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Patrick Bolton, Lee Buchheit, Mitu Gulati, Ugo Panizza, Beatrice Weder di Mauro and Jeromin Zettelmeyer

CLIMATE AND DEBT

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Foreword

The Geneva Reports on the World Economy are published annually by CEPR and ICMB and have been providing innovative analysis on important topical issues facing the global economy since 1999.

Global warming is already happening. The amount of CO_2 which is already in the atmosphere has led to an increase in average global temperature by about 1°C over pre-industrial levels. Scientists estimate that, at current emission levels, the remaining carbon budget, if the 1.5°C goal is to be reached with high likelihood, will be exhausted in less than eight years.

Mitigating and adapting to climate change is both a matter of survival and of economic rationality. Investing in mitigation and adaptation will reduce the economic costs of climate change. In that sense, it saves money. But compared to an alternate world in which climate change does not exist, mitigation and adaptation will be expensive. Debt is needed to distribute the burden of climate action across generations. Even in a one-country world, the link between climate and debt leads to complicated questions. The fact that our planet consists of many countries, each with its own interests and resource limitations, creates an additional challenge related to redistributing the mitigation and adaptation costs in a way which is efficient, fair and feasible.

The 25th Geneva Report discusses these challenges by concentrating on how climate mitigation and adaptation is paid for, and who pays for it. This requires analysis of instruments such as sovereign bonds, carbon credits, conditional official grants, and debt relief from both public and private sources.

The report points out that there are two reasons that make cross-country transfers essential to effectively address climate change.

First, country-level actions can create global externalities. A relatively small number of countries are responsible for 90% of total greenhouse gas emissions and most countries do not emit much CO_2 because they are poor. However, if poor countries grow by adopting the same brown technology adopted by today's large emitters, they will become themselves large emitters. It is thus key that these countries leapfrog to greener technologies.

Second, the majority of countries that are most affected by climate change require and deserve external fiscal support. They require it because they do not have the fiscal space for scaling up climate-related investment. They deserve it because they are generally not responsible for most of the stock of CO_2 that is causing climate change. The advanced economies have thus a moral responsibility towards poorer countries that suffer from the consequences of climate change.

The report concludes that no single instrument is right for all countries or at all times. Instead, it is essential to deploy multiple instruments and actions bearing in mind their limitations and potential trade-offs between them. The report summarizes these instruments and actions with six main proposals and policy recommendations that focus on financial instruments as a means of incentivizing and committing governments to do the right thing and providing fiscal space for climate investment in countries that could not otherwise afford it.

Making these policies happen requires substantial political will, not only in the richer countries that have benefitted from brown development and created the problem, but also in the developing countries that must commit to not repeat these mistakes. Both sides must rise to the challenge of supporting a fair and rapid transition to a net zero economy.

This report was produced following the Geneva Conference on the World Economy held in May 2022. CEPR and ICMB are very grateful to the authors and several discussants for their efforts in preparing material for this report, as well as to the conference attendees for their insightful comments. We also thank Laurence Procter for her continued efficient organisation of the Geneva conference series, Antoine Cornevin and Guilherme Suedekum for recording and summarising the discussions, Xi Kang for research assistance, and to Anil Shamdasani for his excellent handling of its production.

CEPR, which takes no institutional positions on economic policy matters, is delighted to provide a platform for an exchange of views on this important topic.

Tessa Ogden
Chief Executive Officer, CEPR

Ugo Panizza
Director, ICMB

September 2022

CHAPTER 1

Introduction

Mitigating and adapting to climate change is both a matter of survival and of economic rationality. Investing in mitigation and adaptation will reduce the economic costs of climate change. In that sense, it saves money. But compared to an alternate universe in which climate change does not exist – and compared to the world we lived with in the past, in which the threat of climate change was largely ignored – mitigation and adaptation will be expensive. It will consume real resources that have so far been spent on other items. Even in a one-country world, this would create a link between climate action and debt. Debt is needed to distribute the burden of climate action across generations. How much debt creation does climate action justify? Can climate sustainability and debt sustainability be reconciled? And how should debt instruments be designed to best support climate change?

Answering these questions is hard enough. But the planet consists of many countries, each with its own interests and resource limitations. This creates an additional challenge: how to align the individual country interest with the global interest of limiting temperature rises. It also creates an additional opportunity: some countries can (and should) help other countries overcome their resource constraints. The countries most exposed to climate shocks tend to be poorer and at high risk of debt distress; and they did not, for the most part, contribute to today's stock of global emissions. This creates a *prima facie* argument for fiscal transfers. But making such transfers happen raises challenges of its own – both technical and political.

The purpose of this report is to provide analysis and recommendations that help address these challenges. It does so by focusing attention on how climate mitigation and adaptation – in particular, *public* spending – is paid for, and who pays for it. This requires thinking about instruments such as sovereign bonds, carbon credits, conditional official grants, and debt relief from both public and private sources. Sovereign bonds channel funding from private sources to the sovereign, and can potentially be structured to create incentives for climate actions. Carbon credits, conditional grants and debt relief channel real resources across countries. Such cross-country transfers are essential to effectively address climate change, for two reasons.

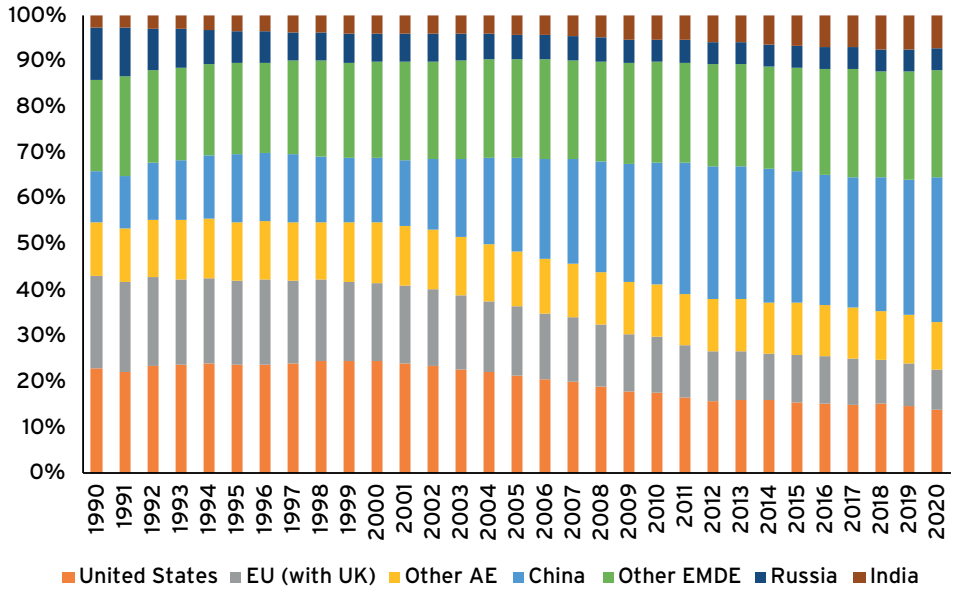
First, country-level actions can create global externalities. These include (i) the reduction of additional greenhouse gas (GHG) emissions; (ii) the reduction of the stock of GHGs that are already in the atmosphere; and (iii) actions to preserve biodiversity. We will refer to these as 'mitigation and conservation'. Some mitigation and conservation actions require public expenditure, while others, like regulation or taxation, do not. For instance,

