structured collaboration among international financial institutions and development partners could help develop a coherent package of support for resilience building to small/poor capacity-constrained countries. Section V discusses the areas in which the Fund can effectively support design and implementation of a DRS, reviews how Fund engagement with disaster-vulnerable countries has evolved in recent years and identifies areas for future work.

DEALING WITH NATURAL DISASTERS: STYLIZED FACTS

A. The Economic Impact of Natural Disasters

7. The frequency of natural disasters and the damage associated with them have been increasing over time and are expected to intensify with ongoing climate change (Figure 1a). Small states in the Caribbean and the Pacific are particularly vulnerable to natural disasters, with annual average damage of 2–3 percent of GDP (Figure 1b). The annual average, however, masks the severity of major disasters, as illustrated by the experiences of Dominica (2017) and Grenada (2004) (Figure 1c).

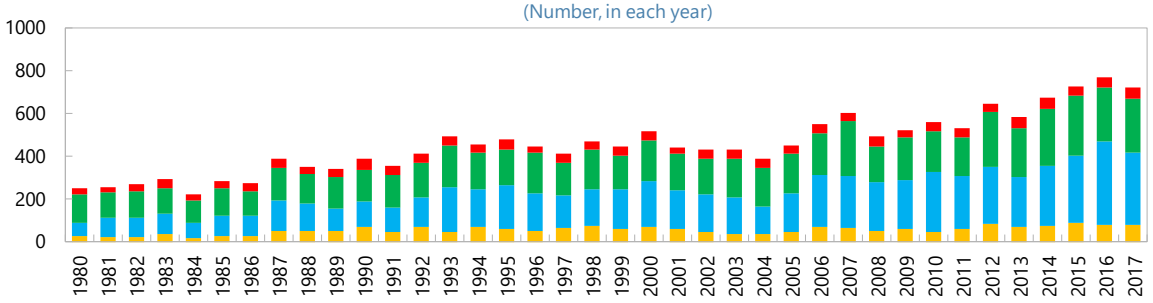
8. Many developing economies that are not small states are also highly vulnerable to natural disasters, including earthquakes, floods, and slow-moving disasters such as droughts (as illustrated in Table 1). Many low-income countries in sub-Saharan Africa—dependent on rain-fed agriculture—suffer considerable damage from repeated droughts and floods (Annex II); the recent cyclone-driven disaster in Mozambique is an excellent case in point. Similarly, developing countries in the Middle East and Central Asia are also subject to drought, floods, and earthquakes; these climate vulnerabilities amplify conflict-related challenges in some countries, such as Afghanistan and Somalia. The Asia-Pacific region is highly exposed to natural disasters such as cyclones, earthquakes, tsunamis, and volcanic activity—with South Asia and the Philippines among the most severely affected.

[2] The term "Disaster Resilience Strategy" is used as a label for a comprehensive national plan to build resilience to limit the disruption caused by natural disasters; equivalent labels would include "National Disaster Plan" or "Disaster Risk Management Framework." The DRS label is chosen here for brevity and intuitive appeal.

Figure 1. Natural Disasters: Frequency and Effects

Panel A. Frequency of Natural Disasters: 1980-2017

(Number, in each year)

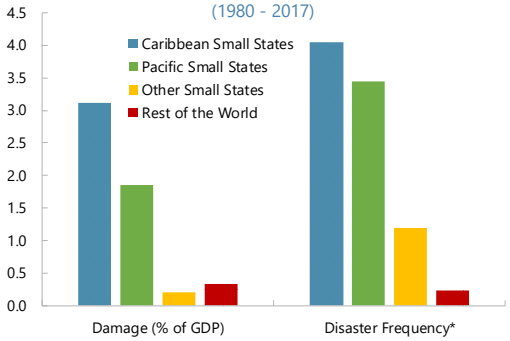


- Geophysical Events (Earthquake, Tsunami, Volcanic Activity)
- Meteorological Events (Tropical Cyclone, Extratropical Storm, Convective Storm, Local Storm)
- Hydrological Events (Flood, Mass Movement)
- Climatological Events (Extreme Temperature, Drought, Forest Fire)

Source: Munich RE.

Panel B. Average Annual Effects of Natural Disasters

(1980 - 2017)



Sources: EM-DAT, WEO, and IMF staff estimates.
*Frequency is the annual average of all natural disaster incidents from 1980-2017 per 10,000 Km sq. of land area.

Panel C. Top Ten Natural Disasters: 1980-2017

Country	Year	Event	Damage (% of GDP)
Dominica	2017	Storm	226
Grenada	2004	Storm	184
Maldives	2004	Earthquake	179
Mongolia	1996	Wild Fire	158
Samoa	1991	Storm	157
Samoa	1990	Storm	145
St. Kitts & Nevis	1998	Storm	137
Vanuatu	1985	~~Earthquake~~ Storm	131
Haiti	2010	Earthquake	122
Cambodia	1991	Flood	106

Sources: EM-DAT and IMF staff estimates.

Table 1. Illustrated List of Countries at Risk of Major Natural Disasters[1,2]

Emerging and Developing Asia (20 countries)		**Sub-Saharan Africa (22 countries)**	
Bangladesh	Palau	Angola	Kenya
Cambodia	Philippines	Benin	Liberia
Fiji	Samoa	Burkina Faso	Madagascar
Indonesia	Solomon Islands	Cabo Verde	Mali
Kiribati	Sri Lanka	Cameroon	Mauritius
Maldives	Timor Leste	Chad	Mozambique
Micronesia	Tonga	Comoros	Niger
Myanmar	Tuvalu	Eswatini	São Tomé and Príncipe
Nepal	Vanuatu	Gambia	Senegal
Papua New Guinea	Vietnam	Guinea	Sierra Leone
		Guinea-Bissau	Zimbabwe
Latin America and the Caribbean (18 countries)		**Middle East and Central Asia (4 countries)**	
Antigua and Barbuda	Guatemala	Afghanistan	
Bahamas, The	Guyana	Djibouti	
Belize	Haiti	Sudan	
Chile	Honduras	Tajikistan	
Costa Rica	Nicaragua		
Dominica	Jamaica		
Dominican Republic	St. Kitts and Nevis		
El Salvador	St. Lucia		
Grenada	St. Vincent and the Grenadines		

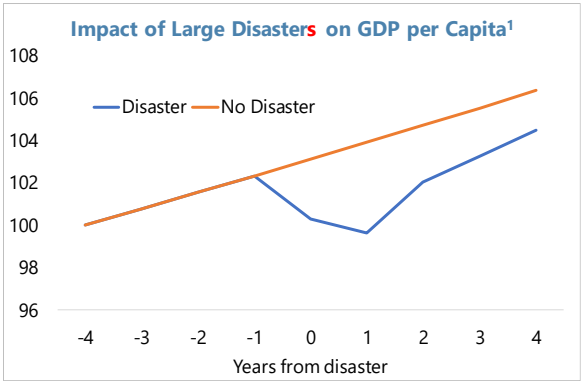
Source: World Economic Outlook.

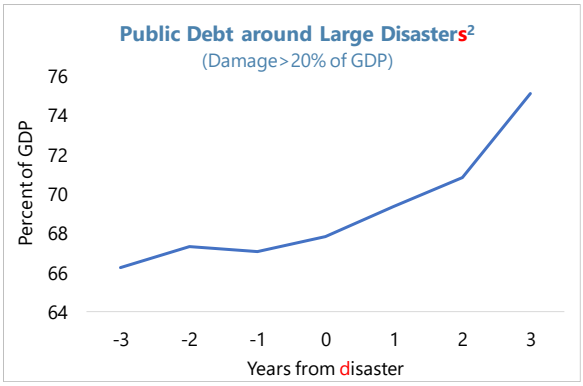
[1]Data limitations preclude relying on any single source for an assessment of vulnerability to disasters; the listing here is illustrative and does not have any operational implications.

[2]Countries are included in the listing if: (1) they experienced reported cumulative damage of at least 20 percent of GDP between 1998-2017 from natural disasters that each caused damage of at least 5 percent of GDP (source: EM-DAT, IMF (2016a)); or (2) they were classified as being small states at extreme or high risk of experiencing natural disasters in IMF (2016a); or (3) they are in the top quartile of countries ranked by disaster vulnerability in the World Risk Index 2018 (World Risk Report, 2018). Three countries (Guinea, Liberia, and Sri Lanka) were added on the basis of staff judgment.

9. Natural disasters can have large and long-lasting macroeconomic effects in vulnerable countries. Indeed, large natural disasters causing significant damage can substantially setback output growth and contribute to a significant rise in public debt (Figure 2). Vulnerability to recurrent disasters affects medium-term growth potential, both directly through repeated adverse shocks to physical capital and indirectly through a higher effective cost of capital and higher levels of out-migration. Natural disasters also generate significant social costs in terms of lost lives, worsening food insecurity, and deterioration in human capital, with longer-term ramifications for growth and poverty in poorer countries (IMF, 2016b). These disasters also disproportionately hurt the poor, who have fewer coping mechanisms.

Figure 2. Macroeconomic Impacts of Natural Disasters





Sources: EM-DAT database and IMF staff estimates.

Note: For each country in EM-DAT database, the disaster with the largest damage in percent of GDP was identified. The sample was then restricted to only developing countries where the largest disaster caused damages of 20 percent of GDP or higher. The cross-country average growth of GDP per capita, and public debt, around the time of largest disasters were calculated for this restricted sample. For the GDP per capita chart, the orange line shows a GDP per capita path based on average growth rate in years one, two, and three prior to the largest disaster. The blue line is based on average growth of GDP per capita in year of the disaster and the years following it.

[1]Disasters with damage greater than 20 percent of GDP; based on average growth rate from 15 episodes in developing countries between 1991-2016.

[2]Average public debt for 11 episodes of large natural disasters in developing countries between 1992 to 2016 for which data are available.

10. Fiscal space, institutional capacity, and ex-ante preparedness can help mitigate the cost of natural disasters. Countries with fiscal space—be it financial buffers, lower debt levels, and/or significant insurance coverage—can move quickly to finance reconstruction; countries without fiscal space (e.g., due to high debt levels, disaster-related implicit and explicit contingent liabilities, low borrowing capacity or limited revenue mobilization) are constrained in their capacity to react. Similarly, ex-ante preparedness and associated institution building play an important role in limiting the output loss and humanitarian costs of natural disasters—the key theme of section III.

B. State Capacity and Disaster Preparedness

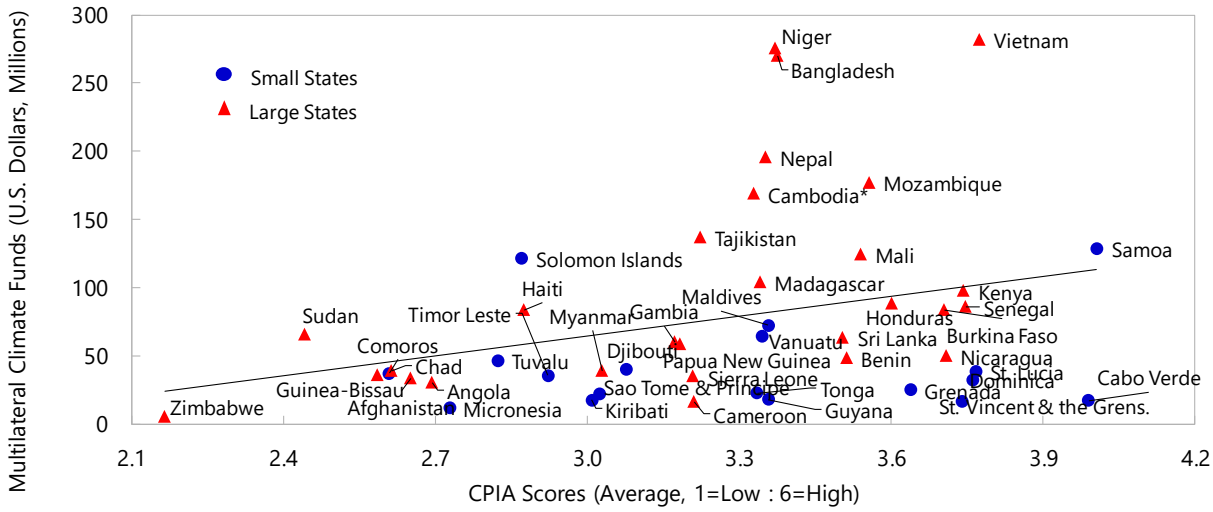
11. The roadmap for building ex-ante resilience to large natural disasters is well established. The Sendai Framework for Disaster Risk Reduction for 2015-2030 outlines policy targets and action priorities to prevent new and reduce existing disaster risks. It underscores the importance of: (i) developing an understanding of the risks to which a country is exposed; (ii) strengthening disaster risk governance; (iii) investing in risk reduction; and (iv) enhancing preparedness for effectively responding to disasters.[3] The World Bank has been helping countries develop disaster risk

[3] Adopted by the UN at the World Conference on Disaster Risk Reduction in Sendai, Japan, in March 2015 as a more ambitious successor to the 2005 Hyogo Framework, the Sendai Framework is a voluntary, non-binding agreement, which recognizes that the state has the primary role to reduce disaster risk, but that responsibility should be shared with other stakeholders including local governments, the private sector and others. It aims for a substantial reduction (continued)

management (DRM) and Disaster Risk Financing and Insurance (DRFI) strategies for over a decade, organized around the five principles of i) risk identification, ii) risk reduction, iii) risk preparedness, iv) financial protection, and v) resilient recovery. The three-pillar strategy discussed in the next section, which is informed by the Sendai framework and the Bank's DRM framework (World Bank, 2019), provides an intuitive organizing framework for discussing the key elements of a DRS with Finance Ministries in a surveillance context and for better integrating the component parts into the budget process.

12. The challenges of developing/implementing a DRS are likely to be bigger in small or poor states. As noted above, countries that are small in geographical size and/or have large agricultural or tourism sectors dependent on variable weather conditions are particularly exposed to adverse shocks that have a large macroeconomic impact—underscoring the need for a robust DRS in such cases. But these states—typically with small populations or poor or both—also have limited domestic capacity/resources to develop a DRS and often find it difficult to manage their engagement with multiple development partners (often with diverse agendas) and financial markets in support of such a strategy.

Figure 3. Institutional Capacity and Access to Multilateral Climate Finance: 2003-2018[1]



Sources: ODI Climate Finance Database; World Bank; and IMF staff estimates.

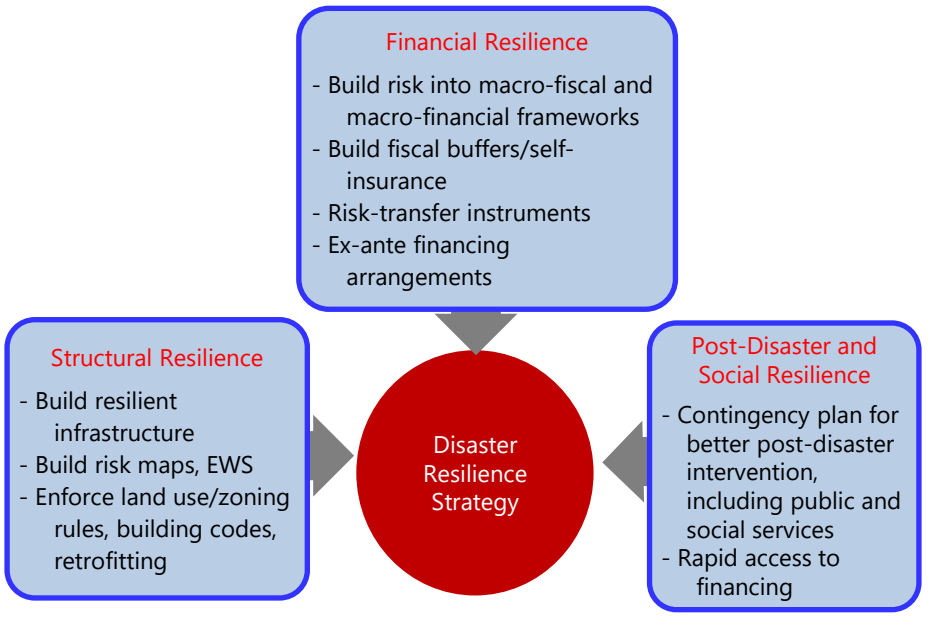
[1]CPIA data are not available for Antigua and Barbuda, Bahamas, Barbados, Belize, Chile, Costa Rica, Dominican Republic, El Salvador, Eswatini, Fiji, Guatemala, Indonesia, Jamaica, Mauritius, Palau, Philippines, St. Kitts and Nevis, and Trinidad & Tobago.

of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.

BUILDING RESILIENCE

13. The components of a national DRS can be grouped into three complementary pillars: measures to improve structural resilience, financial resilience, and post-disaster resilience (Figure 4). Improving structural resilience entails appropriately chosen and prioritized investments that limit the impact of disasters; ensuring financial resilience entails the use of fiscal buffers and pre-arranged financial instruments to manage recovery costs in the wake of a disaster; and post-disaster resilience requires contingency planning to support a speedy response to public needs in the aftermath of a disaster. The actions planned under each pillar need to be grounded on a strong diagnostic of the country's vulnerability to disaster risk and the quality of its preparedness and response mechanisms.[4] They also need to fit within a coherent medium-term macroeconomic policy framework that ensures debt sustainability, supported by strengthened institutional and public financial management (PFM) arrangements.

Figure 4. National Disaster Resilience Strategy
(Three complimentary pillars)



A. Pillar I: Structural Resilience

14. In disaster-vulnerable countries, investing in structural resilience should be a high priority. Such investment includes both "hard" policy measures (e.g., upgrading infrastructure, developing irrigation systems) and "soft" measures (e.g., developing early warning systems, customizing building codes and zoning rules). In many disaster-vulnerable countries, these

[4] This diagnostic should be seen as the foundation on which the three pillars are based: it incorporates the "risk identification" and assessment of "risk preparedness" components of the World Bank's framework, cited above.

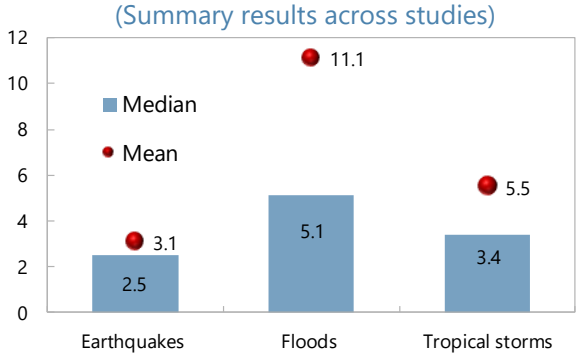
investments have taken a back seat to other urgent social and development needs, reflecting a combination of limited fiscal space, short time horizons for policymakers, and capacity constraints. As a result, efforts to build structural resilience, notably of public infrastructure and key economic sectors, remain well short of the scale that is called for. Moreover, in the absence of a comprehensive strategy to build resilience, investment in adaptation is often poorly coordinated and not sufficiently prioritized.

15. The upfront cost of investing in structural resilience is significant but benefits that typically accrue over the medium to long run can exceed costs by a large margin.

- *Costs of building structural resilience*. Priorities vary from country to country and so do the associated costs, but accurate estimates of the overall needs require full costing of investment plans (and their maintenance costs), which is often missing in disaster-vulnerable countries. This said, the required investments are likely to be significant relative to a vulnerable country's GDP and could far exceed its capacity to build meaningful resilience to climate change over the longer term. For example, according to UNEP (2016), the costs of adaptation to climate change in developing economies are currently estimated at about US$56–73 billion, 2–3 times higher than currently available financing, and potentially rising to US$140-300 billion by 2030. For Fiji, adapting to climate change and natural disasters is estimated to require structural investments of around 100 percent of GDP over the next ten years, which—coupled with an increase in private investment—could be plausibly achieved by sustaining the public investment to GDP ratio at around 10 percent of GDP.

- *The benefits of structural resilience*. While costs are front-loaded, benefits usually accrue over many years, often well beyond the time horizon of governments seeking re-election. In addition to reducing expected losses from natural disasters, investing in structural resilience should raise returns to private investment, employment and output (thereby reducing outward migration), and facilitate continuous provision of public services. Such investment should also help reduce start-stop spending and protect the returns from other disaster-vulnerable development projects. Ultimately, resilient capital will also reduce the need for, and cost of, financial protection and ex-post assistance. For the countries in the ECCU, for example, staff estimates that public infrastructure resilient to natural disasters could increase potential output by 3–11 percent, with a growth dividend of 0.1–0.4 percentage points per year during the transition to the new steady state. Staff analysis for the Solomon Islands also shows that in addition to higher growth outcomes, public debt would be lower over the medium term from prioritizing resilient investment, strengthening public financial

Figure 5. Benefit-Cost Ratios for Ex-Ante Interventions
(Summary results across studies)



Sources: World Bank (2013), and IMF staff estimates.

management and increasing public investment efficiency (see also Annex VI). According to a summary of microstudies by the World Bank, the benefit-cost ratio of investing in resilient infrastructure ranges from $2.5–$11 for every $1 spent on resilient investment across various hazards (World Bank, 2013).

16. Several vulnerable countries are making progress in building structural resilience (Annex III). For instance, Fiji introduced a "build back better" campaign after cyclone Winston in 2016. Fiji and Tonga have made their electricity grids more disaster resilient, while Tuvalu has done the same for its docks. Madagascar, Malawi, and Mauritius have improved construction standards to better withstand storms, while Lesotho, Madagascar, and Mozambique have developed flood resistant infrastructure. Bank-Fund Climate Change Policy Assessments (CCPAs, Box 4), conducted so far for Belize, Seychelles, and St. Lucia, suggest that between one fourth and one third of the investment budgets in these countries are already devoted to resilience-building projects. Similarly, the World Bank's Climate Vulnerability Assessment (CVA) for Fiji, conducted in 2017, suggests that government spending on resilience grew fourfold over the preceding five years to about US$170 million, and was about a tenth of the budget in FY2016/17. In Dominica, about half of the public investment since Hurricane Maria in 2017 has been allocated for disaster-resilient projects, in line with the government's goal to make Dominica the first disaster-resilient state. In Somalia, following recurrent drought, a recovery and resilience framework has been developed with the help of the UN and World Bank, and is being incorporated into their 9th National Development Plan.

17. Notwithstanding the progress, investment gaps in resilience building remain large. The three CCPAs noted above have estimated resilience investment gaps—the difference between required investment for building structural resilience and current investment levels—of 2-3 percent of GDP a year over a decade or more. Resilience gaps are also significant for some larger LICs: Ethiopia would have to more than double its current annual investments in climate adaptation (of US$400 million or 0.5 percent of GDP) to fully implement the authorities' strategy for mitigating the impact of droughts on agriculture.

The Way Forward

18. Underinvestment in structural resilience reflects a mix of factors, including short-term bias in policymaking, tight fiscal constraints, and limits on borrowing capacity due to elevated debt levels or poor credit-worthiness; concessional financing from the international community is also limited.

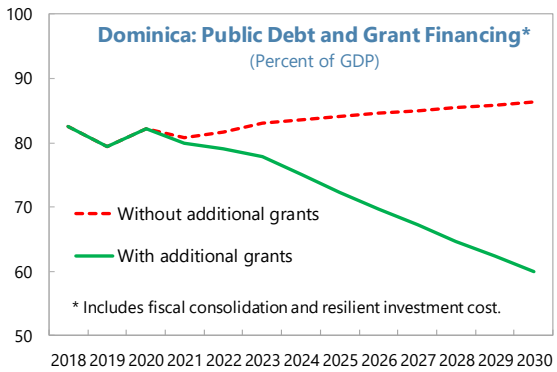
- Policymakers need to make the case for additional investment, financed through a mix of measures to generate additional fiscal space (by improving revenue mobilization and/or prioritizing expenditures) and, in some circumstances, higher levels of external borrowing—with the appropriate mix depending on country conditions, including the outlook for debt sustainability (IMF, 2019).

- Additional aid flows targeted at key high-return projects are likely to be needed to ease the trade-off between fiscal adjustment and debt accumulation. In countries particularly exposed to

large disasters, the scale of high-return resilience-building projects may be much larger than can realistically be financed through fiscal policy adjustments and prudent levels of commercial borrowing, implying that full implementation of the DRS will be feasible only if domestic efforts are complemented by significant new aid flows, whether from bilateral partners or multilateral institutions, including climate funds (Box 1).

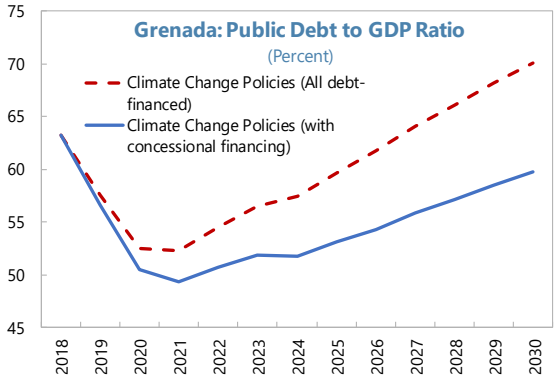
Box 1. Investing in Structural Resilience—Implications for Debt Sustainability and Concessional Financing

Dominica was devastated by tropical storm Erika in 2015 and hurricane Maria in 2017, with estimated damages of near 100 percent and over 200 percent of GDP, respectively. High rehabilitation and reconstruction costs are compounded by costly resilient investment. With assistance from development partners, the government has developed a Public Sector Investment Plan, which includes resilient infrastructure projects. Incorporating the multi-year investment plan in the macro framework has implications for fiscal sustainability and for meeting the regional debt target of 60 percent of GDP by 2030. Staff assumes that to finance resilient investment the government can credibly (and at most) carry out additional fiscal adjustment of 4 percent of GDP, which is both back loaded (to allow output to first recover to pre-hurricane levels) and gradual. Given the additional fiscal adjustment, staff estimates that sustaining resilient investment will require an increase in grants of around 2.8 percent of GDP annually to meet the public debt target of 60 percent of GDP by 2030, or about US$200 million cumulatively.



Source: IMF Staff estimates.

Grenada has made important strides in preparedness for climate change, including developing a National Climate Change Policy and National Climate Adaptation Plan in 2017. It has also established a Ministry of Climate Resilience in 2017 to help mainstream climate change policies. A joint World Bank-IMF CCPA is also underway, which has identified a list of projects and a multi-year investment plan that would help build disaster resilience. Preliminary estimates indicate that public capital spending would need to be scaled up by 3 percent of GDP annually to implement all resilient investments by 2030. To finance this, staff estimates that additional grant financing of US$15 million annually (or US$185 million in total) would be required for Grenada to stay within the regional public debt target of 60 percent of GDP. If such grants do not materialize, and the estimated increase in public investment is financed entirely by new borrowing, public debt as a share of GDP would rise to 70 percent by 2030.



Source: IMF staff estimates.

19. The private sector can play a useful role in supplementing public funding. For individual projects, the costs and benefits of private versus public solutions should be assessed by

governments and private investment encouraged where it is economically and environmentally sustainable. Any contingent public sector liabilities, as with some PPP projects, need to be allowed for in comparing options, particularly in countries where capacity to negotiate sound PPP contracts is limited.

20. Supporting investment in resilience can produce net savings for those bilateral donors that are likely to provide significant support for post-disaster recovery efforts. As examined in Box 2, such investments reduce the costs of post-disaster recovery—and hence the ex-post financial support needed from donors. Realizing such a "win-win" outcome would require coordinated action by key donors to produce aggregate investment levels that yield large cuts in post-recovery costs.[5]

Box 2. Savings from Ex-Ante Interventions[1]

The benefits of ex-ante action for building resilience is assessed by using a dynamic stochastic general equilibrium model calibrated for six small states—Dominica, Antigua, St. Lucia, St. Vincent, Haiti and Fiji. These countries are assumed to be hit by various size disasters during a twenty-year period based on the historical frequency of these shocks. The following two policy options are assessed over this 20-year span:

- *Option 1: Ex-post resilience investment.* The government invests in resilient infrastructure only when public capital is damaged by natural disasters. Donors are assumed to cover the full cost of rebuilding after disasters, including the additional cost of resilient capital, which is assumed to be 10 percent more expensive than the non-resilient one.
- *Option 2: Ex-ante resilient investment.* The government maintains the same public capital stock as in option 1 in real terms but invests ex-ante in resilience building by replacing the depreciating capital fully with resilient capital every year. Because resilient infrastructure is more expensive, the government's nominal spending is 1 percent of GDP higher than it would have been without such ex-ante investment. It is assumed that donors finance this additional 1 percent of GDP a year, plus all post-disaster reconstruction as in option 1.

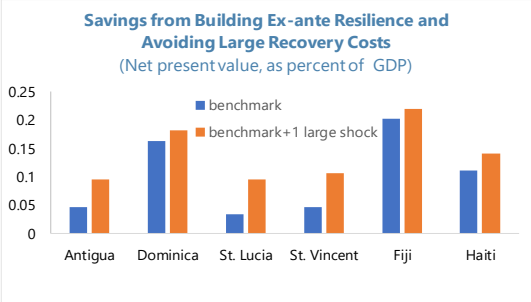
The cost of rebuilding is larger in the first option than the second as the stock of infrastructure is less resilient. The simulation suggests that the international community can save on average 10 percent of recipient's GDP across six countries, in net present value terms, by investing in ex-ante resilience and avoiding expensive rebuilding costs (left chart below). The savings would be less if the relative cost of resilient infrastructure is higher than the assumed 10 percent. In addition, the recipient countries benefit from better growth performance in the event of the disaster, with GDP on average 4 percent higher under ex-ante resilience building (right chart).

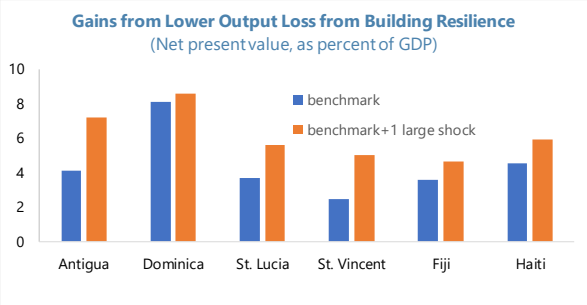
If the frequency of disasters increases due to climate change (in the simulation, there is one additional large natural disaster exceeding 20 percent of GDP damage in the 20-year period), the benefits of ex-ante interventions are higher. Savings for donors would increase to 14 percent of recipient's GDP and the overall GDP level would be about 6 percent higher under ex-ante resilience building.

[1] Based on Wei Guo and Saad Quayyum "Building Resilience to Natural Disaster in Vulnerable States: Savings from Ex-Ante Interventions", forthcoming, IMF working paper.

[5] Each donor-supported resilience-building project, by reducing the costs of post-disaster recovery, generates a positive externality for other donors who are likely to provide support in the wake of a disaster.

Box 2. Savings from Ex-Ante Interventions *(concluded)*





Source: IMF staff estimates.

B. Pillar II: Financial Resilience

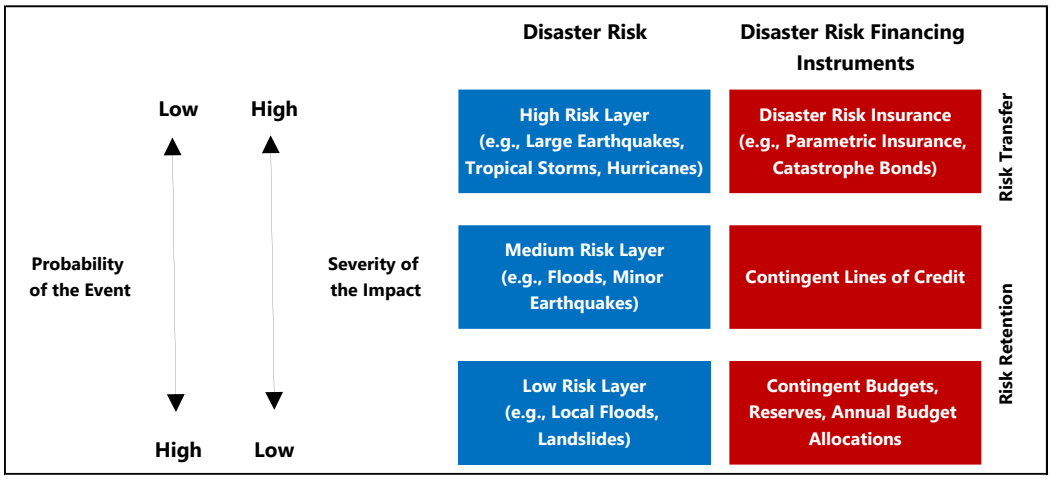
21. Strengthening resilience also requires policy action to manage the financial costs of natural disasters. Since the impact of disasters can be partially contained but not eliminated, disasters will still create sizable fiscal/financing shocks that need to be planned for. Absent planning, disaster-hit countries would encounter significant financing needs at a time when credit-worthiness has been adversely affected by the disaster, leaving the country with constrained and/or much more costly access to financing.

22. Securing ex-ante financing for disaster costs through a multi-instrument strategy supports better management of the fiscal and macroeconomic impacts of natural disasters. The World Bank's multi-layer risk approach—which combines different instruments for different layers of risk—provides a cost-effective approach for governments to address expected funding needs in the wake of disasters (Figure 6). Depending on the frequency and severity of disasters, governments may choose to manage their disaster risk by: (i) self-insurance through fiscal buffers; (ii) transferring risk through insurance or other risk-sharing mechanisms; (iii) arranging contingent financing via pre-arranged credit lines with IFIs;[6] or (iv) reliance on concessional financing and humanitarian assistance from the international community when risk transfer is not cost effective for very large and rare disasters.

23. Countries have pursued, to various degrees, such multi-instrument strategies. Several Caribbean countries are exploring or already have mechanisms to self-insure (e.g., the Bahamas, Dominica, Grenada, Jamaica, St. Kitts and Nevis, and St. Vincent and the Grenadines). In the Pacific Islands, five countries have considered pooling resources to form a regional savings fund. To provide immediate funding for emergency responses, the IDB and/or World Bank have contingent credit lines in Jamaica, Dominican Republic, Kenya and Seychelles, with several more in the pipeline; the ADB also has contingent financing lines for Pacific Islands (Cook Islands, Samoa, Tonga and Tuvalu). In addition, disaster-vulnerable countries have access to risk transfer through insurance, generally parametric, provided by regional pooling arrangements (Table 2). The Bank and IFC are supporting countries in the development of natural disasters and property insurance (including in Fiji).

[6] Examples include the World Bank's CAT DDO, the Inter-American Development Bank's contingent credit line (CCL) and facility (CCF), and the Asian Development Bank's Contingent Credit Line and contingent grants.

Figure 6. World Bank's Multi-Layer Risk Approach to Financing Disaster Risk



Source: World Bank.

Table 2. Regional Sovereign Insurance Pools

	Hazards insured	Member states/territories (latest season available)	Avg. premium income/ Avg. coverage
CCRIF (2007)	Earthquake Tropical cyclone (hurricanes) Excess rainfall Drought	Insured members (20): Anguilla, Antigua & Barbuda, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Dominica, Grenada, Haiti, Jamaica, Montserrat, Nicaragua, St. Kitts & Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad & Tobago, Turks & Caicos Islands Other eligible members (15): Aruba, Costa Rica, Curacao, Dominican Republic, El Salvador, Guadeloupe, Guatemala, Guyana, Honduras, Martinique, Panama, Puerto Rico, Saint Barthelemy, Suriname, US Virgin Islands	US$21.5m US$650m
PCRAFI (2013)	Tropical cyclone Earthquake/tsunami Excess rainfall	Insured members (5): The Cook Islands, the Marshall Islands, Samoa, Tonga, Vanuatu Other eligible members (10): Fiji, Kiribati, Federated States of Micronesia, Nauru, Niue, Palau, Papua New Guinea, Solomon Islands, Timor Leste, Tuvalu	US$2m US$45m
ARC (2013)	Drought Extreme weather (*drought, excess rainfall, heatwaves and tropical cyclones*)	Insured members (6): Burkina Faso, Mali, Mauritania, Niger, Senegal, The Gambia Other eligible members (6): Chad, Ethiopia, Madagascar, Malawi, Kenya, Zimbabwe	US$22m US$50m
SEADRIF (2018)	Mainly flood risk	Signatories to agreement: Cambodia, Indonesia, Japan, Lao PDR, Myanmar, Singapore	TBD

Source: CCRIF, World Bank, data on premium and coverage from World Bank (2017).

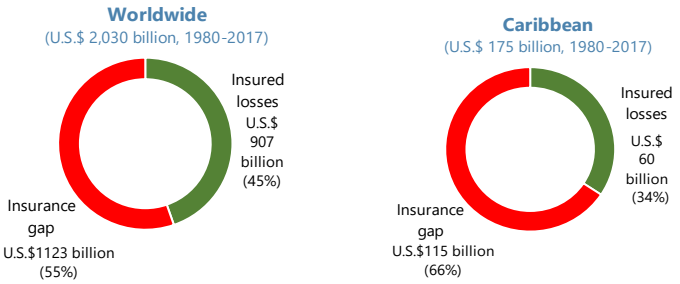
24. Despite the availability of these instruments, and their known benefits, their use has been limited due to cost and capacity constraints. Indeed, two thirds of the natural disaster losses in the Caribbean are uninsured, compared to about half in the rest of the world (Figure 7a).

- For sovereigns, weak fiscal positions, competing demands on public resources, and cost considerations typically limit their ability to self-insure or buy substantial disaster insurance. For instance, the cost of parametric insurance and catastrophe bonds (or "cat bonds", which are also based on parametric triggers; see Annex IV) is estimated to be in the range of 1.5–3.2 times the expected annual payout, reflecting a mix of factors, including large tail risks facing vulnerable countries (Figure 7b) geographical correlation of risks across potential buyers, and thin insurance markets facing small states. In addition, while sovereigns have relied on regional pools to reduce costs, these pools cannot fully cover very large losses because they have limits on maximum coverage and carry the risk that the payout would not be triggered or will be smaller than actual losses (the so-called basis risk).

- Private insurance penetration is also low, reflecting high premia, unfit construction that fails to meet insurability standards, and lack of social tradition of purchasing insurance.

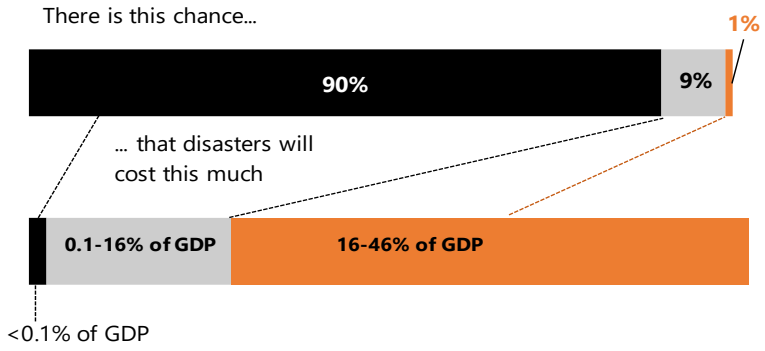
Figure 7. Limited Risk Transfer through Insurance, and Losses from Natural Disasters

Panel A. Limited Risk Transfer through Insurance:
Large Share of Unisured Losses
(Meteorological loss events)



Sources: Munich RE; and IMF staff estimates.
Notes: Meteorological loss events include tropical cyclones, extratropical storms, convective storms, and local storms

Panel B. Losses from Natural Disasters
(Ex-ante loss for this country=0.4% of GDP, but…)



Sources: CCRIF data, and IMF staff estimates.

The Way Forward

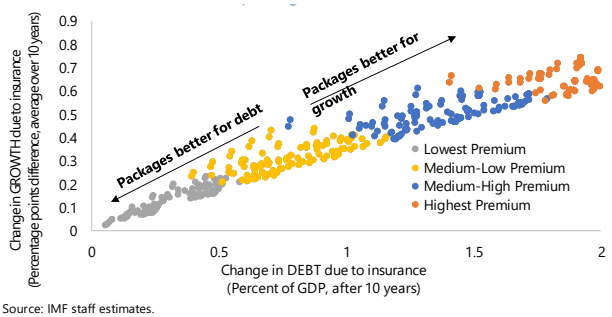
25. In considering the choice of options, policy-makers need to take account of country-specific factors and of how choices complement one other. In particular, to self-insure, countries need to decide how large their own fiscal buffers should be and how to build them (IMF, 2019). While building self-insurance funds—with strong institutional and governance arrangements—may be easier in countries benefiting from sizeable windfall revenues (such as from natural resource rents or "Citizenship by Investment" programs), most disaster-vulnerable countries will need sustained fiscal effort to build a fund of adequate size. For countries that decide to build such funds, at a minimum, the effort should aim at annual contributions into the savings funds equivalent to: (i) the expected value of annual damages from disasters (which could range upward from 0.4 percent of GDP for highly vulnerable countries); and/or (ii) the deductible under existing parametric insurance schemes. For many vulnerable countries, the high opportunity cost and capacity requirements of a fiscal savings fund argue for smaller funds and alternative arrangements, such as contingent financing.

26. Initial approval of some of the contingent credit lines provided by IFIs' boards requires demonstration of fiscal and debt sustainability. While many countries have successfully accessed the World Bank's CAT-DDO (e.g., Dominican Republic, Seychelles, and Kenya), approval of the instrument requires that countries have in place an adequate macroeconomic policy framework, including the policy adjustments needed to achieve fiscal and debt sustainability, which has been a challenging pre-condition for some Caribbean countries.

27. Higher uptake of insurance products by sovereigns requires cognizance of the trade-offs between the fiscal costs of insurance and its growth benefits. In particular, higher risk transfer would provide higher protection to growth by enabling a faster recovery but could impact fiscal costs due to premium payments (Cebotari et al. forthcoming). Optimal financial protection requires considering these trade-offs, which differ across countries depending *inter alia* on risk preferences. Staff simulations of existing parametric insurance options under various disaster profiles allows optimal packages to be identified depending on country risk preferences. Prioritizing fiscal sustainability considerations may require choosing less costly insurance packages, associated with lower payouts, and thus less beneficial growth outcomes (gray and yellow insurance coverage in Figure 8). Prioritizing higher growth outcomes (e.g., for more severely exposed countries) may require choosing more

Figure 8. Choosing Optimal Risk Transfer: The Trade-offs

(Each dot = insurance package with different risk transfer) 1/



Source: IMF staff estimates.

1/ Each dot shows the average, for a given insurance package, of the difference in debt and growth outcomes between insurance and no-insurance scenarios over 1,000 states of the world.

expensive insurance packages, with higher payouts (orange and blue insurance packages). On balance, this trade-off is more difficult—and protecting growth is costlier—for severely-exposed countries; in such cases, focusing on fiscal considerations alone could result in suboptimal insurance choices in the absence of additional financial support (Annex V).

28. Support from development partners could ease the fiscal constraints in choosing the right level of insurance and enhance growth. Specific mechanisms include subsidizing insurance premia paid by countries either directly (e.g., by matching premia) or indirectly (e.g., by augmenting the capital of regional pools, thereby reducing reinsurance costs and allowing higher insurance coverage). The recent launch of the Global Risk Financing Facility(GRiF) by the World Bank, Germany, and the UK is a significant step in this direction.

29. Additional ways to expand coverage of sovereign parametric insurance and reduce disaster costs include:

- *Diversifying risk further within and across regional pools*. While regional pools are already working to diversify risks by expanding memberships and insured perils, pools could also share risks among themselves to reduce costs.

- *Developing additional risk transfer tools.* Subject to country demand, innovative parametric and indemnity insurance products could be developed. For example, the currently small *cat bond* market could be expanded—with support from the World Bank—to help countries build the necessary capacity to access such products. Likewise, *state-contingent debt instruments* could help expand the sovereign toolkit for risk transfer and preserve policy space when it is needed most (Box 3). Innovative *indemnity-based insurance* (under which payouts are proportional to the actual, rather than modeled, losses) could help expand existing coverage (which cannot be scaled indefinitely due to basis risk and insurance capital requirements) and could be offered by the regional pools directly or as aggregators of indemnity risk from national-level insurance contracts.

- *Increased private insurance penetration* can also help reduce the fiscal cost of disasters and implicit contingent liabilities for sovereigns. Possible solutions include: (i) regional pooling of private insurance risk; (ii) government-sponsored pools for natural disasters to overcome private insurance market failures;[7] (iii) incentives to private providers of risk transfer instruments if market failures exist; (iv) strengthened local (re)insurance supervision and regulation; and (v) enhanced financial literacy.

[7] In advanced economies, such pools include the National Flood Insurance Program (US), Florida Hurricane Catastrophe Fund, California Earthquake Authority, and New Zealand's Earthquake Commission. In emerging markets, the Turkish Catastrophe Insurance Pool established in 2000 with World Bank assistance manages the compulsory earthquake insurance in the country, limiting the fiscal contingent liability.

