

5-31-2016

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Recommended Citation

Michael Bennett and Sophie Smyth, *How Capital Markets Can Help Developing Countries Manage Climate Risk*, 43 B.C. Env'tl. Aff. L. Rev. 251 (), <http://lawdigitalcommons.bc.edu/ealr/vol43/iss2/2>

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HOW CAPITAL MARKETS CAN HELP DEVELOPING COUNTRIES MANAGE CLIMATE RISK

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Abstract: Climate change is exacerbating the frequency and severity of catastrophic weather events around the world. The economic impact of these events on developing countries can be severe, and roll back years of development gains. To help face this growing challenge, the governments of developing countries need improved access to insurance and alternative risk transfer mechanisms to manage their exposure to climate risk. Multilateral development banks, such as the World Bank, can help. For example, they can catalyze the creation of sovereign risk pools and facilitate access for developing country governments to the substantial reinsurance capacity of the capital markets. The World Bank's role in creating the Caribbean Catastrophe Risk Insurance Facility, and the World Bank catastrophe bond issue in 2014 for that Facility, serve as models for this kind of assistance. In order to maximize the developmental impact of these kinds of interventions, donor governments, acting through multilateral development banks, should encourage beneficiary countries to invest in *ex ante* climate risk preparedness and resilience as a condition of receiving this kind of development assistance.

INTRODUCTION

Recent international commitments made in the Addis Ababa Agenda for Action (agreed upon in July 2015) signal a new willingness on the part of governments around the world to acknowledge that disasters caused by extreme weather events and the reality of climate change are inter-connected.¹

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¹ See U.N. Third International Conference on Financing for Development, *Draft Resolution Submitted by the Chair of the Main Committee: Outcome Document of the Third International Conference on Financing for Development: Addis Ababa Action Agenda*, ¶ 62, U.N. Doc. A/CONF.227/L.1 (July 15, 2015) [<https://perma.cc/FB7C-HD26>] (original hyperlink no longer active) (confirming that it is important to take account of climate and disaster resilience in development financing and to invest in strengthening the ability of local and national actors to manage and

In line with this signal, both the Sendai Framework for Disaster Risk Reduction (agreed upon in March 2015) (the “Sendai Framework”) and the Paris Agreement adopted at the twenty-first meeting of the Conference of the Parties to the United Nations Framework Convention Climate Change (“UNFCCC” or the “Convention”) in December 2015 emphasize that disaster risk management is an integral part of managing climate change.² Further, they recognize that developing countries need and deserve assistance with this task.³ The day of proactively managing the risk of loss from extreme weather events caused by climate change (hereafter referred to as climate risk) has arrived.

Proactive climate risk management requires the party exposed to the risk to achieve a reasonable balance between risk reduction, retention, and transfer.⁴ Most developing countries cannot achieve this balance alone.⁵ For several reasons, including constrained resources, lack of risk transfer opportunities, and a reluctance to pay for insurance, most developing countries’ default

finance disaster risk); *see also* UNITED NATIONS, SENDAI FRAMEWORK FOR DISASTER RISK REDUCTION 2015–2030, at 9–10, ¶¶ 6–7, 9, 11 (n.d.) [hereinafter SENDAI FRAMEWORK], http://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf [<https://perma.cc/RRW2-UAR9>] (emphasizing the need for improved coherence across policies, institutions, goals, indicators, and measurement systems).

² *See* SENDAI FRAMEWORK, *supra* note 1, at 10, ¶ 11; *see also* U.N. Framework Convention on Climate Change, *Adoption of the Paris Agreement: Proposal by the President: Draft Decision /CP.21, 1*, U.N. Doc. FCCC/CP/2015/L.9 (Dec. 12, 2015) [hereinafter *Paris Agreement*], <http://unfccc.int/resource/docs/2015/cop21/eng/109.pdf> [<https://perma.cc/6GXX-6MB7>] (adopting the Sendai Framework for Disaster Risk Reduction).

³ *See* SENDAI FRAMEWORK, *supra* note 1, at 14, ¶ 19(m) (stating that developing countries, middle income countries, and other countries facing specific disaster challenges need adequate, sustainable, and timely provision of support).

⁴ *See* U.N. Framework Convention on Climate Change, *Mechanisms to Manage Financial Risks from Direct Impacts of Climate Change: Technical Paper*, at 4, ¶ 1, U.N. Doc. FCCC/TP/2008/9 (Nov. 21, 2008) [hereinafter *UNFCCC Technical Paper*], <http://unfccc.int/resource/docs/2008/tp/09.pdf> [<https://perma.cc/88LL-VUZ2>]. The Technical Paper was prepared at the suggestion of the *Ad Hoc* Working Group on Long-term Cooperative Action under the UNFCCC, which requested that the Secretariat to the Convention prepare and make available for the Working Group’s consideration, a “technical paper on mechanisms, including innovative insurance tools, that [could] be used to manage financial risks from direct impacts of climate change in developing countries.” *See id.*

⁵ *See* J. DAVID CUMMINS & OLIVIER MAHUL, CATASTROPHE RISK FINANCING IN DEVELOPING COUNTRIES: PRINCIPLES FOR PUBLIC INTERVENTION 47 (2009), <http://siteresources.worldbank.org/FINANCIALSECTOR/Resources/CATRISKbook.pdf> [<https://perma.cc/6EX5-W6KZ>] (highlighting the importance of donor funding). The World Bank classifies countries’ economies annually into four categories: high income, upper middle income, middle income, and low income, based on estimates of gross national income (“GNI”) per capita for the previous year; all but the high income countries qualify for World Bank assistance. *See New Country Classifications*, WORLD BANK (July 2, 2015), <http://data.worldbank.org/news/new-country-classifications-2015> [<https://perma.cc/5MU5-DF8D>]. Except where otherwise specified, the term *developing countries* as used in this Article refers to countries that qualify for World Bank assistance.

position is to over-retain.⁶ In doing so, they expose themselves to devastating losses and the vagaries of post-disaster humanitarian relief after a natural disaster strikes. As extreme weather events become more frequent and increase in intensity, this pattern of developing countries failing to engage in *ex ante* risk management poses a significant threat to their economic well-being.⁷ The uninsured losses from one major catastrophe can roll back years of development gains.⁸ Therefore, development assistance to help developing countries better manage this risk is crucial.⁹ Along with providing financial resources to reduce the risk, such assistance must include expanding developing countries' opportunities to transfer a portion of the risk of loss from climate change off their balance sheets.¹⁰

So what might development assistance in support of climate risk transfer look like? In June 2014, the World Bank (the "Bank") launched a catastrophe bond on behalf of a sovereign climate risk insurance facility that is an example of this kind of assistance.¹¹ The bond is linked to the risk of earthquakes and tropical cyclones in sixteen Caribbean countries that face a constant threat of economic devastation from these extreme weather events, a threat now acknowledged to have intensified because of climate change.¹² The bond

⁶ *See id.*

⁷ *See generally* STANDARD & POOR'S RATINGS SERVS., STORM ALERT: NATURAL DISASTERS CAN DAMAGE SOVEREIGN CREDITWORTHINESS 16, 23 (2015) [hereinafter S&P 2015], <http://unepfi.org/pdc/wp-content/uploads/StormAlert.pdf> [<https://perma.cc/M6A9-BGY4>] (using the terms "developed" and "developing" to refer to the sub-groupings of countries put forward by the International Monetary Fund, which divides countries' economies into "advanced economies" ("advanced sovereigns"), "emerging and developing economies," and "low-income developing economies" (both of which constitute "developing sovereigns")); *see also UNFCCC Technical Paper, supra* note 4, at 4, ¶ 4 ("Climate-related disasters represent a major source of risk to the poor in developing countries, and the losses caused are seen as a major threat to the achievement of the United Nations Millennium Development Goals (MDGs)."). The U.N. "Millennium Development Goals" have been built upon, and are now known as the U.N. "Sustainable Development Goals." *See* UNITED NATIONS, TRANSFORMING OUR WORLD: THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT 3 (n.d.) <https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf> [<https://perma.cc/Q3PC-VB5D>].

⁸ *See UNFCCC Technical Paper, supra* note 4, at 17, ¶ 76 ("Disasters often cause great social and economic devastation. The impacts of these events can set back the development process by years . . .").

⁹ *See id.*

¹⁰ *See* CUMMINS & MAHUL, *supra* note 5, at 2–3 (noting that the disaster risk management framework the World Bank and donor community support relies on three pillars: assessing the government's contingent liability to natural disasters; enabling risk transfer; and financing sovereign risk).

¹¹ *See UNFCCC Technical Paper, supra* note 4, at 67, ¶¶ 289–290; WORLD BANK, FACILITATING CATASTROPHE RISK TRANSFER (2014), http://treasury.worldbank.org/bdm/pdf/Case_Study/Caribbean_CatastrophebondforCCRIF.pdf [<https://perma.cc/6E9X-Q434>].

¹² *See* CHRISTOPHER B. FIELD ET AL., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: IMPACTS, ADAPTATION, AND VULNERABILITY: SUMMARY FOR POLI-

has the effect of enabling those countries' governments to transfer some of that risk of economic loss to capital market investors.¹³ In broad brush terms, it ensures that a pooled sovereign risk facility, in which many Caribbean countries participate, will receive a significant and fast cash payout if any of the countries is hit by an earthquake or cyclone of a certain magnitude.¹⁴ On the other side of the equation, the bondholders will lose their right to receive some or all of their principal if such an event occurs.¹⁵

This transfer of risk is accomplished by a composite of economic transactions orchestrated by the World Bank and funded in large part by the development aid resources of several donor countries.¹⁶ The first part of that composite was the creation of an independent shared sovereign risk facility, the Caribbean Catastrophe Risk Insurance Facility ("CCRIF").¹⁷ The second part of the composite was the World Bank catastrophe bond that enabled the facility to access capital markets as a form of risk transfer.¹⁸ The Bank coupled its issuance of the bond with a swap transaction between itself and the facility through which the Bank hedged its exposure on the bond.¹⁹

The question this Article examines is whether these interventions are model forms of development assistance that we should emulate in the future. On the one hand, the CCRIF and the World Bank catastrophe bond are on the cutting edge of development assistance with climate risk management.²⁰ They give developing countries an opportunity to use financial mechanisms to proactively manage the risk of economic loss from extreme weather events through risk transfer.²¹ On the other hand, the global financial crisis has

CYMAKERS 4, 6 ¶ A-1, 12 Assessment Box SPM.1 (n.d.) [hereinafter IPCC 2014], https://ipcc-wg2.gov/AR5/images/uploads/WG2AR5_SPM_FINAL.pdf [<https://perma.cc/MJM5-25R5>] (indicating that recent extreme weather events have exposed significant vulnerability and exposure of some ecosystems and human systems to current climate variability and that moderate climate-change-related risks from extreme weather events increase to high risks with one degree Celsius additional warming).