lower GHG emissions can be achieved by investing in clean technology, by taxing carbon emissions, or by setting caps on emissions or by protecting and preserving carbon sinks and preventing deforestation. Reduction of CO_2 in the atmosphere can be achieved by reversing the degradation of forests, reforestation and investing in technology for carbon capture and sequestration.

Although some of these actions may not have a direct fiscal cost, all of them have an opportunity cost. A country that decides to protect its forests must give up employment opportunities linked to farming and ranching, and a country that imposes a carbon tax may face economic and political costs (in terms of lower economic growth and social unrest), as demonstrated by the *gilets jaunes* movement in France. As a result, mitigation and conservation will not happen – at least not to the globally desired amount – unless people (and countries) are compensated (for actions that generate positive externalities) and taxed (for actions that generate negative externalities).

In 2020, just four countries (or groups of countries) were responsible for 60% of total greenhouse gas emissions, with China accounting for nearly one-third of total emissions, and the United States, the European Union (including the United Kingdom), and India for another 30% (Figure1.1). In total, twelve countries (the four just mentioned plus Brazil, Canada, Indonesia, Iran, Japan, Russia, Saudi Arabia, and South Korea) accounted for 80% of total emissions in 2020, and 23 countries for 90% of total emissions. Several countries do not emit much CO_2 because they are poor. If these countries grow by adopting the same brown technologies adopted by today's large emitters, they will themselves become large emitters. It is thus key that these countries leapfrog to greener technologies.

FIGURE 1.1 **FLOW OF ANNUAL CARBON EMISSIONS**

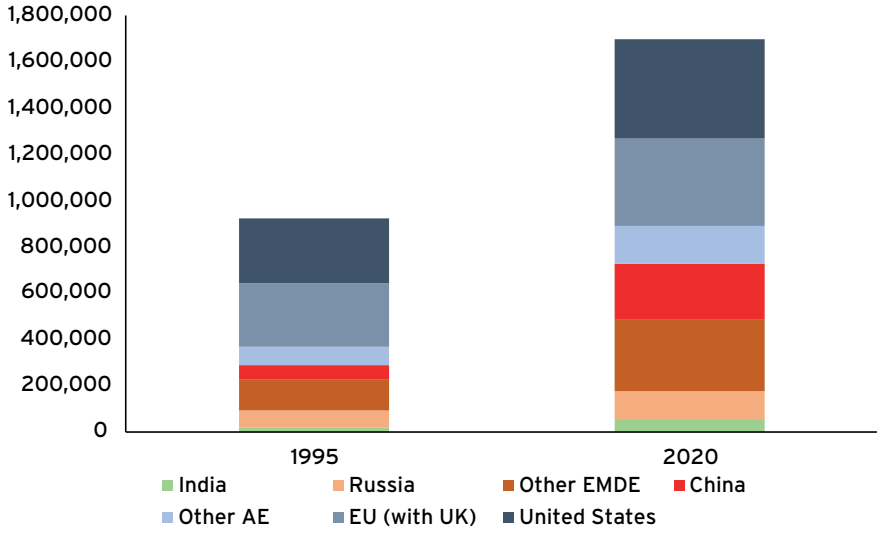


Second, many countries that are most affected by climate change both require and deserve external fiscal support for adapting to – and hence protecting themselves from – climate change.

Adaptation may consist of building dams to protect certain areas from high tides and flooding, investing in crop diversification, reducing the human toll of extreme temperatures through the diffusion of air conditioning systems, or developing early-warning systems for extreme climate events. Given limited fiscal space – high debt levels and limited scope for raising taxes or lowering other expenditures without inflicting great pain – many countries will require external support (transfers, not just loans) to undertake these investments.

Since the benefits of adaptation are mostly local, there is no clear efficiency argument for such support. Yet, cross-country transfers are justified on fairness grounds. The countries with the greatest adaptation needs are generally poor and do not have the resources needed to finance essential adaptation activities. A second powerful fairness argument is that advanced economies are responsible for most of the CO_2 that is causing climate change (Figure 1.2). These countries have a moral responsibility towards poorer countries that suffer from the consequences of climate change. Moreover, there is a close relationship between emissions per capita and income per capita. It therefore seems fair that richer countries should make a greater effort in reducing emissions and in compensating poorer countries that suffer the negative effect of climate change. This is especially the case if emissions can be reduced without drastically affecting standards of living.[1]

FIGURE 1.2 **CUMULATED CARBON EMISSIONS**



1 Several European countries that have a standard of living comparable to the United Sates have per capita emissions which are lower than those of the US (14.2 tonnes) and lower than those of China (7.4 tonnes). For instance, emissions per capita in Italy, France, Switzerland and the UK range between 4 and 5 tonnes. One caveat with these per-capita emissions values is that they are production based and not consumption based.

Our report is structured as follows.

Chapter 2 describes the essential objectives of climate-related policies. These include (i) limiting the global average temperature rise (mitigation); (ii) limiting local effects of climate change (adaptation); (iii) conservation of nature; and (iv) promoting climate equity. The fact that the world has a limited carbon emissions 'budget' – only 300 Gigatonnes of CO_2, just eight years of emissions at the current level, if the average temperature rise is to remain below 1.5°C – raises difficult choices around the allocation of this budget. This requires balancing ethical considerations with political realism, taking into account how much countries have contributed to the historical burden, their emissions per capita today, their level of income per capita and their natural endowments.

Chapter 3 focuses on the fiscal constraints that policymakers operate under when seeking to meet these objectives, and the links between these fiscal constraints and climate change. Debt is high and fiscal space is tight for many countries, mostly for reasons that have nothing to do with climate change. But climate change will add to debt distress, making climate adaptation essential. However, the fiscal cost of adapting to climate change is also high. As a result, high-debt developing countries will not be able to afford climate adaptation without some form of fiscal support from advanced countries.