Box 3. A Case for Climate-Resilient Debt Instruments

Climate-resilient debt instruments may help disaster-vulnerable countries transfer risks in a more cost-effective manner (IMF, 2017, has a fuller discussion of the role of SCDI instruments and how they fit within the existing financial risk-transfer toolkit). At the request of the ECCU, the staff of the IMF and the World Bank have explored two instrument design options that could complement ongoing efforts to build financial resilience.[1]

The **first option** would embed "disaster-linked clauses" inside debt contracts, to allow for an automatic extension of debt service in the event of a natural disaster that meets specified parameters. The occurrence of a natural disaster that meets these parameters would result in deferral either of principal or interest payments or both on these debt instruments for a specified time period. This deferral would reduce gross financing needs in the event of a disaster, thus reducing the likelihood of countries needing to enter into costly debt restructurings and/or arrears. The implied risk of payment reprofiling would be borne by creditors, who could demand a compensatory yield premium; this could be addressed at least in part by making the maturity extension NPV-neutral for creditors (e.g., a coupon enhancement could be attached to the extended debt). A draft term sheet for such clauses has been prepared by the International Capital Market Association (ICMA) and Clifford Chance to facilitate use by interested sovereigns.[2]

There are significant "first-mover" obstacles to be overcome in introducing new debt with such features—particularly when the new issuers are likely to be small states with relatively thin investor bases. For the first debt issued, the debt service relief after a qualifying disaster would be modest, the reduced risk of default would be correspondingly modest, and buyers may need higher yields to compensate for having claims pushed back relative to others. Given this, faster progress may be possible:

- where the debtor has a relatively short maturity of external commercial debt, so that a large volume can be reissued with the clauses in a small period of time.
- via liability management operations by one or more sovereigns; this will require coordination among sovereigns (say in the Caribbean), and support from the international community.
- by bilateral official creditors adopting a standardized approach to embedding disaster-linked clauses in their own lending, thus ensuring equal treatment and fair burden-sharing across this creditor group. This issue is currently under review in the Paris Club.
- in debt restructurings, where all creditors would receive new debt instruments with disaster-linked clauses. Grenada 2015 and Barbados 2018 are two recent, susccessful examples of this.

The **second option** is akin to acquiring sovereign insurance against natural disasters, where countries purchase insurance to cover a specified amount of debt service payments following catastrophic disasters. Specifically, countries would take insurance cover from a private insurance company or a regional risk pooling mechanism, such as the CCRIF, for a "predefined set of debt obligations," including scheduled amortization, interest payments, or both. The precise structure and coverage could be tailored to the country's specific needs. If a disaster occurred, the country would be paid by the insurer the predetermined amount for servicing the debt. The corresponding payout would also reduce the stock of debt, as the debt service will not be financed by the country but by a payout provided by the insurance policy.

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[1] These options were discussed at the November 2018 high-level conference on *Building Resilience to Natural Disasters and Climate Change in the Caribbean*.

[2] The draft term sheet is at https://www.icmagroup.org/resources/Sovereign-Debt-Information/

Box 3. A Case for Climate-Resilient Debt Instruments *(concluded)*

This option has merits, as it is broad and not limited to a specific type of debt, potentially applying to all new and existing debt (though cost savings, in the form of lower interest rates, are likely to be larger if insurance is acquired on debt to be issued). The cost of buying such insurance could be at the lower end of the insurance pricing spectrum, since the amount of the payout is predetermined, and could be further trimmed if risks are pooled across countries.

But there are also drawbacks to this approach. As with any insurance, it requires countries, many with constrained fiscal positions, to finance ex-ante premia for an uncertain return; with underdeveloped and thin insurance markets, the costs of such insurance relative to expected return could be high. And tying insurance to debt service payments, rather than seeking untied disaster insurance, is likely warranted only if it is expected to produce significantly lower coupon rates on new issues and/or strengthen the sovereign's ability to maintain market access in the aftermath of a disaster.

30. As noted earlier, building resilience via the mechanisms discussed under pillars I and II constitutes a meaningful strategy only if it is embedded in a realistic macroeconomic framework that is consistent with maintaining a sustainable debt position. Staff analyses of building disaster resilience in the Caribbean and Pacific Islands provide illustrations of how this can be done (Annex VI).

C. Pillar III: Post-Disaster Resilience

31. While scaling up structural and financial resilience building may take time, early action is warranted to develop a detailed action plan to guide the response of government agencies and the wider public in the wake of a disaster. Such an emergency response plan (i.e., disaster recovery framework) would clarify institutional arrangements, responsibilities, and the post-disaster decision-making process in order to strengthen the ability to rapidly mobilize financial and physical resources to contain disruption to public services including water, electricity, medical services, schools, citizen security, and critical financial services.

32. Existing social protection systems can be an important instrument in facilitating a speedy response to humanitarian needs in the wake of a disaster. Providing support to the segments of the population severely hit by a disaster without established mechanisms for providing social protection is likely to be delayed, poorly targeted, and vulnerable to corruption abuse. By contrast, an established social protection system, including primary care networks, that can be scaled up in response to a disaster would lay the basis for a speedy response to address humanitarian needs in a more efficient manner.[8] For example, Ethiopia's Productive Safety Net Program—an efficient and transparent government cash transfer program—has several features that make it easy to scale up as needed to address food insecurity and dispense aid.

33. The quality of public procurement systems also influences the government's response to a natural disaster. Technical support may be needed to ensure that there is adequate capacity in place to

[8] An assessment of social safety nets to calibrate their adequacy for disaster resilience can help identify gaps and shape necessary reforms (¶50).

process supplies and procurement challenges linked to large aid inflows; weak procurement systems would undermine the effectiveness of the government's response to the disaster and deter donors from distributing assistance through existing government instruments and systems.

34. Disaster-vulnerable countries have taken important steps to improve emergency preparedness. Most countries have enacted legislation, policies, platforms and coordination institutions for disaster risk management and early warning, with significant focus on regional expertise pooling:

- *In the Caribbean*, 18 countries have established a regional inter-governmental agency for coordination of emergency response to generate economies of scale and facilitate logistics more systematically (The Caribbean Disaster Emergency Management Agency, CDEMA). CDEMA's comprehensive disaster management strategy supports management of all phases of a disaster management cycle and is developing a regional risk information system to make information accessible to stakeholders and generate greater risk awareness and preparedness, as well as evidence-based decision making.

- *In Central America*, common institutions were created in the context of the regional Policy on Comprehensive Disaster Risk Management to coordinate the prevention, mitigation, preparation and response to natural disasters. These include the *Coordination Center for the Prevention of Natural Disasters in Central America*, which covers six countries.

- *In the Pacific region*, the Pacific Islands Emergency Management Alliance works with national and regional disaster agencies to strengthen a country's disaster response and has created a framework for national and regional agencies to work in partnership preparing, responding and recovering from a disaster. Likewise, the Pacific Catastrophe Information System has been created to enhance data collection and information sharing. Early warning systems have been successful in Vanuatu.

- *In Africa*, the Africa Regional Strategy for Disaster Reduction was adopted by the African Union in 2004. In line with the Sendai Framework in 2015, governments have committed to a revised Program for Action that strengthens efforts to increase resilience. While a coordinated approach to disaster risk reduction in SSA is still in development, with the Africa Risk Capacity Agency allowing for some coordination at the regional level, particularly in the Sahel, the EAC countries have been working on coordinating their efforts, and Indian Ocean countries share information regarding storms.

The Way Forward

35. Despite the progress noted, many disaster-vulnerable countries face constraints in developing ex-ante preparedness to natural disasters. Logistical capacities (e.g. evacuations, providing effective relief), remain relatively limited. The pooling of regional expertise is a welcome approach which could be further developed to provide economies of scale. Opportunities for peer-learning and sharing of resources across countries should be further fostered. There are also policies and strategies which have been successfully adopted in other emerging and advanced economies exposed to natural disasters that can be deployed in smaller economies (e.g., Indonesia, Philippines, Japan and New Zealand; see Annex

VII). Targeted support from development partners to help disaster response planning and minimize disruption to public and social services can also yield high returns.

TOWARD A FRAMEWORK FOR ENHANCED COORDINATED ACTION

A. The Case for Enhanced Coordination

36. There are numerous stakeholders that seek to help disaster-vulnerable countries build resilience to natural disasters. This includes the Bretton Woods Institutions, the regional development banks, and bilateral development partners; the climate funds and private insurance companies also offer products that can be used to support resilience-building efforts. States with strong institutional capacity can develop national strategies that make effective use of the instruments and support provided by these institutions; states with weak institutional capacity are severely constrained in their ability to produce a coherent strategy that takes full advantage of the various forms of support available.

37. The fragmented nature of current practices for provision of external support has been highlighted by Caribbean and Pacific Island authorities. At the recent high-level conference on building resilience in the Caribbean, several leaders voiced their support for "building an alliance" or a "grand bargain" among key stakeholders for coordinated and specific actions to support investment in disaster resilience. This is an ambitious objective, highlighting the frustration with the existing architecture, but previous experiences with stakeholder coordination, as in the provision of debt relief for poor countries, point to the potential for coordination, as well as lessons on what works well and what does not. The PFTAC 25th anniversary event, held in December 2018, also underscored the need for a coherent medium-term approach to help countries prioritize and prepare for natural disasters and noted the complexities of dealing with multiple agencies with differing criteria and requirements.

38. In addition, the current strategies do not fully develop the macro-fiscal aspects of disaster resilience. The national strategies for disaster risk management developed with support from IFIs generally do not fully integrate fiscal and debt sustainability aspects into the macroeconomic framework, which is needed to fully understand the economic trade-offs.

39. The remainder of this section outlines a proposed framework for facilitating effective coordination across development partners in supporting resilience-building efforts. The framework takes account of capacity limitations at the national level, while seeking to make effective use of the specialist expertise of the various development agencies.

B. Developing A Disaster Resilience Strategy

40. The key building block for coordinated support would be a country-owned DRS, identifying the main policy actions needed across the three pillars.

- As noted above, the DRS would need to be grounded on a comprehensive forward-looking diagnostic of the country's vulnerability to natural disasters and the adequacy of existing preparedness. The diagnostic would identify the key projects for inclusion in the investment plan; flag the shortfalls in the current (perhaps implicit) disaster financing strategy; and review the adequacy of the existing systems for post-disaster response.

- The DRS is a shorthand-term for a comprehensive country-owned resilience-building strategy, in which support to be provided by development partners is clearly identified: it would build on, rather than displace, existing resilience-building plans and strategies and should be aligned with the wider national development strategy.

- Many small countries have already embarked on measures to build resilience to disasters (e.g., Fiji, Jamaica, St. Lucia), with support from the World Bank and other MDBs.[9] These measures are an important step forward but may tackle only selected elements of the required three-pillar strategy; the frustrations of country authorities with the fragmented nature of external support suggests that more is needed to address coordination issues.

41. Substantial additional support and engagement from development partners would be needed to help disaster-vulnerable countries flesh out and implement a DRS.[10] For example,

- Development of a well-grounded diagnostic would require substantial external assistance. A valuable tool in this context could be a Climate Change Policy Assessment (CCPA), an instrument currently being piloted in a handful of small island developing states by the IMF, with extensive support from World Bank staff (see Box 4), although the CCPA would need to be supplemented by other analysis and project costing to provide a full diagnostic.

- Technical support would be needed to identify and to cost the key projects needed to build structural resilience, drawing on development partners with the relevant expertise.

- An evaluation of the country's strategy for managing disaster financing, and how it could be enhanced, would need to be provided by external experts—either the IFIs or through technical assistance from bilateral development partners.

- Support for developing a medium-term macroeconomic framework that incorporates the required investments and adjustments in financing strategies could be provided in the context of IMF surveillance activities.

- Engagement with the climate funds to tap into financial support for adaptation to climate change would likely need support from both development partners and from peer-learning and pooling of experiences.

[9] For example, several countries have been implementing DRM/DRFI strategies with World Bank support.

[10] Development partners are already providing support to several disaster-vulnerable countries in a number of the areas cited.

Box 4. The Climate Change Policy Assessment

The Climate Change Policy Assessment (CCPA) is a tool developed by Fund and Bank staff (see IMF, 2016a) to help small states analyze and develop a policy response to the expected economic impact of climate change, and natural disasters arising thereof. The CCPA includes an assessment of projected economic impact, a costing of the planned policy response, and recommendations on fiscal and structural reforms to strengthen national strategies.

The questions addressed by the CCPA include:

- *Climate change risks and expected impact.* How vulnerable is the economy to climate change and what impact is climate change likely to have on long-term economic sustainability?
- *General preparedness.* How well-prepared is the country to cope with more intensified disaster shocks? Is the climate response strategy consistent with broader development goals?
- *Mitigation commitments and strategy*. How does the country plan to meet its greenhouse gas emission reduction targets? Does the current tax and subsidy system deliver appropriate carbon pricing and how could it be reconfigured to enhance its effectiveness?
- *Adaptation needs and plans*. Has the country an appropriate strategy to adapt to climate change? What key elements are missing from current plans? Do regulations, including zoning, provide the right support for adaptation efforts?
- *Financing strategy for mitigation and adaptation programs*. Does the country have adequate financing to implement its climate change strategy? Is the financing of the strategy consistent with maintaining fiscal and external debt sustainability?
- *Risk management strategy*. Does the government self-insure against risks? Does it make sufficient use of risk-transfer mechanisms, including insurance and pooling arrangements? What more should be done?
- *National processes*. Have climate-related projects been integrated into national plans? Are adequate public financial management systems in place to ensure climate-related investments will be executed efficiently?

The CCPA provides a useful framework for identifying policy gaps and capacity constraints; prioritizing and sequencing projects, financing, and capacity-building needs; strengthening coordination across government ministries; and coordinating TA by the Fund and the Bank, based on their respective areas of expertise. To provide a proper diagnostic for a DRS, it would need to be re-oriented to focus on current and near-term disaster risks, both climate-related and other risks.

Since 2017, CCPA pilots have been completed for Seychelles, St Lucia, and Belize; a CCPA is in progress for Grenada and planned for Micronesia and Tonga. Extending use of the CCPA to other countries would require: (i) assessing the lessons from the pilot process and deciding, in conjunction with the Bank, to broaden use of the CCPA beyond the pilot stage; (ii) agreement on formalizing Bank participation in producing CCPAs; and (iii) finding the additional budgetary resources needed, recognizing that not all vulnerable countries are currently committed to developing a comprehensive climate response strategy.

- For many small/low income countries, domestic efforts to generate fiscal space for a comprehensive DRS are unlikely to be sufficient: additional external concessional support for a comprehensive plan will likely be needed to avoid threatening debt sustainability.

42. The adoption of a DRS (or its equivalent) supported by multiple development partners, including IFIs, should have a strong catalytic effect in terms of mobilizing donor support. A critical

mass of partner support would enhance the credibility of the government's strategy; endorsement of individual components of the strategy by development partners, including Fund endorsement of the associated macroeconomic framework, would provide confidence to private markets and other potential partners that the strategy is viable and warrants support.

C. A Potential Division of Labor Across Stakeholders

43. An agreed framework that identifies the role of the various development partners in supporting development of a DRS would help avoid duplication and create synergies. A country's interest in developing a DRS would be the starting point for providing technical assistance; once fleshed out, the DRS would be based on a country-owned plan around which coordinated support can be provided. In this regard, the authorities of Dominica and Grenada have expressed strong interest in collaborating with development partners to develop a DRS.

- Drawing upon available diagnostic tools, the *World Bank and other development banks* could take the lead in helping the country identify and assess disaster vulnerabilities and prioritizing investment needs, based on a Bank-Fund CCPA or alternative diagnostics. They could also contribute to providing unified policy advice on financial resilience, including through technical assistance to help design and operationalize disaster risk finance strategies and make available contingent financial support; and provide technical assistance in building post-disaster and social resilience (such as social safety net design).

- *The Fund* could take the lead in helping the country develop a macroeconomic policy framework that adequately reflects both disaster costs and returns from resilient investment; identify fiscal actions, including domestic revenue mobilization and expenditure management, to support the policy framework; contribute to unified policy advice on financial resilience, focused on the mix of market insurance versus self-protection through fiscal buffers or use of climate-resilient debt instruments; provide balance of payments support, either via an arrangement (precautionary or disbursing) or post-disaster assistance; and deliver targeted capacity building support.

- In addition to helping countries elaborate the DRS, *bilateral development partners* could supply technical assistance for building disaster preparedness; provide concessional financing for projects or the budget in support of resilience-building investments; help alleviate insurance costs as a key component of the country's financial resilience strategy; and work with country authorities to prepare project proposals for financing by climate funds.

- *Climate Funds* could consider the DRS and the IFIs' endorsement of resilience building efforts and macroeconomic policies as a screening device to allow simplification of administrative requirements and criteria for qualification to provide financing for identified projects.

- *Official sector insurance companies,* such as CCRIF, could work with the IFIs to help design the country's financial resilience strategy.

44. The division of labor discussed here is illustrative in nature. Fleshing out general principles would require further discussions with the various potential actors, while the division of labor in an individual country would depend on country circumstances and the various agencies' prior engagement in the country.

THE FUND'S ROLE IN BUILDING RESILIENCE

45. The Fund can play an important role in supporting resilience building in disaster-vulnerable countries, in line with its mandate to analyze and advise on macro-critical issues and support associated capacity development. There is further scope for Fund surveillance to address the impact of natural disasters and the case for resilience building in disaster-vulnerable countries; to support implementation of countries' resilience building strategies through Fund-supported arrangements, with financing to meet balance of payments needs where justified; and to support development of domestic macro-fiscal analytical capacity and related institutions through its capacity-building activities. As described in the previous section, the Fund can help countries integrate the financing of resilience building into national macro-fiscal frameworks and assess fiscal sustainability in a context where the costs are upfront (which could worsen debt dynamics in the short term) while benefits accrue in the longer term.[11] A sound macroeconomic analysis of longer-term debt dynamics may help reassure markets regarding fiscal and debt sustainability.

A. Engagement in Fund Surveillance

46. In disaster-vulnerable countries, country teams should highlight the risks of inaction in the face of disaster risk and analyze the returns to building structural and financial resilience. Where countries are implementing resilience-building strategies, the baseline macroeconomic framework and debt sustainability analyses should seek to incorporate both the costs and benefits of the investment strategy. The returns to potential resilience-building strategies can also be explored via a fleshed-out alternative macroeconomic framework and DSA.

47. The coverage of disaster risks and resilience-building in surveillance of disaster-vulnerable countries has increased significantly in the past few years. Various approaches have been adopted by country teams, partly reflecting data limitations and country-specific features.

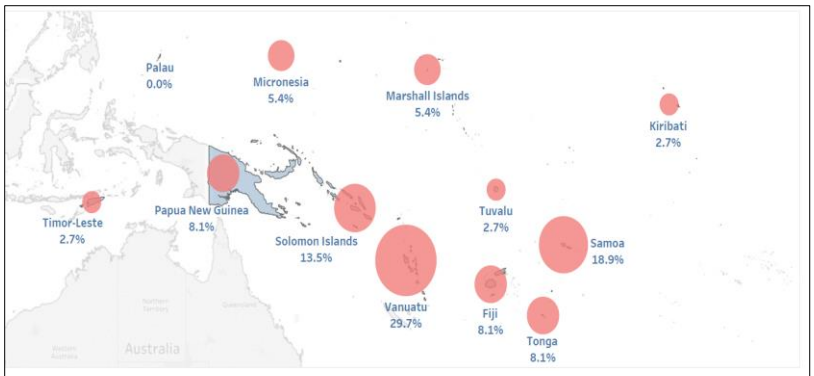
- A wide range of options are provided in IMF (2016a) for incorporating the impact of natural disasters in the macroeconomic framework. Based on a review of Article IV staff reports during 2017–2018 and a survey of country teams, many desks included disaster costs in baseline projections—with some country teams developing innovative methodologies to achieve this (e.g., for the Pacific Islands, see Lee, Zhang and Nguyen (2018) (Box 5), and for Dominica see 2018 Article IV).

[11] There is a close analogy here with analyzing the effects of scaling-up public investment in developing countries.

Box 5. Integrating the Cost of Natural Disasters in the Pacific Islands

Staff investigated the impact of natural disasters in Pacific Island Countries (Lee, Zhang, and Nguyen, 2018). The paper highlights the intensity of natural disasters for each country in the Pacific based on the distribution of damage and population affected by disasters and estimates the impact of disasters on economic growth and international trade using a panel regression. The results show that severe disasters have a significant and negative impact on economic growth and lead to a deterioration of the fiscal and trade balances. The paper then identifies a simple and consistent method to adjust staff's economic projections and debt sustainability analysis for disaster shocks.

Probability of Severe Natural Disasters in PICs



Source: IMF staff estimates.
Note: The size of circle denotes the probability that each country is hit by a severe (above 75th percentile) natural disaster.

Staff explicitly adjust their long-term baseline projections in line with the expected impact of disasters for the region times the probability of a disaster occurring in their specific country each year, subtracting this from a non-disaster projection. The projections vary given the vulnerability of a country to natural disasters—adjustments range from 0.2 percent of GDP up to 0.6–0.7 percent of GDP per year and are largest for Vanuatu, Samoa, Solomon Islands and Tonga for which the recent Article IV reports adopted this approach. Staff reports have also discussed ways in which to help build fiscal resilience to shocks.

Further work is now looking at fiscal balances in Pacific countries using a similar cross-country panel regression methodology (Nishizawa et al, forthcoming). This information is helpful to estimate potential fiscal buffers needed to cover budget shortfalls because of natural disasters and provides input for the DSA of natural disaster scenarios. Staff have also looked at aid uncertainty. In the Pacific, international financial support following disasters has varied widely and unpredictably from 1.7 to 18.5 percent of GDP in recent years. Such uncertainty makes it exceptionally difficult for vulnerable countries to plan the appropriate level of fiscal buffers or lines of credit needed to finance disaster recovery.

This work is aimed at helping countries better incorporate the economic impact of natural disasters into their budget and consider the types of financing needed. Like the Caribbean, insurance has been inadequate in the Pacific at the national and regional level and private insurance markets are largely missing for households and firms. Efforts are being made by different IFIs and bilateral development partners but there is scope to more closely coordinate and scale up these efforts.

- Several country teams have incorporated the impact of natural disasters as a shock to the baseline macroeconomic framework, typically via the debt sustainability assessment. Including a natural disaster shock is now a required scenario for disaster-vulnerable countries in the new LIC Debt Sustainability Framework and is being considered as one of the tail shocks in the ongoing MAC-DSA review.

- Debt sustainability analysis could be augmented to include the costs and benefits of countries securing insurance, by simulating debt paths under various disaster shocks and identifying optimal risk transfer options (see ¶27 and Annex V). Such an analysis can also be integrated with the World Bank's multi-layer approach to financial protection.

- The longer-term benefits of resilience investment have often been overlooked in assessments of debt sustainability, thereby overstating the scale of future debt burdens.[12] In part to counteract this bias, the 2018 Article IV Consultation with the ECCU developed a scenario and associated debt dynamics that allowed for the policy efforts, costs, and benefits of building resilience; the benefits were also assessed in the Solomon Islands and Vanuatu Article IV consultations (Annex VI).

- The Fund's methodology for assessing external positions has been updated to include analysis as to how natural disasters affect the external balance and real exchange rates (IMF, 2019).

B. Support via the Fund's Lending Toolkit

48. Building resilience to natural disasters is a medium-term endeavor that the Fund can support most effectively through medium-term program engagement with member countries. Anchoring a Fund arrangement on support of a medium-term resilience building strategy would be appropriate where natural disaster risk is macro-critical.

49. The existing Fund lending toolkit provides a range of options to support implementation of member countries' development strategies. The available options include:

- *A disbursing arrangement* for countries facing balance of payments needs in implementing their resilience-focused medium-term program.

- *A precautionary three-year SBA,* for countries with potential BOP needs, as an insurance against an adverse shock (whether disaster-related or other) while implementing their Fund-supported program.[13]

[12] It is also important to ensure that the returns to resilience building are not over-stated—which has occurred on occasion in analysis of the scaling up of public investment in low income countries (LICs).

[13] The only concessional facility that is designed for use on a precautionary basis is the SCF, which currently has a maximum length of two years; the maximum length of the SCF is being reassessed in the context of the ongoing LIC Facilities Review.

(continued)

- *A non-financial signaling instrument* (the Policy Coordination or Policy Support Instruments), for countries seeking to signal Fund endorsement of their economic program, which could facilitate access to Fund resources in case of a BoP need from an adverse shock.

- *Post-disaster financial assistance* via the RFI or RCF, to assist countries with an urgent BOP need when hit by adverse exogenous shocks such as a natural disaster.[14]

50. Fund-supported programs could tailor program design toward supporting resilience building. The macroeconomic framework would suitably integrate the short-run costs and longer-term benefits of resilience investment. Structural conditionality would focus on priority actions in the resilience-building strategy, designed in consultation with the World Bank and other active development partners. Capacity-building support would be supplied, where needed, to help countries meet program objectives.

C. Supporting Capacity Development

51. In most disaster-vulnerable countries, significant capacity development is likely to be needed to implement the main components of a DRS. The World Bank has already been playing a key role in providing policy and technical assistance support across the three pillars of the DRS. The IMF has been helping countries integrate resilience-building plans into their fiscal frameworks, including through fiscal rules (Grenada and Jamaica). Under the proposed framework, close cooperation and coordination will be essential among multilaterals and other development partners to cover all the main elements of a DRS, provide consistent technical advice, and enhance absorptive capacity of the country.

52. On building structural resilience (Pillar I), the Fund can help strengthen countries' capacity to finance and manage efficiently the kind of large-scale infrastructure investment programs needed. In particular, the Fund could support:

- *Developing medium-term fiscal and budgeting frameworks*. Fund TA would help countries ensure consistency of infrastructure spending plans with domestic revenue and external financing prospects, prudent debt management, and the building of fiscal buffers.

- *Strengthened domestic revenue mobilization***.** Fund TA on tax policy frameworks, legislation, and revenue administration, in the context of a Medium-Term Revenue Strategy, can play an important role is boosting revenue collections to fund resilience needs.

- *Enhanced Public Financial Management (PFM).* TA to build robust PFM systems will improve the returns on public outlays on resilient infrastructure while enhancing access to concessional financing. In the Pacific, for example, PFTAC has been working with the German development agency (GIZ) to ensure that PEFA assessments and reform roadmaps include measures that facilitate access to Climate Funds.

[14] The LIC Facilities Review is considering the case for increasing access levels to the RCF (and, potentially, the RFI), including a higher cumulative limit for countries vulnerable to large natural disasters.

- *Robust public asset and investment management practice.* A Public Investment Management Assessment (PIMA) can help institute strong public infrastructure procurement and management practices, boosting investment efficiency and enhancing access to external funding.

53. On building financial resilience (Pillar II), the Fund could support capacity development through:

- *Building financial infrastructure and an understanding of risks and risk transfer*. The Fund and the World Bank could support the setup of asset registries, risk management units, and supportive institutional and governance arrangements related to financial resilience choices. Likewise, TA on banking regulations and supervision could be deployed to ensure disaster vulnerabilities are fully allowed for in assessing risks to bank balance sheets.

- *Using convening powers.* The Fund and the World Bank, together with other international institutions, could use their convening power to help coordinate various stakeholders—private insurances, governments, regional pools, donors, climate funds—to resolve existing hurdles to accessing market-based risk transfer, including exploring the financial viability of debt instruments with disaster clauses and addressing scale obstacles to the development of insurance products. The World Bank has been very active in this space, as reflected in its lead role in the establishment of the Global Risk Financing Facility (GRiF) to scale up financial protection solutions.

54. On ex-ante preparedness for disaster recovery (Pillar III), the Fund role in supporting relevant capacity development role is limited. One area of engagement is promoting the development of business continuity plans for both the central bank and for commercial banks; PFTAC has held regional workshops to assist with the development of such plans. Assessing the resilience of banks' loan portfolios to disaster shocks is also part of building ex-ante preparedness: CARTAC workshops on stress testing of the financial system include tests of system vulnerability to hurricanes and other plausible disaster shocks.

55. Capacity development efforts should involve close collaboration between providers, while seeking to exploit similarities in the challenges across countries. Many of the capacity development issues relevant for resilience building do not fit neatly into the "traditional" areas of the various TA providers. Thus, a collaborative approach between institutions is essential to avoid over-loading governments with limited absorptive capacity. Where challenges are similar across countries, scale economies can be realized using regional workshops and development of on-line courses. For example, regional workshops on medium-term fiscal frameworks and fiscal resilience to natural disasters were held in the Pacific by PFTAC, APD, and ICD in 2015 and 2017.

ISSUES FOR DISCUSSION

56. Directors' views are sought on the following issues:

- Do Directors see the three-pillar strategy as a useful lens through which to view the challenges of building resilience in disaster-vulnerable countries?
- Do Directors see a compelling case for closer coordination among development partners in supporting resilience-building efforts in countries with insufficient institutional capacity to manage this coordination directly?
- Do Directors see a government-owned "Disaster Resilience Strategy" as a useful instrument for facilitating donor coordination?
- Do Directors agree that a DRS supported by key development partners could catalyze higher levels of concessional financing from bilateral donors, climate funds, and other financing sources?
- Do Directors see a need for Fund surveillance to give greater attention to resilience-building in disaster-vulnerable countries, recognizing that bilateral surveillance inevitably involves selectivity in regard to the topics covered?
- Do Directors agree that the Fund lending toolkit is broadly appropriate for supporting disaster-vulnerable countries that are implementing a resilience-building strategy?
- Do Directors see merit in the Fund, in collaboration with the Bank, conducting further work on the role of state-contingent debt instruments in disaster-vulnerable countries?
- The CCPA is still operating in a pilot phase. Do Directors see significant value-added for country authorities in the three CCPAs circulated to the Board so far?

References

Asian Development Bank, 2018**, "**Economic and Fiscal Impacts of Disasters in the Pacific," (April).

Cantelmo, A., L. Bonato, G. Melina, and G. Salinas, 2019, "Policy Trade-Offs in Building Resilience to Natural Disasters: The Case of St. Lucia" IMF Working Paper No. 19/54 (Washington: International Monetary Fund).

Cebotari, A., I. Otker, and K. Youssef, forthcoming, "Natural Disaster Insurance for Sovereigns: Optimality and Affordability," IMF Working Paper (Washington: International Monetary Fund).

Cevik, S. and G. Huang, 2018, "How to Manage the Fiscal Costs of Natural Disasters," IMF How-To Notes No. 18/03 (Washington: International Monetary Fund).

Cummins, J.D. and O. Mahul, 2009, "Catastrophe Risk Financing in Developing Countries: Principles for Public Intervention," ISBN 978-0- 8213-7736-9 (Washington: World Bank).

Gamper, C., B. Signerii, L. Altonii, and M. Petrie, 2017, "Managing Disaster-Related Contingent Liabilities in Public Finance Frameworks," OECD Working Papers on Public Governance, No. 27, (Paris: OECD Publishing). Available on the internet: https://doi.org/10.1787/a6e0265a-en.

Ghesquiere F., and O. Mahul, 2010, "Financial Protection of the State Against Natural Disasters: A Primer," World Bank Policy Research Working Papers No. 5429 (Washington: World Bank).

Gurenko, E., 2004, "Catastrophe Risk and Reinsurance: A Country Risk Management Perspective," (London: Risk Books).

International Monetary Fund, 2016a, "Small States' Resilience to Natural Disasters and Climate Change—Role for the IMF," IMF Policy Paper (Washington).

———————, 2016b, "Enhancing Resilience to Natural Disasters in Sub-Saharan Africa," in *Regional Economic Outlook* "Sub-Saharan Africa Multispeed Growth," October (Washington).

———————, 2017a, "Large Natural Disasters—Enhancing the Financial Safety Net for Developing Countries," IMF Policy Paper (Washington).

———————, 2017b, "State Contingent Debt Instruments for Sovereigns", IMF Policy Paper (Washington).

———————, 2018, "ECCU: 2018 Common Policies Discussion," IMF Staff Country Report (Washington).

———————, 2018, "Sri Lanka: Selected Issues," IMF Staff Country Report No. 18/176 (Washington).

———————————, 2018, Dominica: 2018 Article IV Consultation" IMF Staff Country Report (Washington).

———————————, 2018, "Solomon Islands: Selected Issues", IMF Staff Country Report (Washington).

———————————, 2019, "Fiscal Policies for Paris Climate Strategies: From Principle to Practice," IMF Policy Paper (Washington).

International Panel on Climate Change Report, 2015, "Small Islands," Chapter 29.

International Red Cross, 2018, "Disaster Trends and IFRC Insights," in *World Disasters Report 2018*, ed. by D. Fisher, K. Hagon, S. Swithern and L. Walmsley.

Lee, D., H. Zhang, and C. Nguyen, 2018, "The Economic Impact of Natural Disasters in Pacific Island Countries: Adaptation and Preparedness", IMF Working Paper No. 18/108 (Washington: International Monetary Fund).

Marto, R., C. Papageorgiou, and V. Klyuev, 2017, "Building Resilience to Natural Disasters: An Application to Small Developing States", IMF Working Paper No. 17/223 (Washington: International Monetary Fund).

Nishizawa, H., S. Roger, and H. Zhang, forthcoming, "Fiscal Buffers for Pacific Island Countries"

United Nations Environment Programme, 2016, "The Adaptation Finance Gap Report."

Werner, A. and K. Srinivasan, 2019, "How to Buffer the Caribbean from Financial Storms," Financial Times, Alphaville. Available on the internet: https://ftalphaville.ft.com/2019/02/11/1549861202000/How-to-buffer-the-Caribbean-from-financial-storms/

World Bank, 2013, "Benefit-Cost Analysis for Risk Management: Summary of Selected Examples," Background paper for the World Development Report 2014 by Wethli, Kyla (Washington).

———————————,2016, *Confronting Drought in Africa's Drylands*, edited by Rafaello Cervigni and Michael Morris (Washington).

World Bank Group, 2016, "Fiscal Disaster Risk Assessment and Risk Financing Options, Sri Lanka," (March). Available on the internet: https://openknowledge.worldbank.org/handle/10986/24689

———————————,2017, "Sovereign Catastrophe Risk Pools: World Bank Technical Contribution to the G20" (Washington). Available on the internet: https://openknowledge.worldbank.org/handle/10986/28311

———————————, 2018, "Climate Development Goals Through the Multiple Benefits of Disaster Risk Management" (Washington).

———————————, 2019, "Boosting Financial Resilience to Disaster Shocks Good Practices and New Frontiers," World Bank Technical Contribution to the 2019 G20 Finance Ministers' and Central Bank Governors' Process (Washington).

Annex I. The World Bank Group's Support for Building Resilience

1. The WBG has played a key role in providing support for adaptation and resilience to climate change. Over the past decade, the WBG, supported by the Global Facility for Disaster Reduction and Recovery (GFDRR) and its development partners, has mainstreamed disaster risk management into its operations. The Bank's annual funding of disaster risk management (DRM) projects has increased steadily over the past six years – from $3.7 billion in fiscal year (FY) 2012 to $5.3 billion in FY 2018. These projects were implemented across many sectors, including agriculture, environment and natural resources, transport, social protection, information and communications technology (ICT), and water.

2. The Bank gives special attention to small states, most of which are highly vulnerable to natural disasters and climate change. As an exception to regular IDA eligibility criteria, several small states (population less than 1.5 million) that are vulnerable to natural disasters are given access to concessional IDA resources. Total IDA lending to the 23 IDA-eligible small states increased from $604 million in IDA15 to about $1.2 billion in IDA17. The Bank also provides a platform to small states (Small States Forum) for high-level dialogue on how the WBG can help address their special development needs.

Structural Resilience

3. The WBG hosts several Funds that actively promote climate-resilient development. These include the Climate Investment Fund (CIF), the Forest Carbon Partnership Facility (FCPF), and the Global Environment Facility (GEF)/Adaptation Fund (AF) Secretariat.

4. The CIF's Pilot Program for Climate Resilience (PPCR) has been one of the largest financing sources of adaptation programs and projects with client countries. The program operates in partnership with other multilateral development banks (AfDB, ADB, EBRD, IDB, and WBG) to support adaptation in a coherent and integrated way. The World Bank has the largest PPCR portfolio, with 30 projects ($490 m or about 40 percent of the total $1.2 billion funding envelope) and takes responsibility for delivery of climate change resilience programs in the countries. The programmatic approach of the CIF's PPCR has proven integral to helping the WBG drive climate resilience action by developing a two-phased programmatic approach that mainstreams resilience in government agencies and provides risk-appropriate concessional financing for associated investments.

Financial Resilience

5. Through the Disaster Risk Financing and Insurance (DRFI) program, the WBG has supported more than 60 countries in developing and implementing financial protection strategies against climate and disaster shocks, including the development of regional sovereign catastrophe risk pools.

6. The WBG has also developed a series of innovative financing mechanisms. For instance, the Development Policy Loan with Catastrophe Deferred Drawdown Option (CAT-DDO) is a policy

instrument to strengthen disaster risk management and financial preparedness, to support countries' recovery after disasters and enhance client government's resilience to shocks. To date, some 13 countries have benefitted from this instrument for a cumulative amount in excess of US$3 billion. In addition, the World Bank has intermediated market-based risk transfer solutions such as catastrophe swaps and cat bonds for a cumulative amount in excess of US$4 billion.

7. The WBG is also managing new programs such as the Global Risk Financing Facility (GRiF), launched during the October 2018 Annual Meetings of the World Bank and International Monetary Fund. The GRiF aims to strengthen financial resilience of vulnerable countries by enabling earlier and more reliable response and recovery to climate and disaster shocks, and over time to a wider range of crises, through establishing and/or scaling up pre-arranged crisis risk financing instruments, including market-based instruments. It is delivered through a Multi-donor Trust Fund hosted by GFDRR and implemented by WB/DRFIP with expected donor contribution of US$145M from Germany and UK with further contributions under discussion with other donors.

Post-disaster Resilience

8. The WBG also offers a Contingent Emergency Response Component (CERC) under investment project financing, which is a contingent line that does not require fiscal and debt sustainability for its approval. Given that investment project financing is about 60-70 percent of World Bank financing and is used in most countries, CERC is an important financial instrument that provides either quick disbursements following an event to finance critical emergency goods (e.g. imports, domestically-manufactured goods, etc.) or to finance emergency recovery and reconstruction works and associated services. The advantage of including a CERC in a standard investment lending operation is that it establishes an ex-ante mechanism which enables the recipient to rapidly begin to address their post-disaster needs.

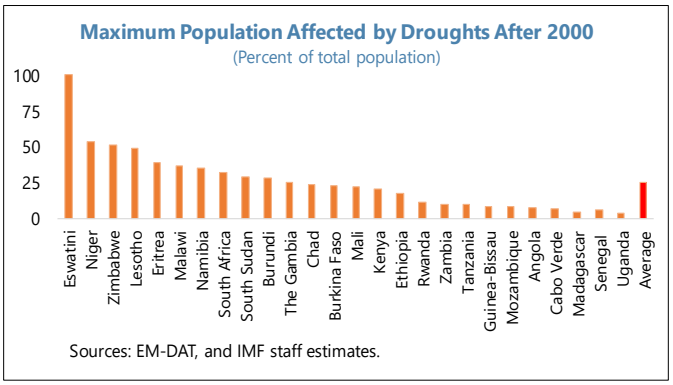
Annex II. Natural Disasters in Sub-Saharan Africa

1. Floods and slow-moving disasters such as droughts account for 80 percent of loss of life and 70 percent of recorded economic losses linked to natural hazards in SSA. Slow-moving disasters such as droughts and recurring weather-related epidemics can cause substantial economic disruptions, even if they lack the initial "shock and awe" associated with other disasters. Their slow onset creates the risk that the initial response is inadequate, while their persistence increases the risk of a prolonged impact (IMF 2016b). The full economic impact is usually not quantified or recorded. The cascading effects of a rapid onset hazard, such as flood or earthquake, can evolve into a public health emergency, as the health care system is overwhelmed, and displaced populations are concentrated in emergency camps. The squalid living conditions facilitate the transmission of diseases such as malaria and cholera.

2. The 2015/16 droughts in Southern Africa linked to El-Niño typified the large social costs that slow-moving disasters can impose. Failed crops, depleted grain stocks, and de-herding represented a significant loss of income and savings for households. A lack of access to water and food contributed to malnutrition and missed schooling, highlighting the human costs, both in terms of deaths and deterioration of human capital. Many people above the poverty line temporarily dropped into poverty and malnutrition. Social tensions increased as people migrated to less affected regions and competition for grazing land among pastoral farmers rose.

3. The economic costs were also significant. Agricultural production was decimated in some of the most affected countries, leading to lower growth. Notwithstanding increased donor support, the fiscal situation deteriorated as governments scaled-up food distribution programs to mitigate the impact of the drought. The electricity supply was impacted by a shortage of hydro-power, hampering energy-intensive mining and manufacturing activities in several countries.

4. The region's rising population, climate change, and latent vulnerabilities compound the risks. SSA's current population is projected to more than quadruple to nearly 3.7 billion by 2100, with 1 out of every 3 citizens on the planet being from the region (IMF, 2015). At the same time, the region is the least prepared to face the effects of climate change, including due to the heavy reliance on rain-fed agriculture, limited resources to foster resilience, and already elevated levels of poverty and food insecurity. Chart shows that SSA populations are highly exposed to droughts—with a quarter of the population affected on average during the worst droughts that countries experience after 2000. Given the rising intensity and unpredictability of such climatic events, building resilience is paramount



Annex III. Policies to Enhance Resilience: Examples

Sub-Saharan Africa

1. African countries have undertaken a range of policies to enhance their resilience and preparedness to natural disasters. Reflecting capacity and financing constraints, these policies, focused mostly on agriculture and infrastructure investment, tend to emphasize cost-effectiveness, mitigating the impact of natural disasters at a low cost. Many of these initiatives have been aided by new technologies and/or focused on the local level.

2. Appropriately, agriculture has received significant attention given its economic importance and vulnerability to drought[1]. Countries are trying new crop varieties that are more resilient to droughts and water stress. The harvesting of rain water at a local level also features prominently in country strategies. For instance, in Burkina Faso, large cisterns in sugarcane fields collect water that is distributed via efficient irrigation methods.

3. Leveraging technology is an important part of the resilience strategy. Several countries (including Ethiopia, Rwanda, Kenya) are using mobile technology to reach out to farmers with rainfall forecasts to optimize planting of crops and purchase crop insurance. Better coordination of information and associated logistical preparedness helped significantly in mitigating the social impact of the 2015 drought in Ethiopia through improved targeting of food delivery.

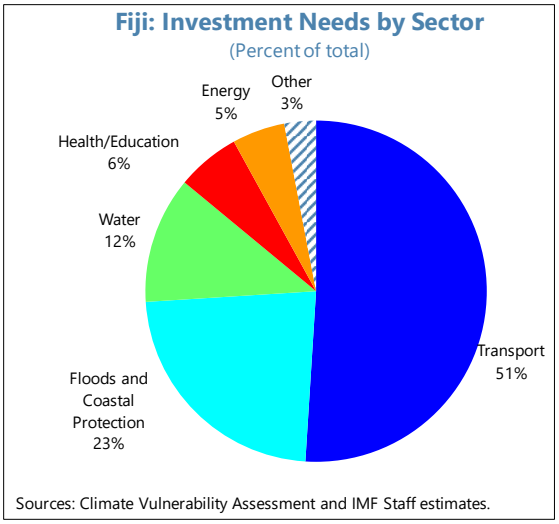
4. Countries are also placing increased emphasis on disaster-resilient infrastructure, which can be more expensive to build but offer higher returns in the long-run. As part of risk-informed planning, São Tomé and Príncipe and Zambia have moved people away from flood-prone areas. Kenya has diversified its energy generation away from drought-prone hydropower to include gas and geothermal.

Fiji

5. Fiji has stepped up efforts to build resilience to climate change. The government hosted the 23rd Conference of the Parties to the UN Framework Convention on Climate Change, pledged to transition completely to renewable energy sources by 2030, and adopted a reforestation policy to store carbon. A "Build Back Safer" program was launched after the 2016 cyclone Winston with the aim of teaching residents to rebuild homes that are more resilient to natural disasters. The government is also looking at parametric insurance instruments to help households who cannot be insured or are "semi" insurable. They have established a Construction Implementation Unit to ensure reconstruction in the education and health sectors is done to higher resiliency standards. The findings of the 2017 Climate Vulnerability assessment are incorporated into the National

[1] Pre-disaster interventions to boost resilience can be cost-effective, especially compared to post-disaster relief. Dissemination of productivity-enhancing, resilient agricultural and herding techniques would cost about US$1 billion in the Sahel and the Horn of Africa; humanitarian aid to the region totaled US$4 billion in 2013 (World Bank 2016).