¹³ See WORLD BANK, *supra* note 11.

¹⁴ See UNFCCC *Technical Paper*, *supra* note 4, at 67, ¶¶ 289–290; WORLD BANK, *supra* note 11.

¹⁵ See UNFCCC *Technical Paper*, *supra* note 4, at 75, ¶ 320(c).

¹⁶ See WORLD BANK, *supra* note 11.

¹⁷ See *id.*

¹⁸ See *id.*

¹⁹ See *id.*

²⁰ See *id.*

²¹ See Michael Bennett, *Disaster Risk, Using Capital Markets to Protect Against the Cost of Catastrophes*, WORLD BANK: VOICES, PERSPECTIVES ON DEV. BLOG (Aug. 11, 2014), <http://blogs.worldbank.org/voices/disaster-risk-using-capital-markets-protect-against-cost-catastrophes> [<https://perma.cc/T53B-NKN8>].

taught us to be skeptical of the claims of new financial instruments.²² Financial markets have the capacity to transfer risk among parties, but not to eliminate risks entirely. Therefore, with any risk-transferring financial instrument, it is important to understand where the risks end up and to assess whether those parties have the requisite capacity to bear those risks. Moreover, all international organizations (and the World Bank can be no exception) have shown the capacity to pursue activities, which while generally well intentioned, fail to achieve their goals.²³ Further, scholars of the perverse incentives that resulted from the U.S. National Flood Insurance Program (“NFIP”) might well question whether the World Bank’s catastrophe bond and the CCRIF could suffer from the same incentive problem. Unfortunately, under the NFIP, the U.S. Federal Government’s subsidization of flood insurance has ended up encouraging development and redevelopment in flood plains and inhibiting retreat, which, in the face of rising sea levels, is the kind of prudent adaptation that should and likely would happen if subsidized insurance were not available.²⁴

Analyzing the CCRIF and the World Bank catastrophe bond with these concerns in mind, we maintain that such interventions have a vital role to play in developing countries’ climate risk management, provided certain caveats are observed. Specifically, the legal agreements that underpin these interventions should place clear and measurable demands on the countries that benefit from them to actively reduce their exposure to climate risk to an extent consistent with each country’s level of development. In other words, as a condition of providing either direct or indirect assistance, donors and other development assistance partners should require beneficiary countries to devise and maintain a robust national natural disaster risk management strategy aimed at reducing their exposure to climate risk, both by mitigation and improved resilience. This requirement should be reflected in all tiers of these interventions, both in the terms and conditions of insurance coverage, and in the terms and conditions of any agreement providing for payments to be made by or to a third party to cover the costs of such coverage. All parties involved, both

²² See generally THE PANIC OF 2008: CAUSES, CONSEQUENCES AND IMPLICATIONS FOR REFORM (Lawrence E. Mitchell & Arthur E. Wilmarth, Jr. eds., 2010) (noting how, throughout the 1990s with the aid of de-regulation, investment and commercial banks turned the invention of new financial instruments into a major business, generating huge profits for themselves but ultimately exposing themselves, and the U.S. economy as a whole, to dangerous levels of credit risk).

²³ See generally Michael N. Barnett & Martha Finnemore, *The Politics, Power, and Pathologies of International Organizations*, 53 INT’L ORG. 699 (1999) (questioning whether international organizations really do what their creators intended them to do).

²⁴ See J. Peter Byrne & Jessica Grannis, *Coastal Retreat Measures*, in THE LAW OF ADAPTATION TO CLIMATE CHANGE: U.S. AND INTERNATIONAL ASPECTS 267, 270 (Michael B. Gerrard & Katrina Fischer Kuh eds., 2012).

public and private, must be part of both requiring robust climate risk management and policing compliance with any such requirements.

The extent of such requirements should be scaled to be commensurate with each individual beneficiary country's level of development, including the extent of financial resources it has available to devote to disaster risk preparedness and resiliency. For example, while a middle income developing country may be required to have a comprehensive disaster risk management plan in place, lesser developed countries should be permitted to have implemented less complete measures. Such scaling of requirements is essential to ensure that highly at-risk poor countries are not denied disaster risk management assistance solely due to their understandable inability to fund and operate full scale risk management programs.

Part I of this Article traces the evolution of the development assistance mandate to help developing countries proactively manage climate risk.²⁵ Part II shows the role that capital market interventions—such as the Caribbean sovereign insurance risk pool and the related World Bank catastrophe bond—can play in fulfilling that mandate.²⁶ Part III discusses how future interventions like the CCRIF and the World Bank catastrophe bond might increase their impact and strengthen their contribution to advancing both donor and recipient countries' international commitments to address climate change and manage climate risk.²⁷

I. CLIMATE RISK MANAGEMENT AND DEVELOPING COUNTRIES

The risk of significant loss from extreme weather events poses enormous challenges for every country, but especially taxes the resources of developing countries that are poorly equipped both to manage the risk and to absorb the losses when the risk is realized.²⁸ Donor countries have belatedly recognized the vast need these realities generate for development assistance that helps developing countries to actively manage this risk through risk transfer.²⁹

²⁵ See *infra* notes 28–94 and accompanying text.

²⁶ See *infra* notes 95–159 and accompanying text.

²⁷ See *infra* notes 160–199 and accompanying text.

²⁸ See CUMMINS & MAHUL, *supra* note 5, at 13.

²⁹ See SENDAI FRAMEWORK, *supra* note 1, at 18–19, ¶¶ 29, 30(a)–(c).

A. Sovereign Climate Risk Management

All countries need a range of financial mechanisms to manage their exposure to climate risk.³⁰ Ideally, a country will manage sovereign risk, including climate risk, through a balanced mix of risk reduction, risk retention, and risk transfer.³¹ Sovereign risk reduction entails government policies that reduce the risk that an event that causes loss will occur, and policies that limit the amount of loss that will be sustained if such an event does occur.³² Examples include a government investing in more resilient infrastructure as well as promulgating regulations that promote resilience, such as enacting and enforcing stricter building codes. Risk retention involves the government absorbing the risk itself.³³ If retained risk is realized, the resulting losses are covered out of the government's budget resources.³⁴

Countries retain risk in different ways. Retention may involve creating a separate reserve fund dedicated to funding post-catastrophe relief and reconstruction or contracting for contingent loan financing.³⁵ Risk transfer involves transferring the risk to a third party for a price.³⁶ The most common form of risk transfer consists of obtaining insurance.³⁷ Risk may, however, also be securitized and transferred to capital market investors through financial instruments, a method referred to as *alternative risk transfer* ("ART").³⁸ In the case of climate risk, ART may involve catastrophe bonds.³⁹

The availability of opportunities to transfer climate risk to third parties depends on the nature of the risk involved. For example, the risk posed by events that are frequent but limited in impact—such as frequent low intensity storms in an area prone to tropical storms—is amenable to traditional insurance because the scale and probability of loss are predictable and tend to be distributed over a diversified group of insureds.⁴⁰ The frequency of the storms enables an insurer to accumulate experience forecasting both the timing and the degree of loss that can be expected.⁴¹ With this information, an insurer

³⁰ See *UNFCCC Technical Paper*, *supra* note 4, at 69–86 ¶¶ 298–377 (providing information on the financial mechanism used to manage risks from direct impacts of climate change).

³¹ See *id.* at 70, ¶¶ 300–303.

³² See *id.*

³³ See *id.*

³⁴ See *id.*

³⁵ See *id.*

³⁶ See *id.* at 74, ¶ 320(b).

³⁷ *Id.*

³⁸ See *id.* at 44, ¶ 179.

³⁹ See *id.* at 75, ¶ 320(b).

⁴⁰ See CUMMINS & MAHUL, *supra* note 5, at 187 app.8 (noting that insurance works best for high-frequency, low-severity events, which are statistically independent and have probability distributions that are reasonably stationary over time).

⁴¹ See *id.* at 188.

can quantify with a reasonable degree of certainty how much the high frequency storms will cost it in terms of expected pay-outs on an annualized basis.

In contrast, the risk of major loss from high intensity, infrequent storms exposes insurance companies to large and unpredictable levels of loss. As a result, there is a need for significant reinsurance capacity to address these events.⁴² The capital markets can provide some of this reinsurance capacity in the form of catastrophe bonds. Capital market investors have both the will and the capacity to absorb the unpredictability of catastrophic risk.⁴³

B. Developing Countries' Challenges

Every step of the climate risk management process presents particular challenges for developing countries. Currently, developing countries primarily rely on risk retention, counting on budget re-allocations and externally provided disaster response aid to deal with losses from natural disasters.⁴⁴ Risk reduction efforts require resources and strong government, both of which may be in short supply in many countries most at risk to extreme weather events.⁴⁵ Further, even where a developing country might be interested in transferring this risk to a third party, opportunities for most developing countries to make such a transfer are severely limited.⁴⁶

Risk transfer opportunities are limited in developing countries both at the local and sovereign level.⁴⁷ Property and casualty insurance, the most common form of climate risk transfer in developed countries, are not com-

⁴² See *id.* at 79 (noting that the efficient financing of natural disasters relies on a public-private partnership between the private insurance, reinsurance industry, and governments); *id.* at 185 app.8 (noting that insurers are critically dependent on the global reinsurance market to provide coverage and claims for losses suffered from extreme weather events of the magnitude incurred in the United States during the 2004 and 2005 hurricane season).

⁴³ See generally Robert J. Rhee, *Terrorism Risk in a Post-9/11 Economy: The Convergence of Capital Markets, Insurance, and Government Action*, 37 ARIZ. ST. L.J. 435, 503–05 (2005) (explaining that the key difference between insurance and insurance-linked securities is that insurance and reinsurance markets provide catastrophic risk coverage whereas insurance-linked securities provide additional financial capacity).

⁴⁴ See UNFCCC *Technical Paper*, *supra* note 4, at 19, ¶ 84; CUMMINS & MAHUL, *supra* note 5, at 47.

⁴⁵ See UNFCCC *Technical Paper* *supra* note 4, at 62, 69, ¶¶ 270, 292 (noting that external support to the most vulnerable countries for national-level catastrophe insurance is essential and that there are significant barriers to the use of insurance in developing countries, including the fact that their financial systems are generally weak).