Chapter 4 discusses green sovereign bonds and sustainability-linked bonds. In principle, such instruments can both increase fiscal space and provide incentives for climate action. As an empirical matter, however, green bonds do not seem to enjoy a significant 'greenium' (i.e., a borrowing cost advantage), except in countries facing substantial climate risk. We also document that none of the currently issued sovereign or quasi-sovereign green bonds includes enforceable climate commitments, and argue that the lack of a greenium and the lack of enforcement could be related. Increasing the greenium may require either enforceable 'genuine green bonds', or well-designed sustainability-linked bonds whose debt servicing terms are contingent on attaining prespecified environmental impact targets.

Chapter 5 focuses on carbon offsets. It shows that, for now, a deep global carbon credit market is still largely a promise. Delivering on this promise will require institutional foundations as solid as the most sophisticated stock exchanges in the world. To achieve scale, a comprehensive monitoring and certification infrastructure must be put in place, carbon credits need to be standardised, and a registry must be put in place for all the carbon credits that have been traded. Most importantly, the global carbon offset market must be built on mandatory direct and indirect carbon emission reduction mandates for all large emitters. These regulations will guarantee and enforce decarbonisation in the aggregate and sustain a predictable aggregate demand for offsets from those emitters that are not able to directly reduce their emissions as required.

Chapter 6 asks how to best deliver external fiscal support for climate investment in high-debt developing countries – through conditional grants, debt-climate swaps (partial debt relief operations in exchange for climate action) or comprehensive debt restructuring. The answer depends on the objective. To ensure that climate investments get funded, conditional grants generally work best, as they can be structured to escape sovereign risk. Restoring debt sustainability, on the other hand, calls for comprehensive debt restructuring – which should be conditional on climate adaptation when the latter materially lowers debt risks. Debt–climate swaps can make sense either for pragmatic reasons, to tap an additional source of fiscal support, or for efficiency reasons, when a comprehensive debt restructuring is unnecessarily heavy-handed. However, the last argument needs to be handled with great care, as it may simply serve as an excuse to put off a needed comprehensive debt restructuring.

THE WAY FORWARD

Some climate activists suggest that it would be easy to address climate change if only rich countries were willing to make the necessary sacrifice through regulation and emission caps and transfer enough resources to poorer countries. Pro-market enthusiasts think that climate-friendly financial instruments such as green bonds can do the trick. The natural attitude of card-carrying economists is that appropriate carbon pricing can solve most problems.

We are somewhere in between these positions. While we think that higher carbon taxes are a necessary element for any mitigation strategy (after all, some of us are card-carrying economists), they are not a silver bullet. This is not only because of large cross-country externalities and the fact that taxes that are high enough are not politically feasible under current conditions, but also because prices are not always the best allocation mechanism. There is no single solution for the climate change problem. However, there are several policy actions that can address climate change while also guaranteeing debt sustainability. Grants, debt-for-nature swaps, climate-friendly debt relief, green bonds, and carbon offsets are all possible ingredients of the menu – in ways that are described in detail in the chapters that follow, and summarised in the conclusion.

The technical challenge is to ensure that climate finance is allocated to its most efficient use and properly calibrate the different instruments. This is what this report is aimed at. The bigger challenge is to mobilise the political will to address climate risks and debt vulnerability at the global level.

CHAPTER 2

Four perspectives on climate change

Much of the climate change debate focuses on mitigation (reducing emissions) and adaptation (adapting to the inevitable consequences of climate change, so as to minimise its economic and social costs). In this chapter, we suggest two additional goals: conservation and equity.[2] We discuss four different perspectives:

1. limiting global average temperature rise (mitigation);
2. limiting local effects of climate change (adaptation);
3. providing conservation services; and
4. achieving climate equity.

2.1 LIMITING GLOBAL AVERAGE TEMPERATURE INCREASE TO 1.5°C WARMING

This is the 'planetary', science-based global perspective, and the one adopted in the Paris Agreement setting a ceiling on the average world temperature increase. Economists are familiar with the basic problem of climate change since it is a prime example of a market failure. GHG emissions generate a negative externality on a global scale, as the private or local costs of emissions are much lower than their social costs at the global level. As a consequence, we emit too much. However, even many economists are not aware that this is a special type of externality. Carbon emissions (over the absorption capacity of the planet) lead to a *stock* problem, not a *flow* problem. An example of a flow externality is a neighbour playing loud music late at night. In this case, the problem ends when the music stops, and you can go to sleep. Some grudges may remain in the neighbourhood, but the noise each night does not add on to that of previous nights. This is different with GHG emissions – each molecule of additional CO_2 emitted (over the absorption capacity of the planet) stays in the atmosphere and increases the concentration in the layer of gases that create the greenhouse effect. All additional CO_2 emitted since the Industrial Revolution is still in the atmosphere, and it is already contributing to global warming. In other words, GHG emissions have a stock effect on the climate.

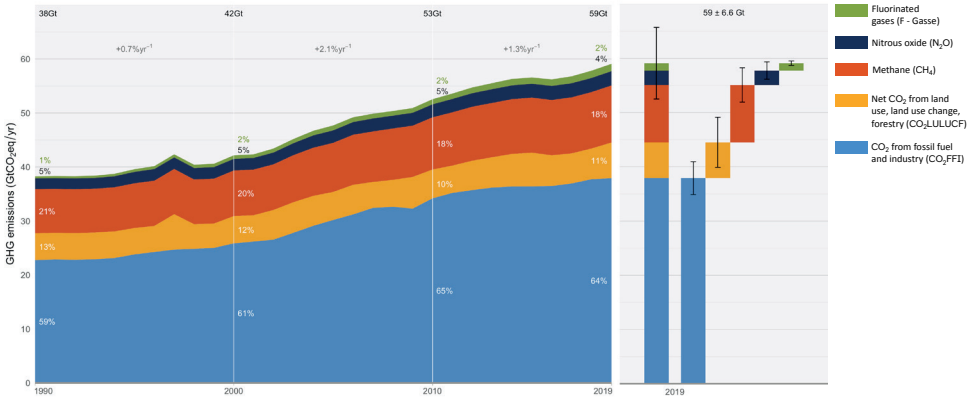
2 Strictly speaking, conservation services are part of mitigation activities as they contribute to limiting global temperature rise. We separate the goals because standard mitigation has to do with reducing emissions in general, while conservation relates to a specific method of reducing emissions linking to preserving natural resources.