Development Plan. Strengthening infrastructure is a priority in the strategy to adapt to climate change, with largest needs in the transport sector, investment in flood risk management, coastal protection measures, water and the energy sectors. Investments in education and health infrastructure are also required, as is enhanced asset and resource management. Private sector investment is being sought to help finance these needs. Fiji also issued a novel financing instrument—a sovereign Green Bond—on the London Stock Exchange in 2017, becoming the first developing country to undertake such an initiative. So far, the take-up of the bond has been mainly by domestic investors.



Bangladesh

6. The Bangladesh authorities are taking steps to address disaster and climate vulnerability. In 2014 the authorities introduced a Climate Fiscal Framework (CFF) to monitor public spending on climate change. The CFF is integrated in the medium-term budgetary framework and the tracking methodology is supported by the latest budget accounting classification system, developed with IMF support.

7. In addition, the Bangladesh Planning Commission has formulated the Bangladesh Delta Plan 2100. Under the plan, mitigation and adaptation measures will focus on flood protection, river erosion control, river management including navigability, water supply and waste management, and flood control and drainage.

8. Meanwhile, as of May 2018, Bangladesh has received grants from the Green Climate Fund amounting to $85.4 million for three climate change projects. The Bank of Bangladesh has issued Policy Guidelines of Green Banking for scheduled banks and nonbank financial institutions (NBFIs). These cover green banking policy and governance, the incorporation of environmental risk in credit risk management, and the creation of a Climate Risk Fund. Banks and NBFIs are requested to allocate ten percent of their corporate social responsibility budgets to finance economic activities in flood, cyclone, and drought-affected areas.

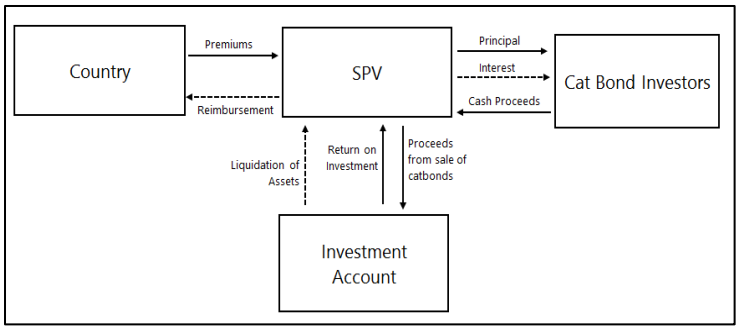
9. Still, more actions are needed for sufficient financing to address natural disasters and climate change. A clear priority for Bangladesh is to raise domestic revenue from its current low base. At less than ten percent of GDP, Bangladesh's tax revenue is insufficient to adequately invest in mitigation activities and adaptation infrastructure while concurrently addressing other SDG 2030 objectives. A carbon tax could raise significant revenues and a related priority should be to address energy subsidies. Additional longer-term investments in infrastructure are also needed with a greater fiscal buffer to cope with the immediate consequences of potential natural disasters.

Annex IV. The Structure of Cat Bonds

1. Cat bonds are not materially different from traditional insurance, but are structured differently. They can help governments transfer disaster risk to capital markets, where investors are looking to diversify their portfolio with assets that are not correlated with the stock market or the economic cycle. As an alternative to traditional insurance, cat bonds have been rarely used by sovereigns to date.

- A cat bond is a fixed income security where the coupon paid to the bondholders is enhanced by a premium commensurate to the risk from losing part or all the invested capital if a predefined natural disaster occurs. The premium paid by the sovereigns to date has averaged 1.9 times the expected loss for the investor, but this "insurance multiple" has ranged from 1.2 to 3.2 times depending on the risk metrics of the coverage.

- Under a typical catastrophe bond structure, a special purpose vehicle (SPV) is set up to intermediate the payments. The SPV issues the cat bond to investors and the SPV in turn invests the money it receives from investors in highly rated securities. The government pays the interest plus premium to the SPV, which is used —along with the interest the SPV makes from the investment in securities — to pay the coupon to the cat bond investor. The issuance, importantly, does not increase the debt stock of the sovereign since the SPV issues the debt. If a qualifying natural disaster that meets the trigger conditions occurs and payout is activated, the SPV will liquidate the investments required to make the payment to the government according to the terms of the cat bond transaction. If no trigger event occurs, then the investment is liquidated at the end of the cat bond term and the principal is repaid.

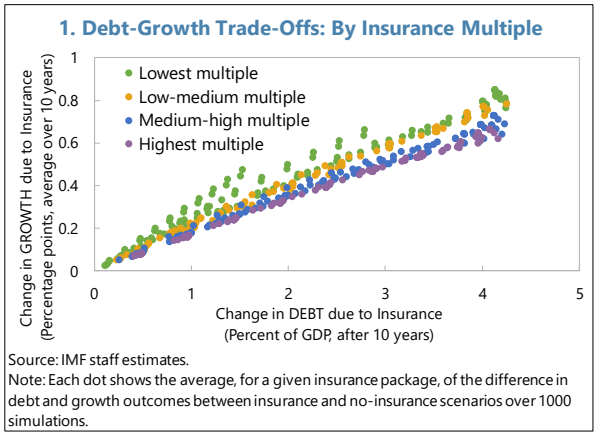


2. Key challenges to accessing cat bonds include (i) the high costs, particularly when fiscal space is constrained, (ii) the use of parametric triggers which need to be calibrated carefully to meet the country's needs, and (iii) capacity constraints in understanding the cat bonds better and communicating its limitations. These challenges are partially mitigated where the World Bank acts as an intermediary, providing cost savings for issuing countries. While only Mexico and Turkey have issued individual cat bonds so far, the Bank facilitated issuance of a first joint sovereign cat bond for members of the Pacific Alliance (Chile, Colombia, Mexico and Peru), delivering cost savings and record-low premium rates stemming from high investor demand for diversification, albeit without pooling the risks.

Annex V. Optimal Risk Transfer in Smaller vs. Larger Countries

In choosing how much disaster risk to transfer to insurance, countries face a trade-off between the implications of this insurance for debt and for growth. The nature of this trade-off and the optimal risk transfer will vary across countries depending on size, exposure to disasters, fiscal space, and risk aversion to growth losses.

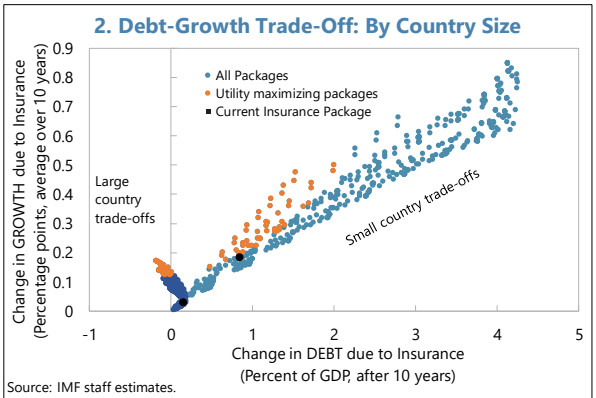
1. For all countries, the best growth-debt tradeoff is provided by packages that have the lowest insurance multiple, that is, packages cost the least relative to the expected payout (green and yellow dots on the top of the trade-off curve in chart 1). These provide the best value for money from the sovereign's perspective. In staff's analysis, packages with the lowest insurance multiples are also the ones that have the lowest deductibles, that is, where insurance starts with higher-frequency disasters.



Source: IMF staff estimates.
Note: Each dot shows the average, for a given insurance package, of the difference in debt and growth outcomes between insurance and no-insurance scenarios over 1000 simulations.

2. In many other respects, risk transfer decisions faced by larger (less exposed) countries are different from those of smaller and more exposed ones.

- *The implications of insurance*. For smaller countries, the cost of protecting growth is higher because disaster losses and therefore insurance premia are larger as a share of GDP, adding more to debt. The debt and growth implications of insurance for larger, less exposed, states are significantly smaller by comparison (chart 2).

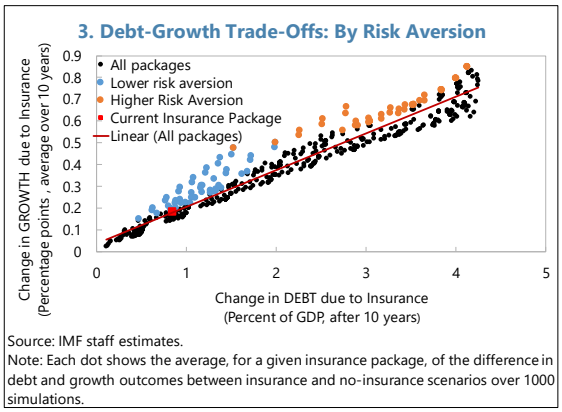


Source: IMF staff estimates.
Note: Each dot shows the average, for a given insurance package, of the difference in debt and growth outcomes between insurance and no-insurance scenarios over 1000 simulations.

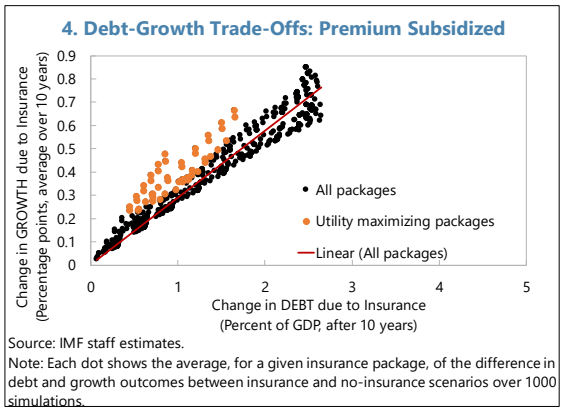
- *Different tradeoffs due to payout limits*. Larger countries may face binding constraints on insurance payouts (e.g., US$100 million in the case of CCRIF), which also limit its premium payments (creating the boomerang shape in chart 2). This de facto eliminates the tradeoffs and shifts optimal risk transfer toward packages that provide maximum growth protection. For smaller countries, the strong trade-off between debt and growth may force a more debt-biased choice, with less expensive package that provide less growth protection.

- Smaller countries' higher risk aversion may imply a need for a growth-biased, but prohibitively costly, optimal insurance; choices improve under donor support. Smaller countries with large exposure are likely to be more risk averse to growth losses or to have stronger preferences for protecting growth rather than reducing debt. This means that they would be seeking higher

insurance coverage with more growth protection as an optimal strategy (orange dots in chart 3), but this can carry a prohibitive cost with large debt implications. Actual small country coverage is thus often less than optimal (red dot in chart 3). A discount on the insurance premium (e.g., through donor support) would allow countries to choose more expensive packages that provide better coverage and hence growth protection (chart 4).

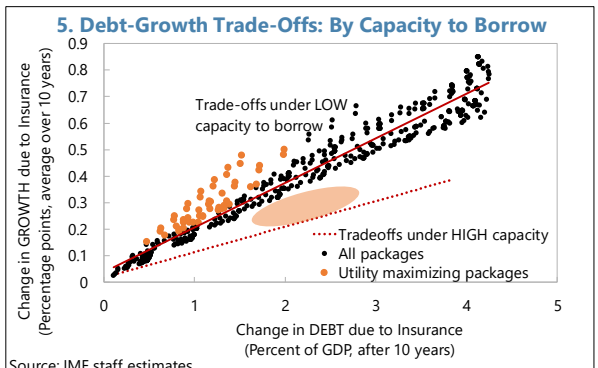


Source: IMF staff estimates.
Note: Each dot shows the average, for a given insurance package, of the difference in debt and growth outcomes between insurance and no-insurance scenarios over 1000 simulations.



Source: IMF staff estimates.
Note: Each dot shows the average, for a given insurance package, of the difference in debt and growth outcomes between insurance and no-insurance scenarios over 1000 simulations.

- *Borrowing constraints increase insurance benefits.* If borrowing capacity is limited relative to the size of the disasters, insurance is more likely to relieve the constraint on financing disaster losses, therefore providing larger growth benefits relative to countries where borrowing constraints are less binding (chart 5).[1] An alternative way of interpreting this is that if countries anticipate assistance following disasters (akin to a non-binding borrowing constraint), they may opt for lower insurance coverage due to the perceived smaller benefits.



Source: IMF staff estimates.
Note: Each dot shows the average, for a given insurance package, of the difference in debt and growth outcomes between insurance and no-insurance scenarios over 1000 simulations.

[1] At the same time, since larger capacity to borrow would provide an overall better protection to growth, it would also reduce the debt ratios, helping offset more the increases in debt due to insurance premia.

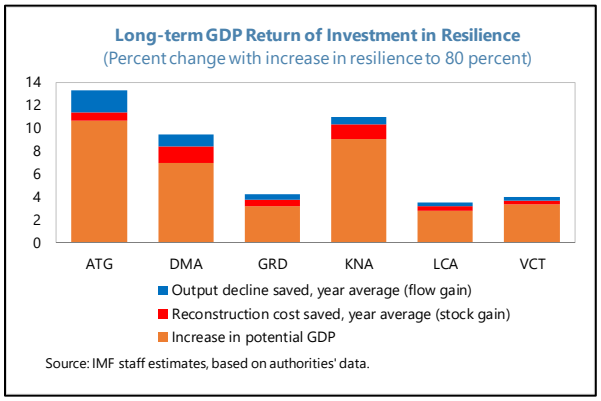
Annex VI. Investing in Pillars I and II - Illustrations for the ECCU and Pacific Islands

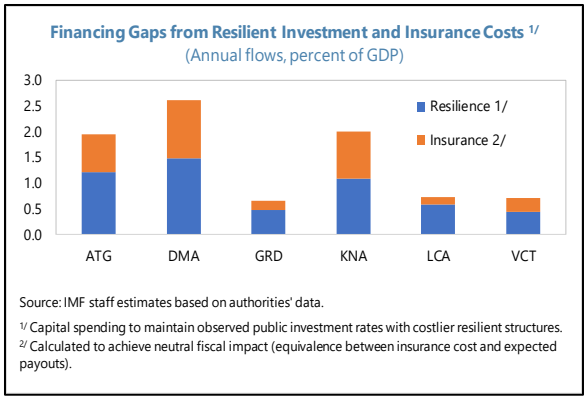
ECCU

1. Estimating the costs and benefits of resilience building and incorporating them into a realistic medium-term macroeconomic framework is integral to building a viable Disaster Resilience Strategy. Some of this work has been initiated in the context of staff consultations with the ECCU countries, where inadequate preparedness against natural disasters and weak fiscal performance represent two critical vulnerabilities (ECCU, 2018):

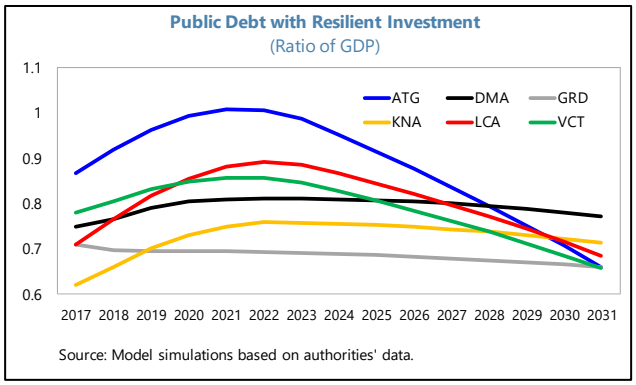
- *Benefits*. Based on model simulations tailored to capture key features of small states affected by natural disasters, staff estimates that scaling up resilient investment in the ECCU to 80 percent of the capital stock would increase potential output by 3-11 percent over the long-term, with a growth dividend of 0.1-0.4 percent per year during the transition to the new steady state (left hand chart). In addition, there are GDP gains of 0.7-2.7 percent of GDP a year from reduced damages and losses from natural disasters.

- *Costs*. The additional near-term fiscal costs of resilient investment would, however, open a transitional financing gap in the range of 0.4-1.5 percent of GDP per annum, drawing on the same model (see blue bar in right-hand chart). In addition, if countries aimed to cover 99 percent of the fiscal cost of natural disasters through self-insurance, maximum insurance coverage under the regional pool and contingent borrowing, the additional fiscal costs would range between 0.5-1.8 percent of GDP in the ECCU but would gradually decline as resilience is built (orange bar in right-hand chart).



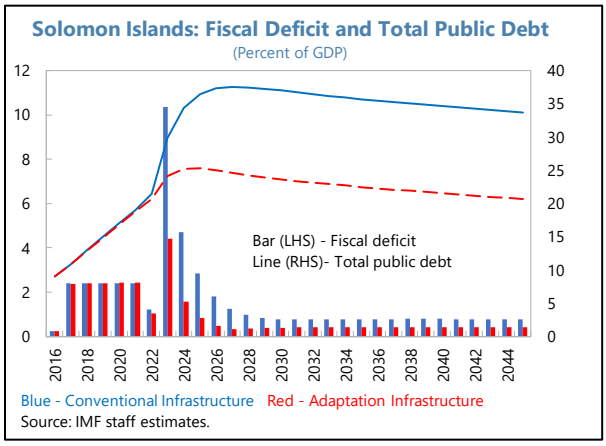


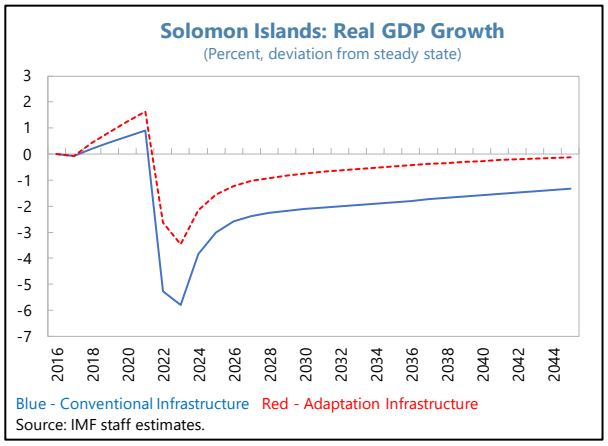
2. However, the transition from standard to resilient capital has upfront fiscal costs, with returns materializing only later. Without fiscal consolidation and in the absence of concessional financing, public debt would exceed the regional debt target of 60 percent of GDP by 2030 by 4–20 ppts of GDP owing to the higher cost of resilient capital (only about half of the public capital stock would be resilient by 2030 at the current investment rates).



The Pacific Islands

3. Staff studies focused on Solomon Islands and Vanuatu, extending the Debt Investment Growth framework to allow government investment in both standard and climate-resilient infrastructure (Marto, Papageorgiou, and Klyuev, 2017). Model simulations considered the islands' vulnerabilities to natural disasters, low public investment efficiency, and limited access to financing. Staff found that although conventional infrastructure has a more favorable effect on growth and private investment in the short term, climate-resilient infrastructure is more likely to be associated with lower public debt and higher growth in the long term, despite its higher cost. Supportive reforms, including strengthening public investment management, are essential to boost the gains from resilient investments and should be pursued without delay given that they require time to bear fruit. Tapping external concessional financing from development partners would be optimal since domestic borrowing can crowd out the private sector.





Annex VII. Advanced and Emerging Asia Pacific Region: Examples of Disaster Resilience Building

Lessons from other advanced and emerging markets emphasize: 1) the need for a cross-cutting approach to disaster resilience to make it central in development planning and the budgetary process, with clear planning at ministry, provincial and local government level; 2) taking into account the maintenance needs and periodic upgrading of infrastructure; 3) consider innovative financing such as catastrophe insurance and reinsurance; and 4) improve education in disaster preparedness and focus financial inclusion efforts on individuals with limited insurance and basic financial products.

1. **Japan**. A long history with natural disasters has led to policies aimed at building resilience in water resources management, management of droughts and floods, earthquake and fire damage control and mitigation, and public awareness for disaster prevention. The recent bill on climate change adaptation aims to accelerate prevention and mitigation measures. Under the new act, Ministry of the Environment undertakes climate change impact assessments every five years, and the National Adaptation Plan is revised accordingly. Municipalities formulate their own Local Climate Change Adaptation Plans and are supported by the National Institute for Environmental Studies (NIES) which provides a hub of scientific information, technical support and advice to promote local adaptation, including through the Climate Change Adaptation Information Platform (A-PLAT). Examples of strengthening structural resilience include:

- *Earthquake/Fire*: The Tokyo Metropolitan Government has designated key disaster prevention areas as fireproof districts. The city also makes effective use of a Fireproof Promotion Program and has improved the subsidy system to make buildings fireproof and encourage joint civic/business reconstruction of old buildings.

- *Flooding*: physical resilience to flooding has been improved through a network of subterranean cisterns, tunnels and engines to protect the Tokyo metropolitan area from extreme flooding. Built at a cost of US$2 billion in 2006, the Metropolitan Area Outer Underground Discharge Channel pulls in water from swollen rivers and pumps it out toward the ocean.

2. *Financial resilience*: Fiscal spending on aged and vulnerable infrastructure is a regular part of annual and supplementary budgets. Japan's institutionalized and government-funded program of "National Resilience" (kokudo kyoujinka) is in some ways more advanced than initiatives in North America, the European Union and elsewhere. Japan's resilience program, including both public and private sector spending, totaled over JP¥24 trillion (US$210 billion) in 2013 and is projected to grow dramatically by 2020. Moreover, Japan's disaster resilience centers on renewable energy, storage and efficiency, and has become a core element of Abenomics.

3. **New Zealand**. Damage from natural disasters including earthquakes, tsunamis, landslips, volcanic eruptions, storms and geothermal activity is addressed by the Natural Disaster Fund, managed by a state-owned enterprise, the Earthquake Commission (EQC), with additional funding guarantees from the government. The EQC also conducts research and education in natural disaster

preparedness. Immediate response to disasters falls under the Ministry of Civil Defence and Emergency Management, with a formal strategy in place, that will be reviewed and renewed in 2019. In the event of a natural disaster, the EQC insures for land damage, and up to a cap of NZ$100,000 on residential damage and NZ$20,000 on contents. 2019 will probably see the cap amended to NZ$150,000, with contents coverage removed – the first amendment of the cap since its definition in 1993. The remainder is covered by private insurance and is a precondition for the provision of EQC insurance. After major events, the government provides immediate emergency aid, and then the EQC's Natural Disaster Fund pays out insurance claims in tandem with private insurers. The Natural Disaster Fund is funded by insurance premia, but it was exhausted by the Canterbury and Kaikoura earthquake claims, leading to extra funding from the government in the near term, as guaranteed by law. Expected EQC revenues from insurance levies and liabilities from current and expected claims are tracked as part of the government's budget, and there are comprehensive reporting requirements from the EQC.

4. **Philippines**. The Disaster Risk Reduction and Management Act of 2010 marked a shift of policy focus from disaster response to risk reduction and preparedness. A key reform was the integration of disaster risk reduction as a cross-cutting policy priority in development planning and budgeting. In 2015, the Department of Budget and Management developed a Climate Change Expenditure Tagging system that identifies government agencies' climate change-related expenditures. The budget allocated to this category has been rapidly rising, including through the National Disaster Reduction and Management Fund focused on climate-related infrastructure investment.

5. *Financial resilience*. The Philippine government has strengthened financial resilience through innovative approaches. The government's Disaster Reduction Financing and Insurance Strategy combines a variety of risk financing instruments to protect against events of different frequency and severity. A recent initiative is the introduction of a catastrophe insurance program (US$206 million) to protect government assets. Under the program, a government-owned insurance agency would provide protection against catastrophe risks to the national government and participating local governments. Subsequently, the risks would be passed on to a group of private international reinsurance companies through a competitive bidding process with the World Bank acting as an intermediary. This program complements the government's existing natural disaster-related reserves and contingency credit lines, as well as the central bank's financial inclusion initiative targeted for people with limited access to insurance and other basic financial products.

6. **Indonesia**. The 2007 law on disaster management established the legal basis for organizing disaster management in Indonesia, including prevention, mitigation, emergency response, rehabilitation and reconstruction. The government established the National Disaster Management Agency (BNPB) in 2008, supported at the regional level by the Provincial Agency for Disaster Management (BPBD) and districts/cities agencies. The 2015-2019 National Medium-Term Development Plan (RPJMN) aims to reduce risk, increase the resilience of national and local governments, and support communities facing disasters. The BNPB Strategic Plan is aligned with both the medium and long-term development plans. Support for disaster risk management has

grown, with BNPB's budget allocation for disaster management increasing 500 percent from 2010 to 2014. However, at the provincial and lower levels agencies, personnel, equipment, and budget are still limited. The government spends US$300 to US$500 million annually on post-disaster reconstruction. Costs during major disaster years reach 0.3 percent of national GDP and as high as 45 percent of GDP at the provincial level.

Annex 523

"Barbados' 2018–19 Sovereign Debt Restructuring–A Sea Change?",
Working Paper WP/20/34, *International Monetary Fund*, February 2020

WP/20/34

IMF Working Paper

Barbados' 2018–19 Sovereign Debt Restructuring–A Sea Change?

by Myrvin Anthony, Gregorio Impavido, and Bert van Selm

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Western Hemisphere Department

Barbados' 2018–19 Sovereign Debt Restructuring–A Sea Change?

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Authorized for distribution Thordur Jonasson and Aasim M. Husain

February 2020

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Abstract

This paper examines the causes, processes, and outcomes of Barbados' 2018–19 sovereign debt restructuring—its first ever. The restructuring was comprehensive, featuring several rarely used approaches, including the restructuring of treasury bills, and the use of a retrofitted collective action mechanism. The debt restructuring has helped to set Barbados' public debt on a clear downward trajectory. A sustained reform effort, maintaining high primary surpluses and ambitious structural reforms, will be needed to gradually reduce public debt from about 160 percent of GDP before the restructuring to the country's 60 percent debt-to-GDP target.

JEL Classification Numbers: F34; G15; H63

Keywords: Sovereign Debt; Sovereign Defaults; Sovereign Debt Restructurings; Barbados

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FIGURES

TABLES

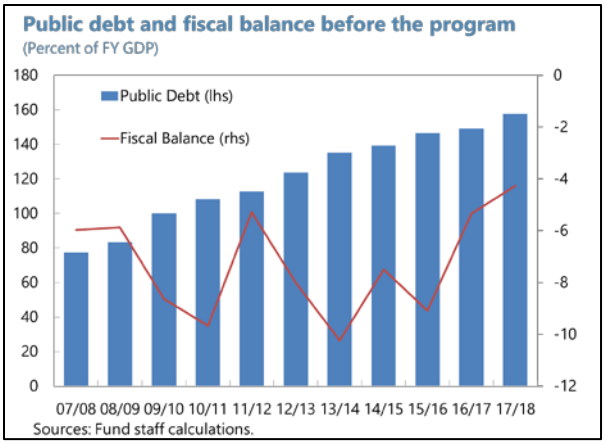
I. INTRODUCTION

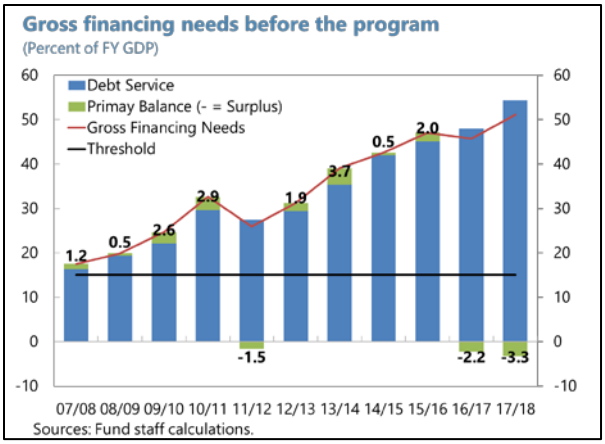
In 2018 and 2019, Barbados restructured its public debt for the first time in the country's history. The debt restructuring announced on June 1, 2018, by a government that had assumed office just a week earlier, was very comprehensive, including external debt to commercial creditors and treasury bills. It took many by surprise—prices on the external bond market fell sharply, and it is one of just a handful of cases over the last few decades where treasury bills were included in a debt restructuring (Russia 1998, Ukraine 1998, and Uruguay 2003). Agreement with domestic creditors was announced by the Prime Minister in a public address on October 14, 2018; the process of reaching agreement with external creditors took somewhat longer, with an agreement with the external creditor committee announced just over a year later, on October 18, 2019. To secure full participation in the domestic restructuring, the authorities retrofitted domestic securities with a collective action mechanism, a rarely used approach (with Greece 2012 as a precedent). Most of the newly issued debt instruments include a natural disaster clause, to help Barbados to stay current on future debt obligations.

This paper adds to the empirical literature on sovereign debt restructuring episodes by examining the causes, processes, and outcomes of Barbados' sovereign debt restructuring. It compares these to other recent debt restructurings, in the Caribbean region and beyond. It describes the role of the IMF in the process, with a Fund-supported program approved by the IMF's Executive Board four months into the process, on October 1, 2018; and it discusses the impact on public debt sustainability, and the net present value (NPV) reduction. Compared to other recent debt restructurings in the region: (i) the perimeter of the debt restructuring was relatively wide, to include treasury bills; (ii) the length of the process was somewhat longer than the recent average for the region, at 18 months; and (iii) the NPV gains were substantial. The paper discusses which country-specific factors, and choices made along the way by the Barbadian authorities, contributed to these outcomes.

II. FROM INVESTMENT GRADE TO SELECTIVE DEFAULT

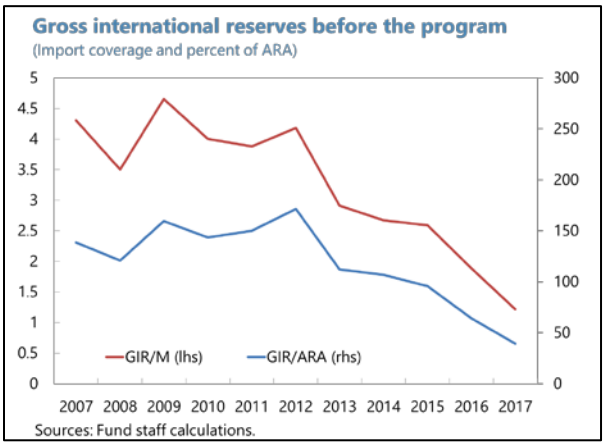
The 2008-09 global financial crisis led to a prolonged recession in Barbados, with a decade of low growth, and fiscal and external imbalances gradually deepened. Between FY2007/08 and FY2017/18, the overall fiscal balance was on average in deficit at about 8 percent of GDP, with very high interest expenditure and transfers to state-owned enterprises (SOEs), averaging 6½ and 7½ percent of GDP, respectively. During this period, public debt (central government debt, arrears, and SOE debt guaranteed by the central government) increased from 77 to 158 percent of GDP. In addition, Barbados' public debt profile worsened considerably. With sovereign credit risk increasing rapidly, commercial banks reduced holdings of long-term debt in favor of short-term debt and, as a result, gross financing needs increased from 16 to 51 percent of GDP. The IMF assessed public debt as unsustainable in its 2017 Article IV report (IMF 2018a: p. 1 and 4).

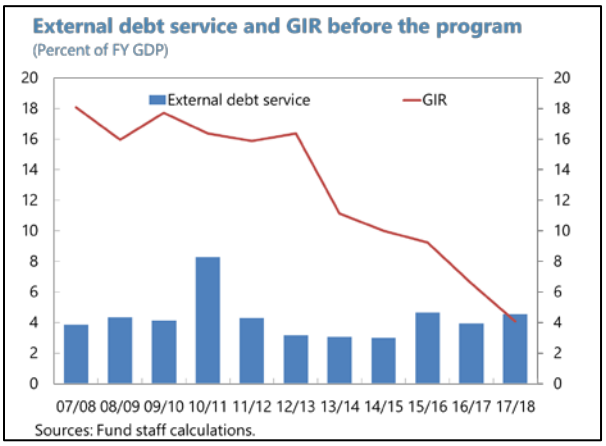


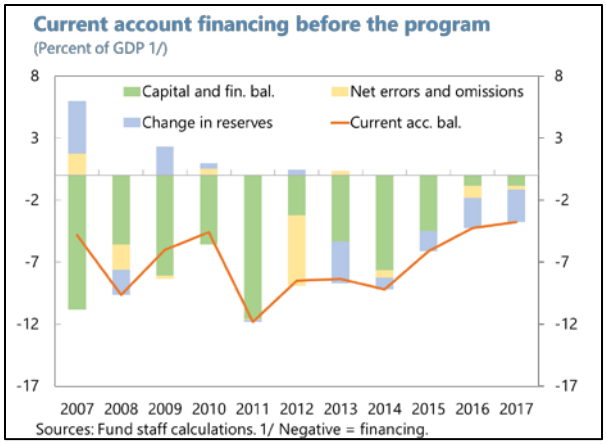


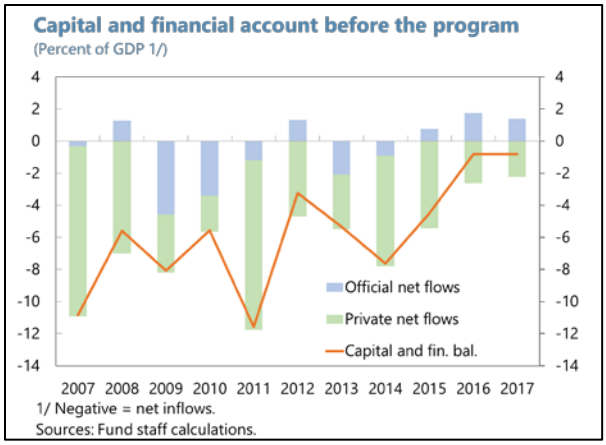
A. Credit Rating Downgrades

With increasing public debt, international investors' confidence gradually deteriorated. Over the last decade, Barbados' credit rating declined in several steps from investment grade (Standard and Poor's BBB+) on the eve of the global financial crisis, to Selective Default on June 6, 2018. Access to international financing gradually dried up, with no access to international capital market after the 2013/14 Credit Suisse facility (discussed in greater detail below). Between 2007 and 2017, international reserves decreased from US$850 million to about US$220 million. This represented a decrease from 4½ months to about 5 weeks of import coverage, or from about 140 to 39 percent of the IMF's reserve adequacy (ARA) metric.



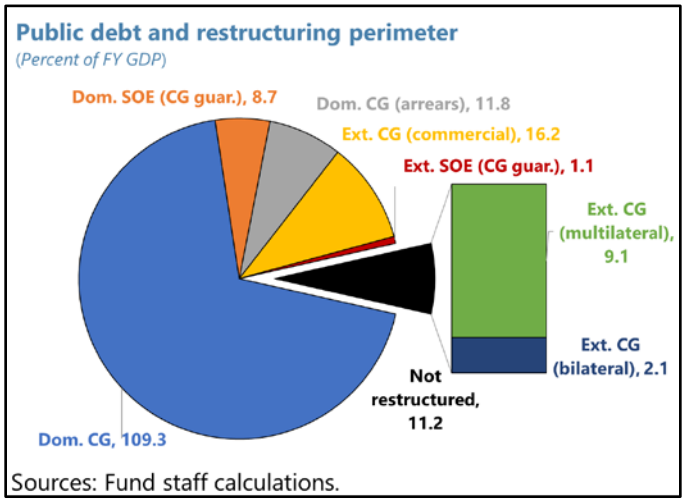






III. Restructuring the Debt: Perimeter and Process

Data limitations led to a focus on central government debt. The Barbadian authorities do not consolidate fiscal statistics for larger fiscal perimeters such as general, non-financial and financial public sector. Hence, the definition of public debt used by the authorities included all debt issued by the central government, all arrears incurred by the central government, and all debt issued by SOEs and guaranteed by the central government. This amounted to 158.3 percent of FY GDP at the time of the start of the restructuring (Table 1).



The government announced a comprehensive debt restructuring, including external debt to commercial creditors and treasury bills, on June 1, 2018. Debt targeted for restructuring amounted to about 147 percent of FY GDP, including claims held by public sector agencies such as the Central Bank of Barbados (CBB) and the National Insurance Scheme (NIS).[1] It covered central government domestic debt including treasury bills and all other short-term claims such as overdrafts, central government debt to external commercial creditors, SOE external and domestic debt guaranteed by the central government, domestic expenditure arrears incurred by the central government, and external arrears that started accumulating after the external default. Only bilateral external debt and debt held by multilaterals was excluded from the restructuring perimeter (see text chart).

[1] Excluding these claims between public entities, Barbados' public debt at the start of the restructuring would have been about 60 percent of GDP lower.

Table 1. Barbados: Public debt structure, FY2007/08–19/20

(percent of FY GDP)

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	Proj. 2019/20
						(In millions of Barbados dollars)						
Public Debt	**7,847**	**8,965**	**9,868**	**10,466**	**11,444**	**12,657**	**13,092**	**13,949**	**14,548**	**15,843**	**12,853**	**12,152**
External	2,162	2,488	2,839	2,898	2,765	3,077	3,204	3,222	3,044	2,853	3,340	3,011
Short Term	0	0	0	0	0	0	0	0	0	0	168	0
Long term	2,162	2,488	2,839	2,898	2,765	3,077	3,204	3,222	3,044	2,853	3,172	3,011
Domestic	5,685	6,476	7,029	7,568	8,679	9,579	9,888	10,727	11,504	12,990	9,513	9,141
Short Term	944	1,178	1,332	1,506	2,033	2,653	2,811	3,128	3,737	5,423	892	653
Long term	4,741	5,299	5,696	6,062	6,646	6,926	7,077	7,599	7,766	7,567	8,621	8,488
Arrears 4/	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,184**	**461**	**126**
External 5/	0	0	0	0	0	0	0	0	0	0	168	0
Domestic	0	0	0	0	0	0	0	0	0	1,184	293	126
SOE Guaranteed Debt	**1,158**	**1,211**	**1,328**	**1,401**	**1,411**	**1,400**	**1,543**	**1,342**	**1,242**	**977**	**93**	**93**
External 3/	204	228	315	357	335	290	399	314	259	108	93	93
Domestic	954	983	1,013	1,044	1,077	1,110	1,144	1,028	983	869	0	0
Short Term	0	0	0	0	0	0	0	0	0	14	0	0
Long term	954	983	1,013	1,044	1,077	1,110	1,144	1,028	983	855	0	0
CG Debt	**6,689**	**7,754**	**8,540**	**9,065**	**10,033**	**11,257**	**11,549**	**12,607**	**13,306**	**13,683**	**12,299**	**11,934**
External 3/ 6/	1,958	2,260	2,525	2,541	2,430	2,787	2,805	2,908	2,785	2,745	3,080	2,918
Domestic	4,731	5,493	6,015	6,523	7,603	8,470	8,744	9,699	10,521	10,938	9,219	9,016
Short Term	944	1,178	1,332	1,506	2,033	2,653	2,811	3,128	3,737	4,225	598	528
Long term	3,787	4,316	4,683	5,018	5,570	5,817	5,933	6,571	6,784	6,712	8,621	8,488
						(In percent of FY GDP)						
Public Debt	**83.4**	**100.0**	**108.2**	**112.6**	**123.7**	**135.2**	**139.3**	**147.0**	**149.5**	**158.3**	**125.6**	**115.9**
External	23.0	27.8	31.1	31.2	29.9	32.9	34.1	34.0	31.3	28.5	32.6	28.7
Short Term	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0
Long term	23.0	27.8	31.1	31.2	29.9	32.9	34.1	34.0	31.3	28.5	31.0	28.7
Domestic	60.4	72.3	77.0	81.4	93.8	102.3	105.2	113.1	118.2	129.8	93.0	87.2
Short Term	10.0	13.1	14.6	16.2	22.0	28.3	29.9	33.0	38.4	54.2	8.7	6.2
Long term	50.4	59.1	62.4	65.2	71.8	74.0	75.3	80.1	79.8	75.6	84.2	81.0
Arrears 4/	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**11.8**	**4.5**	**1.2**
External 5/	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0
Domestic	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.8	2.9	1.2
SOE Guaranteed Debt	**12.3**	**13.5**	**14.6**	**15.1**	**15.2**	**14.9**	**16.4**	**14.1**	**12.8**	**9.8**	**0.9**	**0.9**
External 3/	2.2	2.5	3.5	3.8	3.6	3.1	4.2	3.3	2.7	1.1	0.9	0.9
Domestic	10.1	11.0	11.1	11.2	11.6	11.8	12.2	10.8	10.1	8.7	0.0	0.0
Short Term	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Long term	10.1	11.0	11.1	11.2	11.6	11.8	12.2	10.8	10.1	8.5	0.0	0.0
CG Debt	**71.1**	**86.5**	**93.6**	**97.6**	**108.4**	**120.2**	**122.8**	**132.9**	**136.7**	**136.7**	**120.2**	**113.9**
External 3/ 6/	20.8	25.2	27.7	27.3	26.3	29.8	29.8	30.6	28.6	27.4	30.1	27.8
Domestic	50.3	61.3	65.9	70.2	82.2	90.4	93.0	102.2	108.1	109.3	90.1	86.0
Short Term	10.0	13.1	14.6	16.2	22.0	28.3	29.9	33.0	38.4	42.2	5.8	5.0
Long term	40.2	48.1	51.3	54.0	60.2	62.1	63.1	69.3	69.7	67.1	84.2	81.0
Memorandum items:												
Nominal GDP, FY (BDS$ millio	9,410	8,963	9,124	9,292	9,254	9,364	9,402	9,488	9,734	10,011	10,234	10,481

Sources: Ministry of Finance; Central Bank of Barbados; and Fund staff estimates and projections.

1/ Fiscal year (April–March). Ratios expressed relative to fiscal-year GDP.

2/ Central Government debt, Central Government arrears, and SOE debt guaranteed by the Central Government.

3/ All medium- and long-term.

4/ All short-term.

5/ Excluding principal amortization arrears.

6/ Including principal amortization arrears.

The timing of the government's announcement was driven by large external debt payments due in early June, and Barbados defaulted on these partly with the aim of maintaining reserves. The incoming government quickly secured the support of experienced advisors to support the sovereign debt restructuring.[2] In the weeks following the authorities' June 1 announcement,

[2] White Oak Advisory provided financial advice to the Government of Barbados, while Cleary Gottlieb LLP provided legal advice. The domestic creditors were advised by FTI Consulting, while external creditors were advised by Newstate Partners LLP.

two main creditor committees were formed: one comprising the five domestic banks, and another group representing the main external creditors.

A. Domestic Debt Restructuring

Initial discussions took place during June, July and August, both with the domestic and the external creditor committee. Over the summer, the focus of the debt restructuring was on the domestic side, given that the bulk of Barbados' debt was domestic, and given the urgency of reaching a solution with domestic creditors that would provide meaningful debt relief to the government, without jeopardizing financial stability.

Debt service on external debt held by commercial creditors was halted immediately following the June 1 announcement, whereas the government continued to pay interest on domestic debt, with holders of domestic debt expected to roll over maturing principal. Interest on domestic debt continued to be paid until the government launched an exchange offer for domestic debt (Barbados dollar-denominated) on September 7, 2018. The launching of this domestic debt exchange offer was a prior action for the approval of an Extended Arrangement under the Extended Fund Facility (EFF) for Barbados, approved by the IMF's Executive Board on October 1, 2018. The prior action was deemed necessary as the Fund cannot lend into an unsustainable debt situation. The launch of the domestic restructuring was considered necessary in this case to show that a credible process for restructuring was underway that would result in sufficient creditor participation to restore debt sustainability and close financing gaps within the macroeconomic parameters of the program.

B. Retrofitted Collective Action Mechanism

In September 2018, the parliament of Barbados adopted legislation that retrofitted a collective action mechanism into domestic debt. Under this legislation, in the event of a debt restructuring, creditors holding 75 percent of the aggregate outstanding principal amount of "specified debt instruments" that submit a voting form can, if they accept a restructuring proposal, make the restructuring legally binding for all holders.[3,4] Agreement with the bulk of domestic creditors (including all banks and insurers) was announced on October 14, and the transaction with domestic creditors was closed on November 19, 2018; the legislation adopted

[3] "Specified debt instruments" included treasury bills, treasury notes, debentures, local currency loans incurred by the government and by state owned enterprises, local currency bonds issued by the government and state owned enterprises, and local currency arrears incurred or assumed by the government.

[4] According to paragraph 5(1) of the "Debt holder (approval of debt restructuring) Act 2018-24 published in the Supplement to the Official Gazette dated 29th October 2018, the government debt restructuring proposal is deemed accepted by all holders of specified instruments if holders representing at least 50 percent of the aggregate outstanding principal amount of all specified debt instruments submit a voting form, and holders representing at least 75 percent of the aggregate outstanding principal amount for which a voting form is received, vote in favor of the proposal.