⁴⁶ See *id.* at 12, ¶ 46.

⁴⁷ See CUMMINS & MAHUL, *supra* note 5, at 96 (noting that a lack of data and catastrophe risk modelling in low and middle income countries limits the ability of governments and domestic insurers to access global reinsurance).

mon in developing countries.⁴⁸ For example, more than 40% of the direct losses from natural disasters are insured in developed countries, usually through compulsory insurance.⁴⁹ In contrast, it is estimated that less than 10% of these losses are covered by insurance in middle-income countries and less than 5% in low-income countries.⁵⁰

Both supply- and demand-side barriers impede more extensive insurance coverage in developing countries.⁵¹ Supply-side barriers include a poorly developed financial sector in rural areas where access to banking and financial advice is rare.⁵² The uncertainty of a commercial return and the lack of sufficient data and modeling on hazards and exposures have also made private insurers reluctant to engage in assuming climate risk in developing countries.⁵³ On the demand side, a lack of familiarity with insurance and low risk awareness stifle demand.⁵⁴

The low level of property and casualty insurance in developing countries exacerbates their vulnerability to catastrophic loss from climate change.⁵⁵ In the absence of such insurance, the financial burden of natural disasters falls on the government, which will be forced to re-allocate meager budget resources to finance disaster response and recovery.⁵⁶ At the same time, following a disaster government revenues usually fall because of decreased economic activity.⁵⁷ The scope of this exposure makes it critical for developing countries' governments to transfer some or all of this risk to third parties.⁵⁸ Yet the obstacles that result in a low level of property and casualty insurance in developing countries operate with even greater force to impede would-be insurers and third parties from assuming sovereign catastrophic climate risk.⁵⁹

⁴⁸ See *id.* at 71 (showing low non-life insurance penetration in developing countries).

⁴⁹ See *id.* at 5.

⁵⁰ See *id.* (indicating that under-insurance is a direct consequence of the underdeveloped non-life insurance markets: the insurance penetration, measured as a percentage of gross domestic product, is 1.4% in Latin America and Africa, compared to 3% in Europe and almost 5% in North America).

⁵¹ See *UNFCCC Technical Paper*, *supra* note 4, at 46, ¶ 188.

⁵² See *id.* at 47–48, ¶ 190.

⁵³ See *id.* at 48–49, ¶¶ 192–193, 196, 198–199.

⁵⁴ See *id.* at 49–50, ¶¶ 202–204.

⁵⁵ See CUMMINS & MAHUL, *supra* note 5, at 5 (noting that in low and middle income countries, most direct losses from natural disasters are not covered by insurance, and development of efficient catastrophic insurance markets is undermined by low non-life insurance penetration, inadequate awareness of catastrophic risk exposure, and limited ability to pay insurance premiums).

⁵⁶ See Bennet, *supra* note 21.

⁵⁷ See CUMMINS & MAHUL, *supra* note 5, at 48.

⁵⁸ See *UNFCCC Technical Paper*, *supra* note 4, at 62, ¶¶ 268–270.

⁵⁹ See *id.* at 30, ¶ 135 (a) (noting that problems arise in setting up risk transfer schemes where ownership is difficult to establish and damage is difficult to quantify).

On the demand side, a lack of modeling of climate-related hazard behavior and asset vulnerability results in widespread unawareness on the part of developing countries of the extent of their catastrophic risk exposure.⁶⁰ Lacking that awareness, governments are reluctant to incur the cost of the insurance premiums that would be required to insure this risk.⁶¹ Further, they may invest in disaster insurance for a period but subsequently lose interest if a few years go by without any natural disaster occurring.⁶² On the supply side, a lack of modeling and dearth of data precludes would-be insurers and other third parties from engaging with developing countries on reinsurance and capital market instruments, which the management of catastrophic risk requires.⁶³ In order for any third party to be willing to assume transferred risk, that risk has to be packaged in a way that enables the third party to adequately analyze and price it.

The scope of developing countries' exposure to the risk of catastrophic loss from climate change that results from their inability to transfer that risk to third parties could have devastating consequences for the countries concerned.⁶⁴ Although, in absolute terms, the costliest disasters occur mainly in developed countries, which have the highest concentration of assets, small and less developed economies experience the largest losses as measured by the effect on their gross domestic product (GDP).⁶⁵ The record shows a close connection between a country's economic well-being and the extent of its vulnerability to the risk of catastrophic loss from climate change.⁶⁶ Many developing countries faced frequent losses from natural hazards even without

⁶⁰ See CUMMINS & MAHUL, *supra* note 5, at 5–6.

⁶¹ See UNFCCC *Technical Paper*, *supra* note 4, at 66, ¶ 285.

⁶² See *id.* at 67, ¶ 291.

⁶³ See *id.* at 48, ¶ 196.

⁶⁴ See S&P 2015, *supra* note 7, at 16 (indicating that a country's level of economic development is inversely correlated to the impact of a natural disaster on the country's rating, either due to existing economic and financial vulnerabilities or the state of development of the insurance market in the country). Using the subgroupings of sovereigns put forward by the International Monetary Fund, the countries whose ratings would be most affected by a natural disaster would be low-income sovereigns, with an estimated decline in income per capita of more than 5% over 2016–2020 compared with the baseline scenario. See *id.* Emerging and other developing sovereigns would on average suffer a decline in per capita income of almost 3% compared with the baseline, while advanced sovereigns display much more resilience, with a 0.7% decline. See *id.*

⁶⁵ See CUMMINS & MAHUL, *supra* note 5, at 14–16. The poorest developing countries, namely the Least Developed Countries (“LDCs”), the Small Island Developing States (“SIDs”), and countries in Africa, are the most vulnerable. See *id.*; see also UNFCCC *Technical Paper*, at 4, 18, ¶¶ 1, 79 (noting that the sub-groups of LDCs and SIDs refer to groupings used by the World Bank and that Africa is home to thirty-two LDCs whose economies depend more heavily on agriculture than the economies of other regions of the world).

⁶⁶ See S&P 2015, *supra* note 7, at 16; see also UNFCCC *Technical Paper*, *supra* note 4, at 28, ¶ 125 (defining *vulnerability* in this context as the “degree to which a system is susceptible, and unable to cope with, adverse effects of climate change”).

climate change. Anthropogenic climate change, however, exacerbates old hazards and generates new ones, affecting a wide range of developing countries' assets including human, physical, and socioeconomic assets, and causes widespread indirect losses.⁶⁷ These harsh realities make development assistance with climate risk transfer critically important.

C. Development Assistance for Climate Risk Management

Historically, development assistance to help developing countries to manage climate risk through risk transfer has been sparse.⁶⁸ Until recently, disasters caused by extreme weather events were viewed as an unexpected interruption in development rather than an expected risk.⁶⁹ Donor (and recipient) countries saw the risk of catastrophic loss from climate change as a high cost but low probability risk.⁷⁰ And governments, like most individuals, are disinclined to proactively manage (or help other governments to manage) low probability risks.⁷¹ Thus, donors viewed the costs of creating an insurance infrastructure in countries with a weak financial sector as prohibitively burdensome.⁷² Development assistance for climate change and development as-

⁶⁷ See UNFCCC Technical Paper, *supra* note 4, at 21, ¶¶ 94–95. The hazards exacerbated and/or caused by anthropogenic climate change are grouped into three broad categories: acute hazards, which are severe hazards with a short time frame (e.g., floods); chronic hazards that have a gradual impact (such as sea level rise); and second order hazards (such as reduced access to water) which are caused by the impact of the changing climate on human or natural systems. *See id.*

⁶⁸ *See id.* at 4, ¶ 4 (emphasizing the critical need to create financial risk-sharing and risk-management approaches and mechanisms that can help developing countries to reduce their vulnerability to the impacts of climate change).

⁶⁹ *See id.* at 19, ¶ 84 (“Disaster is still sometimes treated as an unexpected interruption to development rather than as an expected risk.”).

⁷⁰ See HOWARD C. KUNREUTHER ET AL., INSURANCE AND BEHAVIORAL ECONOMICS 235–36 (2013); David Minkow, *How the Public Underestimates the Risk of Climate Change: Interview with Paul Slovic*, CLIMATEACCESS (Jan. 24, 2012), <http://www.climateaccess.org/blog/how-public-perceives-risks-climate-change-interview-paul-slovic> [<https://perma.cc/Z9H9-TWJY>]. In this regard, there has been a prolonged disconnect between the views of governments and the general public on the one hand, and the views of climate scientists on the other, who have been warning about the increasing threat of catastrophic loss from climate change for several years. *See Minkow, supra.*

⁷¹ *See Daniel Kahneman & Amos Tversky, Prospect Theory: An Analysis of Decision Under Risk*, 47 *ECONOMETRICA* 263, 268 (1979) (detailing the phenomenon of myopic loss aversion which shows that consumers are more likely to take an uncertain risk than to suffer a certain loss in the form of a premium payment).

⁷² *See UNFCCC Technical Paper, supra* note 4, at 53, ¶ 218 (explaining that micro-insurance and weather index insurance emerged as potential ways of increasing the use of insurance as a climate risk management tool). Both micro-insurance and weather index insurance require substantial government involvement, at least at the initial stages, which is not always feasible to achieve. *See id.* at 53–56, ¶¶ 220–234. For example, to support micro-insurance, governments have to build the expertise and capacity to regulate the micro-insurers. *See id.* Donors have to invest substantially in capacity-building at both the micro-insurer and the supervisory level for

sistance for disaster relief occurred in separate silos. Neither silo addressed the need to assist developing countries with managing climate risk through risk transfer.

The climate change assistance silo focused on funding developing countries' adaptation and mitigation efforts to further the obligations assumed under the UNFCCC.⁷³ Funding for adaptation efforts included funding for disaster management and early warning signals, but not efforts to transfer the risk from government. The first global collective effort to provide development assistance for climate change was the Global Environment Facility ("GEF"), established in 1992 to serve as the financing mechanism of the UNFCCC.⁷⁴ GEF funding covers the additional costs associated with transforming a project with national environmental benefits into a project with global environmental benefits.⁷⁵ GEF grants to cover the costs of addressing the impact of climate change have emphasized funding sustainable transport, renewable energy, land use and forestry projects, and projects that protect carbon sinks.⁷⁶

Several collective financing efforts to fund developing countries' measures to address climate change followed the GEF, including the Least Developed Countries Fund, the Special Climate Change Fund, the Adaptation Fund, the Climate Investment Funds, and a series of World Bank carbon funds. Like the GEF, these efforts have funded projects and programs to achieve adaptation and mitigation and reduce greenhouse gas emissions. But,

micro-insurance to be offered in a way that incentivizes adaptation. *See id.* Governments, donors, and micro-insurers also have to assume a role in promoting insurance awareness and education. *See id.* Governments also establish the regulatory environment for index insurance. *See id.* Further, governmental meteorological services are the basis for weather index insurance's design and implementation. *See id.* Thus, jump-starting and maintaining the conditions that allow for index insurance also place demands on a country's public resources and, by extension, on sources of development assistance. *See id.*

⁷³ *See* U.N. Framework Convention on Climate Change art. 4, May 8, 1992, S. Treaty Doc. No. 102-38, 1771 U.N.T.S. 107 (stating the commitment of developed country parties to the Convention to provide financial resources to help cover the costs incurred by developing countries in complying with their obligations under the Convention).