The consequence is that the global goal is not just to reduce emissions from current levels but to target a maximum concentration, a maximum stock that can be tolerated. It also means that the usual economic calculus of costs and benefits needs to be adapted to a finite resource setting "the remaining volume of emissions left to the max concentration". Scientists at the Intergovernmental Panel on Climate Change (IPCC) have mapped the concentration of GHGs in the atmosphere to degrees of warming and, from this, calculated the remaining budget. If the main target is to achieve a sufficient reduction of emissions such that the global temperature does not rise above 1.5°C (or 2°C) over pre-industrial levels, the focus has to be on the total amount of CO_2 that can still be emitted globally. This is a number of tonnes, typically expressed in gigatonnes (Gt) of CO_2 equivalent (CO_2e). At the planetary level, it does not matter who emits greenhouse gases, where they are emitted or when. What matters is the absolute number of tonnes of greenhouse gases in the atmosphere.

Focusing on CO_2, there are three numbers to bear in mind: **40**, **300** and **2,400**. [3]

Current yearly global emissions from fossil fuels and industry are nearly 40 Gt of CO_2 (38 Gt to be precise). They constitute the largest part of GHGs and have continued to grow year after year (Figure 2.1). CO_2 emissions from land use, land use change and forestry contribute about another 4 Gt.

FIGURE 2.1 **GLOBAL NET ANTHROPOGENIC GHG EMISSIONS, 1990-2019**



Source: IPCC Working Group III (2022).

Methane, nitrous oxide and fluorinated gases add about another 15 Gt to GHGs. Most of these are much more potent GHGs than CO_2, which is why they are expressed in multiples of CO_2 (or CO_2 equivalents). For instance, releasing 1 kg of methane (CH_4) into the atmosphere has a global warming potential equivalent to 84 kg of CO_2. Hence, the CO_2e

3 See Table SPM.2 in IPCC Working Group I (2021).

of methane is 84x. However, methane only persists in the atmosphere for about a decade.[4] By contrast, CO_2 remains in the atmosphere for between 300 and 1,000 years. This is why we focus on CO_2 emissions, though mitigating methane and the other greenhouse gases needs to be part of the plan for achieving net zero.[5]

The remaining carbon budget of global emissions if the 1.5°C goal is to be reached with high (more than 80%) likelihood is 300 Gt of CO_2. If warming is to be limited to 1.7°C, then the remaining budget would be 550 Gt CO_2. If the goal is set for a maximum of 2°C warming, the remaining budget would be 900 Gt CO_2.

At the current yearly emission rate, the remaining budget will be used up within a few years. At a constant **40** Gt yearly emission rate, the remaining **300** gigatonnes would be 'used up' in less than eight years. This is why the planetary warming goal is also a **net zero goal**. After exhausting the budget, the world cannot emit more GHGs than it absorbs (by natural or technological means).

A final number to bear in mind is the cumulative historical emissions since 1850: **2,400** Gt CO_2. This is the amount of CO_2 which is already in the atmosphere. It is a measure of the historical burden, and it shows that past emissions have almost exhausted the total carbon budget. All additional CO_2 emitted over the past 150 years will remain in the atmosphere and continue to affect the world's climate for thousands of years, and is already warming the earth by about 1°C over pre-industrial levels. This leads us to the next perspective.

2.2 LIMITING LOCAL EFFECTS OF CLIMATE CHANGE (ADAPTATION)

Climate change is not a distant risk. It is already materialising and will continue to do so for the foreseeable future. The accumulated GHGs in the atmosphere are already warming the planet by about 1°C over pre-industrial levels. Therefore, the intensity of climate-related disasters will increase. Storms and droughts will become more frequent, and sea levels will rise – even if the world gets to net zero emissions by 2050.

Although climate change is happening at the planetary scale, the distribution of past and present emissions is anything but equal and nor are their consequences. Already at the current average increase of 1°C , the impact is very different around the world. For instance, the Alps region has experienced an increase of almost 2°C on average. This means that glaciers are dwindling and mountainsides are destabilising. Similarly, arctic

4 While its long-term global warming potential is lower, it does persist at 25x at the 100-year horizon. See https://climatechangeconnection.org/emissions/co2-equivalents/ for the CO_2es of different greenhouse gases and their lifespan in the atmosphere. 'Fun fact': sulphur hexafluoride (SF6) has the highest CO_2 equivalent: 22 800x at the 100-year horizon. In other words, releasing 1 kg of sulphur hexafluoride into the atmosphere is equivalent to 22 tonnes of CO_2. Inter alia, sulphur hexafluoride has been used to fill tennis balls and 'air' cushions in Nike shoes.

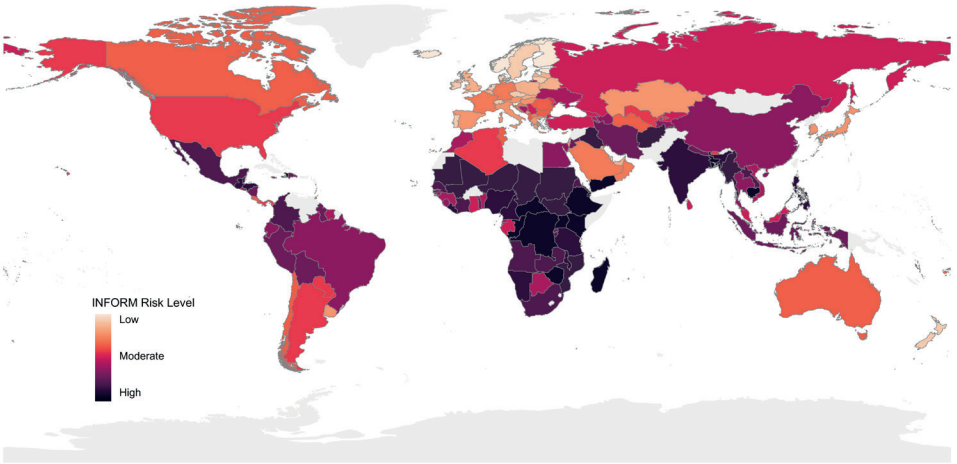
5 Another reason to focus on CO_2 is that some F-gases, which are also ozone depleting, have already been subject to regulation in the EU and multilateral commitments to phase out or replace them (Montreal Protocol of 1987).

icecaps and permafrost regions mostly in the Northern Hemisphere have already been affected by warming temperatures. Permafrost covers about 20–25% of land mass, most of it in Siberia and Canada. Its thawing will release additional carbon and methane, though the extent and speed of this process is uncertain.[6]

Given that it is unlikely that global emissions will remain below the threshold necessary for keeping average temperatures rise to below 1.5°C, adaptation to climate change is inevitable. However, the distribution of adaption needs across the globe is highly unequal. Vulnerability to climate change is highest for emerging and developing economies. Climate-driven risks are concentrated in Africa, the Middle East, South and Southeast Asia, and Latin America (Figure 2.2). Exposure to rising sea levels and increasing storms is particularly high for island economies. On many islands, more than 50% of the population is considered at risk from rising seas (Figure 2.3).