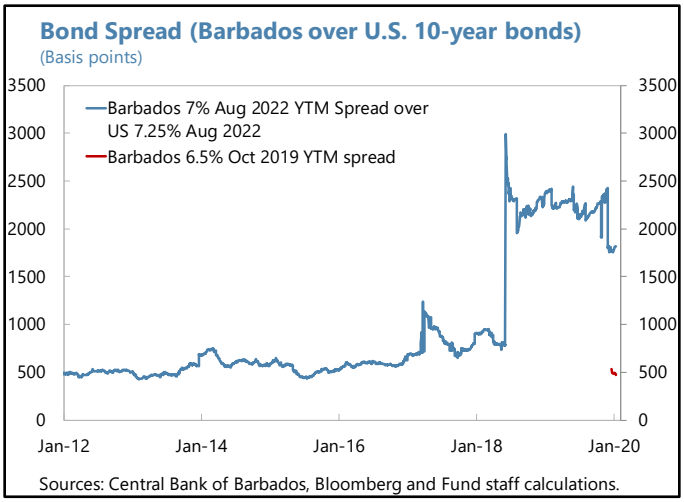
by parliament in September was used to secure 100 percent participation in the domestic debt exchange—the retrofitted collective action mechanism was effective.

C. Bilateral Debt

On the eve of the debt restructuring, Barbados' debt to bilateral creditors was small, at 2 percent of GDP. After the government's June 1, 2018 announcement, Barbados defaulted on a commercial loan guaranteed by the government of Canada (worth just over 1 percent of GDP), while remaining current on a loan provided by the government of China of just under 1 percent of GDP (IMF 2018b: p. 7). The guarantee was called on September 21, 2108 (IMF 2018b: p. 78), which meant that Barbados was in arrears to Canada from then on. At the IMF Executive Board meeting on October 1, 2018, Canada consented to IMF financing on the condition that: (i) Barbados repaid accumulated arrears to Canada, and (ii) if the loan guaranteed by the government of Canada were restructured, Barbados would seek to restructure other bilateral debt and debt with creditor sovereign guarantees on comparable terms. In early 2019, the government of Barbados decided not to pursue a restructuring of bilateral debt and resumed payments on the Canada loan (IMF 2019a: p. 12).

D. External Debt Restructuring

The yield on Barbados' traded external debt jumped sharply following the debt restructuring announcement. External creditors were clearly taken by surprise.



On the eve of the restructuring, external debt to private creditors amounted to about 16 percent of GDP. It consisted of a handful of Eurobond issuances, plus a Credit Suisse loan facility (a facility arranged by Credit Suisse, with participation of other investors). The Eurobonds had been issued with collective action clauses (CACs) at 75 percent participation, but the Credit Suisse facility did not have a mechanism to deal with holdout creditors. The Credit Suisse facility was agreed by the government of Barbados in late 2013, for US$150 million, or about 3 percent of GDP, with a five-year maturity; it was increased to US$225 million in 2014. The maturity of this loan was originally 5 years, but in 2016 it was extended by one year, to 2019. The interest payable on it was linked to Barbados' credit rating, and it had therefore increased significantly over the years, with numerous downgrades, to 12 percent at end-2017. Barbados' Eurobonds had been issued earlier (the most recent one in 2010), at rates between 6½ and 8 percent. Several external investors held positions both in the Eurobonds and in the Credit Suisse arrangement.

During 2019, proposals exchanged between the government of Barbados and the creditor committee gradually narrowed the gap between the positions. The gap between the creditor's initial, September 2018 proposal—a ten year instrument with a single bullet repayment, at 8.25 percent, the average level of the outstanding external debt instruments, with no haircut—and the government's initial proposal, which featured very low (but gradually stepping up) interest rates and much longer maturity (at 25 years), was very large in NPV terms. The loss for investors would have been 29 percent under the creditors' proposal, and 59 percent under the government's proposal.[5] In a series of proposals and counterproposals, this 30-percentage points gap had been reduced to just 5 percent by June 2019. On June 24, 2019, the IMF's Executive Board concluded the first review of Barbados' EFF-supported program.

On October 18, 2019, the government of Barbados and the external creditor committee issued a joint press release to announce agreement on the terms of a debt exchange offer. The agreement featured a 26 percent haircut[6] on original principal and past due and accrued interest; the issuance of a new long-term debt instrument with a 10-year maturity, a 5-year grace period, and a 6.5 percent interest rate; and a US$40 million re-payment (comprising US$7.5 million in cash and US$32.5 million in short-term bonds maturing in 2021 and bearing a 6.5 percent coupon) in the period 2019-2021. In a November 23, 2019 press release, the government announced overwhelming creditor support the debt exchange, with participation well above the 75 percent threshold for the three outstanding Eurobonds (93 percent on average, and 88, 92, and 96 percent for the three instruments). Importantly, the participation rate in the Credit Suisse facility came in at 100 percent (investors in this facility had been represented in the creditor committee)—see Box 1. On December 11, 2019, the transaction closed with full creditor participation. On the same day, and in response to the completion of the debt exchange, Standard and Poor's upgraded Barbados' foreign currency sovereign credit rating from Selective Default to B-.

E. Natural Disaster Clause

Barbados is at risk of extreme weather events, as well as earthquakes, and the government of Barbados effectively used the debt restructuring to strengthen its protection against these events, in addition to existing instruments, such as its insurance under the Caribbean Catastrophe Risk Insurance Facility (CCRIF). The natural disaster clause included in most of the new debt instruments (both in the domestic and in the external debt restructuring) would allow for capitalization of interest and deferral of scheduled amortization falling due over a two-year period following the occurrence of a major natural disaster. The trigger for a natural

[5] Using the 12 percent discount rate that was used by the parties throughout the negotiation process to compare proposals.

[6] The haircut on principal and accrued interest reduces projected cashflows and therefore, for given interest rate used for discounting, their present value.

disaster event for the new domestic debt is a payout above US$5 million by the CCRIF.[7] Similarly, the new external debt instruments also link the threshold for triggering the natural disaster clause to CCRIF payouts, using differentiated thresholds depending on the type of natural disaster (hurricane, flooding or earthquake).[8]

Box 1. Credit Suisse Facility—Use of Exit Consents

While exit consents have been a feature of bond restructurings (see Buchheit et al 2020: p. 358), this has been less frequently used in a sovereign loan restructuring context. Barbados made a novel use of this technique in its sovereign loan restructuring, which resulted in all of the Credit Suisse loans being exchanged for the new bonds.

The exchange offer was accompanied by a consent solicitation, which made use of the power for a majority of creditors to amend the original credit agreement in order to encourage participation in the exchange. In short, the amendments would leave potential holdouts with a less valuable instrument by stripping creditors of critical protections and enforcement powers. The structure of the original credit agreement, which included provisions allowing action by the majority given that it was to be syndicated, made this consent solicitation possible; typical bilateral loan agreements would not have the possibility of majority amendment.

The original credit agreement permitted the amendment of most provisions with a 50.01% majority of creditors. Certain provisions—such as the amount of principal—were exempted and required unanimous consent of all lenders. Under the November 5, 2019 consent solicitation, creditors simultaneously agreed to the exchange and consented to the amendment or waiver of many provisions of the credit agreement. This included removal of all affirmative and negative covenants and most events of default, which only required majority consent. Crucially, Barbados' original submission to the jurisdiction of New York courts and waiver of sovereign immunity for any lawsuit arising out of the credit agreement was drastically narrowed to apply only to lawsuits brought by Credit Suisse as administrative agent—leaving out any actions by individual creditors. Without these two provisions, any litigation by holdout creditors would face serious obstacles when seeking to enforce any claims arising from default under the credit agreement. This approach helped secure full participation in the exchange.

IV. BARBADOS' IMF-SUPPORTED ECONOMIC REFORM PROGRAM

The debt restructuring was part of a comprehensive economic reform plan, aimed at restoring fiscal and debt sustainability, and supported by IMF financing. Plans for fiscal consolidation and debt restructuring were developed simultaneously, to ensure that jointly they would put

[7] Such a payout actually occurred right before the domestic debt restructuring exercise closed: on October 19, 2018, CCRIF made a US$5.8 million payment to the government of Barbados following the passage of Tropical Storm Kirk, under Barbados' excess rainfall policy.

[8] However, for the new external debt instrument, holders of at least 50 percent of the aggregate principal amount of the bonds outstanding at the time Barbados elects to defer payments can block the activation of the clause.

public debt on a clear downward trajectory and that medium-and long-term debt targets would be met. The plan sought to restore debt sustainability while at the same time maintaining broad public support for the adjustment effort, as well as financial sector stability. Program ownership (the implementation of a home-grown economic reform program, developed in close consultation with social partners) was strong from the program's inception, while careful financial sector stress tests were conducted to ensure that the domestic debt restructuring would not jeopardize financial stability.

The June 1, 2018 press release by the government of Barbados announcing the default also included a request for IMF balance of payments support. One of the new government's first actions after winning the elections of May 24, 2018 was the publication of the IMF's 2017 report on the Article IV consultation with Barbados the very next day (see IMF 2018a). Following the elections, an IMF staff team visited Barbados for an initial fact-finding visit in less than two weeks, from June 5-7, 2018. Discussions on a 4-year, 220 percent of quota (about US$290 million) Extended Arrangement under the EFF continued during two more visits in July and in August/September, respectively. Discussions with the IMF staff on the scope and design of a program moved forward in parallel with the negotiations with creditors on the debt restructuring.

A staff-level agreement on an IMF-supported program was announced on September 7, 2018—the same day as the launch of the domestic debt exchange. This was not a coincidence: for the government's launch of its exchange offer for the stock of central government domestic debt held by private creditors consistent with program objectives was a prior action for approval by the IMF's Executive Board. The prior action was necessary as the Fund cannot lend into an unsustainable debt situation, as discussed above.

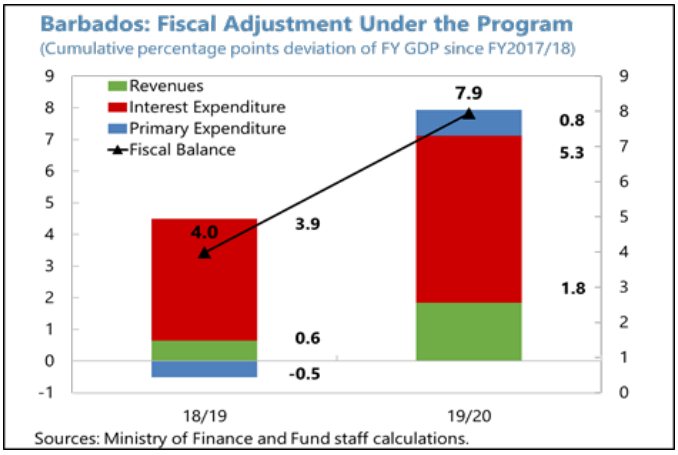
A. The BERT plan

The Barbados Economic Recovery and Transformation (BERT) plan, and the Extended Arrangement that supports it, aim to reduce the central government debt (including arrears and SOE debt guaranteed by the central government—see Table 1) from about 158 percent of GDP by the end of FY2017/2018 to 80 percent by FY2027/28 and to 60 percent by FY2033/34,[9] with a combination of fiscal consolidation, debt restructuring, and measures to boost growth. Public debt declined sharply in the first year of the program, as a result of the debt restructuring, in particular the holdings of the CBB and the NIS (as discussed in greater detail below), and is projected to remain on a clear downward trajectory afterwards. In FY2019/20, both fiscal consolidation (with the government now running an overall fiscal surplus) and debt

[9] The debt threshold under the IMF's debt sustainability framework for emerging markets (MAC DSA) is 70 percent of GDP; however, in light of Barbados' vulnerability to natural disasters, a 60 percent of GDP debt anchor was deemed appropriate in this case, also to ensure that Barbados' debt target was aligned with that of other countries in the region, including Jamaica and the ECCU. Reaching that debt level earlier than the targeted date of 2033 would have implied either a higher primary balance path or a deeper debt restructuring (with higher financial sector losses), or a combination of the two.

restructuring (in particular the 25 percent principal haircut on external debt to commercial external creditors) contributed to a decline in public debt.

B. Fiscal Adjustment



Fiscal consolidation is a cornerstone of the BERT program: in mid-2018, the new government announced its intention to raise the primary surplus to 6 percent of GDP in FY2019/20, from 3½ percent in FY2017/18, and to maintain the primary surplus at this level for several years thereafter. Reforms of state-owned enterprises (SOEs) and Public Financial Management (PFM) reforms underpin the fiscal consolidation. To reduce central government transfers to SOEs, the BERT plan includes measures on: (i) much stronger oversight of SOEs, supported by improved reporting; (ii) a reduction of the wage bill; (iii) revenue enhancement, starting with a review of user fees; and (iv) mergers and divestment. The adoption of a fiscal rule, planned for end-2020, will help sustain the reform effort over the medium and long term.

In June 2018, the government also took steps to improve the composition of revenue by removing a highly distortionary excise tax, the National Social Responsibility Levy (NSRL); and by introducing new taxes on tourism. By doing so, the government aimed to shift the burden of taxation from residents to non-residents—important with a view to maintaining political support for the adjustment process. Similarly, in December 2018, a corporate income tax reform aimed to shift the burden of profit taxes from resident to non-resident companies (by unifying corporate income tax rates at a level above what had been the rate for non-resident companies, but much lower than the previous rate for resident companies). This measure also aimed to ensure that Barbados was compliant with non-discrimination guidelines promoted by the OECD.

C. Structural Reforms

Institutional reforms to sustain prudent macroeconomic policies and avoid a repeat of the 2018 crisis are an important part of the BERT program. In addition to the fiscal rule mentioned above, public pension reform is planned for 2020, to address the rising costs of the public pension scheme in the face of an aging population. A new Central Bank law, expected to be adopted in early 2020, enhances the institutional, personal and financial autonomy of the Central Bank of Barbados, while limiting financing of the government to short term advances in normal times, with a natural disaster clause to facilitate additional financing to the central government in exceptional situations. The large monetary financing in the years leading up to

the crisis—peaking at 8 percent of GDP in FY2016/17—played a major role in the decline of Barbados' international reserves in the years leading up to the crisis, and jeopardized the country's exchange rate peg, with a fixed rate of two Barbados dollars to one US dollar in place since 1975.

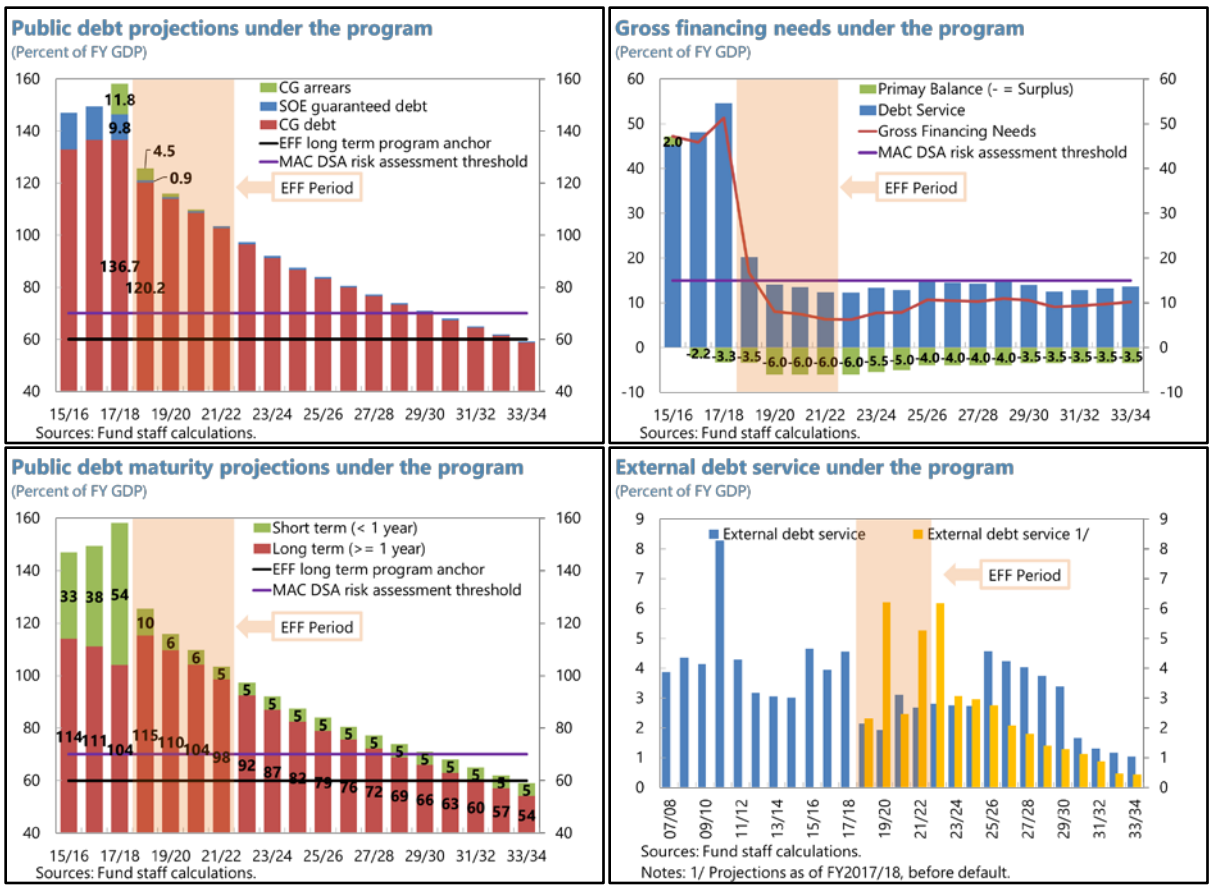
The BERT plan also includes structural reforms to improve Barbados' growth potential and competitiveness. The adoption of a new Town and Country Planning law in January 2019 help to streamline the process for providing construction permits. Barbados' relatively low score in the World Bank's Doing Business rankings—129 out of 190 countries in the October 2019 survey—indicates that there is ample room for further improvement in many areas, from starting a business to facilitating trading across borders, and from protecting minority shareholders to digitizing property records.

D. BERT Monitoring Committee

The government engaged in intensive consultations with the Social Partnership to build public support for the program. In October 2018, a BERT Monitoring Committee (BERT MC) was set up, co-chaired by the Chairman of the Private Sector Association and the General Secretary of the Barbados Workers' Union; the committee reports to the Social Partnership and the public. BERT MC started to issue quarterly press releases, with the first one issued in February 2019.

V. RESTRUCTURING THE DEBT: OUTCOMES

The comprehensive debt restructuring played a critical role in restoring Barbados' debt sustainability. Combined with fiscal consolidation and measures to boost growth, public debt was put on a clear downward trajectory. The maturity profile of public debt was lengthened, gross financing needs dramatically reduced, and the external debt restructuring greatly improved the external debt service profile as illustrated in the charts below. On the other side of the coin, the government's creditors incurred losses, as discussed below.



The terms of the external commercial debt restructuring announced on October 18, 2019 provided an immediate debt reduction (a face value, nominal haircut) of about 4 percent of GDP. This, together with the restructuring of the cashflows implied an NPV loss for creditors (and a gain for the government of Barbados) of about 44 percent of stock and accrued interest and penalties when measured at the discount rate of 12 percent used by the parties in the debt restructuring process. At the exit yield of 7 percent, the NPV gain for the government (and loss for creditors) would be about 30 percent.

The terms of the domestic debt restructuring proposed by the government on September 7, 2018 laid out several new debt instruments, and specified financial institutions' eligibility for these instruments. Commercial banks, life insurers, general insurers, and other financial institutions (including credit unions), were treated differently under the restructuring, while yet different modalities applied to individual debt holders, the NIS, and the CBB.[10] NPV losses from the domestic debt restructuring for domestic creditors (and gains for the central government) averaged about 43 percent, with NPV losses for private creditors around 30 percent, using a discount rate of 7 percent (Table 2).

[10] Details of the debt restructuring can be found on http://gisbarbados.gov.bb/creditors/; the text provides a summary of the main elements of the restructuring.

Table 2. Barbados: Aggregate NPV losses from the domestic debt restructuring

Sector	Unrestructured claims at nominal value (B$ million)	Unrestructured claims at PV /3 (B$ million)	Restructured claims at PV /3 (B$ million)	Nominal to PV loss /3 (Percent)	PV to PV loss /3 (Percent)
Public Sector	6,265.1	6,420.1	2,860.1	-54.3	-55.5
CBB 1/	2,640.7	2,640.1	642.0	-75.7	-75.7
NIS	3,624.3	3,780.0	2,218.2	-38.8	-41.3
Private Sector	5,291.9	5,443.9	3,858.8	-27.1	-29.1
Banks	2,205.8	2,223.0	1,607.6	-27.1	-27.7
Trusts	296.8	303.6	211.4	-28.8	-30.4
Credit Unions	130.9	131.2	91.0	-30.5	-30.6
Insurance	523.2	554.5	391.2	-25.2	-29.4
Pension funds	609.8	639.1	429.4	-29.6	-32.8
Other 2/	1,525.4	1,592.4	1,128.2	-26.0	-29.2
Total Domestic Claims	11,557.0	11,864.0	6,718.9	-41.9	-43.4

1/ Including government sinking fund at CBB and ways and means.

2/ Other holders of government debt, including mutual funds and companies.

3/ Using a 7 percent interest for discounting.

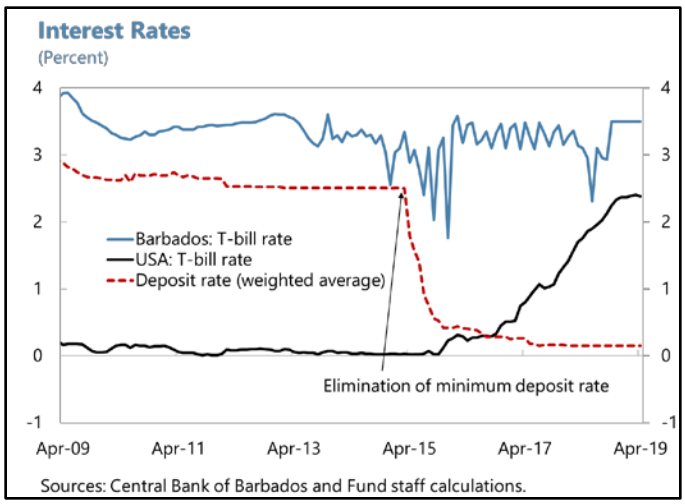
A. Stress tests

Financial sector supervisors—the CBB and the Financial Services Commission (FSC)—conducted extensive stress tests over June-August 2018 to ensure that the proposed debt restructuring would not jeopardize financial stability. While the holdings of commercial banks and insurers were not subject to face-value haircuts, the NPV losses incurred by maturity extensions and interest rate reductions did lead to capital losses, under IFRS-9 applied by financial institutions and their auditors. Stress tests ensured that the proposed terms would not push financial entities below minimum capital requirements.

B. Government Debt Held by Domestic Banks

Commercial banks dominate the financial system in Barbados. On the eve of the debt restructuring (December 2017 data), banks held 53 percent of total financial sector assets. The system was highly solvent, with strong capital buffers well over prescribed levels. All five banks in Barbados are foreign owned, with three Canadian banks (Nova Scotia, RBC and CIBC First Caribbean, all three rated AAA) holding 75 percent of total bank assets, and with the two Trinidadian banks (Republic Bank Barbados and First citizens, both rated BBB+) accounting for the remaining 25 percent. On average, banks had loan-to-deposits ratios of 60

percent, and excess cash reserves of 20 percent of deposits. Banks' funding costs were and are negligible, with deposit rates close to zero (see text chart). At end-2017, the non-performing loan level for the banking system was 8 percent. Banks had large (but not uniform) exposures to the sovereign: they held about B$2.2 billion (22 percent of GDP) of claims on the government. This exposure was almost twice as much as the total capital of banks.



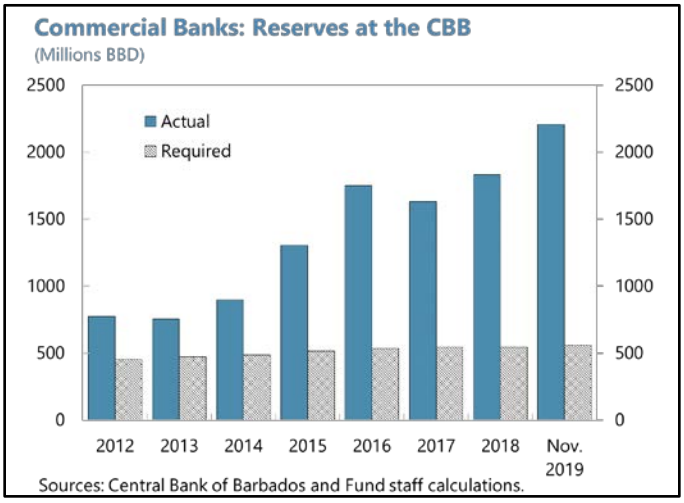
On the eve of the debt restructuring, the bulk of commercial banks' holdings of government debt was in the form of treasury bills, owing to credit risk concerns. In the years prior to June 2018, domestic banks had switched from holding government bonds to treasury bills precisely with a view to reducing credit risk (and considering that short-term debt had rarely been included in past debt restructuring operations around the world). Between FY2006/07 and FY2017/18, short term debt (mainly treasury bills) held by commercial banks increased from 6 to 18 percent of GDP.

C. Statutory Reserve Requirements

Part of commercial banks' accumulation of Barbados government debt had been driven by the authorities themselves: in May 2017, the CBB raised banks' statutory minimum requirement for government holdings from 10 to 15 percent of deposits, and the CBB raised this ratio again on November 1, 2017, to 18 and 20 percent with effect on December 1st and January 1st, respectively (IMF 2018a: p. 7). This allowed the government to rely less intensively on monetary financing in FY2017/18, with CBB financing of the central government down to less than 1 percent of GDP in FY2017/18, from more than 8 percent of GDP in 2016/17. From the point of view of commercial banks, this raised a fairness issue in the debt restructuring: a part of their holdings of government debt being restructured had been acquired in compliance with government regulations, not as an independent investment decision.

The government's decision to include banks' holdings of treasury bills within the debt restructuring perimeter was prompted by both burden sharing and debt sustainability considerations. At 42 percent of GDP, short term debt was a major factor into Barbados' very high gross financing needs. In the Debt Sustainability Analysis included in the IMF's 2017 report on the Article IV consultation with Barbados (IMF 2018a), gross financing needs were flagged as a key risk to debt sustainability; these were projected to rise from about 51 percent of GDP in 2017/18 to 53 percent of GDP in 2022/23. Maturity extension of the bulk of these

instruments was therefore important to reduce financing needs and bring them below the 15 percent of GDP threshold used to assess debt sustainability.



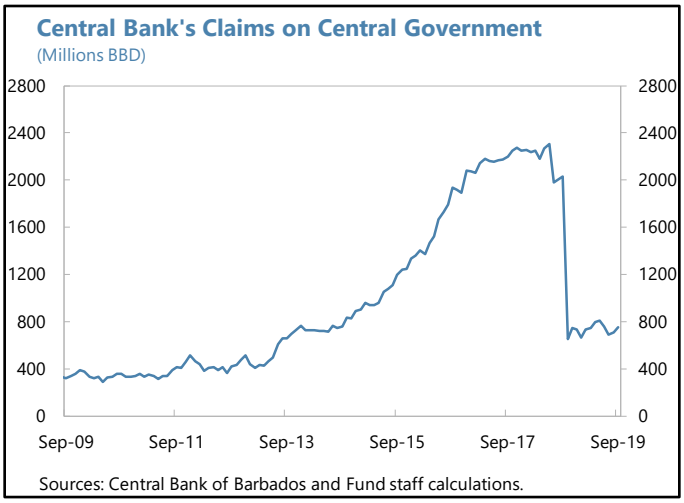
Commercial banks' claims were reprofiled, with no face value reductions (haircuts). Under the restructuring of treasury bills, 85 percent of the claims held by commercial banks were exchanged into 15-year bonds; this maturity extension was critical to reduce gross financing needs and thereby restore debt sustainability. The interest rate on the new instrument is 1 percent for the first three years, 2.5 percent for year 4, and 3.75 percent for the remaining years up to maturity. For the first three years, this entails a significant reduction in interest rates from what prevailed prior to the debt restructuring (about 3 percent). The remaining 15 percent of commercial banks' holdings of treasury bills was converted into new 90-day treasury bills, to be rolled over for 10 years (to meet CBB reserve requirements), with an interest rate of 0.5 percent. This 15 percent carve-out aims to provide banks with a short-term instrument for liquidity management purposes. In addition, banks have excess liquidity parked in the form of excess reserves at the central bank (see text chart) amounting to about BRB$16½ million (or 16 percent of GDP) as a consequence of the liquidity overhang stemming from several years of rapid money supply expansion and continued credit demand constraints resulting in a very low loan to deposit ratio of about 60 percent. Commercial banks' loss on its holdings of government debt amounted to 27 percent in NPV terms (see Table 2)—ensuring an important contribution to public debt sustainability, while at the same time maintaining adequate capitalization of the banking sector.

D. Government Debt Held by Insurers

On the eve of the restructuring, insurance companies held about 7 percent of GDP in government debt (see Table 1), and the sector had large solvency buffers. Government debt held by general insurers was treated differently from that held by life insurers: a part of general insurers' debt holdings were exchanged for debt without a natural disaster clause, as general insurers argued that they would need liquidity in case of a natural disaster, as much as the government would. Conversely, for life insurers, all newly issued instruments contained a natural disaster clause. For both general insurers and life insurers, the maturity of the newly issued debt was in part 15 years, and in part 35 years. A specific agreement was reached with Sagicor, the largest insurer. All of its holdings of government debt were converted into a 50-

year amortizing bond, including a 15-year grace period, with an interest rate of 4 percent during the first 15 years, stepping up to 8 percent over years 25-50 (see Barbados 2018b).[11]

E. Government Debt Held by the Central Bank of Barbados



Owing to significant monetary financing, the Central Bank of Barbados (CBB) acquired a large stock of government debt over the last decade, held mainly in the form of treasury bills, at around 15 percent of GDP on the eve of the debt restructuring. The CBB claims on the central government were restructured in a separate operation, on terms different from those that applied to commercial banks. A nominal haircut (face value reduction) of about 16 percent of GDP was applied to the CBB's claims on the government. The remaining claims were replaced by a portfolio of equally-weighted tradable benchmark treasury notes and debentures with maturities ranging from 5–25 years and a portfolio of 6-month T-bills, priced from the CBB's June 1, 2018 yield curve. This new portfolio contributes sufficiently to the income the CBB requires to meet its expenses. At the same time, the securities provide the CBB with the instruments it requires to implement its monetary policy. The benchmark treasury notes and debentures also help to preserve a domestic government yield curve and facilitate pricing of corporate securities and the return to normal functioning of domestic capital market post-restructuring. The implied NPV loss for the CBB on its holding of government debt was 76 percent (using a discount rate of 7 percent)—see Table 2. After the restructuring, the CBB's capital now stands at minus B$1.6 billion, or a negative 16 percent of GDP. In 2020, a plan to gradually recapitalize the CBB will be developed.

F. Government Debt Held by the National Insurance Scheme

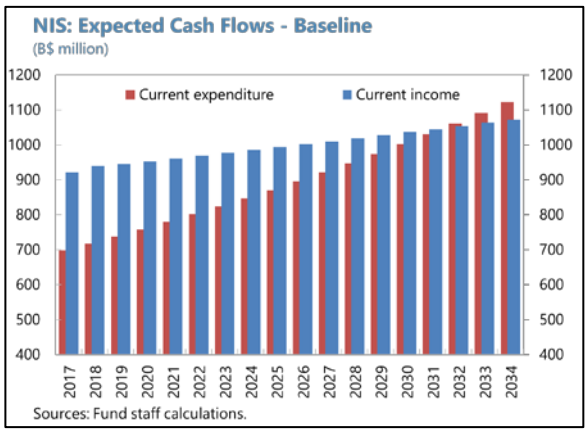
On the eve of the restructuring, the NIS had about B$5 billion (50 percent of GDP) in reserves. Of these, central government securities accounted for B$3.6 billion (36 percent of GDP), almost exclusively in long term securities. The rate of return on both its government and non-central government assets averaged about 7 percent, respectively, before the restructuring.

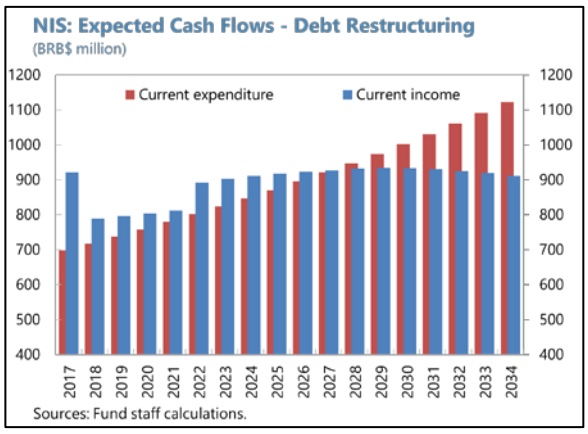
In the debt restructuring, short-term and long-term claims on government were treated differently. The NIS' (small) holdings of treasury bills were converted into the same 15-year

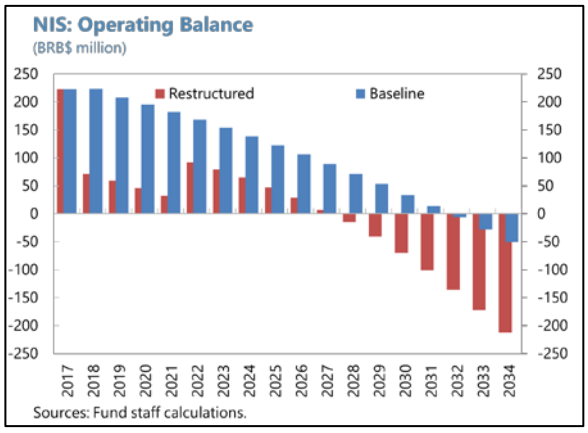
[11] Life companies had an asset-liability structure that favored this type of debt reprofiling. Life companies had excess assets over liabilities for maturity buckets of up to about 5 years while they had excess liabilities at longer maturities. Hence, a lengthening of the maturity structure of their claims, while producing an NPV loss, would also improve asset liability matching. This in turn would free capital and reserves set aside for the mismatch.

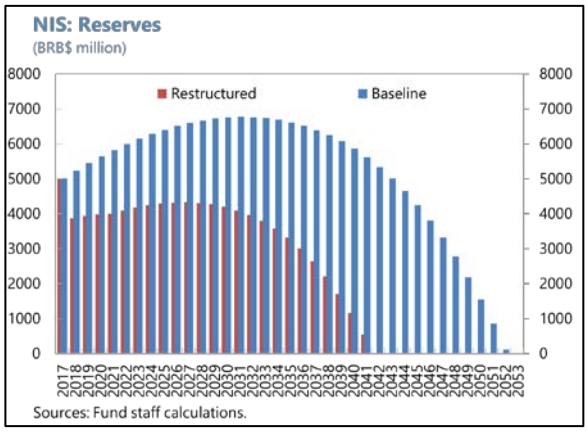
instrument that was used to extend the maturity of commercial banks' holdings of treasury bills, paying 1 percent interest for the first 3 years. Holdings of longer-term government debt were converted into a 25-year bond with a 37.5 percent nominal haircut (about B$1.3 billion), paying 4 percent for the first 3 years, and 8 percent thereafter. This implied an NPV loss for the NIS of 39 percent, using a discount rate of 7 percent (table 2).

As a result of the debt restructuring, NIS liquidity decreased, and its reserves are expected to be depleted 10 years earlier than before the restructuring (see text chart). Before the restructuring, asset cashflows were projected to exceed liability cashflows until 2031-32. At this point, the NIS would have sold reserves to pay for current expenditures and reserves were projected to exhaust in 2052-53. After the debt restructuring, asset cash flows are reduced between 2019-22. The operating balance is expected to become negative around 2027-28, or about 5 years earlier than had been projected prior to the debt restructuring. Lower investment income and the BRB$1.3 billion upfront haircut (13 percent of GDP, or 26 percent of the NIS' reserves) result in reserves being expected to be exhausted around 2040-41, 10 years earlier than expected prior to the debt restructuring. Systemic or parametric pension reform is envisaged in the medium term to strengthen the financial position of the NIS.









VI. Barbados' Debt Restructuring in a Regional and Global Perspective

Barbados' debt restructuring did not entail major innovations, but it did feature several elements that are infrequently encountered in sovereign debt restructurings, in particular (i) the inclusion of treasury bills, (ii) the retrofitted collective action mechanism into domestic debt, and (iii) the inclusion of a state-contingent element in the restructured domestic and external debt—the natural disaster clause. This section puts Barbados' debt restructuring in a regional and global perspective, highlighting selected key characteristics.

A. Perimeter: Including Treasury Bills

Treasury bills are rarely included in debt restructuring operations, with a view to keeping a critical source of short-term credit for the government open, and also to avoid impacting financial markets that may use short-term government paper as collateral, for example the interbank market. Moreover, the stock of government debt held in the form of treasury bills is typically not very large, implying that treasury bills do not need to be restructured for the government to secure significant debt relief (in NPV terms) in its debt restructuring. However, in the case of Barbados, the stock of treasury bills had ballooned to 39 percent of GDP, with commercial banks having converted the bulk of their holdings of government debt into this instrument in the years leading up to the debt restructuring. The government therefore decided that treasury bills had to be included in the restructuring, both to ensure adequate burden sharing in the economic adjustment process, and to reduce gross financing needs.

Barbados experienced no major losses or downsides from the inclusion of treasury bills in the operation. With financial markets relatively underdeveloped, and no meaningful interbank market to start with, not being able to use treasury bills as collateral was not a significant cost in the case of Barbados. Following the debt restructuring, the government of Barbados started running an overall fiscal surplus, and after IMF Executive Board approval of the Extended Arrangement, multilateral banks (the Inter-American Development Bank and the Caribbean Development Bank) swiftly approved policy loans for Barbados; as a result, there was no remaining need for domestic financing following the debt restructuring. With careful stress testing conducted by financial sector supervisors (CBB and FSC), and in the absence of nominal haircuts in the domestic debt restructuring, no financial entity experienced major liquidity or solvency issues on account of the debt restructuring. This in contrast to other cases where treasury bills were included in the restructuring: for example, when Russia restructured its short-term government debt (GKOs) in 1998, this contributed to a severe banking crisis, with a bank run and widespread bank insolvencies (see Das et al. 2012: p. 64).

B. Post-Default vs Pre-Default

Barbados' debt restructuring was post-default—a choice that may have been determined by a very tight timeline, with a new government taking office just a few weeks ahead of large external debt payments falling due; if the government had decided to make these payments, reserves would have fallen to dangerously low levels, covering less than a month of imports.

This sets the Barbados case apart from most of the recent cases in the region, with both Jamaica and Belize repeatedly opting for a pre-default (or preemptive) approach. In their extensive survey over sovereign debt restructuring globally over six decades, Das et al. (2012) count 109 post-default cases, while 77 were preemptive; i.e., globally post-default is slightly more common.

C. Duration of the Debt Restructuring Operation

The operation was announced on June 1, 2018 and wrapped up on December 11, 2019, hence it took 18 months. This was faster than Grenada's 2013-15 operation (which took 2½ years), but slower than Jamaica 2010 or 2013 (in both cases a few months). The average debt restructuring in the Caribbean over the last decade, and not including Barbados' debt restructuring, took 13½ months (see Asonuma et al. 2018, p. 16). Factors that contributed to the duration of the operation include:

(i) **the complexity of the operation**: Barbados undertook a comprehensive debt restructuring, as in the case of Grenada 2013-15, but unlike the two Jamaica operations, which covered domestic debt only; external debt restructuring typically involves a diverse set of creditors, spread geographically, which can make the operation more complicated.

(ii) **relatively quick agreement on an IMF supported program,** and subsequent strong performance under the program, with the timely conclusion of the first and the second EFF review, helped to move the debt restructuring process forward, as this provided assurances to creditors that the government was serious about adhering to its side of the bargain—increasing the primary surplus to 6 percent of GDP, and maintaining this stance for several years thereafter, with both an international (IMF) and a domestic monitoring process in place.

(iii) **domestic administrative capacity** in Barbados may be higher than in the case of Grenada, where it contributed to the long duration of the operation (Okwuokei and van Selm 2017: p. 163).

Duration matters: it is important to keep the process as short as possible, to avoid a negative impact on economic activity. Especially in cases where domestic debt restructuring is an important part of the operation, financial institutions may be hesitant to engage in new investments until it is clear what the impact of an announced debt restructuring operations will be on their balance sheets. Barbados' debt restructuring was successful in keeping the duration of the operation limited, especially the domestic debt restructuring, which was wrapped up in 5 months.

D. NPV Gains

A central objective of any public debt restructuring operation is to help public finances regain a sustainable footing; the NPV gain of the operation is a key indicator. In the Caribbean, in debt restructurings over the last decade, post-default debt restructurings have generally been able to

secure higher NPV gains for the government, in the range of 50-100 percent (Asonuma et al. 2018b: p. 21). In cases where a restructuring of domestic debt takes center stage, NPV gains are typically lower, as meaningful debt relief for the government needs to be weighed against the importance of maintaining financial stability.

The NPV gains realized in Barbados' debt restructuring operation fit into this pattern. The NPV gain on government domestic debt to private creditors was around 30 percent (see Table 2)—a somewhat higher gain for the government than in the 2010 and 2013 domestic debt restructuring operations in Jamaica, which featured NPV gains of around 15-25 percent but lower than the domestic NPV gain in the 2013-15 Grenada operation, at 54 percent (see Asonuma et al. 2018a: p. 83).

Barbados' NPV gain in its external debt restructuring operation is estimated at 44 percent (using the 12 percent discount used by the parties during the debt negotiation process), or 30 percent using the exit yield of 7 percent. This compares favorably to the NPV gains realized in Belize's three pre-default external debt restructurings over the last decade, which each netted NPV gains in the range of 20-30 percent; but it was a bit lower than the gain realized by Grenada in its post-default 2013-15 operation (at 49 percent—see Asonuma et al. (2018b, p. 20)).

E. Natural Disaster Clause

A natural disaster clause was included in the bulk of the new domestic instruments and also in the new external debt instrument, following an approach taken in Grenada's 2013-15 debt restructuring. The trigger used in the two cases are similar, in both cases linked to payouts under the Caribbean Catastrophe Risk Insurance Facility, or CCRIF. A difference is that in Grenada's restructuring, debt payments would be deferred for up to one year after a qualifying event, whereas in the case of Barbados, the clauses allows for the capitalization of interest and the deferral of scheduled amortization falling due over a two-year period. State-contingent instruments have been a component of several sovereign debt restructurings, following the Brady deals from 1989-97 (IMF 2017: p. 20).[12]

F. The Retrofitted Collective Action Mechanism

In Barbados' debt restructuring, the bulk of the instruments to be restructured were issued under domestic law, and these did not contain collective action clauses. Holdout creditors were seen as a risk. To address this, parliament passed a law to retrofit a collective action mechanism into domestic debt. A similar approach was used also in Greece's 2012 debt restructuring (see Zettelmeyer et al. 2012: p. 11): in February 2012, Greek parliament adopted a law that allowed for the restructuring of Greek-law bonds with the consent of a qualified

[12] In 'normal', non-crisis times, use of state-contingent elements in government debt has been limited. In the Caribbean region, an important exception is the state-contingent debt issued under the PetroCaribe arrangement with Venezuela, but Barbados did not participate in this scheme. See IMF (2017: p. 17).

majority. This approach had been suggested in a paper by Gulati and Buchheit (2010), who labeled it a 'Mopping-Up Law' as it aims to deal with hold-out creditors. This approach has some risks, as it could be subject to a legal challenge (Gulati and Buchheit 2010: p. 12)—but with Barbados' 2018 debt restructuring, there are now two recent examples of successful application. As long as such legislative changes pass muster under the country's constitution—including constitutional protections for property rights—they should be valid for debt instruments like those in Barbados; a change in local law is a risk that investors take when buying local-law governed debt instruments (see Buchheit et al. 2020: p. 356).

G. The Role of the IMF

As mentioned above, the newly elected government requested IMF balance of payments support within a week of assuming office, with a call to IMF Managing Director Lagarde on the evening before the public announcement of the debt restructuring (Barbados 2018a: p. 2).

Most, but not all, recent debt restructuring operations in the Caribbean have been conducted in the context of IMF financial engagement, with Belize's three restructurings of its external debt over the last decade as the main exception. Embedding the debt restructuring in a broader economic reform program, supported by the IMF, ensures that the focus of the debt restructuring is on medium and long-term debt sustainability, not just on short-term liquidity gains (Okwuokei and van Selm 2017: p. 158). This may help to reduce the risk of repeated debt restructurings.

Whether or not an IMF member's debt should be restructured is a decision of the member. However, where the Fund has determined that the member's debt is unsustainable, it is precluded from providing further financing unless measures are taken to restructure the debt in a manner that provides for medium-term debt sustainability.