⁷⁴ *See What Is the GEF?*, GLOB. ENV'T FACILITY, <https://www.thegef.org/gef/whatisgef> [<https://perma.cc/JT4C-Z5FJ>].

⁷⁵ *See id.* (discussing how the GEF gathers funds to "tackle our planet's most pressing environmental problems").

⁷⁶ *See id.*; *see also UNFCCC Technical Paper, supra* note 4, at 63, ¶ 275 (noting that GEF funding has included forms of technical assistance that enhance countries' capacity to manage the risk of climate change, such as the conduct of feasibility studies and risk assessments, but on a relatively small scale).

historically, they have not funded developing countries' efforts to manage climate risk through risk transfer.⁷⁷

In the disaster reduction silo, development assistance consisted primarily of providing assistance after a disaster occurred.⁷⁸ Such assistance came at the expense of other goals, as disaster-related external assistance was usually

⁷⁷ See *Least Developed Countries Fund (LDCF)*, GLOB. ENV'T FACILITY, <https://www.thegef.org/gef/LDCF> [<https://perma.cc/P55M-Y7JQ>]. The Least Developed Countries Fund finances the preparation and implementation of least developed countries' national adaptation programs of action under the UNFCCC. See *id.* Such plans include disaster management and early warning systems. See U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE SECRETARIAT, NATIONAL ADAPTATION PROGRAMMES OF ACTION: INDEX OF NAPA PROJECTS BY SECTOR 13–25 (2013), http://unfccc.int/files/cooperation_support/least_developed_countries_portal/napa_priorities_database/application/pdf/napa_index_by_sector.pdf [<https://perma.cc/FT3B-5TMB>]. For these purposes, disaster management includes taking operational measures to adapt, such as, for example, improving crop production by appropriate technologies. See, e.g., REPUBLIC OF MALAWI, MALAWI'S NATIONAL ADAPTATION PROGRAMMES OF ACTION (NAPA): UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC): FIRST EDITION 13–15 (2006), <http://unfccc.int/resource/docs/napa/mwi01.pdf> [<https://perma.cc/66CU-FPQR>]. Disaster management, however, did not originally include pursuing disaster risk management measures such as providing for risk transfer through financial instruments. See GLOB. ENV'T FACILITY, PROGRESS REPORT ON THE LEAST DEVELOPED COUNTRIES FUND AND THE SPECIAL CLIMATE CHANGE FUND 23 (2014), https://www.thegef.org/gef/sites/thegef.org/files/documents/GEF-LDCF.SCCF_17-03,%20Progress%20Report%20on%20the%20LDCF%20and%20the%20SCCF,%202014-10-08.pdf [<https://perma.cc/JUH7-VLUN>] (describing how the Special Climate Change Fund has directed its funding at projects primarily in the areas of agriculture, enhanced resilience in water resource management, coastal zone management, and technology transfer); U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE SECRETARIAT, *supra*; *Funds & Programs*, CLIMATE INV. FUNDS, <https://www-cif.climateinvestmentfunds.org/fund/clean-technology-fund> [<https://perma.cc/82LE-UNY8>] (noting that the Climate Investment Fund's resources are divided up between four focus areas: clean technology, forest investment, pilot programs for climate resilience, and renewable energy scale-up); *Projects and Programmes: All Funded Projects*, ADAPTATION FUND, <https://www.adaptation-fund.org/projects-programmes/> [<https://perma.cc/LL7Y-AUCV>] (describing how the Adaptation Fund established finances projects and programs to help vulnerable communities in developing countries adapt to climate change; such programs and projects concentrate on on-the-ground operational measures (such as climate proofing) to strengthen communities' adaptive capacity and resilience); *Special Climate Change Fund (SCCF)*, GLOB. ENV'T FACILITY, <https://www.thegef.org/gef/SCCF> [<https://perma.cc/QE2J-2E2N>] (stating that the Special Climate Change Fund was established in 2001 to support adaptation and technology transfer in all developing countries party to the UNFCCC); *World Bank Carbon Funds and Facilities*, WORLD BANK (Mar. 19, 2014), <http://www.worldbank.org/en/topic/climatechange/brief/world-bank-carbon-funds-facilities> [<https://perma.cc/6BD6-7K3E>]. The World Bank manages a cluster of carbon funds and facilities that purchase project-based greenhouse gas emission reductions in developing countries and countries with economies in transition on behalf of the funds' contributors. *World Bank Carbon Funds and Facilities*, *supra*. The most recent initiatives aim to scale up emission reductions, focus on readiness for market-based carbon initiatives, increase access to energy in least developed countries, and reduce emissions from deforestation and forest degradation. *Id.*

⁷⁸ See CUMMINS & MAHUL, *supra* note 5, at 13 (noting a shift in donors' focus from providing post-disaster assistance to promoting proactive disaster risk management).

not incremental, but tended to displace funding for development.⁷⁹ Yet donor and recipient countries seemed more willing to provide and receive relief aid than to invest in disaster reduction activities.⁸⁰ This pattern persisted despite findings that climate-related catastrophes can stall, and indeed undo, efforts to reduce poverty.⁸¹

The World Conference on Disaster Reduction convened by the U.N. General Assembly in 2005 in Kobe, Hyogo, Japan marked a turning point in this pattern.⁸² At the conference, 168 participant countries agreed upon a blueprint for disaster reduction efforts and adopted a ten-year plan to make the world safer from natural disasters.⁸³ The agreement, known as the Hyogo Framework, identified the need to promote financial risk-sharing mechanisms, particularly insurance and reinsurance against disasters, as a priority for building the capacity of nations and communities to cope with natural disaster losses.⁸⁴

Following the adoption of the Hyogo Framework, the need to integrate assistance for natural disaster relief with assistance to address the impacts of climate change, and to include climate risk management as a target of such assistance, gradually emerged as a priority. In 2011, the Intergovernmental Panel on Climate Change (“IPCC”) issued a special report on *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* (the “2011 IPCC Special Report”), which recommended integrating development assistance with governmental disaster risk management and climate adaptation policy.⁸⁵ The 2011 IPCC Special Report also recommended that development assistance promote risk-sharing and transfer mechanisms.⁸⁶

In March 2015, the signatory countries of the Hyogo Framework replaced it with the Sendai Framework for Disaster Reduction for the period

⁷⁹ See *id.* at 5 (noting that if not immediate, displacement would usually be experienced over a period of one to two years).

⁸⁰ See BRIDGETTE LEONI ET AL., U.N. INT’L STRATEGY FOR DISASTER RELIEF (UNISDR), DISASTER THROUGH A DIFFERENT LENS 62 (n.d.), http://www.unisdr.org/files/20108_mediabook.pdf [<https://perma.cc/5R7W-ZL5E>] (noting that an effect of climate-related disasters is to reinforce chronic poverty); Eric Werker, *Disaster Politics*, HARV. INT’L REV. (Aug. 23, 2010), <http://hir.harvard.edu/disaster-politics/> [<https://perma.cc/FZ7Z-YMV9>] (discussing the tendency of countries to rely on relief aid and under-invest in disaster prevention).

⁸¹ See LEONI ET AL., *supra* note 80.

⁸² See U.N. World Conference on Disaster Reduction, *Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters*, 1, U.N. Doc. A/CONF.206/6 (Jan. 2005) [hereinafter “Hyogo”].

⁸³ See G.A. Res. 58/214, U.N. Doc. A/RES/58/214 (Dec. 23, 2003).

⁸⁴ See *Hyogo*, *supra* note 82, at 11.

⁸⁵ See IPCC, *MANAGING THE RISK*, *supra* note 72, at 3–5.

⁸⁶ See *id.* at 321.

2015–2030.⁸⁷ They took note of findings on the implementation of Hyogo, showing that reducing disaster risk is a cost-effective investment in preventing future losses.⁸⁸ They also took note of findings showing that effective risk management contributes to sustainable development.⁸⁹ Echoing the recommendations of the 2011 IPCC Special Report, the Sendai Framework expressly advocates integrating global efforts to improve disaster risk reduction and management with efforts to address development and climate change.⁹⁰

This expansion of development priorities to include climate risk management has now spilled over into donors' collective efforts to fund developing countries' measures to protect the global environment. Donors' collective funding efforts to address climate change, including the GEF, have been dwarfed by the Green Climate Fund, established by the Seventeenth Conference of the Parties of the UNFCCC in late 2011, which began operations in 2014.⁹¹ Its goal is to transfer \$100 billion (comprised of public and private funds) annually to developing countries to promote low emission and climate resilient development.⁹² Assistance for climate resilient development is clearly broad enough to encompass assistance with managing the risk of loss from extreme weather events through risk transfer. Recent trends also indicate that, for the future, climate risk management will be included as a target of all development assistance for climate change. For example, the GEF plans to target \$1.4 billion towards enhanced resilience, adaptation, and disaster risk reduction in its current funding cycle.⁹³ The Least Developed Countries Fund now also includes disaster risk management (and not simply disaster management) as a priority need.⁹⁴

II. CLIMATE RISK MANAGEMENT AND CAPITAL MARKETS

Now that developed and developing countries recognize the importance of development assistance for climate risk management, such assistance must

⁸⁷ See G.A. Res. 66/199, U.N. Doc. A/RES/66/199 (Feb. 28, 2012).

⁸⁸ See SENDAI FRAMEWORK, *supra* note 1, at 9, ¶ 3.

⁸⁹ See *id.*

⁹⁰ See *id.* at 10–11, ¶¶ 4–6, 13, 47 (noting that disasters, many of which are exacerbated by climate change, impede progress towards development and addressing climate change as one of the drivers of disaster risk is an opportunity to reduce disaster risk in a meaningful and coherent manner).