Exposed countries and regions will need to invest in climate adaptation. This will require physical infrastructure that is resilient to natural catastrophes, dams and natural barriers to buffer storm surges, but also protecting the vulnerable from extreme heat, reducing water usage, adapting farms and food supply and managing the retreat from shorelines and seaside settlements. Rapid adaptation investment can limit stranded assets and reduce the costs of lives and livelihoods, but it will also be costly.

FIGURE 2.2 **CLIMATE VULNERABILITY**

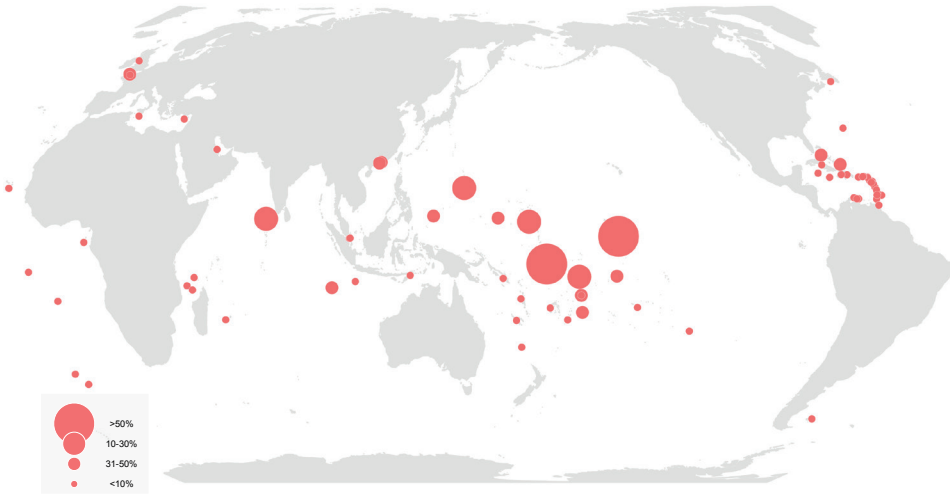


Source: Own elaboration based on INFORM vulnerability

6 In the worst case, permafrost thawing could lead to a 'tipping point', i.e., a sudden acceleration of climate change driven by a vicious circle of warming, which releases large quantities of GHGs, which in turn accelerates further warming, and so on. However, the evidence on such a tipping point is still not conclusive (see, for example, https://bonpote.com/en/permafrost-has-earth-passed-the-point-of-no-return/).

FIGURE 2.3 **SMALL ISLANDS**

Percentage of population exposed to rising sea levels



Source: Own elaboration based on Figure 15.3 in IPCC Working Group II (2022).

There will also be some regions that will benefit from climate change – think of wine growers in the UK – but these are mostly in rich countries. The losers, instead, are mostly in poor countries. As we will argue in more detail in the next chapter, many low- and middle-income countries are unlikely to be able to afford economically efficient adaptation investment without international support. Providing such support is one of the roles of climate finance, but it can also be a way to compensate these countries for providing conservation services.

2.3 PROVIDING CONSERVATION SERVICES

There are two basic ways in which countries can provide conservation services aimed at mitigating climate change:

1. by *not* releasing carbon from existing carbon sinks (preserving forests, leaving coal and oil and gas in the ground); and
2. by increasing the amount of nature-based carbon extraction (reforestation).

Not releasing carbon sinks

Burning wood, oil or gas means releasing stored carbon into the atmosphere. Not burning (i.e., conserving) these carbon storages is a service to the rest of the world. There is, however, an economic opportunity cost related to conservation, and this raises the question of who should pay for this opportunity cost. The current climate agreements are based on two ideas: (i) emissions need to be reduced and avoided based on voluntary

nationally determined contributions; and (ii) there is a need for transfers through 'climate finance' in recognition that poorer countries are at a disadvantage. However, the promise by rich countries to contribute $100 billion in climate finance per year has not materialised so far.

What should a low- or middle-income country with proven gas or oil reserves do? Why should it conserve these natural resources as a service to the rest of the world? In an extreme scenario, the exploitation and export of oil and gas may quickly become unprofitable because the advanced economies will either tax or regulate them out of existence. In this case, these assets would become largely stranded (exploitation for own use may still an option) and 'conservation' of fossil fuel reserves would not require any compensation. While this is not a likely outcome, the possibility may create incentives to extract more now.

The more likely outcome is that advanced and high-emitting economies will continue to procrastinate. The scramble to secure oil and gas following the Russian invasion of Ukraine has shown the enormous dependence of Europe on fossil energy. At the same time, resource-rich countries will resist any attempt to phase out fossil fuel. Most of the world's oil reserves are owned by national oil companies, which do not face the same pressure as private energy companies like Shell or ExxonMobil to transition to renewables or green technologies. In sub-Saharan Africa alone, there are 16 national oil companies. Saudi Aramco is the world's largest oil company, and its energy minister has declared that "every molecule of hydrocarbon will come out."[7] A dispute over coal phase-out almost sank the climate agreement at COP26 in Glasgow because coal-rich countries feared that such phase-out would have a negative effect on their economic development. As a consequence, the language in the agreement changed from "phasing out" to "phasing down".

Adrian et al. (2022) suggest that these distributional issues could be addressed by a "great carbon arbitrage" opportunity. They calculate that the social benefits of avoiding coal emissions minus the cost of ending the use of coal and replacing it with renewable energy are huge (a net gain of almost $80 trillion, according to their estimations). It should therefore be possible to compensate those who incur the losses and need to invest in new technologies, but this would require a well-working market for carbon offsets. We return to this topic in Chapter 5.