IMF conditionality on the debt restructuring operation

These underlying IMF-supported programs typically entail a form of conditionality related to the debt restructuring, as it is a critical part of a package of measures needed to regain fiscal and debt sustainability, and macroeconomic stability. In some cases, finalization of the debt restructuring is required prior to IMF Executive Board approval of the program (as in Jamaica's 2010 and 2013 debt restructurings, and also Uruguay 2003) while in other cases, conditionality relates to a step towards restructuring (for example Grenada 2014, St Kitts and Nevis 2012, and also the Dominican Republic in 2005). Different approaches have been considered appropriate in different cases (see IMF 2015: p. 56). In post-default cases, such as Barbados 2018, program conditionality has typically focused on intermediate steps towards debt restructuring, as opposed to the finalization of the debt restructuring (IMF 2015: p. 57). A key consideration is to find a balance between making sure that program financing assurances are in place and the debt restructuring delivers the required debt relief, while avoiding providing creditors with undue leverage.

Lending into arrears

From June 1, 2018 onwards, Barbados started to accumulate arrears on its debt to external commercial creditors; IMF lending in October 2018 (approval of the Extended Arrangement), June 2019 (first EFF review) and December 2019 (second EFF review) took place on the basis of the IMF's Lending into Arrears (LIA) Policy, as the authorities' discussions with external creditors had not been completed at that point. Under this Policy, the Fund can provide financing to a member with sovereign arrears to external private creditors if prompt Fund support is considered essential for the successful implementation of a member's adjustment program, and the member is making good faith efforts to reach a collaborative agreement with creditors (see IMF 2015: p. 51). The LIA Policy is used in post-default debt restructuring cases, where arrears have already arisen (e.g., in Grenada in 2014, at the time of the Extended Credit Facility approval), St. Kitts and Nevis in 2011 (approval of the Stand-By Arrangement, or SBA), and the Seychelles in 2008 (also an SBA). In the case of Barbados, the LIA Policy allowed the Fund to provide vital balance of payments support at a time when reserves where very low, at just 5-6 weeks of reserve coverage, thereby helping to restore confidence in the country's macroeconomic framework.

VII. Lessons Learned and Conclusion

Barbados' 2018-19 debt restructuring has made an important contribution to restore debt sustainability. It has reduced public debt and put it on a clear downward trajectory. To ensure that it stays on that path, sustained prudent fiscal policy will be required. Debt restructuring can work as a policy response to an exceptional situation—while repeatedly restructuring the same debt is detrimental to market development and access, and to government credibility (see Okwuokei and van Selm 2017: p. 168).

Barbados' debt restructuring also provides important evidence that rarely used approaches, such as the inclusion of treasury bills and a retrofitted collective action mechanism, can make an important contribution depending on country specifics, and with the support of strong financial and legal advice. The collective action clauses included in Barbados' Eurobonds were similarly important to avoid holdout creditors.

In an age of climate change, the inclusion of natural disaster clause in the bulk of Barbados' new public debt instruments is a critical element of the country's financial resilience. While Barbados appears less vulnerable to natural disasters than other Caribbean states (see IMF 2019b), climate change is likely to increase its vulnerability, and a weather-related event could have a major impact on its economy.

The success of Barbados' underlying economic reform program BERT also contains important pointers for a successful adjustment effort, including strong ownership and the establishment of a domestic monitoring team with broad participation. Other successful reform efforts in the region, including Jamaica from 2013-2019 and Grenada's 2014-17 IMF-supported program, also used this approach.

Finally, successful debt restructuring is a balancing act. The right balance between fiscal adjustment and debt restructuring, and between improving public finances while maintaining financial sector stability, needs to be found. Early results from Barbados' adjustment program are encouraging and indicate that it has been able to find the right balance. However, reducing public debt to prudent levels—the targeted 80 percent of GDP by FY2027/78 and 60 percent by FY2033/34—will require sustained efforts, not only by maintaining a cautious fiscal policy, but also by aggressively exploiting opportunities to increase growth.

VIII. REFERENCES

Asonuma, M.X. Li, M.G. Papaioannou, S. Thomas, and E. Togo, 2018a, "Sovereign Debt Restructurings in Grenada: Causes, Processes, Outcomes, and Lessons Learned," Journal of Banking and Financial Economics, Vol2(10), pp.67–105.

Asonuma, T., Michael G. Papaioannou, E. Togo, and B. van Selm, 2018b, "Belize's 2016-17 Sovereign Debt Restructuring—Third Time Lucky?" IMF Working Paper No. 18/121. Washington: International Monetary Fund.

Asonuma, T., and C. Trebesch, 2016, "Sovereign Debt Restructurings: Preemptive or Post-default," *Journal of the European Economic Association*, Vol.14(1), pp. 175–214.

Barbados (2018a), Ministry of Finance and Economic Affairs, Press Release, June 1, 2018.

Barbados (2018b), Ministry of Finance and Economic Affairs, Press Release, September 7, 2018.

Barbados (2018c), Ministry of Finance and Economic Affairs, Press Release, October 15, 2018.

Barbados (2019a), Ministry of Finance and Economic Affairs, Press Release, May 21, 2019.

Barbados (2019b), Creditor Update, June 11, 2019.

Barbados (2019c), Ministry of Finance and Economic Affairs, Press Release, October 18, 2019.

Barbados (2019d), Ministry of Finance and Economic Affairs, Press Release, November 5, 2019.

Barbados (2019e), Ministry of Finance and Economic Affairs, Press Release, November 26, 2019.

Barbados External Creditor Committee (2018a), "Notes IMF Agreement, Expresses Disappointment with Process", Boston and New York, September 11, 2018.

Barbados External Creditor Committee (2019a), "Ready to Continue Discussions with Barbados to Resolve the External Commercial Debt Default", Boston and New York, May 29, 2019.

Barbados External Creditor Committee (2019b), "Negotiations to Reach Consensual Resolution is the Best Path to Resolve the External Commercial Default", Boston and New York, June 14, 2019.

Barbados External Creditor Committee (2019c), Government of Barbados Launches Exchange Offer to Resolve the External Commercial Default, Boston and New York, November 6, 2019.

Buchheit, L., G, Chabert, C. DeLong, and J. Zettelmeyer (2020), "The Restructuring Process", in S. Ali Abbas, A. Pienkowski, and K. Rogoff eds, *Sovereign Debt: A Guide for Economists and Practitioners*, Oxford, pp. 328-364.

Das, U., M. Papaioannou, and C. Trebesch, 2012, "Sovereign Debt Restructurings 1950–2010: Literature Survey, Data, and Stylized Facts", IMF Working Paper No. 12/203. Washington: International Monetary Fund.

Gulati, M, and L.C. Buchheit (2010), "How to Restructure Greek Debt", *Duke Law Working Paper* 47.

IMF (2015), "The Fund's Lending Framework and Sovereign Debt—Further Considerations-Annexes", IMF Policy Paper April 2015.

IMF (2017), "State Contingent Debt Instruments for Sovereigns", IMF Policy Paper May 2017.

IMF (2018a), "Barbados: Staff Report for the 2017 Article IV Consultation", IMF Country Report 18/133, Washington, D.C.

IMF (2018b), "Barbados: Request for an Extended Arrangement under the Extended Fund Facility", IMF Country Report 18/290, Washington, D.C.

IMF (2019a), "Barbados: First Review Under the Extended Arrangement and Request for the Completion of the Financing Assurances Review and Modification of Performance Criteria", IMF Country Report 19/182, Washington, D.C.

IMF (2019b), "Barbados: Second Review Under the Extended Arrangement and Request for the Completion of the Financing Assurances Review and Modification of Performance Criteria", IMF Country Report 19/XXX, Washington, D.C.

Jahan, S. 2013. "Experiences with Sovereign Debt Restructuring: Case Studies from the OECS/ECCU and Beyond," in Schipke, A., A. Cebotari, and N. Thacker, eds. The Eastern Caribbean Economic and Currency Union: Macroeconomic and Financial System. Washington: International Monetary Fund.

Okwuokei, J., and B. van Selm, 2017, "Debt Restructuring in the Caribbean—the Recent Experience," in Unleashing Growth and Resilience in the Caribbean, edited by T. Alleyne, I. Otker, U. Ramakrishnan and K. Srinivasan. Washington, DC: International Monetary Fund.

Robinson, M., 2015, "Assessment of Debt Restructuring Operations in Commonwealth Small States", The Commonwealth Economic Paper 94.

Zettelmeyer, J., C. Trebesch, and M. Gulati, 2013, “The Greek Debt Restructuring: An Autopsy”, Peterson Institute for International Economics Working Paper 2013-8.

Annex 524

"Dominica: Disaster Resilience Strategy", IMF Country Report 21/182,
International Monetary Fund, August 2021

INTERNATIONAL MONETARY FUND

IMF Country Report No. 21/182

DOMINICA

DISASTER RESILIENCE STRATEGY

August 2021

The Disaster Resilience Strategy has been prepared by the Government of Dominica in broad consultation with stakeholders and development partners, including the staff of the IMF and the World Bank. It describes the macroeconomic, structural, and social policies being pursued by the government to build resilience against natural disasters and the associated financing needs. This document for Dominica is being made available on the IMF website by agreement of the member country as a service to users of the IMF website.

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Government of Dominica

February 2021

DOMINICA: DISASTER RESILIENCE STRATEGY

EXECUTIVE SUMMARY

Context. Dominica is among the countries most vulnerable to natural disasters and climate change. During 1997-2017**,** it was the country with highest GDP losses to climate-related natural disasters and ranked in the top 10 percent among 182 countries for climate-related fatalities. Following a huge devastation, owing to back-to-back major storms in 2015 and 2017, Dominica announced its intention to become the first disaster resilient nation. In 2019, it was agreed with the government that the Fund, in consultation and collaboration with other development partners, would provide support for preparing a Disaster Resilience Strategy (DRS), a comprehensive plan including policies, cost, and financing to build resilience against natural disasters.

Recent progress. Following hurricane Maria in 2017, with estimated damage of 226 percent of GDP, there was a significant increase in public investment to rebuild public infrastructure resilient to natural disasters, financed mainly with Citizenship by Investment (CBI) revenues. In addition, the government developed a strategy for disaster preparedness and response with itemized investments and policies and estimates of resource requirements. The Covid-19 pandemic caused significant economic and social hardship owing to Dominica's dependence on tourism receipts, which plummeted in the wake of the pandemic leading to a sharp decline in tax revenues. At the same time, Dominica was forced to increase and reprioritize public spending to address immediate health needs and make transfers to the unemployed. As a result, the fiscal and debt situations came under further strain leading to changes in plans and priorities, because of which a draft DRS prepared just ahead of COVID-19 had to be modified.

Disaster Resilience Strategy (DRS). The DRS is an umbrella document, which draws upon existing government plans and proposals, elaborating a strategy for Dominica to build resilience against natural disasters that is integrated into a credible macro-fiscal framework. It is organized around three pillars: structural resilience, financial resilience and post-disaster resilience. The total cost of transforming Dominica into a disaster-resilient state over a twenty-year period is estimated at US$2.8 billion (five times Dominica's GDP). Model-based estimates calibrated to the Dominica economy indicate that the return to resilient investment outweigh the cost in the long term by supporting higher private investment and employment. However, debt would increase in the medium term as the cost of resilient investments and policies accrue up-front, but returns materialize only in the medium to long-term with a gradual increase in resiliency, which in the DRS takes two decades.

The support of the international community is an imperative. Dominica would be unable to finance the cost of building resilience without concessional financing from the international community. Integration of the cost and returns from DRS policies and

investments indicates an annual financing gap of 8 percent of GDP, after incorporating a phased fiscal consolidation of 5.7 percent of GDP anchored by measures which have been fully identified. Attaining resilience with fiscal and external sustainability crucially depends on an increase in donor grants of about US$63 million per year, 3-4 times above recent levels.

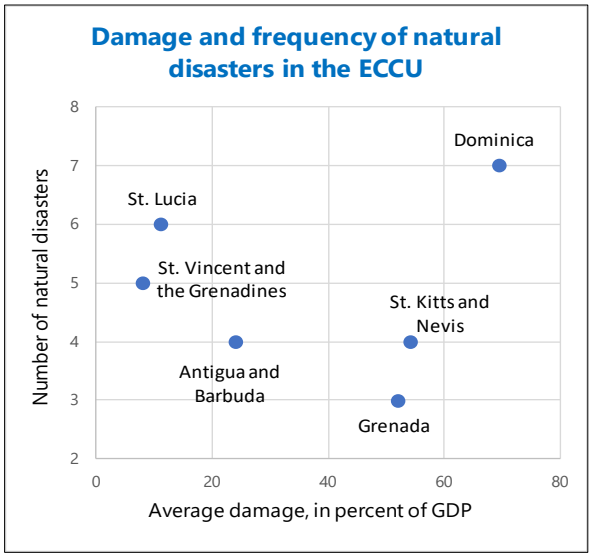
Prepared by the Dominica Ministry of Finance, in consultation with the Climate Resilient Execution Agency of Dominica (CREAD), with support from the International Monetary Fund. The report benefitted of comments from other partners, including the World Bank, and the Caribbean Development Bank.

CONTENTS

DOMINICA: DISASTER RESILIENCE STRATEGY

A. Introduction

1. Dominica is among the countries most vulnerable to natural disasters and climate change. Due to its location within the Atlantic Hurricane Belt, weather events such as high winds, excess rainfall, and hurricanes, often of extreme intensity, have a significant adverse impact on the population and the economy. According to the Climate Risk Index, Dominica was the country with highest GDP losses to climate-related natural disasters during 1997–2017, and among 182 countries, was in the top 10 percent of climate-related disaster fatalities.[1] In 2017, Hurricane Maria devastated the island with an estimated loss and damage of 226 percent of GDP, following soon the heels of damages from Hurricane David (1979) and Tropical Storm Erika in 2015 (Annex 1). The hurricanes caused severe infrastructure damage in the transportation, housing, tourism and agriculture sectors. Moreover, due to its geological conditions, Dominica is also prone to earthquakes and volcanic hazards (Table 1).



Source: Climate Risk Index

Table 1. Dominica: Economic Impact of Natural Disasters
(in US dollars million)

	Hurricane Event	Loss	Earthquake	Loss
Most severe	2017 (Maria)	1316	2004	19
Second-most severe	1979 (David)	523	1839	7
Third-most severe	2015 (Erika)	483	1906	7

Source: CRIFF, Dominica Country Risk Profile

2. Against this backdrop, the government of Dominica has set the objective of becoming the world's first climate resilient country. This requires elaborating a comprehensive strategy that internalizes the macroeconomic impact of various types of disaster-related risks and the costs and returns of investment in building resilience to natural disasters in a credible macro-fiscal framework.

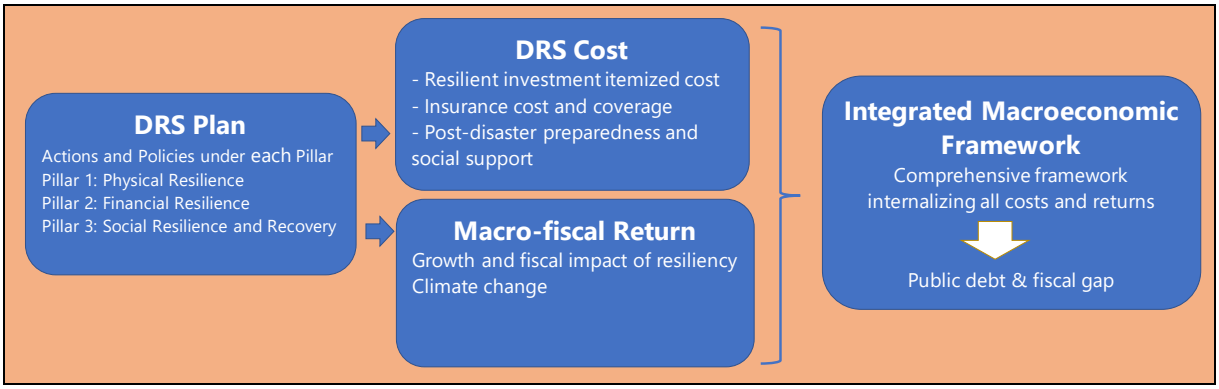
3. The rest of the Disaster resilience Strategy (DRS) is organized in five sections. Section B specifies the three Pillars around which the DRS is organized. Section C presents the DRS plan, including references of progress made in each of the Pillars and the status of the plan going forward. Section D provides the cost of the three Pillars and section E the evaluation of

[1] Global Climate Risk Index 2017/2018 https://germanwatch.org/en/16046

macroeconomic and fiscal implications of DRS investment and policies. Section F integrates all costs and macroeconomic effects into a comprehensive macroeconomic framework that specifies the government plan to create fiscal space for a DRS and estimates financing needs and debt implications. Section G presents some considerations on the way forward, with emphasis on need for international cooperation to address climate change and support disproportionally affected small states such as Dominica.

B. Pillars of a Disaster Resilience Strategy

4. The DRS integrates the costs and returns from investment to build resilience against natural disasters in a consistent macroeconomic framework. This enables identification of financing needs and public debt sustainability implications, critical for planning, prioritization, and identification of financing sources. It can help coordinate development partners' financial and technical assistance and catalyze donor support.



5. The DRS is organized around three Pillars:[2]

- **Pillar I. Structural resilience**. Specifies appropriately chosen and prioritized investments that limit the impact of disasters, including "hard" policy measures (e.g., upgrading infrastructure, developing irrigation systems, ensuring resiliency of roads, bridges, buildings and public service infrastructure), and "soft" measures (e.g. early warning systems, customizing building codes and zoning rules).

- **Pillar II: Financial Resilience.** Includes the use of fiscal buffers and pre-arranged financial instruments to manage recovery and reconstruction costs in the wake of a disaster. Even with resilient structures, the impact of disasters can be partially contained but not eliminated. Time-to-build constraints, and immediate post-disaster financing needs for social support and rehabilitation of key services and infrastructure require a comprehensive insurance framework for rapid access to financing.

[2] See https://www.imf.org/en/Publications/Policy-Papers/Issues/2019/06/24/Building-Resilience-in-Developing-Countries-Vulnerable-to-Large-Natural-Disasters-47020.

- **Pillar III: Post-Disaster Resilience.** Specifies detailed action plans, emergency protocols, and community awareness and preparation to coordinate the response of the different government agencies and the general population in the wake of a disaster. The emergency response plan clarifies institutional arrangements, and distribution of responsibilities to rapidly mobilize financial and physical resources and contain disruption of critical public services including water, electricity, medical services, schools, citizen security, and financial services.

C. Recent Progress on the DRS Pillars and Plan

6. For years, Dominica has been planning and adopting policies to strengthen natural disaster adaptation, mitigation, and risk management. The country is part of the Pilot Program for Climate Resilience (PPCR)[3], a targeted program of the Climate Investment Fund. Under the PPCR, Dominica developed the Low Carbon Climate-Resilient Development Strategy, including the Strategic Program for Climate Resilience (SPCR), a five-year plan launched in 2012 to become a climate-resilient and low-carbon economy, as well as to address climate change impact on agriculture, food security, infrastructure and vulnerable communities. The National Disaster Plan, which includes policy guidance on prevention, mitigation and response, was developed in 1998 and revised in 2006. These legislative and policy efforts were complemented by the National Climate Change Adaptation Policy (2002) and the Disaster Preparedness Plan for the Agriculture Sector (2006). The National Resilient Development Strategy (NRDS), launched in 2018, integrates climate resilience and disaster risk management into the national growth and development planning framework. Dominica's Climate Resilience and Recovery Plan (CRRP), approved in early 2020, operationalizes the NRDS with itemized investments and policies, and estimates of resource requirements (Annex II).

7. Devastation after tropical storm Erika and hurricane Maria heightened the sense of priority for natural disaster preparedness among all Dominicans. After these storms there was a significant increase in the Public Sector Investment Plan in the annual government budget to rebuild public infrastructure with resiliency to natural disasters, under the premise of "building-back-better". This has been done in consultation with technical experts, and development partners, including comprehensive analysis of exposure and vulnerability, resulting in several feasibility studies in different areas of disaster resilience. Progress has also been made with in-depth analysis of the topography, allowing for the identification of vulnerable areas.

8. The Climate Resilience Execution Agency of Dominica (CREAD) is making progress to estimate the total cost of resilience structures and policies. CREAD was created in 2018 under the Prime Minister's mandate to make Dominica the first climate resilient nation. It is a DFID (now Foreign, Commonwealth & Development Office)-funded agency managed and staffed by technical experts with a mandate to identify, plan, cost, and manage the execution of large resilience projects and policies. It is supporting the Ministries to develop a comprehensive resilience plan. The plan is

[3] The Pilot Program for Climate Resilience (PPCR), is one of three targeted programs that make up the Strategic Climate Fund (SCF) of the Climate Investment Funds (CIFs). It supports national governments in integrating climate resilience into development planning across sectors and stakeholder groups. It also provides funding to put these plans into action and pilot innovative public and private sector solutions to pressing climate-related risks.

organized in 10 priority areas, guided by the overarching objectives of building strong communities, a sustainable economy, and well-planned durable infrastructure. With those objectives, strategic actions in different sectors have been identified, with prioritization based on cost and impact of the strategies (Text Table).

Top Ten CRRP Initiatives

(1) Enhanced Social Safety Net
(2) Community Emergency Readiness Initiative
(3) Resilient Housing Scheme
(4) Koudmen Dominik - National Volunteer Initiative
(5.i) Resilient Dominica Physical Plan
(5.ii) Hydrology Survey and Flood/Landslide Risk Management
(5.iii) Resilient Modern ICT Network
(6) Innovative Approach to Insurance
(7) Dominica as a Global Center for Agricultural Resilience
(8) Revised PSIP allocation process and enhanced public sector performance management framework
(9) Data Center for Resilience Decision Making
(10) "ResilienSEA" in the Blue Economy Investment Fund

Source: CRRP.

Pillar I: Structural Resilience

9. Physical resilience requires extensive investment in infrastructure. Dominica's mountainous and rugged landscape creates engineering challenges that require significant financial and human resources. Given the severity of hurricane Maria, initial efforts focused on rehabilitation, reconstruction, with resiliency building now underway. The long-term plan is to expand and upgrade the existing infrastructure, so it is resilient to natural disasters. The early stage of this plan was detailed and costed in the Public Sector Investment Plan (PSIP) of the FY2019/20 budget, and new investments and policies are being identified and costed by CREAD and the government ministries.

Recent Progress and Policies

10. The destruction brought by tropical storm Erika and hurricane Maria required extensive rehabilitation and reconstruction of the road network. A total of 19 bridges and 15 sections of damaged roads were repaired, and several sections were re-built for resilience including slope retention walls and expansion to increase capacity and facilitate movement of large construction machinery. These included rehabilitating Goodwill Road, one of the main roads in Roseau, reconstructing the E.C. Loblack, Elmshall and York valley bridges, and building the retaining wall at Riviere Cyrique. Financing was available with large deposits accumulated under the CBI program.

11. The reconstruction of air and seaports included new structures to ensure resilience and quick return to operations in the event of a disaster. The reconstruction and rehabilitation cost of Douglas Charles Airport after Erika was EC$48 million, under the "building back better" principle.

12. River dredging, key to mitigating flooding, required large spending which needs to be periodically redone in light of strong and frequent rainfall. Large levels of siltation and debris in the higher parts of the rivers exacerbate the risk of flooding. The mountainous terrain coupled with large number of rivers, creates significant flooding risk. Maria caused unprecedent flooding in several areas with overflown rivers and high sea swells. Between 2015-2019, the government allocated US$65 million (12 percent of GDP) to dredge rivers in 11 different locations. The dredging along with other river protection measures such as building river walls and river draining were funded with CBI resources. To minimize this cost and contain possible adverse environmental implications of recurrent dredging, a watershed management, watershed planning, and flood risk management will be conceptualized and integrated into the resilience strategy.

13. Progress has also been made to increase the resilience and sustainability of the energy sector. The country's power distribution network was severely disrupted after Maria, with an estimated damage of 75 percent of its capacity. Damages also included disruption of a significant portion of hydro-generation, and extensive damage to the electric infrastructure of private homes and businesses. After Maria, the Dominica Electricity Services Ltd. (DOMLEC) made investments to restore generation capacity and the distribution network, with electricity becoming available in over 95 percent of the island a year after the storm. Capacity constraints necessitated more time to ensure safe connections of homes and businesses that had been damaged, but steady progress allowed re-connection of all buildings.

14. Housing rehabilitation and reconstruction has been significant. Public expenditure to support housing construction and repair has increased steadily in recent fiscal years, totaling 15 percent of GDP through 2017-19. The government rehabilitated 7,000 homes in the past 5 years, around a quarter of the housing stock. In addition, the towns of Petite Savanne and Dubique were relocated to non-vulnerable areas.

15. Government polices also addressed resilience of agriculture and fisheries, which are particularly vulnerable and of social importance. In the agriculture sector, projects have been aimed at increasing food production and security, specifically banana, coffee, cocoa plantations, and the modernization of traditional crops (cassava, touloma, bay leaf, herbs and spices). Support to farmers also included restoration of irrigation systems and land and soil management, as well as projects to increase diversification into root crops, more resistant to natural disasters. For the livestock industry, there are ongoing projects for the operationalization of the national abattoir and support of the small ruminant industry.

16. The rehabilitation of access roads for agriculture is also a priority in the short and medium terms. Recently, the government launched the 5-year World Bank Emergency Agriculture Livelihoods and Climate Resilience Project (US$25 million), to contribute to restoring agricultural livelihoods and enhancing climate resilience of farmers and fishers affected by Hurricane Maria. This project aims to invest in: (i) the adoption of new technologies and use of climate-smart practices for increasing diversification and climate resilience in crop, livestock, and fisheries sectors;
(ii) reconstruction and climate proofing of key agriculture infrastructure, including buildings, training

facilities, propagation centers, eco-trails and irrigation systems; and, (iii) restoration of forests and vulnerable watershed areas. The project will also assist in strengthening the policy and institutional frameworks to facilitate the implementation of priority climate change measures and the mainstreaming of climate change activities into national, sectoral and community planning/development for the sectors.

The DRS Plan

17. Road network. The road network plan includes: i) revision of road standards; ii) planning and design of the road network considering mapping and vulnerability assessments; iii) realignment of existing roads to minimize flooding and land slippage; iv) improvement of slope stability, by adjusting side slopes, benching and retaining structures; and v) adequate drainage along and through the roads. These strategies will be complemented by regular road maintenance, proven to be an effective way to reduce the impact of natural disasters.

18. Air transport and connectivity. Resiliency of air communications requires alternative options and the capacity to operate larger airplanes typically used to deploy food and medicine supplies and relief structures for shelter. The existing airport will continue to benefit from investment and dredging of adjacent rivers, which have already proved key during hurricane Maria. In addition, albeit not formally part of the resilience plan, the government is planning to build a new international airport in the north-eastern part of the island as an alternative connection point with capacity to operate larger airplanes. Collateral benefits will include support to growth in the tourism sector with enhanced connectivity at lower cost.

19. Sea port. The government is planning the construction of a new seaport with capability for transport and tourism services. Improvement in sea port capacity is critical to provide additional and more resilient structures for uploading and storage—the capacity of the existing port was completely exceeded with the large inflow of imports for reconstruction, food supplies, and restoking after hurricane Maria, which resulted in logistical problems and delayed recovery.

20. Flood prevention. River dredging and reinforcement of riverbanks and hillsides to mitigate flooding risk will remain a recurrent activity. This activity implies significant cost also outside natural disaster events because of abundant and frequent rainfall.

21. Energy. To make the electrical grid more resilient, DOMLEC is preparing a plan to invest in underground transmission and distribution lines in urban centers, increase the penetration of renewable energy, and establish mini grids for isolated communities. The construction of a new 7MW geothermal electricity plant will replace most diesel generation needs, lowering electricity prices, and reducing carbon emissions significantly—the island will eliminate carbon emission except during peak demand periods, with diesel generation becoming a backup system. The project, part of the country's Low-Carbon strategy, will be implemented by the Dominica Geothermal Development Company Ltd, and is financed by the International Development Association (IDA), the Clean Technology Fund (CTF), and grants from the UK's Department for International Development. It is benefitting from technical assistance of the Government of New Zealand and the Agence Française

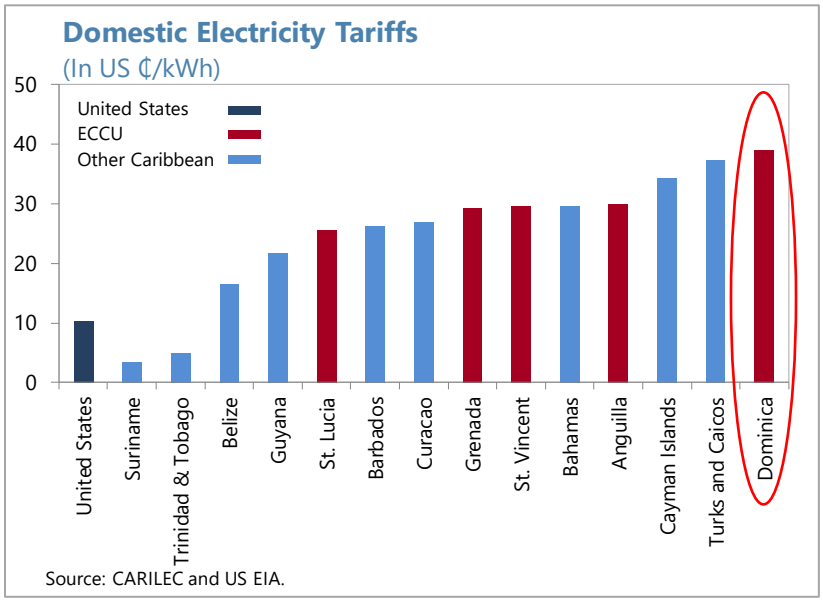
de Dévelopement. In addition, the government launched the Sustainable and Resilient Energy Plan which outlines the future of electricity generation with secure, affordable, resilient and renewable sources (Box 1).

Box 1. Dominica: Making the Energy Sector Disaster Resilient

As part of Dominica's goal to become the first climate-resilient nation in the world, CCI and the Government of Dominica, DOMLEC, CREAD, and other technical partners developed a Sustainable and Resilient Energy Plan (S-REP). The Cabinet officially endorsed the S-REP outlining four energy priorities: 1) cost-efficient generation; 2) increase target share of renewable sources (hydro and geothermal would cover the bulk of needs); 3) improve the reliability of the electrical grid; and 4) significantly upgrade the resilience of homes and buildings in all towns and communities.

The S-REP targets: i) 90 percent of electricity generated by renewable energy sources by 2029; ii) reduction in the annual cost of diesel fuel by 94% by taking advantage of geothermal resources and projects; and iii) a 44% reduction in the total cost of electricity generation between 2020 – 2038.

These targets, if met, could yield significant dividends in terms of competitiveness and growth if the reduction in electricity cost generation is passed to consumers and businesses, especially considering that Dominica is one of the countries with highest electricity cost in the world.

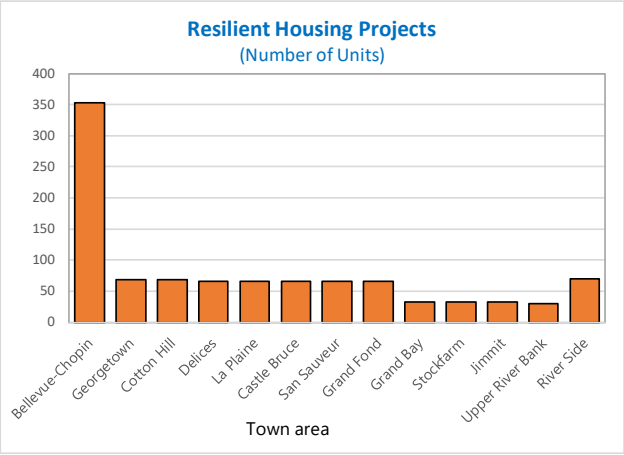


22. Health. A new hospital with significant upgrade of medical services will be constructed. After hurricane Maria the project has been revised for resiliency to natural disasters, including in terms of structure, energy self-reliability, and preparedness to respond in case of a disaster emergency. The project has an estimated cost of U$S300 million. Financing and construction will be provided in the form of a grant by the government of China.

23. Housing. There are several ongoing housing projects, located in the East Coast (5), the West Coast (2) and Roseau City (2). The projects have been designed for disaster resiliency, using modern structures specifically designed to withstand hurricanes and seismic shocks; reinforced concrete

walls and roofs; resistant glass windows; shelters with water and food supplies; and solar water heating structures.

- A significant share of resilient housing has been constructed or is at an advanced stage, and numerous finished units are already inhabited. Construction of near 1000 new homes has been possible with financing from the CBI program revenues. The government is targeting the construction of 5,000 new homes resilient to natural disasters, including shelter structures.



Source: Housing Dominica

- The World Bank approved the Housing Recovery Project ($40 million) designed to contribute to the recovery of housing for households affected by Hurricane Maria; improve the application of resilient building practices; and ensure resiliency of homes constructed under the loan program.
- The development of the housing sector in the medium term integrates planning for natural disasters, as part of the NRDS. The ongoing revision of building codes, with technical support from the OECS, is essential in making the housing sector more resilient, with strong enforcement commitment by the government.
- A new National Shelter Sector Strategy has been prepared.
- The Dominica National Bank, in coordination with the government, will consider financing mechanisms to incentivize middle-income households to retrofit their homes to be hurricane resistant. Government transfers to support rehabilitation and reconstruction of private homes after disasters will include resiliency requirements, including for example on roof construction and reestablishment of public services, particularly electricity. The government is also committed to upgrade insurance sector regulation and supervision to ensure reliable coverage of homes and businesses in case of a natural disaster.

24. Zoning and land use. The National Land Use policy launched in 2014 will be revised to incorporate zone plans identifying high-risk areas for housing development. Remaining communities in vulnerable areas will be resettled. The government will finalize preparation of disaster risk maps indicating permitted areas for new construction and related infrastructure needs. Hazard, vulnerability and risk information will be required to incorporate risk into land use decision-making. To this end, clear definition of roles in the process of generation of disaster risk knowledge will be developed, along with training and capacity building and development of standards and guidelines to prepare hazard, vulnerability and risk studies.

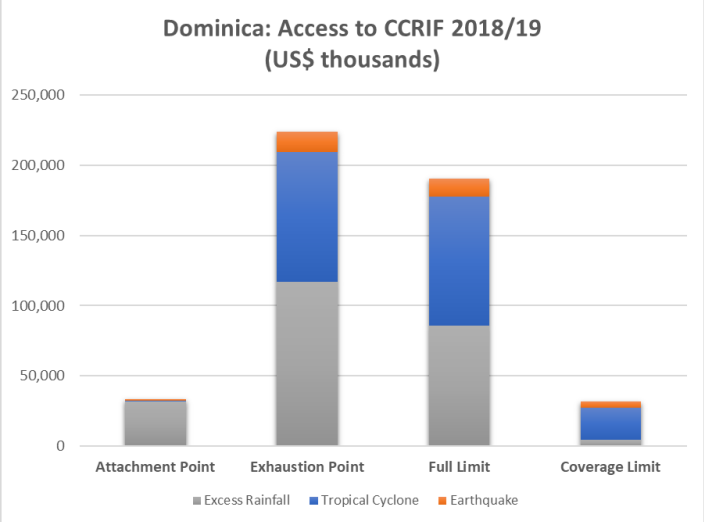
- Including hazard and risk information in urban plans, building standards, and protocol for the issuance of permits is crucial. This may require the strengthening of the Physical Planning Division and other institutions as well as a high level of institutional coordination.
- Dominica has developed land use and development plans that are applied voluntarily. The development of the required normative frameworks to enforce the use of the plans, to define roles and responsibilities, and to establish controls is key. Building of technical and operative capacity to transform the plans into practical instruments in the territory is also necessary.

25. Water and sanitation. The Dominica Water and Sewerage Company Ltd., the provider of water and sewage services, is preparing a strategic development plan that will address key factors related to resiliency to disasters of water supply, including analysis of risks and hazard to infrastructure performance, and operational and maintenance practices.

Pillar II: Financial Resilience

Recent Progress and Policies

26. Dominica has been purchasing natural disaster insurance from the Caribbean Catastrophe Risk Insurance Facility (CCRIF), albeit below desirable levels due to high cost. In FY 2018/19 the government of Dominica purchased coverage for Tropical Cyclone (TC), Earthquake (EQ) and Excess Rainfall (ER). The gross premium was paid to CCRIF by the Canadian government, including an increase in coverage with premium of $1.5 million, up from $1 million in the previous year. Coverage for Tropical Cyclone was augmented, implying an increase of the risk ceding percentage from 21 to 25 percent. Earthquake risk premium and coverage more than doubled (text table and chart).



Coverage under CCRIF Insurance

	Tropical Cyclone	Earthquake	Excess Rainfall
Attachment Point (years)	10	50	5
Exhaustion Point (years)	100	175	25
Ceding Percentage	25%	33%	5%
Gross Premium (US$)	$885,263	$100,000	$531,690

27. CCRIF payouts have been critical to finance post-disaster need and rehabilitation cost, especially considering its fast disbursement, just two weeks after a disaster. Over US$23 million in payouts have been received thus far, the majority following hurricane Maria (text table). However significant, the payouts have been vastly below the post-disaster need, and not always aligned with the extent of damage considering its parametric nature.

CCRIF Payouts to Dominica

Event	Payout (US$)
Earthquake, 29 November 2007	528,021
Tropical Storm Erika, 27 August 2015	2,402,153
Tropical Cyclone Maria, September 2017	20,303,822
Total	**23,233,996**

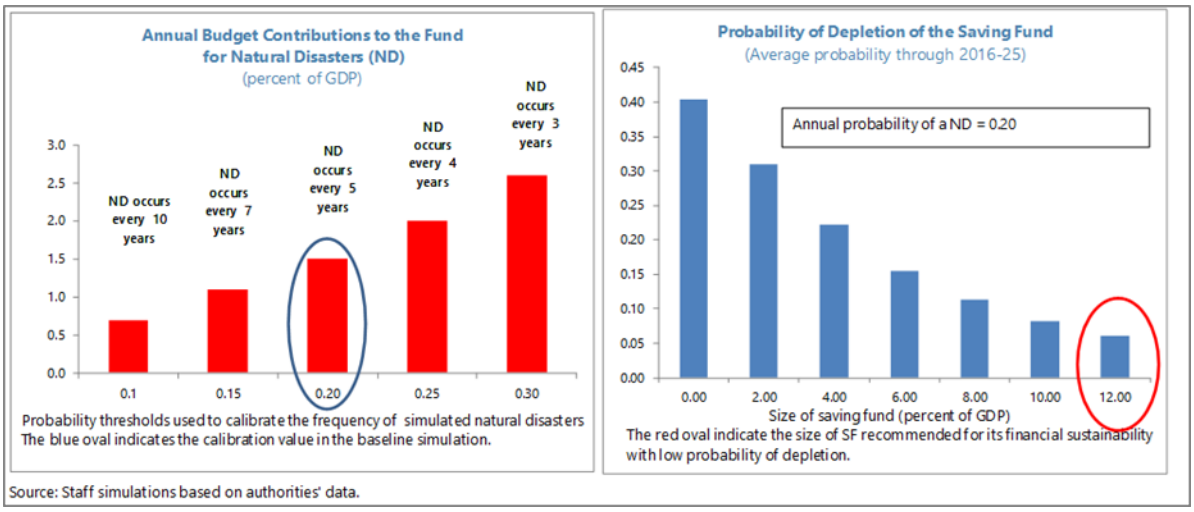
DRS Plan

28. Dominica plans to implement a comprehensive insurance strategy with a risk layering framework. Insurance layers' coverage will be decided to efficiently address risk and damage for an incremental range of disaster intensities, targeting coverage of 99 percent of estimated fiscal costs related to natural disasters[4]:

(i) Layer 1. Small and medium disasters. The first layer will be used to cover losses from small and medium but more frequent natural disasters. This layer will include a savings fund for self-insurance, financed by CBI revenues for start-up cost, plus annual budget contributions to make it sustainable. Given large financing needs for reconstruction after Hurricane Maria, the start-up cost of Layer 1 would also consider contingent credit lines from development partners. Simulation analysis accounting for disasters' frequency, intensity and the dynamic responses of output and government revenue and expenditure indicates that a saving fund of 12 percent of GDP plus annual savings of 1.5 percent of GDP in years with no natural disaster would be sufficient to cover the expected fiscal cost of rehabilitation and reconstruction (text charts).[5]

[4] Calculated based on a Monte Carlo experiment simulating the impact of natural disaster shocks on output and fiscal accounts. It includes related explicit cost, implicit contingent liabilities, and budget reallocation to create fiscal space for priority rehabilitation and reconstruction expense.

[5] Based on a Monte Carlo experiment that simulates the impact of natural disaster shocks on government revenue and expenditure. The simulation accounts for re-prioritization of investment towards rehabilitation and reconstruction activities after a natural disaster. See 2018 ECCU regional consultation report.



(ii) Layer 2. Large disasters. This will be covered with high access under (CCRIF). This implies a change relative to recent CCRIF access choices, which were more attuned to trigger with small and medium disasters—setting aside significant saving for self-insurance was not possible after two consecutive disasters. With high-frequency low-intensity disasters covered in Layer 1, CCRIF parametric options will be re-calibrated to trigger under large disasters, while also considering CCRIF innovations such as Aggregated Deductible Covers to enhance efficiency. This would increase insurance cost efficiency, considering CCRIF's high cost[6], and the probability of disbursement—the correlation of damages and triggers is imperfect for small and medium disasters, a limitation of parametric insurance[7]. CCRIF insurance would therefore top up revenue for large disasters when instruments under Layer 1 are likely to be insufficient. The plan is also to increase coverage from 25 percent to maximum risk ceding. Dominica will continue to pledge for financial support for CCRIF premium—the government of Canada has provided grant financing for CCRIF premia in FY2019/20. High coverage after FY2020/21 would increase net fiscal cost of insurance (premium cost minus expected payouts) by 0.5 percent of GDP per year, thereby worsening debt sustainability in expected terms. This is justified, however, because it reduces uncertainty about debt outcomes, with larger payouts reducing the need for debt issuance after large disasters (Text Table).[8]

[6] CCRIF insurance multiplier, the ratio of annual premia / expected payout, is around 2, depending on parametric options.

[7] CCRIF covers emergency losses, plus a ceding percentage. In the case of Dominica, coverage is only 3.75 percent of total loss (15 percent earthquake and tropical cyclone times 25 percent excess rainfall). For large disasters it is important to target financing of all recovery phases (emergency, recovery and reconstruction). Notice that, for the reconstruction phase, insurance payout does not need to be immediate.

[8] This is also justified on theoretical grounds. Insurance theory indicates that purchase of non-negative amounts of insurance is optimal, even if less than actuarially fair, provided social preferences address "prudence" considerations—that is, risk aversion is increasing in the amount of the loss.

Active Scenario with Alternative CCRIF Insurance Coverage
(In percent of GDP)

	Hurricane impact in Primary Balance	Insurance Payout (US$ m)	Public Debt in 2030 [1/]	Unidentified measures needed for debt target
High CCRIF insurance [2/]				
No major hurricane	0.0	0.0	60.0	3.6
With major hurricane in 2020 [3/]	-12.9	127.0	67.5	4.5
Low CCRIF insurance [4/]				
No major hurricane	0.0	0.0	55.8	3.1
With major hurricane in 2020 [3/]	-12.9	20.3	72.7	5.6

Source: IMF staff calculations based on government and CCRIF data.

1/ Assumes implementation of unidentified fiscal policies/financing of 3.6 percent of GDP.

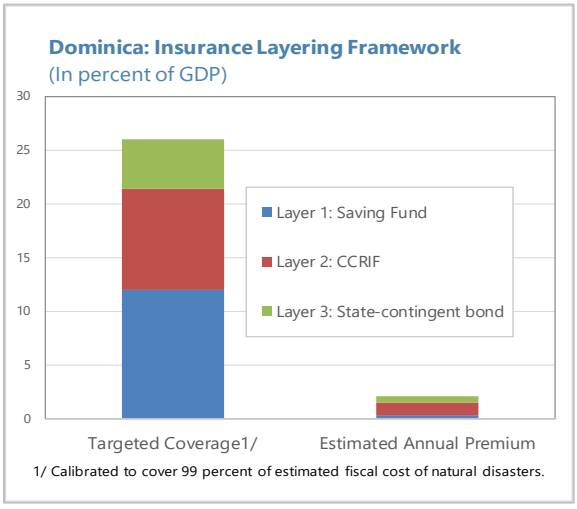
2/ Assumes 1 percent of GDP per year of CCRIF insurance premium that is not included in the baseline scenario, with expected annual payouts of 0.5 percent of GDP.