⁹¹ See U.N. Framework Convention on Climate Change, Report of the Conference of the Parties on Its Seventeenth Session, 55–57, U.N. Doc. FCCC/CP/2011/9/Add.1 (Mar. 15, 2012).

⁹² See *id.* at ann.I, ¶ 3.

⁹³ *Climate Change: Main Issues*, GLOB. ENV'T FACILITY, https://www.thegef.org/gef/climate_change [<https://perma.cc/YZ28-7RM6>].

⁹⁴ See *Least Developed Countries Fund (LDCF)*, *supra* note 77 (noting that the Fund focuses on reducing the vulnerability of those sectors and resources that are central to development and livelihood, including disaster risk management and prevention).

include assistance with finding opportunities to transfer the risk to third parties. These opportunities are a key component of sovereign climate risk management that eludes developing countries.⁹⁵ The Caribbean Catastrophe Risk Insurance Facility (“CCRIF”), and the World Bank catastrophe bond issued on the CCRIF’s behalf, are examples of the kind of development assistance interventions that accomplish that goal.⁹⁶ These interventions package developing country climate risk in a manner that allows the risk to be assumed by third parties.⁹⁷

A. *The Role of Sovereign Climate Risk Pools*

Sovereign risk financing, which allows countries to secure access to financial resources when a natural disaster hits, is particularly necessary for countries for which potential losses caused by natural disasters are large relative to their national economies, or where the cost of mobilizing post-disaster funding is high.⁹⁸ Developing countries have difficulty obtaining sovereign risk financing in the private market.⁹⁹ Insurers may worry that changing budget priorities and political regimes make developing countries governments’ commitments to pay their premiums unreliable over the long term.¹⁰⁰ The pooling of sovereign risk into regional catastrophe insurance pools helps to assuage these concerns. Regional pools can also enable developing countries to access the reinsurance markets.¹⁰¹ The sponsors of the CCRIF pioneered funding a developing country climate risk management pool with the goal of obtaining these advantages on the participant countries’ behalf.¹⁰²

⁹⁵ See CUMMINS & MAHUL, *supra* note 5, at 39–48 (noting that the development of catastrophe insurance and reinsurance markets in low- and middle-income countries is impeded by a variety of demand- and supply-side market imperfections).

⁹⁶ Press Release, World Bank Treasury, World Bank Issues Its First Ever Catastrophe Bond Linked to Natural Hazard Risks in Sixteen Caribbean Countries (June 30, 2014), <http://treasury.worldbank.org/cmd/htm/FirstCatBondLinkedToNaturalHazards.html> [<https://perma.cc/YC6K-DNR8>].

⁹⁷ See generally *id.* (highlighting the CCRIF’s reinsurance model and its benefits).

⁹⁸ See CUMMINS & MAHUL, *supra* note 5, at 162.

⁹⁹ See *id.* at 40 (noting that the underdeveloped state of low- and middle-income countries’ non-life insurance markets makes it difficult to develop comprehensive risk financing strategies for government and private consumers, making outside assistance necessary to help catalyze catastrophe risk coverage).

¹⁰⁰ See *id.* at 29.

¹⁰¹ See *id.* at 24 (noting that donor-supported catastrophe insurance pools can offer policies issued in primary insurance markets, provide liquidity to governments following catastrophes, and facilitate the transfer of risk to global reinsurance and capital markets).

¹⁰² See *id.*

The CCRIF was the first multi-country insurance fund in the world.¹⁰³ It emerged as a response to devastation caused by hurricanes in the Caribbean in 2004, after which the Caribbean Community and Common Market (“CARICOM”) Heads of Government asked the World Bank for assistance to gain access to affordable, fast-disbursing disaster risk financing.¹⁰⁴ Caribbean countries cannot spread risk geographically because of their small size, or over time (through borrowing) because of their high debt levels.¹⁰⁵ But a feasibility study, financed with development assistance funds from Japan, showed that because of their particular geographic location, two or more islands are rarely affected by the same hurricane.¹⁰⁶ Accordingly, the region provides a reasonably diversified portfolio of risk, amenable to being aggregated into a single pool.¹⁰⁷

The CCRIF constitutes that single shared sovereign risk pool, aggregating Caribbean countries’ exposure to the risk of loss from hurricanes and earthquakes.¹⁰⁸ It mitigates the short-term cash flow problems that its beneficiary countries suffer after major natural disasters by providing rapid payouts to help finance their initial disaster response and maintain basic government functions after a catastrophic event.¹⁰⁹ The payouts are relatively rapid because they are based on a parametric model whereby payments are automatic on the occurrence of certain trigger events identified in the terms of the coverage, rather than being based upon an assessment of loss actually sustained.¹¹⁰

¹⁰³ *About Us*, CARIBBEAN CATASTROPHE RISK INS. FACILITY, <http://www.ccrif.org/content/about-us> [https://perma.cc/JQS8-78WK].

¹⁰⁴ Memorandum from the President, World Bank, to the Executive Directors, Proposed Transfer of IBRD Surplus to Support a Caribbean Catastrophe Risk Insurance Facility 1 (Feb. 9, 2007) [hereafter “IBRD Board Paper February 2007”]; WORLD BANK, PROJECT APPRAISAL DOCUMENT ON A PROPOSED GRANT IN THE AMOUNT OF SDR 6 MILLION (US \$9 MILLION EQUIVALENT) TO THE REPUBLIC OF HAITI FOR A HAITI CATASTROPHIC INSURANCE PROJECT 15 (2007), http://www-wds.worldbank.org/servlet/WDSContentServer/IW3P/IB/2007/02/21/000020439_20070221163058/Rendered/PDF/38540.pdf.

¹⁰⁵ See WORLD BANK, *supra* note 104, at 1 (using Haiti as an example).

¹⁰⁶ See *id.* at 15.

¹⁰⁷ See *id.*

¹⁰⁸ See Memorandum from the President, World Bank, to the Executive Directors, Proposed Trust Fund for the Caribbean Catastrophe Risk Insurance Facility 1, ¶ 1 (Mar. 6, 2007) [hereinafter “Proposed Trust Fund for CCRIF”], http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2007/03/08/000020439_20070308113842/Rendered/PDF/38927.pdf.

¹⁰⁹ See *About Us*, *supra* note 103 (“Since the inception of CCRIF in 2007, the facility has made 13 payouts for hurricanes, earthquakes and excess rainfall, to 8 member governments totaling approximately US\$38 million to eight member governments.”).

¹¹⁰ See CUMMINS & MAHUL, *supra* note 5, at xxiii (“Parametric Insurance makes indemnity payments based not on an assessment of the policyholder’s individual loss, but rather on measures of a parametric index that is assumed to proxy actual losses.”).

With development assistance funds from the European Union, the Caribbean Development Bank, several donor governments, and some of its own funds, the World Bank established the facility as a special purpose insurance entity under Cayman law, owned by a trust that is also established and registered under Cayman law.¹¹¹ Donors' contributions funded both the establishment costs and the first few years of the facility's operating expenditures.¹¹² Countries insured by the facility pay an initiation fee and annual premiums, the amount of which is adjusted according to each country's individual risk profile.¹¹³ The poorer beneficiary countries paid their initiation fees and first three years' premiums with funds provided by the International Development Association, the arm of the World Bank Group established to provide low interest loans to the world's poorest countries.¹¹⁴

From the beginning, the CCRIF's sponsors intended the facility to become self-sustaining within five years.¹¹⁵ They intended their contributions to catalyze the private sector to become involved and viewed their initial financial support as helping to resolve what they perceived to be a temporary market failure.¹¹⁶ To pave the way for a gradual transition to a wholly private entity, the facility's governance structure was dominated by the private sector.¹¹⁷ A board of directors governed the facility, composed of four representatives drawn from the private banking, insurance, and risk management sectors, along with a CARICOM appointee (representing the interests of the participating countries) and a Caribbean Development appointee (representing donor countries).¹¹⁸ A captive manager, drawn from the private sector and answerable to the board, managed the facility's day-to-day operations.¹¹⁹ In due course, the facility engaged a facility supervisor, insurance manager, asset

¹¹¹ See WORLD BANK, *supra* note 104, at 3.

¹¹² See *id.* In addition to Japan, donor governments included the Governments of Canada, United Kingdom, France, Ireland, and Bermuda. See *id.* at 2, ¶¶ 4–5.

¹¹³ See IBRD Board Paper February 2007, *supra* note 104, at 10.

¹¹⁴ See Proposed Trust Fund for CCRIF, *supra* note 108, at 2, ¶ 2. The International Development Association (IDA), a separate international organization from the International Bank for Reconstruction and Development (IBRD), played a key role in assisting Caribbean countries in the development of the CCRIF. See *id.* Haiti, Dominica, Grenada, St. Lucia, St. Vincent, and the Grenadines received such assistance from the IDA. See *id.*

¹¹⁵ See *id.* at 2, ¶ 6.

¹¹⁶ See *id.* at 2, ¶¶ 5–6 (noting that while donor support was essential for establishing the CCRIF, the facility was expected to become self-sustaining over time).

¹¹⁷ See IBRD Board Paper February 2007, *supra* note 104, at 10–11.

¹¹⁸ See *id.*

¹¹⁹ See *id.* at 11.

manager, reinsurance broker, and communications manager, all drawn from the private sector.¹²⁰

The facility has been hailed as an effective use of development assistance resources because it catalyzed the creation of a self-sustaining entity that met a strong development need: Caribbean countries' need for insurance against loss from extreme weather events.¹²¹ Since 2014, it has functioned without contributions from the World Bank or other external contributors to its operating capital.¹²² It has re-structured from a trust and captive special purpose entity to become a segregated portfolio company.¹²³ Further, it has expanded to offer coverage to Central American countries.¹²⁴ It has also expanded its coverage options to include excess rainfall coverage.¹²⁵

B. The Role of Catastrophe Bonds

The CCRIF's sponsors always envisaged a sovereign risk insurance facility that would become self-sustaining in due course.¹²⁶ At the same time, the sponsors recognized that the facility's sustainability would depend on its ability to transfer some of its financial risk to the international capital markets through reinsurance and/or alternative risk transfer mechanisms, such as catastrophe bonds.¹²⁷ The three-year \$30 million catastrophe bond the World Bank issued in June 2014 aims to further that goal.¹²⁸

Catastrophe bonds help private entities, countries, and sovereign risk management facilities, such as the CCRIF, manage their exposure to catastrophic loss by enabling the transfer of that risk to private investors in the capital markets.¹²⁹ The advantage of a catastrophe bond is that it provides for a non-contingent, non-reimbursable infusion of liquidity to a country experiencing a specified climate event of a specified magnitude, designated in the bond documentation as a *trigger*.¹³⁰ Like the insurance provided by the

¹²⁰ See generally CARIBBEAN CATASTROPHE RISK INS. FACILITY, CCRIF ANNUAL REPORT FOR 2009–2010 (2010) (acknowledging throughout the importance of each of these roles).