Conserving primary forests

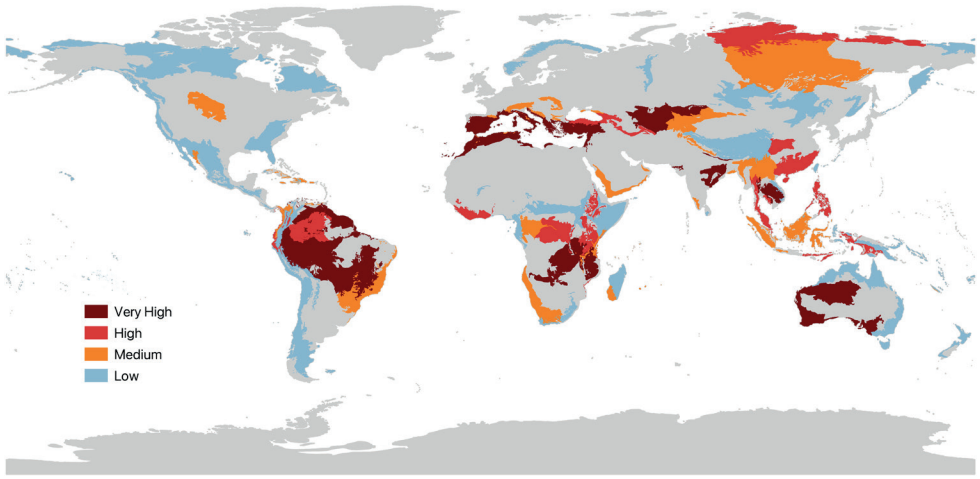
The world's **forests** are important carbon sinks. Between 2001 and 2019, forests withdrew about twice as much carbon dioxide from the atmosphere as they emitted (Harris and Gibbs, 2021). However, deforestation, illegal logging and burning, conversion of primary to managed forests and unsustainable forest management result in significant emissions of GHGs. Conversion of peat swamp forests to palm oil plantations in Southeast Asia alone

7 See "Nationally determined contributors", *The Economist*, 25 July 2022.

is contributing 0.8% of total global yearly emissions (Cooper et al., 2020); this is almost half as much as global aviation (Sjogersten, 2020).[8] The Amazon rainforest has recently been emitting more CO_2 than it absorbs. Only the Congo tropical forest is still a net carbon sink (Harris and Gibbs, 2021) – and it is under threat from oil exploration. Overall, land use, land use change and forestry (LULUCF) is currently a positive contributor to GHG, accounting for about 10% of global CO_2 emissions.[9]

Biodiversity conservation is an important aim in its own right, but it is also closely related to conserving primary forests and ecosystems. Biodiversity is at risk on two fronts: the degrading of forests for agricultural use, and rising temperatures. A map of the main biodiversity hotspots shows that endangered biodiversity areas exist on all continents. Figure 2.4 shows the projected impact of terrestrial hotspots to climate warming and loss of habitat derived from the current and future projected distributions of around 130,000 fungi, plants, invertebrates, and vertebrates (IPCC WGII, 2022). Estimates of the percentage of the hotspots remaining as a climatically suitable areas (i.e., as refugium) show the extreme effects of climate change. For instance, in the Amazon River flooded forests, warming of 1.5°C would shrink the refugium to 34% of the current area, 2°C warming to 16%, and at 2.5°C warming there would only be 4% left.

FIGURE 2.4 **LOSS OF BIODIVERSITY HOTSPOTS WITH 1.5°C WARMING**



Source: "Cross-Chapter Paper 1: Biodiversity Hotspots", supplementary material to IPCC Working Group II (2022) (https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_CrossChapterPaper1_SupplementaryMaterial.pdf).

Note: The map is based on Table SMCCP1.1, using the second set of row for each biodiversity hotspot (the% of natural land projected to be a climate refugium based on the ESA CCI 2015 satellite derived land-cover data). Four projected loss categories are set according to SMCCP1.1 as: >50% of the land as rrefugia remained- low loss, 30-50% of the land remained - medium loss, 17-30% of the land remained - high loss, <17% of the land remained - Very high loss

8 https://theconversation.com/palm-oil-research-shows-that-new-plantations-produce-double-the-emissions-of-mature-ones-130330

9 This is defined by the United Nations Climate Change Secretariat as a "greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use such as settlements and commercial uses, land-use change, and forestry activities".

It follows that the best biodiversity conservation strategy is to limit global warming at the planetary level and forest degradation at the local level. For the latter, specific financial instruments aimed at conservation of carbon sinks, nature-based solutions and preserving biodiversity hotspots may be highly valuable.

A global carbon market would, in principle, compensate emerging and developing economies for conserving their natural resources. In practice, this market is small and voluntary. Sustainable finance products such as nature-based solutions can also channel some private funding into conservation (see Chapter 5).

2.4 ACHIEVING CLIMATE EQUITY

The planetary target focuses on 'tonnes' and is blind to distributional questions. The climate does not care if the rich or poor emit CO_2. But *people* do care about the distribution. While economists tend to focus on efficiency, a global solution to climate change can only work if it is perceived to be fair by all the main players.

How can we design a system that is both equitable and effective in achieving the goal of staying within the 300 Gt emissions budget? Basic economics states that free trade with well-defined property rights will lead to an efficient outcome. But the initial allocation matters for the fairness of the final outcome. The key question is: what should the initial allocation of pollution rights be before trading? According to which criteria should the 300 remaining Gt of CO_2 emission be distributed?

There are many possible criteria that could be relevant to deciding this initial allocation, and these criteria depend on different definitions of fairness. The criteria could be:

- cumulative past emissions (climate debt);
- current emissions per capita; or
- ease of avoiding future emissions.

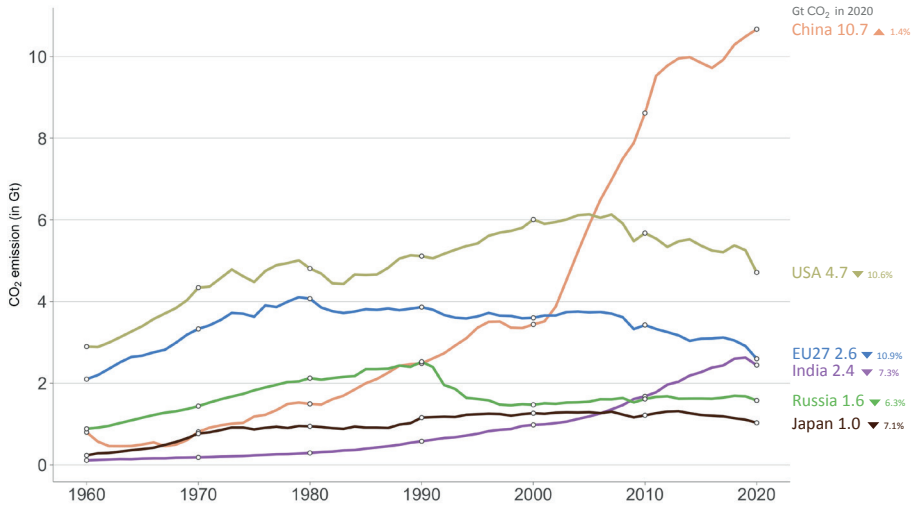
Past emissions: Who did it?

A first approach is to allocate rights by focusing only on past emissions. The allocation of remaining rights would be based on the "how much of the pie have you already eaten?" criterion. Countries with the highest climate debt would receive almost no emission rights and would have to purchase them from those with low past emissions.