3/ Impact on fiscal balance and GDP similar to the impact of 2017 Hurricane Maria. The initial shock includes output decline of 15 percent in FY2020/21. Afterwards it is assumed a gradual recovery until FY2023/24.

4/ CCRIF annual premium and annualized cost of natural disaster as in baseline scenario.

(iii) Layer 3. Extreme disasters. A third insurance layer with issuance of Catastrophe (CAT) bonds for extreme events could also be considered, albeit at a cost exceeding expected payouts. This option would require regional issuance pooling considering the high administration cost to enable market demand; it is therefore considered a strategy to be developed in the medium term.

29. This risk layering framework would target total coverage of up to 26 percent of GDP, with estimated annual fiscal cost of 2.1 percent of GDP.[9] It could trigger disbursements of up to about US$150 million in an extreme event—smaller payouts for relatively milder disasters for which upper layers are not triggered. The coverage amount has been calibrated to cover 99 percent of estimated fiscal cost of natural disasters, at a gross annual premium of US$12 million annually. This strategy implies 7-8 times the CCRIF coverage compared with when Dominica was hit by hurricane Maria. However, it is below the amount of government deposits from CBI revenue that has so far been used to finance rehabilitation and reconstruction. The simulations indicate that a relatively small amount of CAT bond issuance would be needed to reach 99 percent coverage of natural



[9] This cost is calculated as the gross annual premium for the insurance instruments, and the opportunity cost in terms of interest on public debt for the saving fund. Notice that net insurance costs would be lower in light of insurance disbursements after natural disasters.

disasters' fiscal cost. However, issuance of this instrument would not be considered in the near-term considering the high cost and the need to prioritize reconstruction and resilient investment.

30. The government has taken steps to legislate the establishment of the self insurance fund. An amendment to the Public Financial Management Act has been prepared with technical assistance from the International Monetary Fund, which provided the institutional framework to formalize the creation of a Vulnerability and Resiliency Fund (VRF). Savings of over 1 percent of GDP have been set aside in the 2019/20 fiscal year despite the large fiscal need for reconstruction, and in 2020/21 additional 0.4 percent of GDP has been saved despite the financial challenged posed by the Covid-19 pandemic. To operationalize the VRF, an option under consideration is to establish an automatic allocation of CBI revenue, maintain savings of at least 12 percent of GDP, enforce a minimum saving contribution every budget cycle, and allow any excess above 12 percent of GDP to be used to finance resilient investment and to meet public debt service committments. In this way, the VRF will strengthen fiscal sustainability, critical in light of the recurrence of natural disasters. VRF disbursements after natural disasters will be triggered by a government declaration of national emergency.

31. The government is advancing additional institutional fiscal reform to strengthen the government's financial resiliency. This reform is part of a World Bank budget support operation expected in early 2021. The reform will contribute to the creation of fiscal space to finance the cost of resiliency, while strengthening debt sustainability, with reforms in several key institutional fiscal areas:

- Address PFM weaknesses in basic budget processes, including budget preparation and execution, as well as developing and clarifying emergency-related PFM procedures.[10]
- Adoption of a Fiscal Rules and Responsibility Framework that will establish fiscal targets, and to reduce the gap between the budget, budget projections and actual execution.
- Strengthening of the annual Medium-Term Economic and Fiscal Framework (MTEFF) and budget preparation process through a revision of the Financial Administration Act.
- Improve domestic revenue mobilization, including with better auditing and collection of tax arrears.
- Strengthen transparency in debt reporting including the annual publication and presentation of a Debt Portfolio Review.
- Operationalization of the VRF.
- Address constraints and delays in public procurement through a new Public Procurement Bill—Dominica spends significant fiscal resources on goods, civil works and services, particularly in post- natural disaster periods. A greener and more effective and efficient procurement system

[10] The reform needed have been identified in the Dominica Post-Disaster Public Financial Management Review (World Bank, 2019).

will enable a more climate resilient approach, greater competition, improved transparency, better value for money, and generate efficiencies and fiscal savings over the medium term.

32. Private sector insurance will be strengthened, including a government program to cover low-income households. A significant share of the population remains uninsured or underinsured, especially the most vulnerable segment for which insurance is not affordable. Households with mortgages are insured as per legal mandate, and most large businesses insure buildings and other productive assets. However, the severity of hurricane Maria, with simultaneous and extensive damage across the entire country, revealed weaknesses that resulted in payment delays and liquidity shortages in the domestic insurance sector.

- The government is considering alternative ways to insure low income households. The doubling of insurance cost after hurricane Maria, makes market insurance unaffordable for vast segments of the population. This is important for the internalization in fiscal accounts of expected government financial support to poor households after natural disasters, creating fiscal space and ensuring resources are available to support private recovery and reconstruction. Two policies are being considered: government purchase of parametric insurance for the most vulnerable sectors with instruments such as the Caribbean Oceans and Aquaculture Sustainability Facility (COAST) policy for the fisheries sector. This insurance offers coverage for losses caused by adverse weather on fisheries and direct damages caused by tropical cyclones to fish vessels, fishing equipment and fishing infrastructure. Similar instruments are being considered for the agriculture sector. To maximize the fiscal space to support low income households and incentivize insurance coverage of the non-poor, the government is committed to introduce proxy means-tested post disaster support, minimizing moral hazard. The Government will develop a fisheries' community insurance model to build resilience and reduce the potential risks, with World Bank financing support under the Emergency Agriculture Livelihoods and Climate Resilience Project will support this initiative.
- Strengthening the Insurance sector. The Eastern Caribbean Currency Union is advancing a plan to harmonize and consolidate regulation and supervision at a regional level, with full support of the Dominica government. The regional harmonization will enable efficiency gains and effectiveness by pooling financial resources and technical capacity, while also strengthening the independence of supervisors. This will enhance competition and can reduce the cost of insurance premia, which nearly doubled after hurricane Maria, by favoring participation of strong market players who are appropriately capitalized, diversified, and re-insured.

Pillar III: Post Disaster and Social Resilience

Recent Progress and Policies

33. The enormity of the challenges after hurricane Maria made clear the need to significantly upgrade post-disaster preparedness of the government and communities. Food distribution was challenging with loss of agricultural output and productive capacity, destruction of secondary and feeder roads critical to accessing towns and communities (some of which become isolated). Food and water donations and distribution by friendly nations were critical for survival after hurricane Maria. The government followed advice of international development partners and prioritized resumption of schooling just a month after the hurricane Maria, important to restore some degree of normalcy to children's lives. As several school buildings had to be repurposed as shelters for families whose homes became inhabitable, the government had to set up provisional school facilities, which in some cases were below the authorities' desirable standards. Distribution of roofing and construction materials accelerated rehabilitation of homes, supported by a 6-month suspension of VAT on construction inputs. Insufficient information about population numbers, socioeconomic conditions, and location limited the government response effectiveness—population needs were largely addressed upon direct requests to cabinet and the Ministry of Finance, resulting in inefficiencies from inability to identify priority support and minimize possible duplication of benefits.

34. The agriculture sector benefitted from significant technical and financial support with government programs for crop resiliency and food security. This included the promotion of root crops more resilient to heavy rain and wind, farmer training programs, and government assistance with provision of seeds and fertilizers. The government is working on a plan to strengthen food security, including specific policies for the resiliency of agriculture and fisheries. The reforms are included in a loan by the World Bank approved in June 2020—an operation that followed the Rapid Credit Facility disbursement by the International Monetary Fund in April 2020 to cover projected fiscal and external financing gaps caused by the Covid-19 pandemic.

35. Extreme social conditions after Hurricane Maria triggered some episodes of looting and social unrest, highlighting the need to strengthen civil security. The government rapidly declared a curfew and deployed all security forces to ensure peace and order. Protection of property, however, remained insufficient and slowed recovery as key businesses critical for the recovery, such as food distribution and access to savings, could not be fully protected, and some of the related losses would typically not be insured against crime.

36. Dominica has received support through the Global Facility for Disaster Reduction and Recovery (GFDRR) in risk reduction and post-disaster recovery and reconstruction assistance. The activities supported include data collection for a better understanding of landslide and flood hazards; disaster shelter; transport and road infrastructure management for resilience; post-disaster prioritization of rehabilitation activities; and development of vulnerability maps and mitigation plans (Box 2).

Box 2. Dominica: Activities supported by the Global Facility for Disaster Reduction and Recovery (GFDRR)

- Improvement in the government's ability to collect, store, and share geospatial data through the development of a risk data management platform, DomiNode. Due to these efforts, there is a greater understanding among ministries and better availability of information about landslide and flood hazards. The DomiNode platform was strengthened in 2014 with additional datasets that help increase climate change adaptation measures in development planning.
- Revision of the approach to assess shelters in Dominica that better account for vulnerability. In addition, GFDRR facilitated knowledge exchange related to shelter building standards, helping improve the government's capacity to identify and retrofit vulnerable shelters, and design and construct resilient new structures.
- Facilitate development of a risk-based transport Infrastructure Asset Management System in Dominica since 2016. These efforts will enable the government to systematically track infrastructure conditions, perform comprehensive and detailed vulnerability disaster assessments of the road network, and prepare a disaster mitigation action plan.
- Dominica has participated in the regional Caribbean Risk Information Program. This led to the creation of flood and landslide hazard maps for the country, as well as the development of a handbook that supports hazard and risk analyses for physical and infrastructure planning.
- Training on prioritizing reconstruction investment decisions to support reconstructing critical infrastructure damaged by disaster. With support from the African Caribbean & Pacific (ACP)-European Union (EU) Natural Disaster Risk Reduction program, GFDRR has also facilitated engagements following major disaster events. This includes supporting the government to conduct a rapid damage and impact assessment following 2015's Tropical Storm Erika, which led to support from several regional and international organizations for reconstruction of damaged infrastructure. Similarly, a rapid damage and loss assessment in response to Hurricane Maria, jointly conducted with the Caribbean Development Bank, the Easter Caribbean Central Bank, the European Union, the United Nations, and the World Bank, is informing a planned financial package of over $100 million for Dominica to provide immediate support to farmers, rebuild resilient public infrastructure, strengthen resilience, and help create financial buffers.
- Identify vulnerable locations estimating upstream risks, including debris flow and landslide risks, using aerial imagery and soil sample data. These efforts aim to identify locations for construction of potential mitigation measures which will support Dominica to address the risks that have caused major infrastructure failures in the past and to develop an adequate mitigation plan.

DRS Plan

37. The government CRRP has a strong focus on food security. The CRRP identifies food supply as a critical high-impact climate resilience activity, specifying the accumulation of 15 days of food self-sufficiency in each community before the beginning of hurricane season every year. To this end, emergency shelters being built as part of the housing program will be equipped with water and food storage facilities. The plan also targets a reduction in the food import dependency ratio to below 40 percent by 2030 (currently above 60 percent). This includes plans to transform agriculture and fisheries for resiliency to natural disasters, including crops more resilient to high and persistent wind and rain (i.e. root crops), and infrastructure for the protection of fishing equipment. The Responsible Land Stewardship Initiative will seek to improve access to land for agricultural use. In addition, the Global Centre for Agricultural Resilience will seek to develop appropriate policy and legislation to improve capacity for data and information management and risk profiles for main

hazards affecting agriculture, increase expertise in agro-meteorology, support adoption of more resilient crops and livestock, develop both Agriculture and Fisheries Disaster Risk Management Plans, explore options for hurricane insurance for fishing/farming communities in collaboration with appropriate support agencies and financial institutions, and develop protocols for the safe shelter of fishing boats during a storm and educate fishers on safe practices before and during a storm.

38. The Effective Disaster Response and Recovery in the Climate Resilient National Plan will minimize disaster impact and accelerate the recovery. Effective procedures to assess damage loss and to identify the supports and resources to be mobilized are critical. To this end, the government will establish a Disaster Management and Preparedness Fund to empower and facilitate the disaster committees at the community level. More coordination and cooperation are crucial at the community, district and national levels. Building on lessons learned from Erika and Maria, this plan develops a best-practice model for post-disaster response and recovery, including:

- Efficient systems for search and rescue, relief coordination, restoration of roads and ports, clean up and sanitation and the preservation of law and order.
- Development of networks to guarantee food, water supply, and medical services.
- Cooperation among telecommunication service providers for the dissemination of vital and life-saving information.
- Business continuity measures for the public sector to ensure essential operations resume quickly.
- Business continuity plans for key private subsectors to ensure rapid availability of food supplies, particularly food wholesale and retail, agriculture, and fisheries.

39. Building strong communities that are well prepared to withstand shocks is a key component of the CRRP. The objective is to reduce overall vulnerability of all Dominicans by building mental and physical preparedness, enhancing social cohesion, ensuring continuity of access to education and health services, as well as welfare. Some specific goals include:

- Increase the participation of marginalized individuals and groups.
- Strengthen the capacity of the local authorities to manage resources before, during and after and event.
- Develop a transparent, data driven method for social welfare distribution.
- Minimize mortality and morbidity as the result of a natural disaster through access to a well-equipped, safe shelter.
- Increase the effectiveness of community health and education systems to build preparedness and respond to disasters.
- The estimated cost of the strong communities' initiatives, to be delivered within the next 10 years is $87 million (Text table).

Each One Reach One (EORO)-Youth Resilience Initiative	EC$11 M	2025
Responsible Land Stewardship Initiative	EC$ 250.000	2021
Kalinago Territory Development Strategy	EC$45 M	2030
Community Emergency Readiness Initiative	EC$11 M	2020
Modern Village Council Initiative	EC$100.000	2022
Enhanced Social Safety Net Initiative	EC$20 M	2022

40. The government is preparing a National Action Plan for Disaster Risk Reduction under the NDRS. Disaster preparedness will include the participation of all concerned parties in government, development partners, private sector and civil society organizations. It will be spearheaded by the Office of Disaster Management (ODM). The plan, targeting completion by 2022, includes five components:

- Strengthening of disaster management institutions at the national, sub-national, and local community levels.
- Enhancement of disaster risk assessment and monitoring and improving early warning systems.
- Developing knowledge and innovation on vulnerabilities and building a culture of safety and disaster resilience.
- Reduce the risk factors and strengthen recovery plans in vulnerable sectors and populations.
- Strengthen preparedness for effective emergency response at the national and local community levels.

41. The DRS plan includes improvement of population data collection and coverage for comprehensive assessment of disaster social impact and design of safety net programs. The roll-out of several cash transfer programs after Hurricane Maria pointed to critical gaps in services, capacities and resources, due to a lack of an effective information system. These gaps created data errors at the beneficiary, programmatic and systemic levels. To modernize social service delivery, the government is planning to: (i) establish a social and beneficiary registry and a management information system for social programs; (ii) design an electronic post-disaster household assessment system with tablet support; (iii) modernize payment delivery for social safety net programs to promote financial inclusion; and (iv) introduce a multi-purpose unique identification system to facilitate better data management, post-disaster household identification, and further the financial and economic inclusion of the poor and vulnerable. The Disaster Vulnerability Reduction Project, a government program financed partially by the World Bank, includes a component to improve hazard data collection and monitoring systems.

D. DRS Cost

42. The estimated total cost of transforming Dominica into a disaster-resilient state is US$2.8 billion, five times the size of its GDP. Despite the fast pace of reconstruction to date, costs ahead are larger than those incurred thus far. The costs of the three DRS pillars is as follows:

- *Pillar 1. Structural Resilience*. The government CRRP preliminary estimate indicates total investment need in resilient infrastructure in the range of US$2.1-2.6 billion, spread over a 20-year period (averaging 13 percent of GDP per year); the DRS projections are based on the upper bound of this range (text table). This would require investment rates above historical levels of 15 percent of GDP per year until 2041, of which resilient physical structures would reach at least 10 percent of GDP. The initial phase of resilient infrastructure investment was included in the Public Sector Investment Plan (PSIP) of the 2019/20 and 2020/21 budgets.

- *Pillar 2. Financial resilience*. Building additional financial resilience would cost around US$ 65 million, spread over a 20-year period (averaging around 1 percent of GDP per year). Costs of a layered insurance framework include: (i) opportunity cost of government saving fund for self-insurance of US$2.5 million per year (0.4 percent of GDP), part of which could be covered with access to World Bank CATDDO (insurance layer 1); and (ii) high-CCRIF access for medium and large disasters, at an estimated annual net cost of US$4 million per year (0.7 percent of GDP, net of expected disbursements). This cost estimate includes an increase of risk ceding for Tropical Cyclones to maximum available and will require a calibration of CCRIF's attachment point to medium and large disasters –current policy triggers for relatively small and frequent disasters. Importantly, the cost of Layer 3 with market instruments such as CAT bonds is not included in the DRS framework due to its high cost. The net present value of this insurance cost for the next 20 years, net of estimated expected payouts, is US$65 million, or 12 percent of GDP.

- *Pillar 3. Post-Disaster Relief and Social Resilience*. Building additional post-disaster and social resilience would cost around US$270 million, spread over a 20-year period. This includes policies with total cost of US$15-20 million annually (2 percent of GDP on average per year) for the development of resilient agriculture and food security, integration of CREAD functions into the Ministry of Finance regular operations, promotion of renewable energy use, and development of sustainable ecosystems. This cost would gradually decline in the long term as initial programs have been established to about 1 percent of GDP.

DRS Cost

		US$ bn	Percent of GDP
Pillar 1	Physical Resilience	2.5	450
Pillar 2	Financial Resilience	0.1	12
Pillar 3	Social and Post-disaster Resilience	0.3	49
DRS Total Cost		**2.8**	**510**

E. A Comprehensive Macro-Fiscal Plan Incorporating DRS Cost

43. This section develops a macroeconomic framework incorporating the DRS policies and investments' cost and return. It includes the estimated cost of the three DRS pillars stated in Section III, and the anticipated economic response of higher public investment with resilience, including the feedback effects on output and tax revenue from private investment and employment. Simulation analysis indicates that the economic returns of investment in resiliency outweigh the cost, not only as a result of reduced cost or rehabilitation and reconstruction after natural disasters, but also because it reduces private sector expected losses, in turn increasing investment and employment (Box 3). Given the high DRS cost, particularly of Pillar 1, the macroeconomic framework assumes DRS execution is spread until 2041, an ambitious target considering possible execution capacity and financing constraints (text table).

DRS Pillars Projected Execution
(Percent of GDP and US$ million)

	2021	2022	2023	2024	2025	2026/41	Total	Total (NPV) /1
Pillar 1	13	13	13	13	13	10		
Pillar 2	1.1	1.1	1.1	1.1	1.1	1.1		
Pillar 3	2	2	2	2	2	1		
Total	16.1	16.1	16.1	16.1	16.1	12.1		
Pillar 1 Cumulative (US$mn)	75	158	248	346	449	2018	2467	2467
Pillar 2 Cumulative (US$mn)	6	13	21	29	38	220	258	65
Pillar 3 Cumulative (US$mn)	12	24	38	53	69	200	269	269

1/ Net Present Value of the insurance cost, net of estimated expected payouts. Cost declines over times as the country builds resiliency.

44. The total cost of Pillar 1 requires sustaining public investment rates of 17 percent of GDP until 2041. This includes 13 percent of GDP until 2025 in resilience-specific projects (Pillar 1) and 2-1 percent of GDP for ex-post social resilience (Pillar 3)—the remaining is investment not related to resiliency. In the DRS macroeconomic framework, investment rates are above 17 percent of GDP in the near term to account for the remaining reconstruction after hurricane Maria.

Box 3. Does It Pay to Invest in Resiliency?

Simulation analysis using a Dynamic Stochastic General Equilibrium Model calibrated to the Dominica economy indicate that the real and fiscal returns of resilient investment outweigh the cost. Economic performance improves with positive responses to resilient investment of private investment and employment, ultimately strengthening fiscal performance. The results incorporate increased expected damages from disaster intensification under global warming.

Climate change is expected to increase NDs' expected Average Annual Loss (AAL) by 8-18 percent by 2050 and by 25-49 percent by 2100 under RCP8.5 global warming scenarios –increase in atmospheric temperatures of 1.2-2.2 degrees Celsius by year 2050 and 3.0-5.6 degrees Celsius by 2100. This is based on CCRIF—estimated AAL to calibrate the amount of capital destruction with NDs, augmented by the percent increase in estimated annual damage, based on estimates in Acevedo (2016).

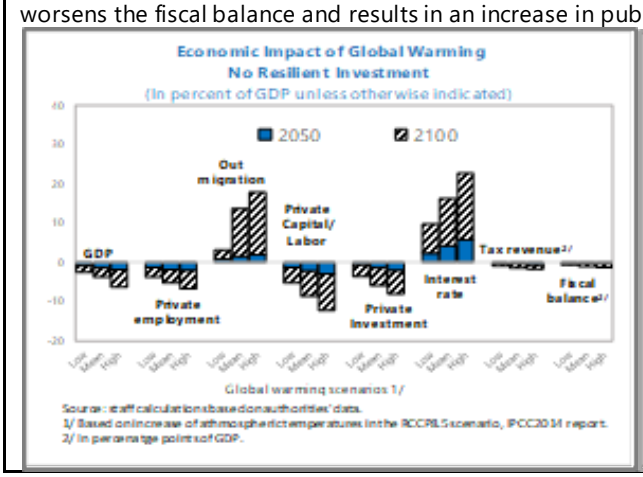
Economic cost of climate change is significant. Model simulations assuming higher Average Annual Losses (AAL) to account for increased intensity of natural disasters (NDs) with climate change indicate an output decline in the range of 1-2 percent by 2050 and 3-6 percent by 2100. Absent resilient investment, higher expected losses with climate change reduce private investment and thus capital per worker, putting downward pressure on wages, and inducing labor out-migration and a decline in employment. The decline in output reduces tax revenues by about 0.5 percentage points of GDP by 2050 and 1 percentage point by 2100, with a commensurate worsening of the fiscal balance.

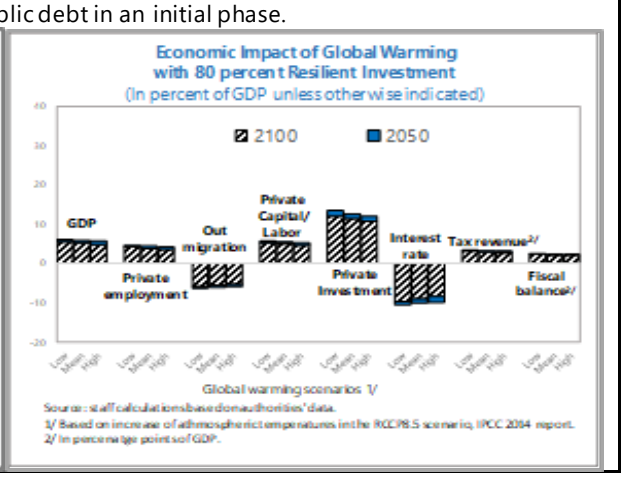
Dominica: Increase in Natural Disaster Damage with Global Warming

RCP8.5 Scenario	Increase in atmospheric temperature (Degrees Celsius)	Average Annual Loss in Simulations (Percent increase)	Average Annual Loss in Simulations (Percent of GDP)
Low			
2050	1.2	7.9	2.2
2100	3.0	25.0	2.5
Mean			
2050	1.7	14.1	2.3
2100	4.3	36.9	2.7
High			
2050	2.2	17.9	2.4
2100	5.3	48.8	3.0

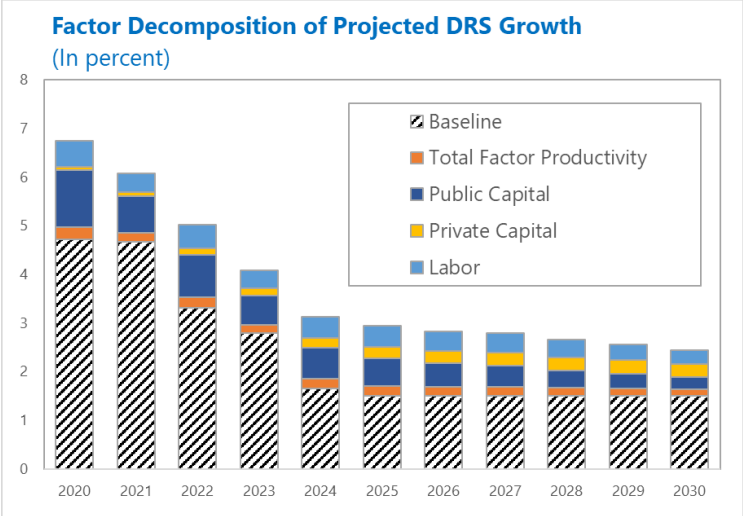
Source: author calculations based on IPCC (2014) report and estimates in Acevedo (2016).

Investment in resilient infrastructure outweighs the cost in the long term. Model simulations assuming climate change increased loss and a shift to resilient investment of 80 percent of total investment show a net positive effect (text chart). Lower expected NDs damages when infrastructure is resilient support private investment, employment and output in the long term, offsetting the negative effect of the increase in expected losses with global warming. The increase in tax revenues underpinned by higher output, labor, and consumption more than offsets the higher fiscal cost in the long-term, with the overall fiscal balance improving by over 3 percentage points of GDP. These benefits, however, accrue in the long-term, as resiliency is gradually built; the high cost of resilient investment worsens the fiscal balance and results in an increase in public debt in an initial phase.





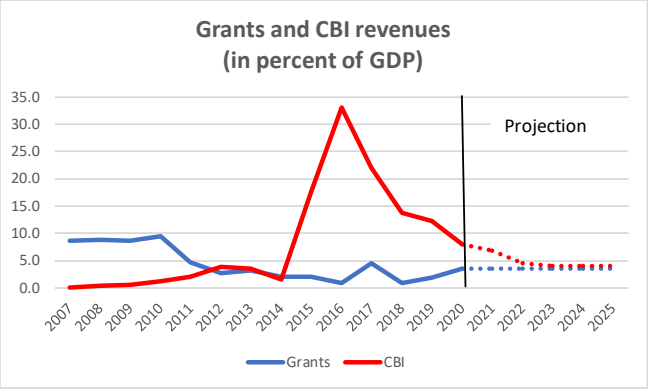
45. The high projected investment rates and the estimated output return to resilience imply long-term output growth of around 3-2.5 percent. With resilient investment financing expected to come from external sources, high public investment in the DRS will boost aggregate demand in the near term and increase productive capacity in the long term, with multiplicative effect on private investment and employment. Using a production function estimate including public capital, private capital, employment, and total factor productivity, and assuming the public investment rates in the CRRP plus the anticipated response of other factors of production, output growth would increase by about 3 percentage points of GDP in an initial phase, and then gradually decline to an increase of 2 percent in the long term, relative to a baseline with public investment in line with historical trends (text chart). In the near-term, growth rates are below potential owing to the impact of the Covid-19 pandemic, and a somewhat negative impact of fiscal consolidation in the DRS plan. In the long-term, projected growth gradually declines to near 2 percent, but remains above historical potential output growth estimates of 1.5 percent based on investment, employment and productivity trends in the absence of the DRS. On the external front, enhanced resilience investment would boost total imports, thus widening the current account deficit during the period of investment.



46. The projection incorporates committed external financing for post-Maria reconstruction. Financing envelopes allotted to Dominica of about US$200 million from the World Bank and the Caribbean Development Bank (CDB) to fund Post-Maria reconstruction and structural reform, including fiscal institutions, remain largely untapped. Adding other sources, commitments for reconstruction and development of resilience add up to near 40 percent of GDP. The World Bank is supporting resilient housing and geothermal energy generation and has provided financing to support health spending during the Covid-19 pandemic that also includes components of infrastructure resiliency and food security with policies that address vulnerabilities to natural disasters in the agriculture and fisheries sectors. The CDB is preparing a Policy-Based Loan anchored on structural fiscal reform and resilience to natural disasters; roads and bridges rehabilitation remains largely funded by the People's Republic of China government and the World Bank. Financing the front-loaded path of capital expenditure of the DRS requires accelerating the disbursement of committed loans and grants.

47. The DRS fiscal plan includes conservative CBI revenue projections implying upside risk, and the establishment of the VRF for insurance, resilient investment, and debt reduction. CBI program revenue has shown significant historical variability and are difficult to predict. The DRS macro-framework assumes that CBI-program revenue gradually declines, converging to 3 percent of

GDP in the long term. If CBI resources remain high, a share will be allocated to a Saving Fund for NDs to start up layer 1 of the insurance framework. Additional revenue could also be used to support the annual saving contributions for self-insurance, and to invest in resilient infrastructure after a disaster. To ensure an allocation of unpredictable CBI program revenue to resilience to natural disasters, the government will establish a VRF with strong governance framework and transparency standards. In addition to contributing to physical and financial resiliency, the VRF will support fiscal sustainability by ensuring CBI revenue is not used in recurrent government spending, while reducing debt issuance after disasters and reducing infrastructure rehabilitation and reconstruction cost. The government will also consider using VRF excess resources above the insurance need for debt service, further supporting fiscal sustainability. Grants are similarly projected moderately at 3.5 percent, in line with the average during the 2010s, but at a much lower level than in the previous decade. As seen below, an upscale in external grant financing would be key to secure financing of the DRS in a manner consistent with macroeconomic sustainability.



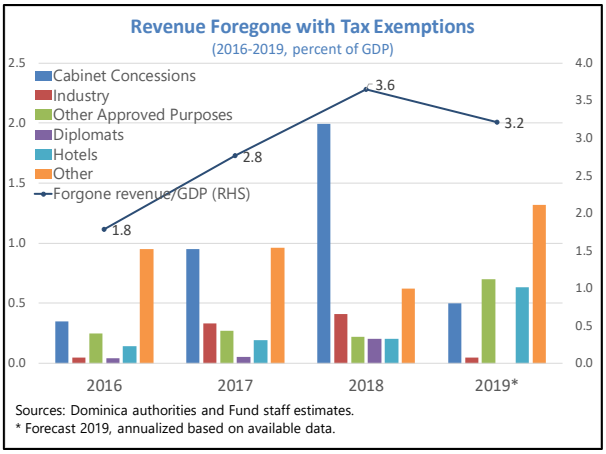
Source: Fund staff calculations, authorities data. Grants exclude additional DRS financing.

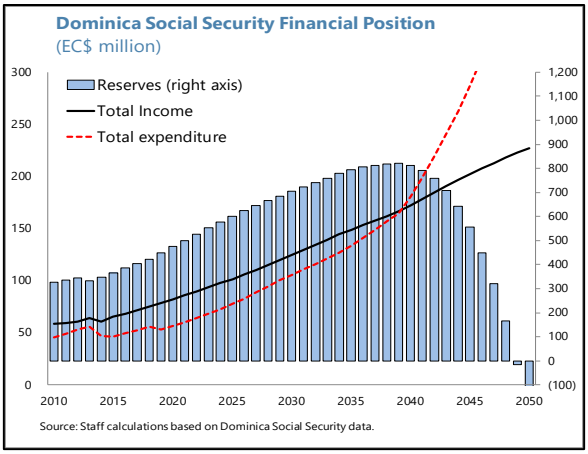
48. To address fiscal sustainability, the government will implement a fiscal consolidation plan targeting savings of near 6 percent of GDP. The consolidation will be phased over the next 6 years to smooth the impact on domestic demand, especially considering the economy is still recovering from Hurricane Maria. The measures under consideration include structural reforms to increase revenue collection efficiency and expenditure cost-effectiveness:

- *On the revenue side*, the main measure is restructuring of tax incentives to maximize returns while minimizing revenue loss through an annual cap on discretionary concessions, with prioritized allocation to support investment, job creation, and social needs (text chart). In addition, increases in tax auditing resources will boost revenue, as observed by recent experience. Acceleration of pension reform with: (i) increase in contributions and retirement age; and (ii) increase in contribution years to qualify for pension would improve sustainability, affected by labor emigration and population aging (text chart).

- *Other structural revenue* measures to increase allocative efficiency include: (i) property tax reform; (ii) a solid waste charge; (iii) review of preferential rate of diesel consistent with carbon emissions reduction; (iv) targeted cost recovery fees on health care services[11]; (v) personal income tax reform to broaden the tax base, including implementation of presumptive taxation; and (iv) remove exemptions on water and sewage tariffs (text table).

[11] This reform, developed with support from the Pan-American Health Organization, was interrupted after the hurricane.





- *On the expenditure side*, the government will maintain public wage restraint by ensuring that the wage bill growth is below inflation in the long term and with civil service reform including public employment reclassification and rationalization of allowances. The hurricane allowed identification of nonpriority projects in the public sector investment plan of about 5 percent of GDP, which have been discontinued after hurricane Maria and are not related to rehabilitation and reconstruction of critical infrastructure. These projects will be scrutinized to identify additional efficiency saving. Further review of the pension calculation formula commensurate with contribution effort and increased life expectancy will contribute to the sustainability of the pension system, complementing the ongoing reform to increase pension contributions and retirement age. Rationalization of capital transfer programs would also increase efficiency. Social transfers will be better targeted with proxy means testing and better household and social information systems planned under Pillar 3 of the DRS, which will increase efficiency in allocation according to need and facilitate identification of beneficiaries to minimize possible duplication

Fiscal Measures in the Disaster Resilience Strategy [1/ 2/]

	FY 2020/21	FY 2021/22	FY 2022/23	FY 2023/24	FY 2024/25
Cumulative Fiscal consolidation	**0.2**	**3.6**	**4.5**	**4.9**	**5.7**
Revenue measures	**0.0**	**2.3**	**2.9**	**3.2**	**3.6**
Restructuring of tax incentives for allocational efficiency	0.0	1.0	1.3	1.6	1.9
Better tax auditing and collection of arrears	0.0	0.4	0.6	0.6	0.6
Property tax reform	0.0	0.0	0.0	0.0	0.1
Solid waste charge for environmental preservation	0.0	0.1	0.1	0.1	0.1
Environmental reduction of preferential rate of diesel fuel	0.0	0.1	0.1	0.1	0.1
Health care and expenditure financing reform	0.0	0.1	0.1	0.1	0.1
Personal and corporate income tax reform and presumptive tax	0.0	0.3	0.4	0.4	0.4
Review cost and income structure of water and sewage service	0.0	0.3	0.3	0.3	0.3
Expenditure measures	**0.2**	**1.4**	**1.6**	**1.7**	**2.1**
Review of wage allowances and civil service reform 2/	0.0	0.5	0.5	0.5	0.8
Review of pension benefits 3/	0.0	0.5	0.5	0.6	0.7
Increase capital transfers efficiency	0.2	0.4	0.6	0.6	0.6
Fiscal gap to reach regional debt target by 2030	**7.8**	**7.8**	**7.8**	**7.8**	**7.8**
Public sector debt with fiscal or financing gap	**97.0**	**102.5**	**105.7**	**110.0**	**111.1**
Public sector debt with measures	**95.5**	**94.4**	**91.1**	**89.2**	**84.3**

1/ In fiscal years (July-June).
2/ Increase in public employment efficiency with category reclasification and rationalization of allowances.
3/ Review of pension formula commensurate with contribution effort.

49. The commitment to fiscal consolidation, however, is insufficient to sustain the execution of the DRS plan, underscoring the role of donor assistance for sustainability. With the inclusion of the DRS costs and return, and despite full implementation of the fiscal consolidation plan, public debt would take an increasing trajectory, reaching 120 percent of GDP by 2030. This means that the cost of resiliency implies an unsustainable debt burden for Dominica, eventually stalling the ongoing progress to build a disaster-resilient state (text table and charts). Therefore, attaining resilience with fiscal and external sustainability crucially depends on donor support. With full implementation of the fiscal consolidation plan, reaching the regional debt target (of 60 percent of GDP by 2030) with the DRS cost would still result in a fiscal gap of close to 8 percent of GDP per year. This implies the need for "additional" donor grants, which would increase to near 11 percent of GDP per year (US$63 million). This amount is higher than the average in the 2010s, which were in the range of US$ 5-15 million per year, but similar to the grant support received in the 2000s.

DRS Macroeconomic Framework

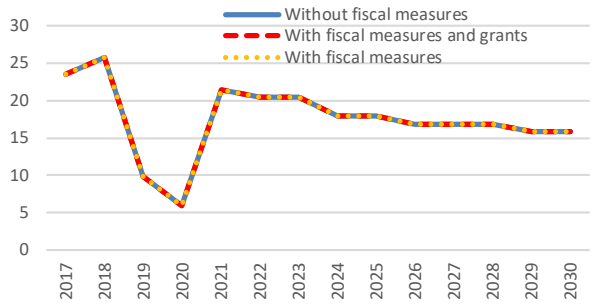
	Est.		Projections							
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2030
Output and prices										
Real GDP 1/	-9.5	0.5	7.6	-10.5	3.4	9.0	7.3	5.7	5.5	3.1
Overall fiscal balance 2/	0.3	-19.9	-10.3	-4.3	-6.0	-5.5	-5.3	-2.0	-1.7	0.1
Overall fiscal balance, excl. CBI 2/	-21.8	-33.7	-21.1	-10.8	-11.4	-8.6	-7.8	-4.5	-4.3	19.6
Public debt 2/ 3/	83.8	79.1	90.2	95.5	94.4	91.1	89.2	84.3	80.0	60.0
Current account balance	-8.8	-44.6	-26.0	-18.7	-28.5	-26.7	-25.9	-20.0	-19.5	-13.5
Credit to the private sector growth 4/	-3.0	-2.7	-1.5	-2.1	-1.1	-0.3	0.3	0.8	1.0	2.9

Sources: Dominican authorities; Eastern Caribbean Central Bank (ECCB); and Fund staff estimates and projections.
1/ At market prices.
2/ Data for fiscal years from July to June.
3/ Includes estimated commitments under the Petrocaribe arrangement with Venezuela.
4/ Annual percent change.

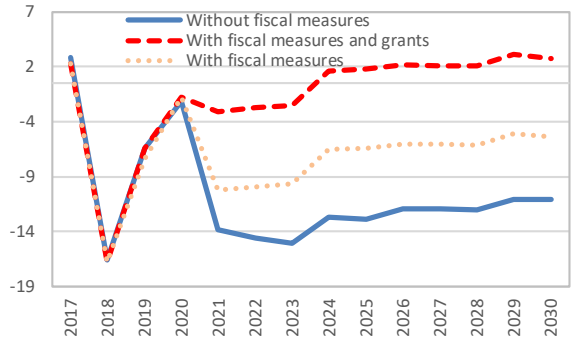
DRS Fiscal Framework: Fiscal Consolidation and Grant Financing Need

(in percent of GDP)

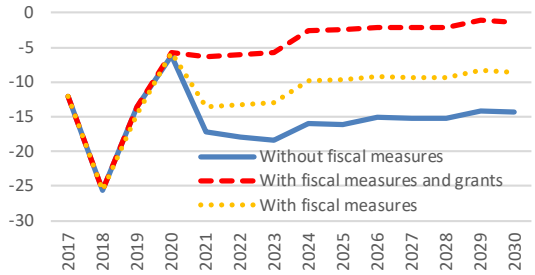
Capital Expenditure



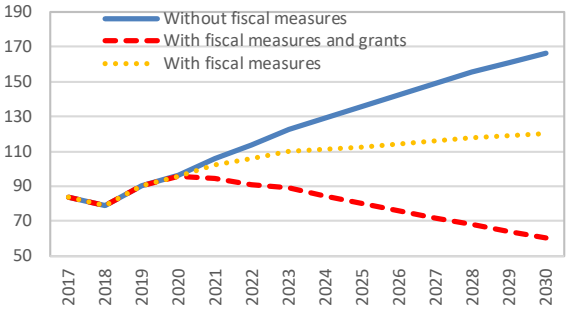
Primary Balance



Underlying Primary Balance 1/



Public Debt



1/ Primary balance excluding CBI revenues, grants, and transitory increase in public investment after Hurricane Maria.

F. The way forward

50. The DRS will be updated periodically to update the framework with recent economic developments, resilience cost revisions and additions. A share of the cost amounts used in the scenarios are still broad estimates, and specific infrastructure and insurance needs may continue to be identified. However, the DRS does include specific investments under all three pillars that could help mobilize financing, including from donor assistance, with clarity and transparency about the allocation of financing and the contribution of each project and financing component to the overall strategy.

51. Materialization of a DRS requires a cultural change of the Dominicans towards resilience, and also a strong support from the international community. The people of Dominica are committed and determined, understanding that becoming a resilient state is not an option but a survival imperative, especially considering disaster intensification with climate change. The fiscal gap identified in the DRS, however, shows that a small state like Dominica, which had negligible contribution to the causes of global warming and climate change, cannot become resilient with substantial technical and financial support. A concerted effort from the international community is therefore necessary for the DRS to materialize.

52. Access to donor financing could be facilitated with streamlined requirements and application process. The government of Dominica understands the importance of due-diligence procedures and is fully committed to satisfy all transparency and accountability requirements of financial assistance and donor grant. However, complicated and diverse administrative processes for grant application and disbursement impose disproportionate burden on small state such as Dominica affected by limited capacity and human constraints. Dominica continues to support regional initiatives to pool resources for access to grant financing, including with accreditation in regional institutions such as the Caribbean Development Bank and the Organization of Eastern Caribbean States. However. streamlining of qualification, application, and disbursement requirements remains key to facilitate mobilization of globally available donor funding, requiring coordination among the international donor community and global political commitment.

DRS Macroeconomic Framework

I. Social and Demographic Indicators

Area (sq. km.)	Adult literacy rate (percent, 2016)	94
Population (2016)	Unemployment rate (2016)	23
Total		
Annual rate of growth (percent)		
Density (per sq. km.)	Gross Domestic Product (2016)	
Population characteristics	Millions of E.C. dollars	1,554
Life expectancy at birth (years, 2016)	Millions of U.S. dollars	575
Infant mortality (per thousand live births, 20	U.S. dollars per capita	7,870

II. Economic Indicators

		Est.	Projected						
	2018	2019	2020	2021	2022	2023	2024	2025	2030
Output and prices	(annual percent change, unless otherwise specified)								
Real GDP 1/	0.5	7.6	-10.5	3.4	9.0	7.3	5.7	5.5	3.1
Nominal GDP 1/	1.9	9.3	-10.4	5.0	11.2	9.5	7.8	7.6	5.1
Consumer prices									
Period average	1.4	1.6	0.1	1.6	2.0	2.0	2.0	2.0	2.0
End of period	1.4	1.8	-0.2	2.0	2.0	2.0	2.0	2.0	2.0
Central government balances 2/	(in percent of GDP, unless otherwise specified)								
Revenue	46.4	39.8	34.2	42.9	40.3	40.1	40.2	40.2	39.3
Taxes	28.6	24.2	21.5	23.6	23.4	23.6	23.7	23.7	22.8
Non-tax revenue	16.9	13.7	9.2	8.6	6.3	5.8	5.8	5.8	5.8
Grants 3/	0.9	1.9	3.5	10.7	10.7	10.7	10.7	10.7	10.7
Expenditure	66.3	48.7	37.1	47.4	44.4	43.9	40.7	40.4	37.7
Current primary expenditure	38.5	36.4	29.2	23.7	21.7	21.2	20.8	20.7	20.7
Interest payments	2.0	2.5	2.1	2.4	2.3	2.2	2.1	1.9	1.2
Capital expenditure	25.8	9.8	5.8	21.3	20.4	20.4	17.8	17.8	15.8
Primary balance	-17.9	-6.3	-0.8	-2.1	-1.8	-1.5	1.6	1.7	2.7
Overall balance (incl. ND cost buffers), of which:	-19.9	-10.3	-4.3	-6.0	-5.5	-5.3	-2.0	-1.7	0.1
Central government debt (incl. guaranteed) 4/	79.1	90.2	95.5	94.4	91.1	89.2	84.3	80.0	60.0
External	54.7	57.3	67.6	69.5	74.0	73.8	72.6	70.6	54.9
Domestic	24.5	33.0	27.9	24.9	17.1	15.5	11.8	9.4	5.1
Money and credit (annual percent change)									
Broad money (M2)	0.7	-0.4	0.1	0.5	0.4	0.4	0.5	0.6	0.3
Real credit to the private sector	-2.7	-1.5	-2.1	-1.1	-0.3	0.3	0.8	1.0	2.9
Balance of payments									
Current account balance, of which:	-44.6	-26.0	-18.7	-28.5	-26.7	-25.9	-20.0	-19.5	-13.5
Exports of goods and services	29.6	37.9	21.3	19.6	28.3	31.7	34.6	36.4	36.4
Imports of goods and services 5/	78.7	69.4	44.1	50.1	57.2	61.0	58.2	59.4	53.5
Capital and financial account balance	15.8	1.3	2.5	8.6	1.4	-2.6	-1.7	1.6	14.3
FDI	-14.3	-6.2	-2.1	-4.5	-4.8	-4.8	-4.8	-5.9	-5.9
Capital grants	27.6	13.7	9.5	17.8	14.3	11.9	9.4	10.8	14.1
Other (incl. errors and omissions)	2.5	-6.2	-4.9	-4.8	-8.2	-9.7	-6.3	-3.3	6.1
External debt (gross) 6/	104.9	107.5	120.1	119.4	117.7	117.5	112.5	108.5	80.8
Saving-Investment Balance	-44.6	-26.0	-18.7	-28.5	-26.7	-25.9	-20.0	-19.5	-13.5
Saving	-10.9	-2.2	-7.3	-6.5	0.0	-2.7	2.5	1.6	5.7
Investment	33.7	23.7	11.5	22.0	26.7	23.3	22.5	21.2	19.2
Public	26.2	17.2	8.5	15.0	21.7	21.3	20.0	18.7	16.7
Private	7.5	6.5	3.0	7.0	5.0	2.0	2.5	2.5	2.5
Memorandum items:									
Nominal GDP (EC$ millions)	1,440	1,574	1,410	1,480	1,646	1,802	1,943	2,090	2738
Nominal GDP, fiscal year (EC$ millions)	1,507	1,492	1,445	1,563	1,724	1,873	2,017	2,154	2807
Net imputed international reserves:									
End-year (millions of U.S. dollars)	189.2	190.3	178.8	170.8	174.2	177.6	181.2	185.6	207.4
Months of imports of goods and services	5.4	5.6	9.3	7.5	6.0	5.2	5.2	4.8	4.6

Sources: Dominican authorities; Eastern Caribbean Central Bank (ECCB); and Fund staff estimates and projections.