¹²¹ See CUMMINS & MAHUL, *supra* note 5, at 102 (citing the CCRIF as an illustration of a successful regional risk aggregator vehicle).

¹²² See *About Us*, *supra* note 103.

¹²³ See *id.*

¹²⁴ See *id.* (noting the expansion to include Nicaragua, the first Central American government to become a CCRIF member).

¹²⁵ See *id.*

¹²⁶ See Proposed Trust Fund for CCRIF, *supra* note 108, at 2, ¶ 6.

¹²⁷ See IBRD Board Paper February 2007, *supra* note 104, at 10; WORLD BANK, *supra* note 104, at 3, 9.

¹²⁸ See Bennett, *supra* note 21.

¹²⁹ See CUMMINS & MAHUL, *supra* note 5, at 214–15.

¹³⁰ See *id.* at 212–32; Christopher Kampa, *Alternative Risk Transfer: The Convergence of the Insurance and Capital Markets, Part II*, INS. STUDIES INST., July 28, 2010, at 3–4. For an excel-

CCRIF, the liquidity infusion provided by the bonds is based on parametric insurance, not actual loss.¹³¹ For this reason, the coverage may well fall far short of the loss actually sustained.¹³² Nonetheless, these bonds play a useful role in a country or entity's overall climate risk management portfolio.

Catastrophe bonds can be an effective form of risk transfer because they have a high market appeal to a particular investor base, despite their inherent riskiness (given the vagaries of the extreme weather events they rely upon as triggers).¹³³ They are marketed to a limited set of institutional investors with expertise in evaluating insurance risk.¹³⁴ Over the last decade, these bonds have become an increasingly important part of the global reinsurance market, as they now represent about 15% of the total volume of global catastrophe reinsurance.¹³⁵

Catastrophe bonds based on developing country climate risk have a particular appeal because the risks covered by catastrophe bonds have tended to be "highly concentrated in a small number of perils—hurricanes in southeastern United States, earthquakes in California, windstorms in Europe and earthquakes in Japan."¹³⁶ Indeed, the market data shows that investor demand for catastrophe bonds referencing other risks is so strong that investors will accept a lower interest rate on these bonds than they will accept on bonds with an equivalent level of risk that reference the main perils in the market.¹³⁷ Accordingly, catastrophe bonds have significant potential to serve as a cost-effective way for developing countries to manage their exposure to climate risk.

Without development assistance, however, many developing countries cannot avail of the opportunity to transfer climate risk to the market that this investor demand presents.¹³⁸ Most developing countries' governments face

lent treatment of the regulatory issues posed by catastrophe bonds, see Qihao He, *Climate Change and Disaster Risk Management: A Law and Economics Analysis of Insurance and Insurance-Linked Securities* (Seminar on Market Integration: The EU Experience and Implications for Regulatory Reform in China, Working Paper, 2014) (unpublished manuscript) (on file with authors).

¹³¹ See WORLD BANK, *supra* note 11.

¹³² See Kampa, *supra* note 130, at 8 (Figure 6, Cross-Comparison of Catastrophe Bond Triggers).

¹³³ See U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-02-941, CATASTROPHE INSURANCE RISKS: THE ROLE OF RISK-LINKED SECURITIES AND FACTORS AFFECTING THEIR USE 5, 15–17 (2002), <http://www.gao.gov/new.items/d02941.pdf> [<https://perma.cc/4K44-KCMW>]; Bennett, *supra* note 21.

¹³⁴ See Bennett, *supra* note 21.

¹³⁵ *Id.*

¹³⁶ *Id.*

¹³⁷ *Id.*

¹³⁸ *See id.*

significant barriers to entry into this market.¹³⁹ Government officials tend to lack familiarity with reinsurance in general and the catastrophe bond market in particular.¹⁴⁰ Further, modeling of the natural disaster risk exposure of many countries is either limited or non-existent, which makes the private financial sector unwilling to engage.¹⁴¹ The intervention of an institution like the World Bank, or other international development bank, however, can overcome these barriers. Developing countries' need of that intervention creates an opportunity for the intervening institution to condition its intervention on the developing country's agreeing to undertake sound climate risk management practices.¹⁴² Understanding how the opportunity to demand sound risk management as a *quid pro quo* for issuing a catastrophe bond on a country's behalf arises requires understanding how a catastrophe bond works.

There are several steps in the workings of a catastrophe bond. Briefly, in a typical catastrophe bond structure in the private sector, the entity exposed to the risk of catastrophic loss—frequently an insurance company, which, in return for a premium, assumes the risk from the business that is actually exposed to physical harm—enters into an insurance contract with a special purpose vehicle (“SPV”) created for the sole purpose of issuing catastrophe bonds. For example, a hypothetical business, Sunny Beach Vacation Resort (a business exposed to risk of loss from hurricanes), will buy hurricane insurance from Extreme Weather Insurance Co.¹⁴³ Instead of retaining this risk, Extreme Weather Insurance Co., known as the “sponsor of the bond,” creates an SPV (Extreme Weather Events SPV) to issue catastrophe bonds as a way of transferring this risk exposure away from Extreme Weather Insurance Co. and onto the capital markets.¹⁴⁴

The terms and conditions of the catastrophe bonds issued by the Extreme Weather Events SPV will provide for the investors (the bondholders) to receive interest throughout the life of the bond, and the return of their principal (the purchase price of the bonds) upon the bonds' maturity subject to no *trigger event* occurring over the life of the bond.¹⁴⁵ If a *trigger event* occurs,

¹³⁹ *Id.*

¹⁴⁰ *See id.*

¹⁴¹ CUMMINS & MAHUL, *supra* note 5, at 60–61 (noting that transferring catastrophe risk to securities markets through sophisticated financial instruments requires the development of exposure maps and catastrophe-loss simulation models, which do not exist for most developing countries); Bennett, *supra* note 21.

¹⁴² *See* CUMMINS & MAHUL, *supra* note 5, at 18 (noting that the World Bank aims to persuade developing countries to adopt a proactive and strategic framework for natural disaster risk management).

¹⁴³ *See* CUMMINS & MAHUL, *supra* note 5, at 53; Bennett, *supra* note 21.

¹⁴⁴ *See* CUMMINS & MAHUL, *supra* note 5, at 53; Bennett, *supra* note 21.

¹⁴⁵ *See* CUMMINS & MAHUL, *supra* note 5, at 53; Bennett, *supra* note 21.

however, the investors will lose some or all of their principal.¹⁴⁶ The *trigger event* for a catastrophe bond linked to hurricane risk will be the occurrence of a hurricane of a specific magnitude.¹⁴⁷

Upon issuing the bond, the SPV places the bond proceeds (the purchase price paid by investors) in a collateral trust.¹⁴⁸ The assets of the collateral trust are then invested in highly rated securities.¹⁴⁹ The Extreme Weather Events SPV then uses the insurance premiums it receives from the bond sponsor (Extreme Weather Events Insurance Co.), and the return it receives on the assets in the collateral trust, to make periodic interest payments to the bondholders. If a *trigger event* occurs during the term of the bond (i.e., a hurricane of the specified magnitude), the SPV liquidates some or all of the assets held in the collateral trust and pays that money to the sponsor (Extreme Weather Insurance Co.) pursuant to its insurance contract with the sponsor. That money puts the sponsor in funds to cover the loss it has insured (the insurance payable to Sunny Beach Vacation Resort).¹⁵⁰ If no *trigger event* occurs, the SPV liquidates the assets in the collateral trust on the maturity date of the bonds and uses them to repay the principal on the bonds to the bondholders.¹⁵¹

With its issuance of a catastrophe bond on behalf of the CCRIF in 2014, the World Bank modified the typical catastrophe bond structure to lower the cost for the CCRIF.¹⁵² The World Bank catastrophe bond eliminates the need for an SPV or a collateral trust.¹⁵³ Instead, the Bank serves in a role akin to that played by the SPV in a traditional catastrophe bond structure, but relies on its own balance sheet (not the investment income earned on a specially created trust of the bond proceeds) to support the bond interest and principal payments.¹⁵⁴ Eliminating the need for an SPV and a dedicated pool of collateral reduces the costs of issuing the bond (which would have been borne by CCRIF and, ultimately, the countries that are its beneficiaries).¹⁵⁵

The World Bank hedged its risk on the bond by entering into a simultaneous swap contract with the CCRIF that mirrors the terms of the catastrophe

¹⁴⁶ See CUMMINS & MAHUL, *supra* note 5, at 53; Bennett, *supra* note 21.

¹⁴⁷ See CUMMINS & MAHUL, *supra* note 5, at 53; Bennett, *supra* note 21.

¹⁴⁸ See CUMMINS & MAHUL, *supra* note 5, at 53; Bennett, *supra* note 21.

¹⁴⁹ See CUMMINS & MAHUL, *supra* note 5, at 53; Bennett, *supra* note 21.

¹⁵⁰ See CUMMINS & MAHUL, *supra* note 5, at 53; Bennett, *supra* note 21.

¹⁵¹ See CUMMINS & MAHUL, *supra* note 5, at 53; Bennett, *supra* note 21. See generally PARTNERRE, A BALANCED DISCUSSION ON INSURANCE-LINKED SECURITIES (2008), <https://www.yumpu.com/en/document/view/25162720/a-balanced-discussion-on-insurance-linked-securities-partnerre> [<https://perma.cc/26A7-2SZX>] (detailing the mechanics of a catastrophe bond).

¹⁵² See Bennett, *supra* note 21.

¹⁵³ See *id.*

¹⁵⁴ See *id.* (“The most recent Capital-at-Risk Notes program streamlines the process further by eliminating the need for an SPV or a collateral arrangement.”).