We do not think that this is the right approach in terms of either feasibility or fairness. First, this extreme form of 'climate justice' that only considers the full historical burden of 'climate debt' would lead to a very unequal distribution of emission rights – so unequal that it is completely unrealistic and may be perceived as unfair. Second, citizens of rich countries would have to bear full responsibility for the 'sins of their fathers and grandfathers', even though they could not influence their actions. Third, those who released carbon into the atmosphere during their industrialisation process were unaware

they were committing a sin against the environment at the time.[10] Finally, there are now several emerging market economies with large emissions. In 1990, the advanced economies would have been responsible for virtually all of the accumulated emissions. However, the rapid growth of emerging markets over the last the decades has changed the picture. In particular, China tripled its emissions within one decade and has now surpassed both the European Union and the United States as the largest CO_2 emitter (Figure 2.5).[11] At the current rate of emissions, China alone would exhaust the 300 Gt carbon budget by 2050.

FIGURE 2.5 **TOP GLOBAL EMITTERS, 1960-2020**



Source: Global Carbon Project

While we agree that rich countries should bear a high responsibility, on balance, we do not think that an emissions allocation scheme based only on past emissions is either desirable or feasible.

10 Of the 2,400 gigatonnes of CO_2 accumulated in the atmosphere the lion's share came from the advanced economies, because the process of industrialisation has been largely based on fossil fuels.

11 China now accounts for about 30% of global emissions, the Untied States for about 15% and Europe for about 10%.

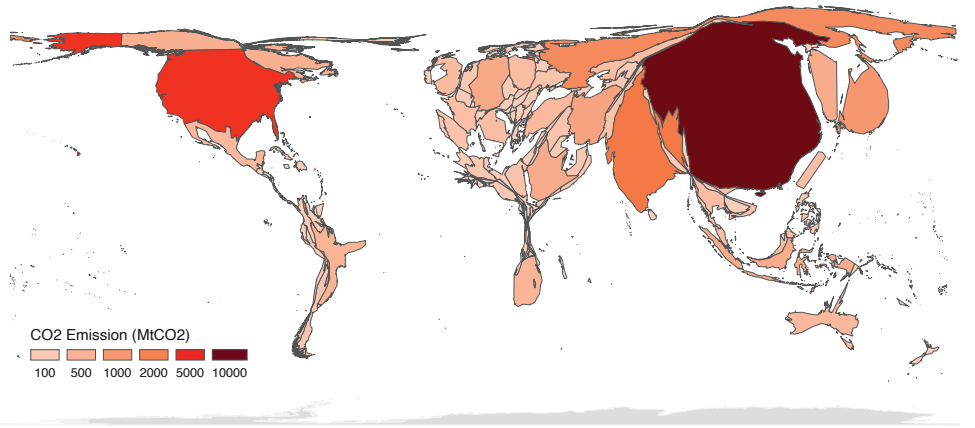
Current emissions: Who is doing it now?

A second approach to allocating the remaining budget is to 'start from here', i.e., from the present distribution of emissions. A radical approach would be to distribute the remaining emissions rights equally per capita across the globe. Alternatively, emission rights (and reduction requirements) could be proportional to the current emissions levels (also known as 'fair contributions'). The latter would be far more generous to the large emitters.[12]

What is the distribution currently? Figure 2.6 shows a world map with country sizes scaled by total emissions. Emissions are concentrated in 'the North'. Except for South Africa, Africa is barely visible on this map, and Latin America is also stunted.

This suggests that a planetary target of limiting emissions would have to focus primarily on the advanced economies plus China and the Middle East. The map also illustrates that the (currently) low-emitting low-income countries will not be able to 'grow like China' by using cheap, brown energy. Otherwise, all efforts to reduce emissions in 'the North' could be in vain and the planetary target of net zero would be unreachable.

FIGURE 2.6 **DISTRIBUTION OF TOTAL EMISSIONS WORLDWIDE**
Countries scaled by total CO_2 emissions



Source: Own compilation based on Friedlingstein et al. (2021).

12 For example, suppose the world were divided into two emitting blocks – North and South – with equal populations. Suppose that in a business-as-usual scenario, total emissions would be 600 by 2050, with the North emitting twice as much (400) as the south (200). Then suppose that in order to get to net zero, the world needs to cut these emissions in half (i.e., by 300). If emission rights were allocated in proportion to current emissions, both the North and South would need to cut their emissions in half (as 200 + 100 = 300). But if they were allocated in proportion to population (i.e., 150 each), both would need to reduce them to the same absolute level, which implies that the percentage decline in emissions in the North would need to be (400-150)/400 = 62.5%, while emissions in the South would need to decline only by (200-150)/200 = 25%.

CO_2 taxes or emission trading systems should be the primary instruments in curbing emissions, but the transformation will also require private and public spending. The largest emitters need large-scale investment in clean energy sources, new technology and green infrastructure to manage the transition to net zero, to decarbonise and retire brown assets. The countries that are currently low emitters need investment to leapfrog to new technologies that will allow them to avoid the brown path followed by today's large emitters.

China is the largest emitter worldwide, but this is mainly because it has the world's largest population. The average Chinese citizen emits about half as much CO_2 per year as the average US citizen. The average Indian emits about 20% as much as the average American, but since India has a large population, in terms of tonnes this adds up.

There is a close relationship between per capita emissions and GDP per capita. Column 1 of Table 2.1 shows that, in 1990, a 1% increase in income per capita was associated with a 0.7% increase in GHG emissions (see also the top-left panel of Figure 2.7). The elasticity is slightly lower if we include land use, land-use change and forestry (column 2 of Table 2.1). The lower elasticity is driven by the fact that several advanced economies have negative values for LULUCF and most emerging and developing economies have positive values. A regression of per capita LULUCF over the log of GDP per capita yields a negative and statistically significant value (column 3 of Table 2.1 and Figure 2.8). Columns 4 and 5 of Table 2.1 show that the elasticity of GHG emissions to GDP has somewhat decreased over the past 30 years, and columns 7 and 8 show that the elasticity is much lower in advanced economies.