1/ At market prices.

2/ Data for fiscal years from July to June.

3/ Does not include grants received but not spent.

4/ Includes estimated commitments under the Petrocaribe arrangement with Venezuela.

5/ Includes public capital expenditure induced imports from 2019 onwards to account for possible mitigation of natural disasters.

6/ Comprises public sector external debt, foreign liabilities of commercial banks, and other private debt.

Annex I. Cost and Damage in Recent Tropical Storms

1. Tropical Storm Erika hit Dominica in August 2015, resulting in significant economic losses and high reconstruction costs. The storm produced extraordinary rainfall that caused intense and rapid flooding. As a result, the country suffered severe infrastructural damage, primarily in the transportation, housing and agriculture sectors. A total of 7,229 people (out of a 72,340 population) were affected by the storm, with 713 evacuated, 574 homeless, 22 missing and 11 dead. A summary of the damages is presented in Table 2.

Table 1. Tropical Storm Erika: Summary of Damages and loss by Sector (in US$ millions)

Sector	Damage (US$ m)	Loss (US$ m)	Total (US$ m)
Productive			
Agriculture, Fisheries and Forestry	42.46	4.87	47.33
Tourism	19.48	11.70	31.18
Industry and Commerce	9.13	0.56	9.69
Infrastructure			
Water and Sanitation	17.14	2.38	19.52
Air and Sea Ports	14.90	0.08	14.98
Roads and Bridges	239.25	48.28	287.53
Electricity	2.19	0.33	2.52
Telecomm	10.0	0.00	10.0
Social			
Housing	44.53	9.61	54.14
Education	3.55	0.45	4.00
Health	0.64	1.30	1.94
Total	**403.28**	**79.56**	**482.84**

Source: Commonwealth of Dominica. Rapid Damage and Impact Assessment.

2. Hurricane Maria hit Dominica in 2017 while it was still recovering from tropical storm Erika. Maria has been Dominica's worst natural disaster, affecting almost every household and economic sector. 58 percent of losses and damage fell on the private sector, where private housing damage was equivalent to 61 percent of GDP. Losses and damage in the tourism sector, amounted to about 16 percent of GDP, heavily concentrated in hotels. Labor-intensive sectors sustained substantial loss and damage, particularly agriculture, transport, and commerce. The remaining damage fell on the public sector, with infrastructure carrying the brunt (43 percent of GDP).

Table 2. Damage, Losses, and Recovery Costs after Hurricane Maria

Sector	Damage [1/]			Losses [2/]			Recovery Cost [/3]		
	Public	Private	Total	Public	Private	Total	Public	Private	Total
	(in millions of U.S. dollars)								
Agriculture	38	18	55	0	124	124	50	23	73
Forestry	28	0	28	0	0	0	15	0	15
Fisheries	0	2	3	0	1	1	0	2	2
Commerce/Microbusines	0	70	70	0	7	7	0	73	73
Tourism	0	20	20	0	71	71	0	26	26
Education	49	25	74	2	1	3	61	32	93
Health	11	0	11	7	0	7	22	0	22
Transport	162	39	201	49	8	58	261	64	325
Roads	144	39	182	44	8	53	238	64	302
Ports and Airports	19	0	19	5	0	5	23	0	23
Water and Sanitation	24	0	24	13	25	38	56	0	56
Electricity	33	0	33	33	0	33	51	0	51
Telecommunications	0	47	48	0	8	8	0	47	48
Housing	0	354	354	3	25	28	260	260	520
Other 4/	26	-20	6	75	-71	4	38	-26	12
Total	372	556	928	183	199	382	815	501	1316
				(in percent of GDP) [/5]					
Agriculture	6.5	3.0	9.5	0.0	21.4	21.4	8.6	4.0	12.5
Forestry	4.9	0.0	4.9	0.0	0.0	0.0	2.6	0.0	2.6
Fisheries	0.1	0.4	0.5	0.0	0.1	0.1	0.0	0.3	0.4
Commerce/Microbusines	0.0	12.1	12.1	0.0	1.2	1.2	0.0	12.6	12.6
Tourism	0.0	3.5	3.5	0.0	12.2	12.2	0.0	4.5	4.5
Education	8.4	4.3	12.7	0.4	0.2	0.6	10.5	5.4	16.0
Health	1.9	0.0	1.9	1.2	0.0	1.2	3.8	0.1	3.8
Transport	27.9	6.6	34.6	8.5	1.4	9.9	44.8	11.0	55.8
Roads	24.7	6.6	31.3	7.6	1.4	9.0	40.9	11.0	51.9
Ports and Airports	3.2	0.0	3.2	0.8	0.0	0.8	3.9	0.0	3.9
Water and Sanitation	4.1	0.0	4.1	2.3	4.3	6.6	9.7	0.0	9.7
Electricity	5.7	0.0	5.7	5.7	0.0	5.7	8.8	0.0	8.8
Telecommunications	0.1	8.1	8.2	0.0	1.4	1.4	0.1	8.2	8.2
Housing	0.0	60.9	60.9	0.6	4.3	4.9	44.7	44.7	89.4
Other	4.5	-3.5	1.1	12.8	-12.2	0.6	6.6	-4.5	2.1
Total	64.0	95.6	159.6	31.4	34.3	65.7	140.1	86.2	226.3

Source: Commonwealth of Dominica Post-Disaster Risk Assessment, November 2017.

1/ Includes mainly replacement cost of structures.

2/ Includes flow losses, typically in terms of output foregone.

3/ Captures the costs of reconstrauction of structures with resilience to natural disasters.

4/ Includes costs for disaster-risk reduction and other cross-cutting costs.

5/ Based on 2016 GDP.

Annex II. CRRP Estimated Cost

Dominica Climate Resilience and Recovery Plan 2020-2030	
Strong Communities	*1.1B*
Initiative	Estimated cost (XCD)
1. Each One, Reach One	11M
2. Responsible Land Stewardship	250K
3.Community Emergency Readiness	25-29M
4. Modern Village Council Initiative	100K
5. Enhanced Social Safety Net	35M
6. Resilient Housing Scheme	1B
7. Kalinago Territory Development Plan	42M
8. National Shelter Plan	Applied to Infrastructure
9. SMART Health Care	Applied to Infrastructure
10. SMART Schools	Applied to Infrastructure
Robust Economy	*218-528M*
Initiative	Estimated cost (XCD)
1. Global Centre for Agricultural Resilience	200-500M
2. Support for Resilient Tourism	100K
3. Rehabilitation of Essential Oils Sector	3-7M
4. Development of High Value Export Sector	10-15M
5. Development of Knowledge and Technology Sector	1-2M
6. Unlocking Local Finance	100K
7. Crowd Funding Platform	100K
8. Venture Capital Investment - Women's Agriculture	1.2M
9. Innovative Approach to Insurance	500K
10. MSME Capacity Building	1M
11. Innovation Award	500K
Well-planned and Durable Infrastructure	*4.6-5.5B*
Initiative	Estimated cost (XCD)
1. Resilient Dominica Physical Plan (RDPP)	36.4M
2. RDPP - (Capital Works Program based on double cost of PDNA damage cost assessment to build back better)	4.5-5.4B
3. Centre of Excellence for Data in Resilience Decision-making	6.75M
4. Procurement Capacity Building	1.35M

Strengthened Institutional Systems	*320-550M*
Initiative	Estimated cost (XCD)
1. Centre of Excellence for Data in Resilience Decision-making	Applied to Infrastructure
2. Resilient Dominica Physical Plan (RDPP)	Applied to Infrastructure
3. Updated Policies & Regulations	400K
4. Revised PSIP Allocation Process and Performance Management Framework	100K
5. Enhanced Disaster Risk Management Agency	8M
6. Government Continuity Plan	200K
Enhanced Collective Consciousness	*4M*
Initiative	Estimated cost (XCD)
1. Koudmen Domnik Volunteer Initiative	2.5M
2. Respect for All	1.5M
3. Community Emergency Readiness Initiative	Applied to Community
Protected and Sustainably Leveraged Natural and other Unique Assets	*93M*
Initiative	Estimated cost (XCD)
1. Blue Economy Investment Fund	20M
2. Geothermal Export	TBC
3. Debt for Nature Swap	Success fee
4. Forest/Ecosystem Audit	2.2M
5. Plant One Million Trees	10M
6. Marine Environment Audit/Plans	2.3M
7. Mangrove Stabilization	2.1M
8. Waste Management	4M
9. Post Disaster Waste Management	2.1M
10. Renewable Energy	30M
11. Museum/Hurricane Experience Knowledge Centre	20.25M
12. Export Resilience in a Box	N/A

Annex 525

"Sovereign Climate Debt Instruments: An Overview of the Green and Catastrophe Bond Markets", *International Monetary Fund*, July 2022

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NOTES

Sovereign Climate Debt Instruments: An Overview of the Green and Catastrophe Bond Markets

Sakai Ando, Chenxu Fu, Francisco Roch, and Ursula Wiriadinata

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IMF Staff Climate Note 2022/004

Sakai Ando, Chenxu Fu, Francisco Roch, and Ursula Wiriadinata*

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Sovereign Climate Debt Instruments: An Overview of the Green and Catastrophe Bond Markets

Sakai Ando, Chenxu Fu, Francisco Roch, and Ursula Wiriadinata
July 2022

Summary

Financial markets will play a catalytic role in financing the adaptation and mitigation to climate change. Catastrophe and green bonds in the private sector have become the most prominent innovations in the field of sustainable finance in the last 15 years. Yet the issuances at the sovereign level have been relatively recent and not well documented in the literature. This note discusses the benefits of issuing these instruments as well as practical implementation challenges impairing the scaling up of these markets. The issuance of these instruments could provide a wider source of stable financing with more favorable market access conditions, mitigate the stress of climate risks on public finances, and facilitate the transition to greener low-carbon economies. Emerging market and developing economies stand to benefit the most from these financial innovations.

Introduction

When it comes to dealing with climate change, fiscal policy is crucial. In addition to the essential carbon pricing that incentivizes low-carbon activities, fiscal policy can aid the transition to a greener low-carbon economy by investing in climate-smart infrastructures, such as renewable energy generation, and encouraging climate-smart technology research and development. Even though these policies would yield substantial long-term economic benefits, they require a substantial amount of financing. The prepandemic research by G20 Foundations Platform calculated that the world needs 2.2 percent of GDP invested annually to deliver commitments from the 2030 Sustainable Development Goals and the Paris Agreement. Furthermore, adapting to the consequences of climate change and minimizing damage from climate-related natural disasters usually necessitates an increase in government spending, among other things, which must be accommodated within a country's overall budgetary structure.

Financial innovation can then play a crucial role in financing these interventions. The development of green and catastrophe bonds has been one of the most important financial breakthroughs in the domain of sustainable finance during the last 15 years. Green bonds are often structured similarly to traditional “plain vanilla” bonds, with the distinction that the bond contains a “use of proceeds” clause stating that the funds would be utilized for green investments. A catastrophe bond is a debt instrument that allows the issuer to get funding from the capital market, if and only if catastrophic conditions, such as a hurricane, occur. Climate change is expected to increase the likelihood and severity of these extreme weather events. Although the two instruments are of different nature, this paper analyzes them together given that both of them can contribute to the resilience to climate risks and have been recently issued at the sovereign level. These innovative finance instruments allow policymakers to tap wider capital markets for the financing of Sustainable Development Goal–related projects (green bonds) and mitigate the stress on debt sustainability after natural disasters (catastrophe bonds). Thus the financial industry is becoming increasingly important in accelerating the transition to sustainability and carbon neutrality.

While green and catastrophe bonds have gained significant popularity, their markets remain fairly shallow at the sovereign level. For instance, sovereign green bonds make up about 0.2 percent of all government debt securities in the Organisation for Economic Co-operation and Development (OECD) area. In emerging market and developing economies (EMDEs), sovereign green bond issuances account for 12 percent of total green bond issuances (OECD 2021). However, the sovereign green bond market is likely to expand as more countries see green bond issuance as a vital tool for demonstrating moral leadership on climate change and sustainability, as well as funding commitments under the Paris Agreement. Similarly, a few countries have insured themselves against natural disasters, and even large catastrophe bonds only cover a small portion of the total possible damage.

The literature on sovereign green and catastrophe bonds is minimal. Since both green and catastrophe bonds issuances at the sovereign level are a recent development, most of the literature on sustainable finance has focused on the issuances by the corporate sector and local governments. This note fills this gap and studies the developing markets for sovereign green and catastrophe bonds, examines the characteristics of these instruments, and analyzes their costs and benefits. Our analysis contributes to the understanding of the markets for climate financing and the workstream of the Fund to help mobilize both public and private finance (see, for instance, IMF 2021a and IMF 2021b).

There are several potential benefits from tapping sovereign climate bond financing, but also limitations and challenges. First, the growing popularity of green bonds may allow governments to issue bonds with longer maturities (given the longer horizon of green projects) and at a lower borrowing cost relative to plain vanilla bonds (the "greenium"). However, there are still several obstacles impairing the further development of the green bond market: lack of an international set of guidelines of what constitutes a green bond, narrow investor base, the risk of fund mismanagement (greenwashing), and little issuances in emerging market and developing economies. Second, catastrophe bonds provide effective insurance against natural disasters and can be considered adaptation policies for the countries with exposure to climate change risks. Yet the note discusses significant barriers to the scale up of the catastrophe bond market: high transaction costs, the requirement of complicated underlying catastrophe models, and a narrow investor base (which could in turn be a consequence of the previous two factors).

The rest of the note is organized as follows. The next section analyzes the sovereign green bond market and estimates the greenium. The note then overviews the sovereign catastrophe bond market and discusses the associated benefits and challenges. A final section offers concluding remarks and policy lessons.

Green Bonds

A wide range of instruments is available for governments to finance green projects. For example, Rose (2021) discusses green bonds as well as other instruments, including green Sukuk, green loans, and green Schuldschein. World Wildlife Fund (2018) describes other examples including equity finance and debt for climate swaps. Among these instruments, the green bond is one of the fastest-growing segments. In this section, we overview sovereign green bonds, highlighting the recent development and policy issues.

What is a green bond?

Green bonds refer to debt securities issued to raise capital earmarked for green projects. The exact definition, however, varies depending on what constitutes green projects. For example, the Green Bond Principles (GBPs), which were established in 2014 and are maintained by the International Capital Market Association (ICMA), provide guidelines and green project categories (ICMA 2021). The Climate Bonds Standards (CBSs), built on top of the GBPs by the Climate Bonds Initiative (CBI), provide a sector-specific definition of "green" and are used for the certification of green bonds by CBI (Climate Bonds Initiative 2019).

For example, the CBSs categorize eligible projects into eight groups: energy, transport, water, buildings, land use and marine resources, industry, waste and pollution control, and information communications and technology.[1] Thus green bonds cover a wide range of environmental activities, some of which could be broader than climate objectives. As reporting requirements, the CBSs ask the issuers to document the use of proceeds, the process for evaluation and selection of projects and assets, and the management of proceeds, both before the issuance and annually after the issuance. A green bond issuer can obtain certification if the issuer pays fees to one of the verifier organizations and it confirms that the CBSs are met. This is, however, a private initiative, so compliance by bond issuers to the CBSs is voluntary.

Green bond data can differ across databases. ICMA (2017) explores four databases (Bloomberg, Environmental Finance, Dealogic, CBI) and discusses the difference in the definitions. For example, Bloomberg tags the "Green Bond" label when an issuer self-labels its bond as green or declares its compliance with the GBPs on the use of proceeds.[2] The Green Bond Database by Environmental Finance lists all bonds that are self-labeled as "Green." Eikon is another database that provides green bond data, whose definition is aligned with the CBSs; the data are reviewed by CBI. Thus the analysis of green bonds, in general, should be understood with caveats on the data. The analysis in this paper relies on Eikon as it is consistent with the CBSs and has been used extensively in the literature of the sovereign green bond (for example, Doronzo, Siracusa, and Antonelli 2021). For sovereign green bonds, Eikon and Bloomberg are comparable.

The public sector has accelerated its development of definition and regulatory framework following private initiatives. For example, the People's Bank of China issued guidelines in 2015 and a catalog in 2021, defining the projects that are eligible for green bond issuance (People's Bank of China 2021). The European Union adopted the regulation of EU taxonomy in 2020 that defines environmentally sustainable economic activities. In 2021, the European Commission proposed the legislation of the European green bond standard (European Commission 2021). Many other countries have issued green bond guidelines and frameworks as summarized by CBI (2022).[3]

Evolution of sovereign green bonds

Sovereign green bonds are a recent phenomenon, starting in 2016. The literature often cites the bond issued by the European Investment Bank in 2007 as the first green bond (Cortellini and Panetta 2021; OECD 2021).[4] Since 2007, international organizations, municipalities, and private sectors have increased the issuance. Until 2015, although the annual issuance of green bonds had reached $40 billion, no issuance by central governments was recorded. In 2016, building on the momentum of the Paris Agreement adopted in 2015, Poland became the first issuer of sovereign green bonds.

A wide range of sovereigns has issued green bonds since 2016. Figure 1, panel 2, shows the green bond in Eikon issued by the central government.[5] The list of green bonds used for the figure is provided in Annex 1. Poland was the first country to issue a sovereign green bond in 2016, followed by France in 2017, and the issuance recorded nearly $80 billion in 2021. Most issuance was by advanced economies until February 2022 (Figure 1, panel 1).[6] Geographically, the cumulative issuance from 2016 to 2021 is mostly concentrated in European countries ($161 billion), followed by Asian Pacific countries ($9 billion), Western hemisphere countries ($8 billion), the Middle East and Central Asian countries (less than $1 billion), and African countries (less than $1 billion).

[1] The high-level explanation of eligible projects in each group is summarized as Climate Bonds Taxonomy, and the detailed definitions are provided by the Sector Eligibility Criteria.

[2] In Bloomberg, green and blue bonds are separate categories.

[3] The details of individual countries' regulations can be found in the Green Finance Platform (2022).

[4] The World Bank issued the first labeled green bond in 2008 (World Bank 2015). Eikon includes older bonds, such as the bond issued by Danske Bank in 1985, as a green bond.

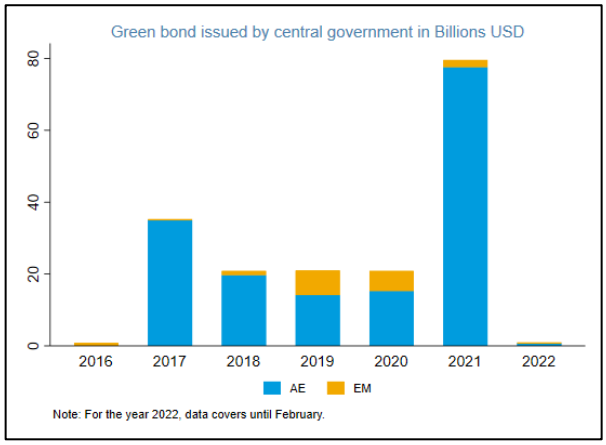
[5] The boundary is restricted to the central government for the calculation of greenium, as discussed later.

[6] Some emerging markets have alternative financing instruments. For example, Indonesia has issued Green Sukuk for a total of US$3.2 billion since 2018.

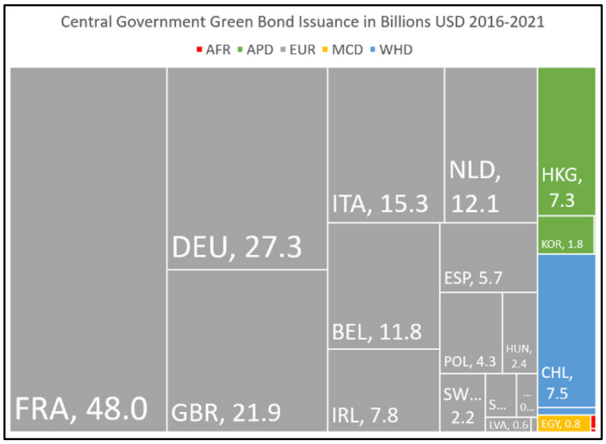
France has issued nearly $48 billion for green projects and is the largest issuer as of February 2022. In terms of cumulative green bond issuance relative to GDP at the country level, Chile has the highest ratio of 2.37 percent (relative to its GDP in 2021). Others are all below 2 percent as of February 2022. The average maturity as of issuance is 12.6 years with a standard deviation of 8.4 years. Although the holder's information is not available from Eikon, Doronzo, Siracusa, and Antonelli (2021) suggest that real money investors, such as pension funds, sovereign funds, and insurance companies, invest their money with a long-term perspective and a buy-and-hold strategy in Europe.

Figure 1. Green bonds issued by central government in billions of US dollars

1. Across years



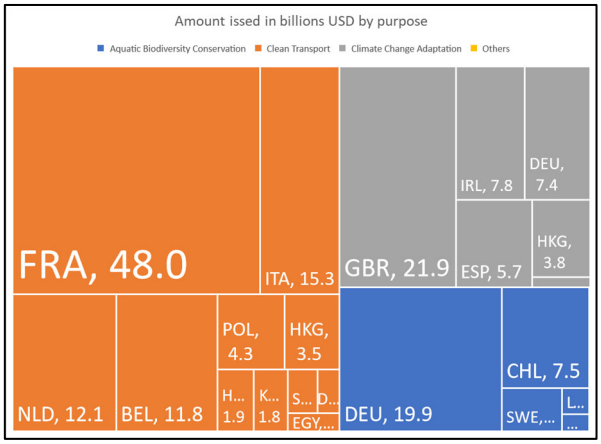
2. Cumulative from 2016-2021



Source: Eikon and IMF staff calculations.

The main purpose of issuing green bonds in the sample is clean transport (Figure 2). The classification of purpose is not necessarily mutually exclusive, but the available data in Eikon shows that clean transport is the main purpose of green bonds. The share of climate change adaptation and aquatic biodiversity conservation is also significant. One caveat is that the purpose of green bonds is classified by Eikon and may not reflect all purposes of each bond issued.

Figure 2. Green bond issued amount by purpose



Source: Eikon and IMF staff calculations.

Costs and benefits of sovereign green bond issuance

Several costs associated with sovereign green bond issuance have been discussed in the literature. For example, Doronzo, Siracusa, and Antonelli (2021) discusses three types of costs relative to the costs of the conventional bond:

1. Green bond requires more disclosure and tracking for the use of proceeds. For example, if a green bond issuer wants certification from CBI, documentation to show that the CBS is met and engagement with verifiers is needed. But more information provision could lead to less uncertainty for buyers, so the net impact is not clear.
2. The reputation of the issuer could be damaged if the green project that the green bonds finance fails or is perceived as greenwashing (falsely claiming that the financed investment is green). The net impact is again ambiguous since the green bond plays the role of a commitment device and thus can lower the probability of failure by motivating better planning and governance of the projects.
3. The issuance of green bonds can crowd out that of conventional bonds, resulting in lower liquidity and higher funding costs for both segments. Doronzo, Siracusa, and Antonelli (2021) summarize Danish and German techniques to mitigate the liquidity problems. For example, the Germany Finance Agency mitigates the impact on the liquidity of conventional bonds by increasing its stock of conventional bonds at the time it issues green bonds by the same amount. The additional own holdings in conventional bonds can be used on the secondary market for repo transactions or for lending activities.

OECD (2021) also points to gaps in supply constraints. A pipeline of green projects needs to be established to sustain the supply and liquidity of the green bonds. OECD (2021) argues that the supply constraints can be mitigated by utilizing technical assistance from experts and aggregation of small-scale projects with securitization.[7] Another obstacle to sovereign green bonds is that most sovereign debt legal frameworks do not allow the earmarking of proceeds.

The literature discusses a wide range of benefits. OECD (2017) points out their reputational benefits and their role as a commitment device, among other benefits. Unlike conventional bonds whose proceeds can be used for general purposes, the proceeds from green bonds need to finance green projects, tying the hands of the issuer. This commitment to finance green projects can send signals and improve the reputation of the issuer, leading to a higher price of the issuer's nongreen bonds (halo effect). For sovereign issuers, Doronzo, Siracusa, and Antonelli (2021) mention that the issuance of sovereign green bonds can encourage other issuers to enter the green bond market as it provides a market benchmark. Doronzo, Siracusa, and Antonelli (2021) also argue that green bonds tend to be issued with a long maturity, so the refinancing risk is lower, and the benefit could be larger for emerging or less-developed countries that have less stable demand for extra-long maturities.

A central benefit associated with green bonds has been labeled as the green premium (greenium). When a green bond exhibits a lower yield compared to a similar conventional bond without the green label, the green bond is said to exhibit positive greenium.

Greenium = yield of similar conventional bond - yield of green bond

A positive greenium implies that the price of the green bond is higher than that of a similar conventional bond.

Theoretically, the greenium can take either positive or negative signs. On one hand, the issuance amount and liquidity are smaller than the conventional bond, which could lead to a negative greenium. On the other hand, environmental, social, and governance investors' demand for green bonds and more information on the use of

[7] OECD (2021) also mentions subsidies for green bond issuing, but it is less relevant for sovereign issuance.

proceeds can justify a positive greenium.[8] Thus whether a green bond is traded at greenium is an empirical question.

The literature on sovereign green bond greenium is limited. Doronzo, Siracusa, and Antonelli (2021) discuss that the evidence of sovereign greenium reported by private financial institutions is mixed and estimate greenium in both the primary and secondary market using Eikon's data. They show that the greenium is negative in the primary market but is slightly positive (0.5 bps) in the secondary market. IMF (2021a, 2021b) shows that the greenium of 5- and 10-year green bonds are around 3 to 5 bps and that the greenium implied by swap spreads from 1 to 7 bps for six EU countries. In the context of the US municipal bonds, Karpf and Mandel (2018) find that the greenium was negative but has turned positive recently, suggesting that green bonds have become more attractive to investors in recent years. Baker and others (2021) also find that the greenium is positive except when it is issued simultaneously with ordinary bonds from the same issuer; in that case, a premium emerges over time on the secondary market.

How large is the sovereign greenium?

Since the literature on the sovereign green bond is scarce, this section provides greenium estimates. We first present the result of Germany since it issues twin bonds for the purpose of measuring greenium. For other countries, we impose additional assumptions and estimate the greenium.[9]

Germany

Germany has issued twin bonds since 2020 to provide a benchmark of greenium. Twin bonds consist of a conventional bond and a green bond that share the same maturity date and coupon. The main difference is that the use of proceeds from the green bond is limited to green projects. They are, however, also different in that the green bond's issuance volume is smaller and the issuance date is later. For example, in the twin bonds with maturity in 2030, the conventional bond was issued in August 2019 with a size of €30 billion, while the green bond was issued in May 2021 with a size of €6 billion. Through the issuance of twin bonds, Germany aims to establish the yields of green federal securities as the reference for the Euro green finance market (German Finance Agency 2022).

Germany's greenium oscillated between 2 to 5 basis points. As of February 2020, four twin bonds are on the market with maturity dates in 2025, 2030, 2031, and 2050. Coupons are zero for all bonds. Figure 3 shows that although the behavior of greenium differs across maturity dates and yields of the twin bonds can be positive or negative, the greenium is consistently positive.[10] The greenium does not seem to react much to large uncertainty shocks such as the Russian invasion of Ukraine in February 2022.

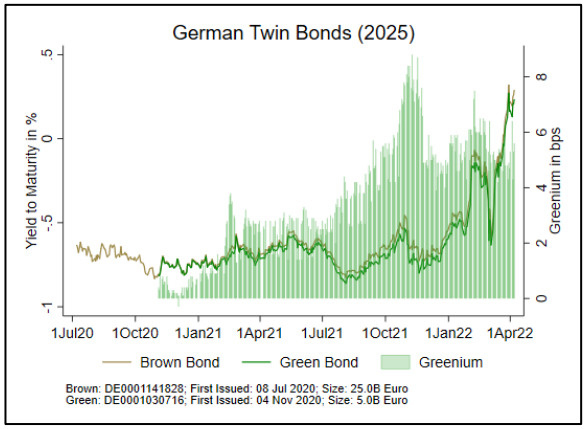
[8] Demand could be driven by the pure interest in Sustainable Development Goal investment or by regulations. In the former case, greenwashing is a concern that could reduce demand. The development of KPIs and penalties in the contract design can help mitigate the concern. In the latter case, the optimal level of market intervention becomes a policy issue. From an issuer perspective, the greenium should not exist given that the default probability is the same as conventional bonds.

[9] Note that the estimation could be subject to selection bias, as countries may not issue the green bonds if the greenium is expected to be negative.

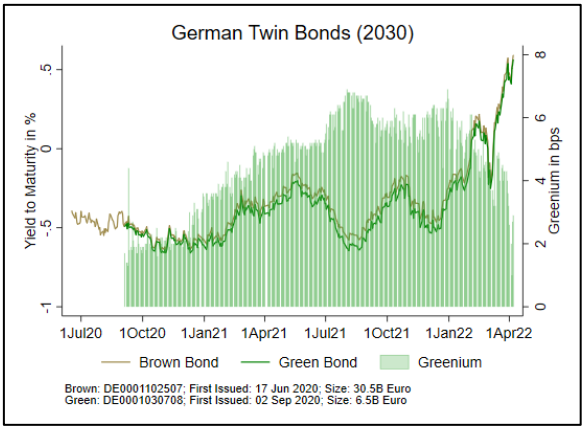
[10] The finance agency facilitates switch trades where investors can exchange their green bonds for the conventional twin.

Figure 3. Germany's Twin Bonds by Tenor

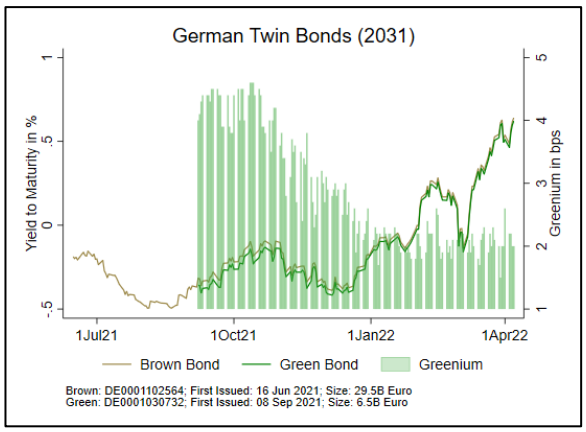
1. The greenium was small at issuance but has increased



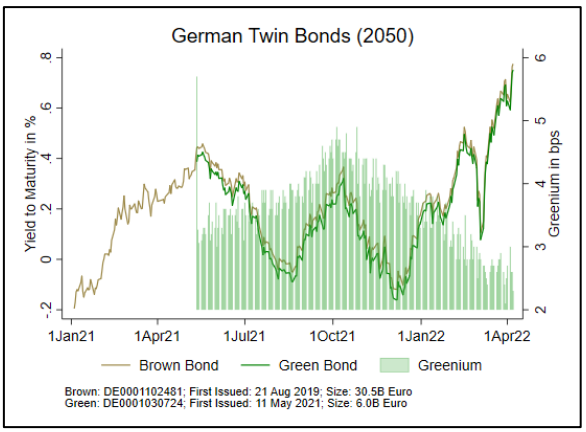
2. The greenium at issuance was high and is increasing



3. The greenium has been declining for 2031 maturity



4. The greenium increased first but has declined recently



Source: Eikon.

Other countries

Since twin bonds are not available in other countries, greenium needs to be estimated with a different approach. The rest of the section presents summary statistics of green versus conventional bonds, and greenium estimates using regression analysis.

Summary statistics of green versus conventional bonds. Annex Table 3.1 in Annex 3 shows the summary statistics of issuance size, yield-to-maturity, spread, and maturity of the green and conventional bonds in the sample, separately for advanced and emerging market and developing economies. Annex Tables 3.2 and 3.3 show the statistics for euro- and USD-denominated bonds, respectively.

- *Issuance size.* Green bond issuance is still relatively small, about 2.0 percent of the total issuance (2016–2022 average), but growing over time from 2.6 percent in 2018 to 3.2 percent in 2021. The share of green bond issuance and its growth are larger for emerging market and developing economies than advanced economies.

- *Maturity.* In the whole sample, the average maturity is 12.9 years for green bonds and 12.3 years for conventional bonds. This pattern is consistent with the idea that green bonds help countries extend their debt maturity profiles. The longer maturity of green bond debt is more pronounced in emerging market and developing countries; the difference is almost three years for EMDEs.
- *Yield.* The summary statistics already indicate a degree of greenium: the average yield of green bonds is lower than conventional bonds. The regression analysis will better estimate the size of the greenium, by controlling for relevant variables such as maturity and liquidity.

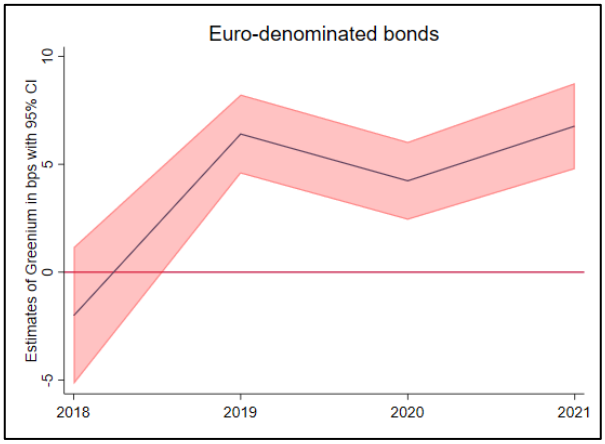
Greenium estimate. The average greenium is 3.7 and 30.4 basis points for euro- and USD-denominated bonds, respectively, as shown in Annex Table 3.4.[11] The difference is partly explained by the fact that a larger portion of USD-denominated green bonds is issued by emerging markets. Also note that the sample sizes of the two groups differ by around five folds.

Greenium is larger for emerging market and developing economies than advanced economies, for all currencies of debt denomination. Specifically, the greenium estimates for emerging markets are 49.3 and 12.5 basis points for the USD- and euro-denominated bonds, respectively, compared to 5 to 6 basis points for advanced economies as shown in Annex Table 3.5. There can be various reasons behind the difference, and formal analysis of the determinants with richer data is warranted and left for future research.

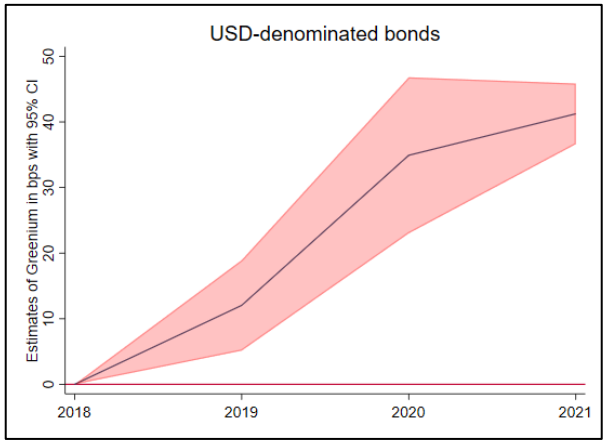
Time-series variation. Figure 4 plots the estimated greenium separately for euro-denominated and USD-denominated bonds in each year, from 2018 to 2021. The greenium of both USD- and euro-denominated bonds—though they started small—has been increasing over time. In the case of euro-denominated bonds, the greenium increased from on average –2.0 basis points in 2018 to 6.8 basis points on average in 2021.

Figure 4. Greenium Estimate

1. Estimated greenium of euro-denominated bonds



2. Estimated greenium of USD-denominated bonds



Sources: Eikon; and IMF staff calculations.

[11] The greenium estimates are robust to alternative estimation approaches (see Annex 3).

Catastrophe Bonds

Extreme weather is expected to be one of the consequences of climate change, and will result in both physical and fiscal damage. There are many ways to mitigate fiscal risks that originate from extreme weather events. For example, OECD and World Bank (2019) list both ex ante and ex post financing tools to mitigate the fiscal risks (Table 1).[12] Debt with maturity extension provisions such as hurricane clauses is another alternative.[13] A debt instrument with a unique structure is catastrophe bonds.

Table 1. Examples of Mitigation Tools for Residual Fiscal Risk

Ex Ante Financing	Ex Post Financing
Dedicated reserve fund	Budget reallocation
Contingency budget	Debt financing
Contingent financing (credit/grant)	Taxation
Sovereign risk transfer	Multilateral/international borrowing
Insurance of public assets	International aid
Catastrophe bonds	

Source: Organisation for Economic Co-operation and Development and World Bank (2019).

What is a catastrophe bond?

A catastrophe bond is a debt instrument that allows the cedent (the insured) to get funding from the capital market, if and only if catastrophic conditions, such as an earthquake or hurricane, occur. From an economic point of view, the instrument insures the cedent against the loss from catastrophic events (called peril) by shifting risks to the holders who bet on the nonoccurrence of catastrophic events. The insurance against natural disasters can be considered an adaptation policy for countries with exposure to climate change risks.[14]

The catastrophic conditions can be defined by various types of triggers. For example, a trigger based on actual monetary losses experienced by the cedent is called an indemnity trigger, the one based on industrywide losses is called an industry loss trigger, and the one based on noneconomic catastrophic conditions such as the magnitude of an earthquake or wind speed of a hurricane is referred to as parametric index trigger. The advantage of indemnity type is that it insures cedents against the actual loss, while a disadvantage is time-consuming loss verification since the damages need to be assessed. In contrast, the parametric type may not insure cedents against the amount of actual loss, but it has the advantage of speedy settlement since parameters such as wind speed and magnitude of an earthquake are easier to measure. The idea can be extended to noncatastrophic conditions, such as mortality rates, in which case the concept of catastrophe bonds is generalized to insurance-linked securities (ILS).

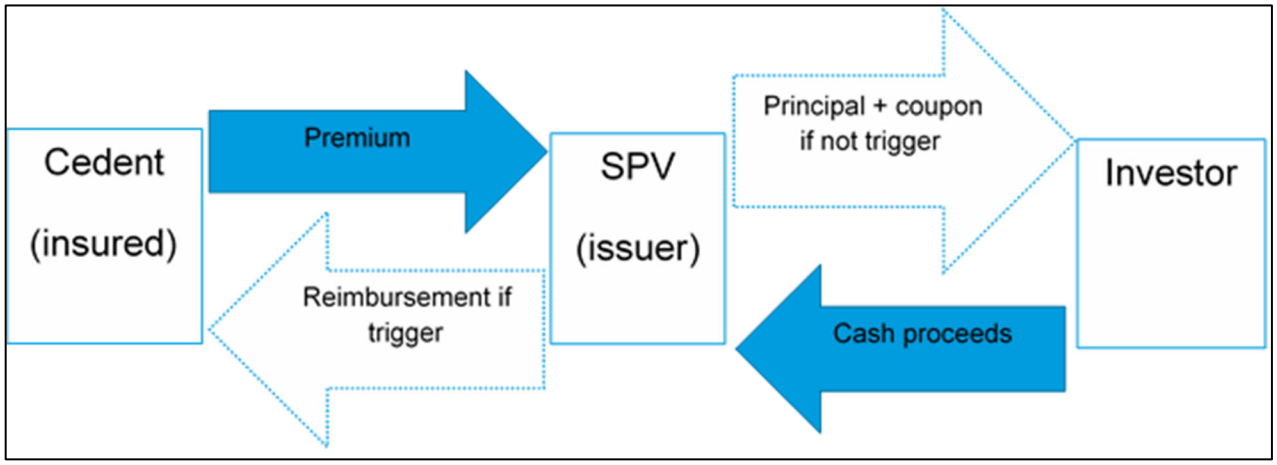
The legal structure of a typical catastrophe bond is designed to minimize counterparty risk. Specifically, a special purpose vehicle (SPV) is set up, and the cedent (often called the sponsor) enters an insurance agreement with the SPV. Cedents pay premiums upfront in exchange for future reimbursement conditional on catastrophic events. The SPV issues catastrophe bonds to the holders in exchange for cash, promising future principal and interest payments conditional on the nonoccurrence of catastrophic events. Thus, what an SPV does is to collect cash from cedent and investors, keep the cash typically in safe assets, and disburse it to either cedent or investors depending on the occurrence of catastrophic events. In this way, an SPV can secure the cash for later distribution, and who owns the bond does not affect the capacity to pay cedents, so the bond can be traded in the secondary market (Figure 5).

[12] IMF (2019) also discusses building resilience in developing countries vulnerable to large natural disasters.

[13] See Cohen and others (2020) for a discussion.

[14] Catastrophe bonds, however, are not considered green bonds by CBI. See https://www.climatebonds.net/cat-or-out.

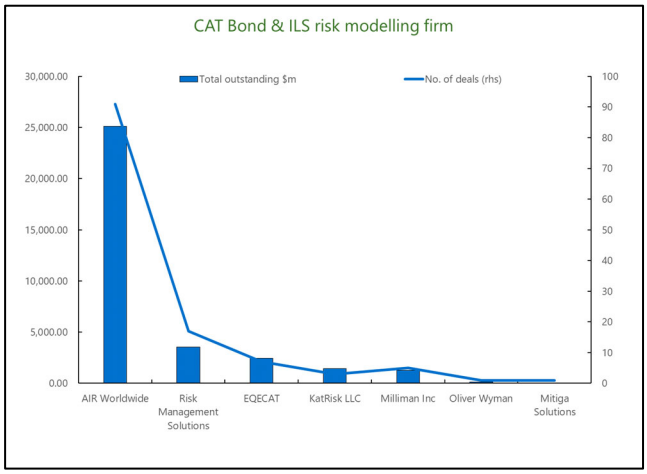
Figure 5. Legal structure of catastrophe bonds



Source: IMF staff.
Note: SPV = special purpose vehicle.

The legal structure has financial, statistical, and economic implications. Financially, the catastrophe bond is insulated from the cedent's financial condition, so the credit rating is different from that of the cedent. Statistically, the catastrophe bond is issued by the SPV and not by the cedent, so the cedent's debt does not increase. Economically, the cash proceeds are kept by the SPV, so they cannot be used by the cedent to spend on items including consumption, investment, etc., until triggered.

Figure 6. CAT bond and ILS risk modelling



Source: Artemis.