¹⁵⁵ See *id.*

bond. Under the terms of the swap contract, the Bank receives premiums from CCRIF which match the interest payments due to the bondholders. Under the terms of the swap contract, if a trigger event occurs (a hurricane or earthquake of specified intensity), the principal amount of the bond will be reduced and an equivalent amount will be paid to the CCRIF under the terms of the swap. If no such event occurs, the bondholders will receive a payout at the end of the three years (the term of the bond).¹⁵⁶

The swap ensures that the Bank's intervention to facilitate a risk transfer by the CCRIF to the capital markets does not expose the Bank's balance sheet itself to risk. Nonetheless, the transaction of the catastrophe bond placed demands on the Bank's resources, not least of which included the fact that the Bank created a new capital-at-risk program to serve as the umbrella for such bonds.¹⁵⁷ Bonds issued, or to be issued, under the capital-at-risk program may be rated less than the World Bank's own Triple-A rating, or may be unrated to take account of the fact that investors in these bonds risk losing the return of some or all of their principal if specified risks occur.¹⁵⁸ The program is intended to ensure that investors are aware that the catastrophe bond and any other bonds issued under the program have a markedly distinct risk profile from the Bank's usual Triple A-rated bonds.¹⁵⁹

III. FUTURE APPROACHES TO CAPITAL MARKET TOOLS FOR CLIMATE RISK MANAGEMENT IN DEVELOPING COUNTRIES

As the Caribbean Catastrophe Risk Insurance Facility ("CCRIF") and the World Bank ("the Bank") catastrophe bond show, sovereign risk insurance pools and catastrophe bonds can play a vital role in managing climate risk. Thus, development assistance that helps countries to avail of such arrangements is a step towards fulfilling the Sendai Framework and Paris Agreement imperatives.¹⁶⁰ Looking forward, we must commit to taking bold steps in the global effort to combat climate change and manage disaster risk by maintaining a strong link between such assistance and the receipt of commitments from beneficiary countries to do their part on risk reduction.

Forging and enforcing that link will involve intervening in the terms and conditions of the insurance contracts that are a key part of the risk coverage

¹⁵⁶ See *id.*

¹⁵⁷ See *id.*

¹⁵⁸ See *World Bank Capital at Risk Notes*, WORLD BANK, <http://treasury.worldbank.org/cmd/htm/CapitalAtRiskNotesProgram.html> [<https://perma.cc/DDX9-4ZSC>] (explaining that notes issued under the World Bank Capital-At-Risk program may not be assigned any security rating or may be assigned a lower security rating than other World Bank debt issues).

¹⁵⁹ See *id.*

¹⁶⁰ See *Paris Agreement*, *supra* note 2, at ¶ 11; SENDAI FRAMEWORK, *supra* note 1, at 13–14.

that these arrangements provide.¹⁶¹ Intruding on the domain of private ordering arrangements such as financial contracts, however, will become an increasingly necessary step in realizing the imperatives of these international commitments. The scale of the global climate change challenge, and the extent of countries' reliance on the financial sector to raise the resources to address it, makes close coordination between global climate change management and global economic governance essential. Having development assistance donors influence the terms of coverage offered by future CCRIF-like facilities is just one example of the kind of coordination required.

A. The CCRIF and the World Bank Catastrophe Bond as Role Models

The CCRIF and the World Bank catastrophe bond fill a void in the development assistance landscape. The CCRIF models aggregate sovereign climate risk in a way that makes it palatable for the private insurance industry to assume the risk and extend coverage.¹⁶² The World Bank catastrophe bond reinforces that effort. It allows the facility to access private investor demand for high yield securities and investors' willingness to assume a certain amount of climate risk as the price of that yield.¹⁶³ Both interventions enable the member countries of the CCRIF to better manage climate risk by transferring a portion of that risk to third parties.¹⁶⁴ To that extent, both interventions achieve their stated goals. To what extent then are these interventions model forms of development assistance that we should emulate in the future?

These interventions model much that is worth emulating, and future interventions should aim for similar goals. Specifically, future interventions should condition assistance on firm commitments from the countries that benefit from the interventions to undertake climate risk reduction efforts to an extent consistent with each beneficiary country's level of development. In the case of assistance to establish a sovereign insurance pool like the CCRIF, this conditionality can be included in the terms and conditions of coverage set out in the insurance contracts between the countries obtaining coverage and the entity providing the coverage, such as the CCRIF. Further, the provider of

¹⁶¹ See GFDRR, CARIBBEAN CATASTROPHE RISK INSURANCE FACILITY (CCRIF), DISASTER RISK FINANCING CASE STUDY (2011), http://www.gfdr.org/sites/gfdr.org/files/documents/DRFI_CCRIF_Jan11.pdf [<https://perma.cc/R22P-5CNJ>] (summarizing the terms of the insurance contracts CCRIF enters into with beneficiary countries).

¹⁶² See CUMMINS & MAHUL, *supra* note 5, at 154–66 (noting that to place reinsurance coverage on primary insurers on favorable terms, it is necessary to provide the global reinsurers information on the distribution of exposures and the probability distribution of losses and that the CCRIF allows beneficiary countries to obtain insurance at approximately half the price they would pay if they approached the reinsurance industry on their own).

¹⁶³ See GFDRR, *supra* note 161.

¹⁶⁴ See *id.*

coverage can be required to monitor beneficiary countries' compliance with their obligations to reduce risk. In turn, assistance in the form of a World Bank catastrophe bond, which enables an entity like the CCRIF to access the capital markets, can be limited to intermediaries that require and police risk reduction from their insureds.

In creating such a facility, there are two pivotal points where the facility's sponsors can seek to impose conditions requiring beneficiary countries to undertake risk reduction. The first opportunity to impose such conditions arises when funds are raised from donors to cover the facility's establishment costs, operating expenses, and insurance payouts during the first few years of its operation.¹⁶⁵ The terms of the grant agreements with donors could specify that the facility shall require risk reduction by the countries it insures.¹⁶⁶

The second opportunity to require risk reduction measures be taken by insured countries is at the point where the facility's sponsors agree that external funds (from the International Development Association ("IDA"), for example) should be used to cover the costs of some participant countries' initiation fees and premiums.¹⁶⁷ The grant agreements between the source of the external funds and the countries whose initiation and premium fees are being paid could mirror any risk reduction requirements included in the insurance contracts those countries enter into with the facility.¹⁶⁸

This recommendation is not meant to suggest that countries like the Caribbean countries, which are highly vulnerable to extreme weather events exacerbated by climate change, are to blame for their vulnerability. To the contrary, small island countries are primarily victims, not perpetrators, of climate change.¹⁶⁹ In addition, the recommendation does not seek to place an unfair burden on any developing country to develop a disaster risk management plan that goes beyond what can reasonably be expected given that country's level

¹⁶⁵ See Proposed Trust Fund for CCRIF, *supra* note 108, at 2, ¶ 4.

¹⁶⁶ See Kenneth S. Abraham, *Four Conceptions of Insurance*, 161 U. PA. L. REV. 653, 683–86 (2013) (noting that insurance has long had the capacity to influence behavior and serve as a surrogate for government in a range of contexts); see also Jeffrey W. Stempel, *The Insurance Policy as Social Instrument and Social Institution*, 51 WM. & MARY L. REV. 1489, 1494 (2010) (noting that the most common insurance policies are produced in a manner similar to private legislation and share similarities with statutes).

¹⁶⁷ See Proposed Trust Fund for CCRIF, *supra* note 108, at 2, ¶ 4 (noting that IDA grants covered the costs of some CCRIF beneficiary countries' premiums).

¹⁶⁸ GFDRR, *supra* note 161 (summarizing the structure of CCRIF's insurance contracts with its member countries).

¹⁶⁹ See IPCC 2014, *supra* note 12, at 24–25 (noting that the world's least developed countries have contributed the least to the emission of greenhouse gases, but are the most vulnerable countries to the effects of climate change); *id.* at 13 (recording high level risk of death, injury, ill health, or disrupted livelihoods in low-lying coastal zones and small island developing countries due to storm surges, coastal flooding, and sea level rise).

of development. It is clear that developing country governments face many competing priorities for their limited budget resources, of which disaster risk planning is only one. The objective of the recommendation therefore is not to punish countries that are unable to afford to carry out robust disaster risk planning, but rather to push all countries to do as much preparedness and resiliency planning as is possible given their circumstances.

At the same time, the threat posed by climate change is so immense, and the need for a fundamental change in the kind of development we support and encourage so intense, that we need to optimize every opportunity to spur reduction efforts.¹⁷⁰ There may still be measures that countries like the Caribbean countries can reasonably take to improve their resilience and reduce their exposure to loss. Further, future development assistance efforts may apply the CCRIF model and the World Bank catastrophe bond to other countries and to other kinds of economic damage beyond geological and meteorological catastrophe risk events where greater opportunities for reduction apply.

In the absence of a tie-in between such arrangements and a commitment by the insureds to risk reduction, we risk re-creating the kind of problems that the U.S. National Flood Insurance Program (“NFIP”) caused.¹⁷¹ The U.S. Congress created the NFIP in 1968 with the idea, *inter alia*, of using the carrot of federally subsidized flood insurance to encourage local authorities to manage development in floodplains.¹⁷² With rising sea levels causing an exponential increase in the risk of flooding, the subsidized insurance now operates as a perverse incentive that inhibits sound adaptation.¹⁷³ Under the program, homeowners in communities that adopt minimum floodplain regulations are eligible to purchase federal flood insurance at below-market rates.¹⁷⁴

¹⁷⁰ See *Paris Agreement*, *supra* note 2, at 1–2 (noting that climate change represents an urgent and potentially irreversible threat to human societies and the planet and requires the widest possible cooperation by all countries, as well as their participation in an effective and appropriate international response to accelerate the reduction of global greenhouse gas emissions); INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, ASSESSING AND MANAGING THE RISKS OF CLIMATE CHANGE (n.d.), https://ipcc-wg2.gov/AR5/images/uploads/WGII-AR5_SPM_Top-Level_Findings.pdf [<https://perma.cc/DP2B-PDDU>] (noting that climate change currently poses high risks for human and natural systems and that its risks and impact can and should be reduced through adaptation and mitigation).

¹⁷¹ See Byrne & Grannis, *supra* note 24, at 292; see also IPCC 2014, *supra* note 12, at 26 (noting that risk financing mechanisms in the public and private sector, such as insurance and risk pools, can contribute to increasing resilience, but that without attention to major design challenges they can also provide disincentives, cause market failure, and decrease equity).

¹⁷² See Byrne & Grannis, *supra* note 24, at 272, 291.

¹⁷³ See *id.* See generally Sean B. Hecht, *Climate Change and the Transformation of Risk: Insurance Matters*, 55 UCLA L. REV. 1159 (2008) (noting that the insurance industry’s future, and perhaps the future of the planet, will ultimately depend on the insurance industry’s ability to encourage climate-change-mitigating and adaptive behavior on the part of its policy holders).

¹⁷⁴ See Byrne & Grannis, *supra* note 24, at 292.

Unfortunately, the subsidized insurance provides a financial incentive for people to develop and redevelop in the same areas where rising sea levels now indicate that state and local governments should encourage retreat.¹⁷⁵ The federally-backed flood insurance spreads the risk of flood damage to all taxpayers and, therefore, allows property owners to maintain development in flood-prone areas without paying the true costs of the risk.¹⁷⁶ The private market, in contrast, would compel a retreat strategy because, faced with exponentially higher rates to match the exponential increase in risk, many property owners would be forced to relocate out of vulnerable areas.¹⁷⁷

The way in which the NFIP generated perverse incentives serves as a warning of the unforeseen consequences that can arise when governments subsidize insurance premiums directly (as the CCRIF sponsors did when they agreed that the IDA funds could be used to pay some countries' initiation fees and premiums).¹⁷⁸ Perverse incentives could also arise when the access of governments' insurers to capital market investors is facilitated by an international development bank whose members absorb the set-up and transactional costs involved in affording that access. The lesson here is not to deny development assistance for risk management. Instead, it is a reminder to link the assistance with reduction and other forms of adaptation whenever it is reasonably possible to do so.¹⁷⁹

As demand for disaster insurance increases around the world, and entities emerge to meet that demand, the World Bank and other international development banks will have an opportunity to use the carrot of catastrophe bond financing to influence the terms and conditions of the new entity's insurance contracts with its insured. Ensuring that those terms and conditions mandate climate risk reduction efforts should be a priority goal.¹⁸⁰

¹⁷⁵ See *id.*

¹⁷⁶ See *id.*

¹⁷⁷ See *id.* Some (but by no means all) of the problems with NFIP subsidies were addressed by the Biggert-Waters Flood Insurance Reform Act of 2012, Pub. L. No. 112-141, 126 Stat. 405 (codified as amended at 42 U.S.C. §§ 4001–4130). *Id.* The Reform Act authorizes the U.S. Federal Emergency Management Agency (FEMA) to update flood maps based on consideration of “future changes in sea levels, precipitation, and intensity of hurricanes” and establishes a Technical Mapping Advisory Council to make recommendations to FEMA about how to incorporate consideration of climate change in flood insurance rate maps. *Id.*

¹⁷⁸ See Proposed Trust Fund for CCRIF, *supra* note 108, at 2, ¶ 4.

¹⁷⁹ See IPCC 2014, *supra* note 12, at 26.

¹⁸⁰ See UNFCCC Technical Paper, *supra* note 4, at 6, ¶ 13 (affirming the value of assistance with risk transfer, while also recommending that such assistance be coupled with encouraging risk prevention measures, including adaptation to reduce risk, vulnerability, and exposure).

B. The CCRIF and World Bank Catastrophe Bond in Broader Perspective

The CCRIF and the World Bank catastrophe bond that supports it are just two examples of an arsenal of instruments and approaches that developing countries need to manage climate risk. Both arrangements have inherent limitations. For example, the parametric cover that underlies both arrangements can result in extensive uncovered losses.¹⁸¹ While the parametric structure allows for rapid payouts, the extent of under-coverage can be a high price.¹⁸² In addition, both arrangements tie payouts to the occurrence or non-occurrence of a trigger event.¹⁸³ Inevitably, this means that there will be times when an insured sustains significant loss, with potentially crippling economic consequences, but fails to recover because the event falls short of the magnitude required to meet the definition of a trigger event.¹⁸⁴

Moreover, the risk transfer process that both arrangements facilitate is the last step in a country's systematic risk management process.¹⁸⁵ Before a country decides which risks to transfer, it needs to organize itself so as to reduce the risks as far as possible, which requires the preliminary step of assessing the scope of the risk.¹⁸⁶ Assessing the risk entails data gathering, data compilation, processing and analysis, and modeling hazard behavior and asset vulnerability.¹⁸⁷ Once the country assesses the risk, it then has to divide the different aspects of the identified risk into different layers, according to the probability of its occurring and the scale of the loss that it will cause.¹⁸⁸ To know what risk to transfer and how best to transfer it, both the developing countries themselves, and the third parties they rely on for reinsurance, need access to sophisticated risk modelling, databases, risk assessment programs, and information systems. Thus, in addition to helping with risk transfer, we

¹⁸¹ See *id.* at 67–68, ¶ 291.

¹⁸² See *id.* (recognizing that when the bond instrument is too tightly defined, participant countries may be left out and fail to receive a payout because the triggering conditions do not apply).

¹⁸³ See *id.*; see also Bennett, *supra* note 21 (noting that the designated catastrophe must occur for a payout).

¹⁸⁴ See UNFCCC *Technical Paper*, *supra* note 4, at 67–68, ¶ 291 (noting that the CCRIF has been criticized for defining *trigger event* too narrowly, leading to situations where participant countries were denied cover despite suffering significant losses from hurricane damage).

¹⁸⁵ See *id.* at 37, ¶ 161.

¹⁸⁶ See *id.* at 70, ¶¶ 304–306.

¹⁸⁷ See *id.* at 73, ¶ 315; see also *id.* at 70, ¶ 306 (noting that the first component of a risk assessment process involves analyzing hazard behavior and asset vulnerability “through mathematical models and estimating the probability of risk occurrence through historical and simulated events”).

¹⁸⁸ See J. FRANCOISE OUTREVILLE, *THEORY AND PRACTICE OF INSURANCE* 179–191 (1998); see also UNFCCC *Technical Paper*, *supra* note 4, at 70, ¶ 306 (“The second component [of a risk assessment process] is a detailed analysis of pertinent assets exposed to risk and their vulnerability to different levels of hazard impact.”).

need development assistance to fund the creation of this risk management infrastructure.¹⁸⁹

This need has received international attention, but so far inadequate funding.¹⁹⁰ Signatories of the Sendai Framework urged each other to increase their contributions to a United Nations Trust Fund for Disaster Reduction.¹⁹¹ Some years earlier, a Technical Paper on mechanisms to manage the financial risks of climate change commissioned by the United Nations Framework Convention Climate Change (“UNFCCC” or “Convention”) Secretariat at the request of an *ad hoc* working group on long-term cooperative action under the Convention made a much more sweeping recommendation.¹⁹² The paper proposed that donor countries should fund the creation of a global climate risk management mechanism that would provide market solutions, stimulate risk management, focus efforts to prepare for the adverse effects of climate change, and transfer the risk to international markets.¹⁹³

The proposal included setting up two new global facilities; a Technical Advisory Facility to provide technical assistance to countries on risk modeling, findings, and management, and a Financial Vehicle.¹⁹⁴ The Financial Vehicle would administer a central pool of resources to be held in a *Responsibility Fund*, offer reinsurance to countries, and serve as a channel to the capital markets.¹⁹⁵ The Responsibility Fund’s resources would come from premiums paid by countries for reinsurance and development assistance contributions.¹⁹⁶

The proposal has not yet been acted upon. The Green Climate Fund, as the UNFCCC’s core financing vehicle for climate change, however, could create a window to perform similar functions. The relative merits of such a centralized effort over de-centralized efforts that emulate features of the CCRIF and are supported by development banks and others would need to be examined. A 2006 initiative titled the Global Facility for Disaster Reduction and Recovery, however, aims to perform some of the functions indicated for

¹⁸⁹ See *UNFCCC Technical Paper*, *supra* note 4, at 6, ¶ 11 (describing the need to overcome a “lack of awareness, weak financial infrastructure and the absence of databases of risk-relevant information” to create risk pooling services that would help developing countries to manage climate risk).

¹⁹⁰ See SENDAI FRAMEWORK, *supra* note 1, at 25, ¶ 47.

¹⁹¹ See *id.*

¹⁹² See generally *UNFCCC Technical Paper*, *supra* note 4, at 102–03 (noting that risk transfer mechanisms have an essential role to play in developing countries’ climate risk management efforts and that the international community should catalyze the creation of such mechanisms).

¹⁹³ See *id.* at 78.

¹⁹⁴ See *id.* at 79.

¹⁹⁵ *Id.* (emphasis added).

¹⁹⁶ See *id.*

the proposed Technical Advisory Facility.¹⁹⁷ Originally created to fund developing countries' disaster management efforts and to serve as a repository of disaster management best practices, it has now expanded its mandate to include climate risk management.¹⁹⁸ Its activities to date, however, fall far short of pioneering the kind of comprehensive climate risk management infrastructure that the Technical Advisory Facility was intended to be.¹⁹⁹ But given that the Paris Agreement attests to a new sense of urgency about climate risk, perhaps the time for this need to be met has arrived. The Green Climate Fund would be an obvious source to expect to fund the costs of creating such an infrastructure. Once in place, the infrastructure will pave the way for more widespread use of capital markets to absorb developing country climate risk.

CONCLUSION

The ink is barely dry on the Paris Agreement, but "time and tide [and other extreme weather events] wait for no man."²⁰⁰ The Caribbean Catastrophe Risk Insurance Facility and the World Bank catastrophe bond offer concrete examples of the kinds of arrangements we can use to spread developing countries' climate risk more broadly and transfer it to parties better able to absorb it. We need to invest in creating the kind of information infrastructure that will enable more expansive use of such arrangements. The time for treating development setbacks caused by extreme weather events as nasty surprises has long since passed.

¹⁹⁷ See *Donors*, GLOBAL FACILITY FOR DISASTER REDUCTION AND RECOVERY (GFDRR), <https://www.gfdr.org/donors> [<https://perma.cc/ZC3Q-B4EZ>].

¹⁹⁸ See *id.*

¹⁹⁹ The Global Facility for Disaster Reduction and Recovery's (GFDRR) five priorities for action are risk identification, risk reduction, preparedness, financial protection, and resilience recovery. See *Our Portfolio*, GLOBAL FACILITY FOR DISASTER REDUCTION AND RECOVERY (GFDRR), <https://www.gfdr.org/our-portfolio> [<https://perma.cc/5L36-FHA8>]. Though these priorities indicate a commitment to supporting climate risk management, the GFDRR's grant portfolio in its 2014 fiscal year amounted to just \$156 million in grant commitments, an amount far smaller than what is needed to construct the kind of comprehensive climate risk management infrastructure contemplated for the Technical Advisory Facility. See *id.*

²⁰⁰ *Geoffrey Chaucer Quotes*, BRAINY QUOTE, <http://www.brainyquote.com/quotes/quotes/g/geoffreych165940.html> [<https://perma.cc/F2VB-LECQ>].