A notable difference from the traditional bond is the modeling of catastrophe risks (Figure 6). In addition to credit ratings, the risk modeling is prepared by a third-party risk modeler, such as AIR Worldwide (or Verisk), and the results including the expected loss are disclosed in the bond's offering documentation. Investors can ask questions to the modeler in the marketing process of the bond, and they often have their own modeling team to assess the risks. The modeler also calculates the actual loss after catastrophe events. The modeling often

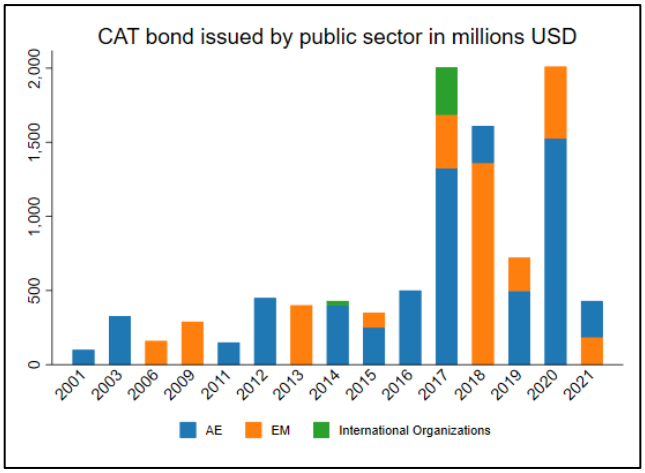
involves the assessment of extreme but nontail events since many catastrophe bonds are structured in the way that investors incur loss only if the loss from catastrophic events exceeds a certain threshold (attachment point), and the investors' loss is bounded by the principal (exhaustion point) (White 2020). The typical maturity is three to five years, so the long-term impact of climate change risks may not be fully reflected.[15]

Evolution of sovereign catastrophe bonds

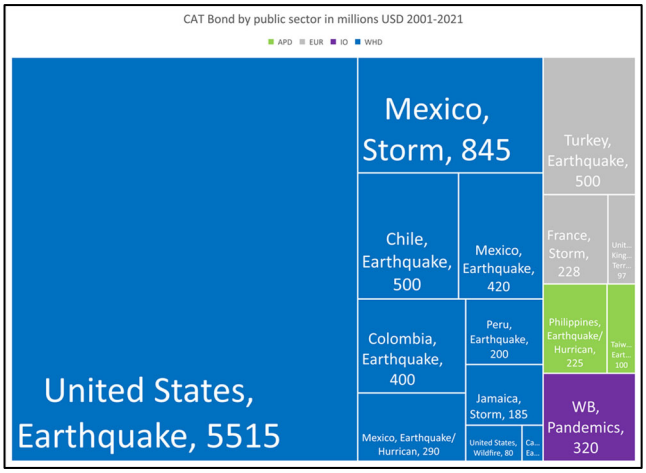
The catastrophe bond issuance by the public sector is increasing over time. Figure 7, panel 1, shows that the nominal amount of issuance is in an upward trend. This is also the case for the number of cedent countries. The largest player is the United States, accounting cumulatively for nearly $5.6 billion, followed by Mexico, Chile, Turkey, etc. Some of them, including the California Earthquake Authority, are local state agencies, but the central governments themselves can be the cedents, including the recent examples of Jamaica (2021), Mexico (2020), and the Philippines (2019). The list of the catastrophe bonds used in the analysis is provided in Annex 2.

Figure 7. CAT bond issued amount in millions of US dollars

1. Across years



2. Breakdown by purposes and countries



Source: Artemis.

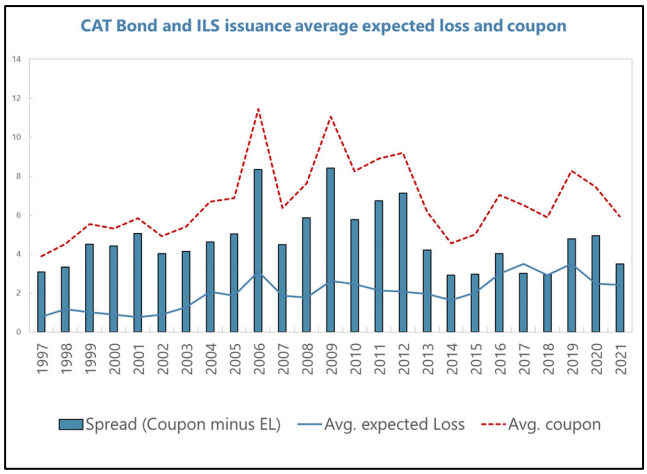
The perils covered by public sector catastrophe bonds have been mainly US earthquakes (Figure 7, panel 2). However, climate-related catastrophic events such as storms and hurricanes also constitute a significant share. Importantly, pandemics can be the perils: in 2017, the World Bank issued a five-year coverage, and then received payment for the COVID-19 pandemic.

Pricing of sovereign catastrophe bonds

Empirically, the cedents pay more than they receive in expectation. According to Artemis, from which only the aggregated data of private and public catastrophe bonds is available, the investors' average return to catastrophe bond in coupon is around 2 to 4 times the expected loss (Figure 8). Difiore, Drui, and Ware (2021) note that risk spreads have widened materially following major catastrophes in the past, such as 2006 following a US hurricane and 2012 following earthquakes in Japan and New Zealand.

[15] If innovation in climate models would allow for a longer forecast horizon, then maturities could potentially be longer.

Figure 8. CAT bond and ILS issuance average expected loss and coupon



Source: Artemis.

Whether the positive spread is expensive depends on the benchmark to compare. For example, self-insurance can save the coupon payment to investors, and thus can be an inexpensive alternative. The cash, however, needs to be stored in a dedicated fund and cannot be used for other illiquid purposes. Therefore, for countries with large opportunity costs, self-insurance can be more expensive than catastrophe bonds. A comparison can also be made with traditional reinsurance. Michael-Kerjan and others (2011) argue that the premiums that traditional reinsurance charges range from 3 to 5 times the expected loss, which is not very different from catastrophe bonds.[16]

Some literature argues that the catastrophe bond market is inefficient. In theory, the premium that cedents pay should be independent of the cedents' credit risks since the SPV stores and disburses cash. Chatoro, Pantelous, and Shao (2021) and Gotze and Gurtler (2020), however, argue that, in both the primary and secondary markets, the risk premium depends on the cedent's characteristics, such as the cedent's length of the time in the market, credit ratings, etc. Thus, new cedents can face challenges not only due to positive spread but also due to higher premiums than other experienced cedents.

Intermediation by the World Bank has mitigated the challenges that countries face in utilizing catastrophe bonds. Since 2016, all the sovereign catastrophe bonds in the data set compiled by Artemis have been intermediated by the World Bank. By providing the service of an SPV, the World Bank simplifies the procurement process as setting up an offshore SPV could be a legal barrier for countries. Anecdotally, the reputation and experience of the World Bank also contribute to narrowing the spread. Thus, catastrophe bond issuance through the World Bank offers an attractive venue for the countries that seek insurance against natural disasters. For example, a case study by the World Bank on its collaboration with Mexico can be found in World Bank (2020a).

[16] The problem may also not be specific to the ILS market. Cohen and others (2020) discuss that GDP-linked warrants, a variant of state-contingent debt based on the performance of GDP, are undervalued by investors.

Holder of sovereign catastrophe bonds

Although the holders' information is scarce, it is available for some catastrophe bonds intermediated by the World Bank. Table 2 summarizes the investor information from three recent issuances (World Bank 2019, 2020b, 2021). Most investors are in Europe, and the type of investors are concentrated on institutional investors with expertise such as ILS funds and insurance companies.

Table 2. Holders of Recent Sovereign Catastrophe Bonds

Cedent (issuance year)	By Geography	By Investor Type
Jamaica (2021)	Europe 60% North America 24% Bermuda 15% Asia 1%	ILS fund 66% Insurer/reinsurer 17% Asset management 14% Pension fund 3%
Mexico (2020)	Europe 52% North America 42% Bermuda 5% Asia 1%	ILS specialist fund 61% Asset management 16% Pension fund 15% Insurer/reinsurer 8%
Philippines (2019)	Europe 58% North America 25% Asia 13% Bermuda 4%	Asset management 50% ILS fund 29% Insurer/reinsurer 13% Pension fund 8%

Source: World Bank.
Note: ILS = insurance-linked securities.

Broadening the investor base to the public sector can help correct the market failure of climate change and improve crisis management. Since climate change has a heterogeneous impact on different regions on the earth, the cost of climate change in one region may not be internalized by other regions. Investing in catastrophe bonds can be an effective mechanism to internalize climate risks that are physically far away from the investors. In other words, by investing in catastrophe bonds, governments can show commitment by putting their "skin in the game" while earning a positive return on average. From a crisis management perspective, countries often pledge financial support after natural disasters in other regions, but aid pledges made while media attention is at its peak may not always be disbursed, could take a long time to arrive, or may replace previously pledged aid (Becerra, Cavallo, and Noy 2012). For example, the US Government Accountability Office (2011) reports that, 20 months after the 2010 Haiti earthquake, only 0.8 percent of the $412 million that the US government pledged for infrastructure construction activities was expensed. Catastrophe bonds offer an ex ante mechanism for countries to pledge financial support for natural disasters and timely disburse funds in catastrophic events.[17]

[17] Ex ante capacity building of the recipient countries is crucial to prevent corruption related to the disbursed funds.

Conclusions

Financial markets will play a catalytic role in financing the adaptation and mitigation to climate change. While catastrophe and green bonds in the private sector have become the most prominent innovations in the field of sustainable finance in the last 15 years, the issuances at the sovereign level have been relatively recent and not well documented in the literature. This note filled this gap by presenting an overview of the development of markets for these instruments, as well as discussing their benefits and the barriers for further development.

Sovereign green bonds can provide various benefits for issuers but also face several challenges. The demand for green instruments can potentially allow governments to issue bonds with a longer maturity (as green projects are long-term projects) and to borrow at lower costs. While the estimated greenium in this note is not large, it has been increasing over time alongside the level of sovereign green bond issuances. Whether the administrative costs associated with green bond issuance exceed the benefit is a country-specific question, but strengthening peer learning and climate information architecture could help reduce the costs and increase the benefits over time (Ferreira and others 2021). It remains an open question whether the purpose of the project associated with the green bond is a key determinant of the greenium, and whether green bonds have resulted in the climate outcomes they intended to achieve. The further development of the green bond market could be facilitated by improving transparency and creating clearer national guidelines and standards relating to eligibility and green definitions.

Sovereign catastrophe bonds are an effective tool to transfer risks to bond investors amid the increasing frequency of natural disasters due to climate change. However, this note has identified several obstacles to the more widespread use of catastrophe bonds. These challenges include their high transaction costs and limited investor base. Catastrophe bond issuance through the World Bank has mitigated some of these barriers and offers an attractive venue for the countries that seek insurance against natural disasters and could also help in broadening the investor base. Although fiscally constrained climate-vulnerable economies face the tradeoff between investing in resilience-enhancing adaptation and buying catastrophe bonds, one should note that the former could reduce the disaster risks, and thus the premium for the catastrophe bonds, and the latter could improve financial sustainability for the former. In this sense, green and catastrophe bonds can complement each other, and policymakers need to optimize their use.

Emerging and developing economies should work to foster larger sovereign issuances of these new instruments as they are the most susceptible to climate change. In the case of green bonds, a greater issuance (with appropriate institutions to prevent greenwashing) would facilitate the financing of climate-related projects and, hence, the transition to greener low-carbon economies. Moreover, increasing the size of the market could make the greenium more sizable, as observed in advanced economies. EMDEs usually face higher premiums and volatility in regular bond markets and thus stand to benefit greatly from green bond issuance by tapping the wider capital markets at reasonable rates. In turn, catastrophe bonds could be critical for EMDEs which face the highest climate risks but still feature low adaptive capacities. Strengthening countries' debt absorption capacity is an important necessary condition to leap the gains from these financial instruments given the large climate finance needs. Overall, the issuance of green bonds seems to be a potentially useful resource for EMDEs at high risk of climate change that need to undertake large green mitigation projects (which may be the reason behind the larger greenium for these countries), while catastrophe bonds seem more appropriate for countries which are already exposed to natural disasters or those in which climate change is expected to increase the likelihood and severity of these events (such as small islands). Finally, although these new instruments could contribute to deepening financial development, LICs and EMDEs with weak fundamentals tend to have limited access. For these countries, combining financial innovation with more traditional support from the international community in the form of grants and equity financing would be useful.

Annex 1. List of Green Bonds Used in the Analysis

From Eikon, there were 50 sovereign green bonds as of March 2022. One thing to note is that there might be two International Securities Identification Numbers for the same bond from Eikon since one International Securities Identification Number is under 144A and another is under Reg S in the United States, despite the same underlying security. There are seven cases in our sample (four for Hong Kong, one for Egypt, one for Serbia, and one for Sweden), which are excluded from Annex Table 1.1. Alternatively, one can filter them out by keeping only bonds that are not privately placed.

Annex Table 1.1. List of sovereign green bonds

	Issuer	Coupon	Maturity	Issue Date	International Securities Identification Number	Principal Currency	Amount Issued (USD million)
1	Belgium	1.25	4/22/2033	3/5/2018	BE0000346552	Euro	11,828
2	Chile	3.5	1/25/2050	6/25/2019	US168863DL94	US dollar	2,318
3	Chile	0.83	7/2/2031	7/2/2019	XS1843433639	Euro	2,231
4	Chile	2.55	1/27/2032	1/27/2020	US168863DN50	US dollar	1,500
5	Chile	1.25	1/29/2040	1/29/2020	XS2108987517	Euro	1,448
6	Colombia	7	3/26/2031	9/29/2021	COL17CT03797	Colombian peso	374
7	Denmark	0	11/15/2031	1/21/2022	DK0009924375	Danish krone	763
8	Egypt	5.25	10/6/2025	10/6/2020	US038461AS83	US dollar	750
9	Fiji	4	11/1/2022	11/1/2017	FJ0406990624	Fijian dollar	9
10	Fiji	6.3	11/1/2030	11/1/2017	FJ0406990632	Fijian dollar	38
11	France	1.75	6/25/2039	1/31/2017	FR0013234333	Euro	35,087
12	France	0.5	6/25/2044	3/23/2021	FR0014002JM6	Euro	12,930
13	Germany	0	8/15/2030	9/9/2020	DE0001030708	Euro	7,371
14	Germany	0	10/10/2025	11/6/2020	DE0001030716	Euro	5,707
15	Germany	0	8/15/2050	5/18/2021	DE0001030724	Euro	6,804
16	Germany	0	8/15/2031	9/10/2021	DE0001030732	Euro	7,371
17	Hong Kong	2.5	5/28/2024	5/28/2019	US43858AAB61	US dollar	1,000
18	Hong Kong	0.625	2/2/2026	2/2/2021	US43858AAC45	US dollar	1,000
19	Hong Kong	1.375	2/2/2031	2/2/2021	US43858AAD28	US dollar	1,000
20	Hong Kong	2.375	2/2/2051	2/2/2021	US43858AAE01	US dollar	500
21	Hong Kong	0	11/24/2026	11/24/2021	HK0000789849	Euro	1,427
22	Hong Kong	1	11/24/2041	11/24/2021	HK0000789856	Euro	571
23	Hong Kong	1.75	11/24/2031	11/24/2021	HK0000789823	US dollar	1,000
24	Hong Kong	2.8	11/30/2024	11/30/2021	HK0000789864	Chinese yuan	394
25	Hong Kong	3	11/30/2026	11/30/2021	HK0000789872	Chinese yuan	394
26	Hungary	1.75	6/5/2035	6/5/2020	XS2181689659	Euro	1,701
27	Hungary	1.03	9/17/2027	9/18/2020	JP534800CL92	Japanese yen	136
28	Hungary	1.29	9/18/2030	9/18/2020	JP534800DL91	Japanese yen	39
29	Hungary	4	4/28/2051	4/28/2021	HU0000404991	Hungarian forint	301
30	Hungary	3.28	12/16/2024	12/14/2021	CND10004QFJ7	Chinese yuan	157
31	Hungary	4.5	5/27/2032	1/26/2022	HU0000405535	Hungarian forint	66
32	Ireland	1.35	3/18/2031	10/17/2018	IE00BFZRQ242	Euro	7,816

33	Italy	1.5	4/30/2045	3/10/2021	IT0005438004	Euro	15,309
34	Korea	2.5	6/19/2029	6/19/2019	US50064FAQ72	US dollar	1,000
35	Korea	0	10/15/2026	10/15/2021	XS2376820259	Euro	799
36	Latvia		1/23/2030	12/13/2021		Euro	566
37	Lithuania	1.2	5/3/2028	5/3/2018	LT0000610305	Euro	78
38	Netherlands	0.5	1/15/2040	5/23/2019	NL0013552060	Euro	12,143
39	Nigeria	13.48	12/22/2022	12/22/2017	NGFGB2022S13	Nigerian naira	26
40	Nigeria	14.5	6/13/2026	6/13/2019	NGFGB2026S27	Nigerian naira	36
41	Poland	0.5	12/20/2021	12/20/2016	XS1536786939	Euro	851
42	Poland	1.125	8/7/2026	2/7/2018	XS1766612672	Euro	1,134
43	Poland	1	3/7/2029	3/7/2019	XS1958534528	Euro	1,701
44	Poland	2	3/8/2049	3/7/2019	XS1960361720	Euro	571
45	Serbia	1	9/23/2028	9/23/2021	XS2388558889	Euro	1,134
46	Seychelles	6.5	10/11/2028	10/11/2018	XS1885544236	US dollar	15
47	Spain	1	7/30/2042	9/14/2021	ES0000012J07	Euro	5,670
48	Sweden	0.125	9/9/2030	9/9/2020	XS2226974413	Swedish krona	2,218
49	United Kingdom	0.875	7/31/2033	9/22/2021	GB00BM8Z2S21	British pound	13,673
50	United Kingdom	1.5	7/31/2053	10/22/2021	GB00BM8Z2V59	British pound	8,204

Annex 2. List of Public Sector Catastrophe Bonds

Annex Table 2.1 summarizes the catastrophe bonds whose cedents belong to the public sector. We thank Artemis.bm for its generosity to allow us to use the data. The identification of public sector is based on reading the description one by one.

Annex Table 2.1. List of public sector catastrophe bonds

	Issuer	Cedent	Risks/Perils Covered	Size	Date	Cedent Country	Central Government
1	Western Capital Ltd.	California Earthquake Authority	California earthquake risks	$100m	Feb-01	United States	0
2	Formosa Re Ltd.	Taiwan Residential Earthquake Insurance Pool	Taiwan earthquake	$100m	Aug-03	Taiwan	0
3	Pylon Ltd.	Electricité de France (EDF)	European windstorm	$228m	Dec-03	France	0
4	CAT-Mex Ltd.	FONDEN	Mexico earthquake	$160m	May-06	Mexico	1
5	MultiCat Mexico 2009 Ltd.	FONDEN (Fund for Natural Disasters)	Mexico hurricane, Mexico earthquake	$290m	Oct-09	Mexico	1
6	Embarcadero Re Ltd. (Series 2011-1)	California Earthquake Authority	California earthquake	$150m	Aug-11	United States	0
7	Embarcadero Re Ltd. (Series 2012-1)	California Earthquake Authority	California earthquake	$150m	Jan-12	United States	0
8	Embarcadero Re Ltd. (Series 2012-2)	California Earthquake Authority	California earthquake	$300m	Jul-12	United States	0
9	Bosphorus 1 Re Ltd.	Turkish Catastrophe Insurance Pool	Turkey earthquake	$400m	Apr-13	Turkey	0
10	World Bank – CCRIF 2014-1	Caribbean Catastrophe Risk Insurance Facility (CCRIF)	Caribbean hurricane and earthquake	$30m	Jun-14	Caribbean	0
11	Ursa Re Ltd. (Series 2014-1)	California Earthquake Authority	California earthquake	$400m	Dec-14	United States	0
12	Bosphorus Ltd. (Series 2015-1)	Turkish Catastrophe Insurance Pool	Turkey earthquake	$100m	Aug-15	Turkey	0
13	Ursa Re Ltd. (Series 2015-1)	California Earthquake Authority	California earthquake	$250m	Sep-15	United States	0
14	Ursa Re Ltd. (Series 2016-1)	California Earthquake Authority	California earthquake	$500m	Nov-16	United States	0
15	Ursa Re Ltd. (Series 2017-1)	California Earthquake Authority	California earthquake	$925m	May-17	United States	0

16	IBRD CAR 111-112 – World Bank pandemic catastrophe bond	Pandemic Emergency Financing Facility (PEF)	Pandemics	$320m	Jul-17	WB	0
17	IBRD / FONDEN 2017	FONDEN / AGROASEMEX S.A	Mexico earthquakes, Mexico named storms	$360m	Aug-17	Mexico	1
18	Ursa Re Ltd. (Series 2017-2)	California Earthquake Authority	California earthquake	$400m	Nov-17	United States	0
19	IBRD CAR 117	Republic of Colombia	Colombia earthquake	$400m	Feb-18	Colombia	1
20	IBRD CAR 120	Republic of Peru	Peru earthquake	$200m	Feb-18	Peru	1
21	IBRD CAR 118-119	FONDEN / AGROASEMEX S.A.	Mexico earthquake	$260m	Feb-18	Mexico	1
22	IBRD CAR 116	Republic of Chile	Chile earthquake	$500m	Feb-18	Chile	1
23	Ursa Re Ltd. (Series 2018-1)	California Earthquake Authority	California earthquake	$250m	Sep-18	United States	0
24	Baltic PCC Limited (Series 2019)	Pool Re	Terrorism risk	$97m	Feb-19	United Kingdom	0
25	IBRD CAR 123-124	Republic of the Philippines	Philippine earthquakes and tropical cyclones	$225m	Nov-19	Philippines	1
26	Ursa Re Ltd. (Series 2019-1)	California Earthquake Authority	California earthquake	$400m	Nov-19	United States	0
27	IBRD / FONDEN 2020	FONDEN / AGROASEMEX S.A.	Mexico earthquakes, Mexico named storms	$485m	Mar-20	Mexico	1
28	Sutter Re Ltd. (Series 2020-1 & 2020-2)	California Earthquake Authority	California earthquake	$700m	May-20	United States	0
29	Ursa Re II Ltd. (Series 2020-1)	California Earthquake Authority	California earthquake	$775m	Oct-20	United States	0
30	Power Protective Re Ltd. (Series 2020-1)	Los Angeles Department of Water & Power	California wildfire	$50m	Dec-20	United States	0
31	Ursa Re II Ltd. (Series 2021-1)	California Earthquake Authority	California earthquake	$215m	Mar-21	United States	0
32	IBRD CAR 130	Government of Jamaica	Jamaica named storms	$185m	Jul-21	Jamaica	1
33	Power Protective Re Ltd. (Series 2021-1)	Los Angeles Department of Water & Power	California wildfire	$30m	Oct-21	United States	0

Annex 3. Summary Statistics and Greenium Estimation

Annex Table 3.1. Summary statistics for main variables

YTM		Panel A: EMs							Panel B: AEs						
		2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	Mean	6.88	6.76	7.51	6.97	6.85	7.56	8.78	1.27	1.67	1.68	1.03	0.59	0.50	0.68
	SD	0.12	4.44	5.18	5.02	5.07	5.42	4.95	0.83	1.07	1.06	0.99	0.81	1.00	1.01
Green	Mean			4.91	3.82	2.09	2.48	2.83			1.20	0.90	0.37	0.62	1.08
	SD			5.88	4.78	2.16	2.59	2.31			0.06	0.81	0.69	0.92	1.02

Zspread in bps		Panel A: EMs							Panel B: AEs						
		2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	mean	471.4	335.3	328.1	367.2	437.4	298	305.4	22.93	55.55	52.03	53.08	53.06	26.2	20.99
	sd	10.49	175.7	192	208.9	315.3	258	313.9	38.15	75.28	84.86	71.94	65.58	71.17	53.16
Green	mean			66.09	114.3	151.9	152.9	147.6			9.1	22.32	22.51	6.16	-3.78
	sd			104.2	124.5	144.1	191.8	176.2			19.27	31.64	38.13	47.39	68.27

Bid-ask spread		Panel A: EMs							Panel B: AEs						
		2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	mean	0.14	0.12	0.15	0.12	0.17	0.2	0.24	0.04	0.06	0.07	0.07	0.07	0.06	0.07
	sd	0.02	0.08	0.09	0.06	0.1	0.12	0.13	0.01	0.04	0.04	0.04	0.04	0.04	0.05
Green	mean			0.04	0.05	0.07	0.09	0.1			0.06	0.04	0.04	0.04	0.05
	sd			0.02	0.02	0.05	0.1	0.11			0.04	0.04	0.04	0.03	0.05

Tenor		Panel A: EMs							Panel B: AEs						
		2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	mean	10	12.83	11.7	11.37	10.59	9.32	8	8.25	16.38	15.3	15.23	14.78	14.93	13.51
	sd	2.01	8.28	7.69	7.9	8.13	8.57	8.38	2.22	12.04	12.2	12.8	14.54	16.61	16.98
Green	mean			8.12	14.06	14.94	14.35	14.15			12.79	12.28	11.77	13.81	13.02
	sd			1.8	9.34	8.59	8.73	8.77			2.32	4.49	4.81	7.94	8.07

Amount USD Billions	Panel A: EMs							Panel B: AEs						
	2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	5.28	53.49	82.14	86.54	138.3	230.3	19.85	47.99	798.4	706.2	881	1205	1584	238
Green		0.03	1.16	6.84	5.59	1.45	0.07			19.85	14.26	15.35	58.81	
Total	5.28	53.52	83.3	93.38	143.9	231.8	19.92	47.99	798.4	726.1	895.3	1220	1642	238

Source: Eikon and IMF staff calculations.

Note: AEs = advanced economies; EMs = emerging markets.

Annex Table 3.2. Euro-denominated Bonds

YTM in %		Panel A: EMs							Panel B: AEs						
		2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	Mean		2.65	2.99	2.71	2.42	1.86	2.26	0.76	1.6	1.55	0.86	0.41	0.21	0.38
	SD		1.01	1.81	1.92	2.27	1.77	2.16	0.7	1.14	1.09	1.02	0.79	0.91	0.85
Green	Mean			1	0.62	0.74	0.73	1.2			1.2	0.49	-0.03	0.14	0.5
	SD			0.08	0.58	0.62	0.6	0.65			0.06	0.4	0.29	0.62	0.66

Zspread in bps		Panel A: EMs							Panel B: AEs						
		2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	mean		213.3	236.7	271.4	270.8	201.3	214.2	21.84	62.72	61.02	63.48	60.78	31.46	26.64
	sd		103.6	171.4	184.9	225.5	171.3	219.7	49.03	76.09	89.48	76.49	68.27	71.63	57.97
Green	mean			25.62	39.64	82.8	63.91	78.61			9.1	12.83	6.72	1.66	5.74
	sd			6.58	25.92	50.74	42.85	56.4			19.27	29.9	27.1	46.5	55.5

Bid-ask spread		Panel A: EMs							Panel B: AEs						
		2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	mean		0.22	0.18	0.14	0.15	0.13	0.14	0.04	0.06	0.07	0.07	0.07	0.06	0.07
	sd		0.11	0.11	0.07	0.06	0.07	0.09	0.01	0.04	0.04	0.04	0.04	0.04	0.05
Green	mean			0.03	0.04	0.05	0.05	0.07			0.06	0.04	0.04	0.02	0.04
	sd			0	0.01	0.02	0.02	0.06			0.04	0.04	0.04	0.03	0.05

Tenor		Panel A: EMs						Panel B: AEs						
		2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	mean		8.27	8.67	8.83	8.92	10.04	9.8	8.67	17.5	16.13	15.94	15.75	16.11	15.11
	sd		3.28	3.11	3.1	3.94	5.85	5.87	1.9	12.44	12.33	12.64	15.02	17.38	18.02
Green	mean			9	15.25	16	15.59	14.71			12.79	13.87	13.86	15.37	15.04
	sd			0	8.85	7.53	7.31	7.42			2.32	3.77	4.43	7.29	7.66

Amount USD Billions	Panel A: EMs							Panel B: AEs						
	2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown		2.83	7	8.47	12.65	12.45	0.23	37.09	701.9	601.9	757.2	1007	1337	176.1
Green			1.14	4.53	3.17	1.14	0.07			19.85	12.26	13.16	54.52	
Total		2.83	8.14	13	15.82	13.59	0.3	37.09	701.9	621.8	769.5	1020	1391	176.1

Source: Eikon and IMF staff calculations.

Note: AEs = advanced economies; EMs = emerging markets.

Annex Table 3.3. USD-denominated Bonds

YTM in %		Panel A: EMs						Panel B: AEs						
		2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	Mean	6.88	6.64	7.18	6.81	7.04	5.91	7.05		2.97	3.23	2.44	1.35	1.27	1.71
	SD	0.12	0.98	1.27	1.36	2.26	2.13	2.63		0.08	0.42	0.66	1.09	1.03	1.04
Green	Mean			6.19	4.67	3.62	4.58	5.16				2.18	1.32	1.53	2.04
	SD			0.14	1.1	1.59	2.3	2.1				0.23	0.37	0.69	0.54

Zspread in bps		Panel A: EMs						Panel B: AEs						
		2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	mean	471.4	446.6	436.6	485.3	639.2	483.1	543.6		72.57	30.93	49.52	75.13	41.76	41.03
	sd	10.49	98.57	122.8	130.8	236.7	192.2	247.6		9.35	32.08	50.87	88.46	53.06	54
Green	mean			332.6	272.8	279.9	336.3	347.3				51.56	65.97	31.54	31.53
	sd			2.18	100.1	177.2	256.1	225.7				14.1	16.55	27.78	36.18

Bid-ask spread		Panel A: EMs						Panel B: AEs						
		2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	mean	0.14	0.09	0.11	0.1	0.14	0.12	0.14		0.03	0.05	0.06	0.08	0.07	0.07
	sd	0.02	0.04	0.05	0.04	0.08	0.05	0.08		0.02	0.02	0.03	0.04	0.03	0.04
Green	mean			0.08	0.07	0.1	0.16	0.17				0.03	0.04	0.05	0.05
	sd			0	0.02	0.07	0.14	0.15				0.01	0.01	0.01	0.04

Tenor		Panel A: EMs						Panel B: AEs						
		2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	mean	10	15.34	15.7	15.37	15.58	16.05	16.53	10	8.7	9.67	9.26	10.68	12.64	
	sd	2.01	8.58	9	9.37	10.22	11.16	11.51	0	6.58	8.89	8.74	11.93	14.19	
Green	mean			10	16.95	16.86	14.52	14.38			7.35	7.5	11.96	11.68	
	sd			0	9.89	9.85	9.87	9.87			2.5	2.5	9.11	8.55	

Amount USD Billions	Panel A: EMs							Panel B: AEs						
	2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Brown	5.28	19.84	25.88	12	14.16	40.98	4	37.09	1	7	11.5	15.63	5.2	176.1
Green			0.01	2.32	2.25						2		3.5	
Total		19.84	25.89	14.32	16.41	40.98	4	37.09	1	7	13.5	15.63	8.7	176.1

Source: Eikon and IMF staff calculations.

Note: AEs = advanced economies; EMs = emerging markets.

Baseline methodology. The following panel regression specification is estimated:

$$Y_{ijt} = \alpha_j + \beta \times green\ bond_{ij} + \gamma_1 \times tenor_{ijt} + \gamma_2 \times bid\ ask\ spread_{ijt} + e_{ijt}$$

where the dependent variable is either YTM or z-spread of bond i in country j at time t, beta is the coefficient on the green bond dummy variable. The control variables are remaining maturity and bid-ask spread to control for liquidity. We are interested in the estimate of beta coefficient—the greenium estimate—as it estimates the average difference in the yield of green versus conventional bonds, after controlling for maturity and liquidity. The country fixed effect controls time-invariant credit risks.

Annex Table 3.4. Baseline result by currency.

	(1) Euro Z-spread	(2) Euro YTM	(3) USD Z-spread	(4) USD YTM
Green Bond	-3.69***	-3.40***	-30.24***	-63.56***
	(0.62)	(0.82)	(2.73)	(2.54)
Tenor (Days)	0.01***	0.02***	0.02***	0.03***
	(0.00)	(0.00)	(0.00)	(0.00)
Bid-Ask Spread	1.60***	2.40***	3.97***	1.95***
(Bps)	(0.02)	(0.03)	(0.05)	(0.05)
Country FE	Y	Y	Y	Y
R^2	0.79	0.71	0.78	0.82
Bond-Day	323,127	328,746	65,521	66,043
Bonds	474	486	116	117
Green Bonds	21	22	15	15
Countries	16	16	11	11

Source: Eikon and IMF staff calculations.
Note: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Annex Table 3.5. Baseline result by currency and AEs/EMs.

Dependent variable: Z-spread	(1) Euro AEs	(2) Euro EMs	(3) USD AEs	(4) USD EMs
Green Bond	-5.61***	-12.45***	6.16***	-49.28***
	(0.72)	(1.37)	(1.34)	(3.52)
Tenor (Days)	0.01***	0.02***	0.01***	0.03***
	(0.00)	(0.00)	(0.00)	(0.00)
Bid-Ask Spread	1.63***	1.96***	1.44***	4.28***
(Bps)	(0.02)	(0.06)	(0.07)	(0.06)
Country FE	Y	Y	Y	Y
R^2	0.59	0.90	0.74	0.58
Bond-Day	290,246	32,881	13,405	52,116
Bonds	421	53	27	89
Green Bonds	14	7	10	5
Countries	11	5	5	6

Source: Eikon and IMF staff calculations.
Note: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. AEs = advanced economies; EMs = emerging markets.

Annex Table 3.6. Baseline result of Euro-denominated bonds over years.

Dependent variable: Z-spread	Euro 2018	2019	2020	2021
Green Bond	2.02	-6.40***	-4.23***	-6.77***
	(1.62)	(0.94)	(0.92)	(1.02)
Tenor (Days)	0.01***	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)

Bid-Ask Spread (Bps)	1.76*** (0.04)	0.88*** (0.03)	1.72*** (0.03)	1.03*** (0.04)
Country FE	Y	Y	Y	Y
R^2	0.89	0.92	0.89	0.68
Bond-Day	48,372	70,407	90,928	113,420
Bonds	229	315	383	474
Green Bonds	4	8	12	21
Countries	14	14	15	16

Source: Eikon and IMF staff calculations.
Note: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Annex Table 3.7. Baseline result of US-denominated bonds over years

Dependent variable: Z-spread	USD 2018	2019	2020	2021
Green Bond	0.00 (.)	-12.04*** (3.52)	-34.92*** (6.07)	-41.24*** (2.36)
Tenor (Days)	0.02*** (0.00)	0.02*** (0.00)	0.02*** (0.00)	0.02*** (0.00)
Bid-Ask Spread (Bps)	0.83*** (0.20)	-5.74*** (0.12)	4.10*** (0.09)	-4.92*** (0.11)
Country FE	Y	Y	Y	Y
R^2	0.84	0.94	0.77	0.91
Bond-Day	7,567	13,786	18,491	25,677
Bonds	43	65	80	116
Green Bonds	1	5	8	15
Countries	6	8	10	11

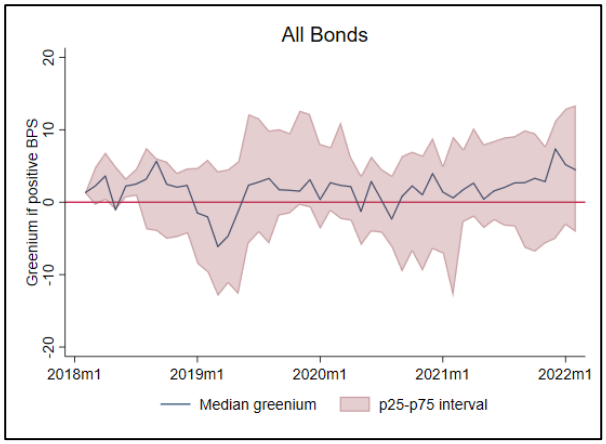
Source: Eikon and IMF staff calculations.
Note: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Synthetic estimation method. First, a regression of *z*-spread on tenor, bid-ask spread, amount issue, currency, country of issue, and weekly fixed effects using conventional bonds is run for each country. Afterward, the *z*-spread of the counterfactual conventional bond is predicted using the relevant information from the green bond and the coefficients obtained from the regressions.

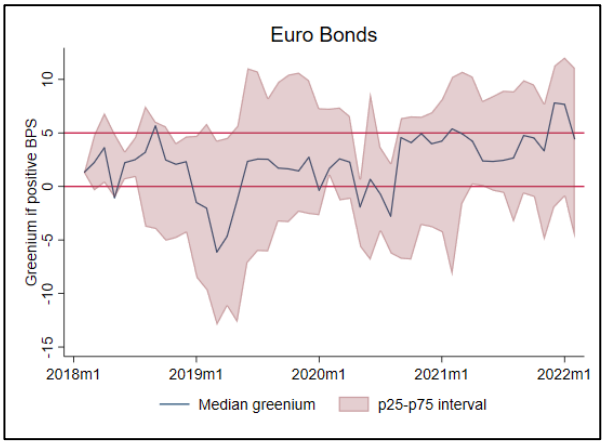
Greenium estimate using synthetic bond approach (Annex Figure 3.1). To find the counterfactual conventional bond that shares the same features as the green, this approach needs a country to issue at least one green bond and one conventional bond in the same currency. This restriction shrinks the sample size from 50 to 29 green bonds. Euro-denominated bonds show a median greenium of 0 to 5 basis points across time. The greenium on USD-denominated bonds are larger, although more volatile. The results from this method are in line with the baseline results. Over the entire time period, around two-thirds of synthetic estimations shows positive greenium.

Annex Figure 3.1. Greenium Estimate Based on the Synthetic Method

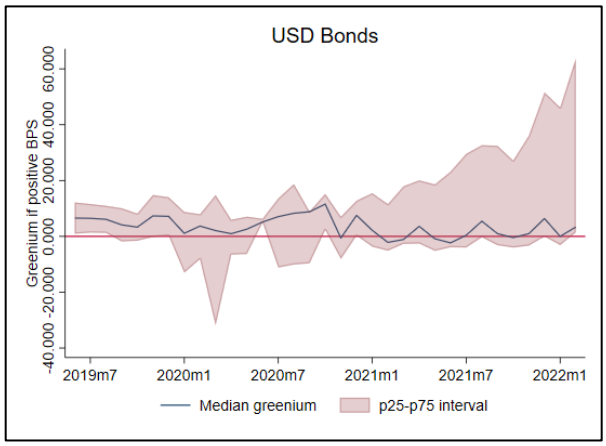
1. All 29 sovereign green bonds



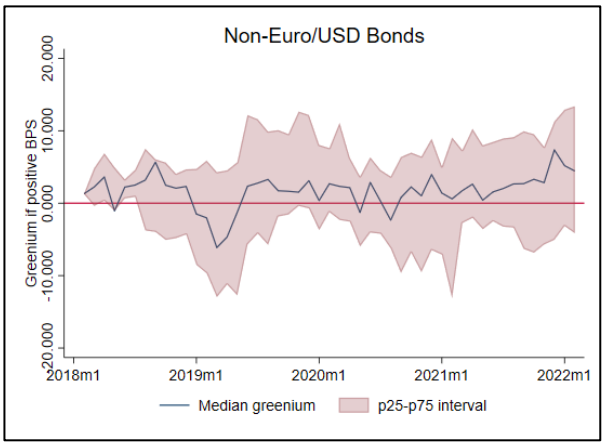
2. Using 19 sovereign green bonds denominated in euros



3. Using four sovereign green bonds denominated in US dollars



4. Using six sovereign green bonds denominated in other currencies



Sources: Eikon; and IMF staff calculations.

References

Baker, Malcolm, Daniel Bergstresser, George Serafeim, and Jeffrey Wurgler. 2021. "The Pricing and Ownership of U.S. Green Bonds." *Annual Review of Financial Economies*.

Becerra, Oscar, Eduardo Cavallo, and Ilan Noy. 2012. "Foreign Aid in the Aftermath of Large Natural Disasters." IDB Working Paper 333, Inter-American Development Bank, Washington, DC.

Chatoro, Marian, Athanasios A. Pantelous, and Jia Shao. 2021. "Exploring Inefficiencies in the Primary Catastrophe Bond Market: Focus on the Issuer Effect." SSRN Working Paper.

Cohen, Charles, Ali Abbas, Myrvin Anthony, Tom Best, Peter Breuer, Hui Miao, Alla Myrvoda, and Eriko Toga. 2020. "The Role of State-Contingent Debt Instruments in Sovereign Debt Restrucruings." IMF Staff Discussion Note 20/06, International Monetary Fund, Washington, DC.

Cortellini, Giuseppe, and Ida Panetta. 2021. "Green Bond: A Systematic Literature Review for Future Research Agendas." *Journal of Risk and Financial Management* 14 (12): 589.

Climate Bonds Initiative. 2019. "Climate Bonds Standard Version 3.0." https://www.climatebonds.net/files/files/climate-bonds-standard-v3-20191210.pdf

Difiore, Peter, Cedric Drui, and Sophie Ware. 2021. "Catastrophe Bonds: Natural Diversification." Neuberger Berman White Paper.

Doronzo, Raffaele, Vittorio Siracusa, and Stefano Antonelli. 2021. "Green Bonds: the Sovereign Issuer's Perspective." Bank of Italy, Markets, Infrastructures, Payment Systems Working Paper 3, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3854966#

European Commission. 2021. "Proposal for a Regulation of the European Parliament and of the Council on European Green Bonds." https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021PC0391

Ferreira, Caio, David Lukas Rozumek, Ranjit Singh, and Felix Suntheim. 2021. "Strengthening the Climate Information Architecture." IMF Staff Climate Note 2021/003, International Monetary Fund, Washington, DC.

German Finance Agency. 2022. "Federal Republic of Germany Green Bond Investor Presentation."

Green Finance Platform. 2022. "Policies and Regulations." https://www.greenfinanceplatform.org/financial-measures/browse

Gotze, Tobia, and Marc Gurtler. 2020. "Hard Markets, Hard Times: On the Inefficiency of the CAT Bond Market." *Journal of Corporate Finance* 62: 101553.

International Capital Market Association. 2017. "The GBP Databases and Indices Working Group – Summary of Green Bond Database Providers." https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/Green-Bond-Databases-Summary-Document-190617.pdf

International Capital Market Association. 2021. "Green Bond Principles Voluntary Process Guidelines for Issuing Green Bonds." https://www.icmagroup.org/assets/documents/Sustainable-finance/2021-updates/Green-Bond-Principles-June-2021-140621.pdf

International Monetary Fund (IMF). 2019. "Building Resilience in Developing Countries Vulnerable to Large Natural Disasters." IMF Policy Paper, Washington, DC.

International Monetary Fund (IMF). 2021a. "ESG Monitor 2021 Q1." Washington, DC.

International Monetary Fund (IMF). 2021b. “ESG Monitor 2021 Q2.” Washington, DC.

Karpf, Andreas, and Antoine Mandel. 2018. “The Changing Value of the ‘Green’ Label on the US Municipal Bond Market.” *Nature Climate Change* 8: 161–65.

Michael-Kerjan, Erwann, Ivan Zelenko, Victor Cardenas, and Daniel Turgel. 2011. “Catastrophe Financing for Governments: Learning from the 2009-2012 MultiCat Program in Mexico.” OECD Working Papers on Finance Insurance and Private Pensions 9, OECD Publishing, Paris.

Organisation for Economic Co-operation and Development. 2017. “Mobilising Bond Markets for a Low-Carbon Transition, Green Finance and Investment.” OECD Publishing, Paris.

Organisation for Economic Co-operation and Development and the World Bank. 2019. “Fiscal Resilience to Natural Disasters: Lessons from Country Experiences.” OECD Publishing, Paris.

Organisation for Economic Co-operation and Development. 2021. “Scaling Up Green, Social, Sustainability and Sustainability-linked Bond Issuances in Developing Countries.” OECD Publishing, Paris

People’s Bank of China. 2021. “List of Eligible Green Bond Categories 2021 (绿色债券支持项目目录 2021).” http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/4236341/2021042115215612655.pdf

Rose, Paul. 2021. “Debt for Climate: Green Bonds and Other Instruments.” Research Handbook on Climate Finance and Investment Law.

U.S. Government Accountability Office. 2011. “Haiti Reconstruction: Factors Contributing to Delays in USAID Infrastructure Construction.” Washington, DC.

White, Harry. 2020. “Modeling Fundamental: So You Want to Issue a Cat Bond.” https://www.air-worldwide.com/publications/air-currents/2020/modeling-fundamentals-so-you-want-to-issue-a-cat-bond/

World Bank. 2015. “What Are Green Bonds (English).” https://documents1.worldbank.org/curated/en/400251468187810398/pdf/99662-REVISED-WB-Green-Bond-Box393208B-PUBLIC.pdf

World Bank. 2019. “World Bank Catastrophe Bond Transaction Insures the Republic of Philippines against Natural Disaster-related Losses Up to US$225 Million.” https://www.worldbank.org/en/news/press-release/2019/11/25/world-bank-catastrophe-bond-transaction-insures-the-republic-of-philippines-against-natural-disaster-related-losses-up-to-usd225-million

World Bank. 2020a. “Case Study Insuring Mexico against Natural Disaster.” https://thedocs.worldbank.org/en/doc/737151585254940284-0340022020/original/FONDENMexicoCatBondCaseStudy3.4.2020final.pdf

World Bank. 2020b. “World Bank Catastrophe Bond Provides Financial Protection to Mexico for Earthquakes and Named Storms.” https://www.worldbank.org/en/news/press-release/2020/03/09/world-bank-catastrophe-bond-provides-financial-protection-to-mexico-for-earthquakes-and-named-storms

World Bank. 2021. “World Bank Catastrophe Bond Provides Jamaica $185 Million in Storm Protection.” https://www.worldbank.org/en/news/press-release/2021/07/19/world-bank-catastrophe-bond-provides-jamaica-185-million-in-storm-protection

World Wildlife Fund. 2018. “Annual report 2018.” Washington, DC: WWF.

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