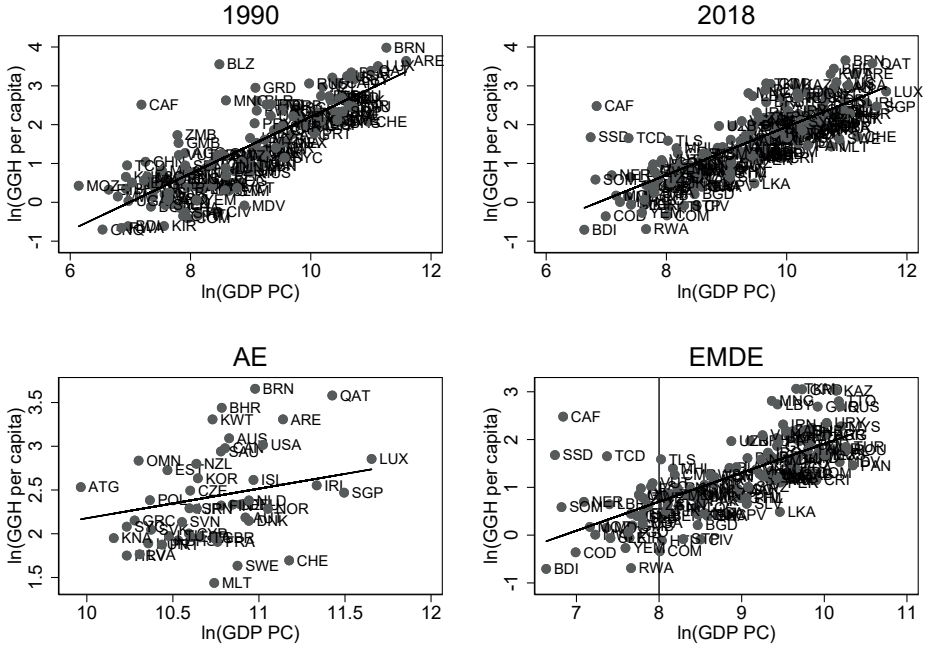
The results of Table 2.1 suggest that income per capita and emissions both per capita and per unit of GDP should play a role in devising a fair allocation of the remaining carbon budget. Arguably, the national determined contributions approach, laid down in the Paris Agreement, may be interpreted as going in this direction: if every country chooses a national target percentage by which to cut emissions, and the large emitters make stronger commitments, there will be a certain levelling effect.

TABLE 2.1 **CARBON EMISSIONS AND GDP PER CAPITA**

	(1) GHG	(2) GHG LULUCF	(3) LULUCF	(4) GHG	(5) GHG LULCF	(6) LULUCF	(7) GHG	(8) GHG LULUCF	(9) GHG	(10) GHG LULUCF
Ln(GDP PC)	0.72*** (0.0416)	0.54*** (0.0619)	-0.58*** (0.189)	0.61*** (0.0353)	0.45*** (0.0484)	-0.64*** (0.113)	0.34* (0.181)	0.37* (0.219)	0.60*** (0.0528)	0.40*** (0.0752)
Constant	-5.03*** (0.374)	-3.09*** (0.556)	5.90*** (1.683)	-4.17*** (0.332)	-2.54*** (0.455)	6.31*** (1.061)	-1.20 (1.937)	-1.62 (2.339)	-4.07*** (0.469)	-2.08*** (0.668)
Observations	145	142	121	183	183	154	50	50	133	133
R-squared	0.679	0.348	0.073	0.625	0.324	0.175	0.067	0.057	0.495	0.175
Year	1990	1990	1990	2018	2018	2018	2018	2018	2018	2018
Sample	All	All	All	All	All	All	AE	AE	EMDE	EMDE

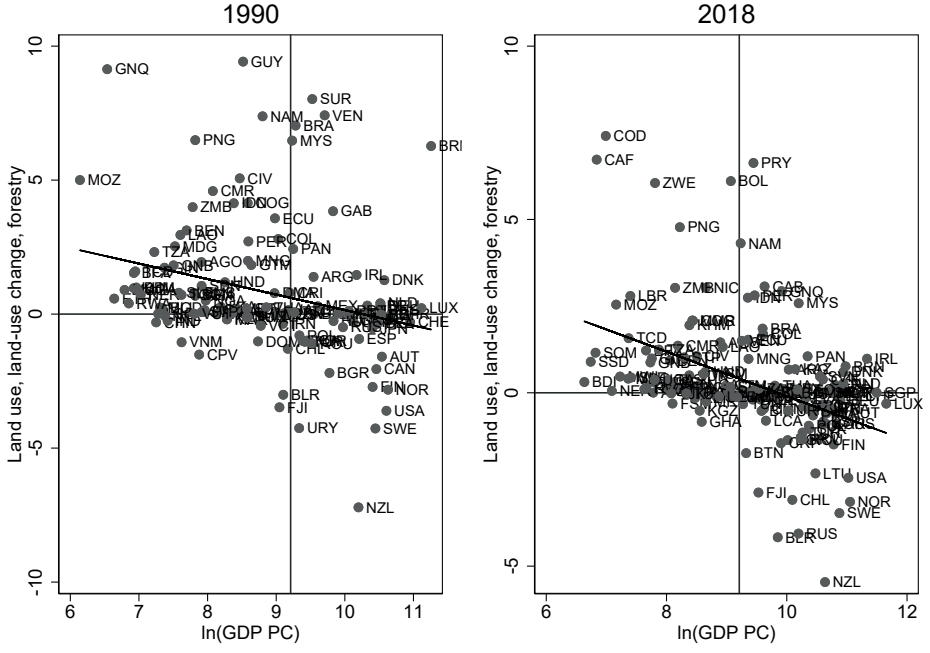
Note: This table regresses per capita carbon emissions (in logs) over the log of GDP per capita (real PPP at 2017 prices). Columns 1, 4, 7, and 9 use total carbon emission excluding Land use, land-use change, and forestry, columns 2, 5, 8, and 10, use total carbon emission including Land use, land-use change, and forestry, columns 3 and 6 only use including Land use, land-use change, and forestry.

FIGURE 2.7 **CARBON EMISSIONS AND GDP PER CAPITA**



Note: This figure plots the relationship between carbon emission and GDP per capita. The top panels are based on columns 1 and 4 of Table 1 and the bottom panels are based on columns 7 and 9.

FIGURE 2.8 **LAND USE, LAND-USE CHANGE, AND FORESTRY AND GDP PER CAPITA**



Note: This figure plots the relationship between land use, land-use change, and forestry and GDP per capita. The figure is based on columns 3 and 6 of Table 1. The vertical line is set at $10,000 GDP per capita in 2017 PPP.

Future emissions

Finally, emission rights may be allocated taking into account differences in the endowment of natural resources. For instance, some countries may have large carbon sinks in the form of forest and fossil fuel reserves. For these countries, the opportunity costs of low future emissions are high. Others may have endowments of natural renewable resources and thus can more easily avoid future emissions. The initial allocation of emission rights could 'correct' for these differences in initial natural resources (for example, such that on a per capita basis, all countries shoulder the same cost of transition to net zero). The global carbon trade would then lead to the efficient use of remaining rights.

2.5 SUMMING UP

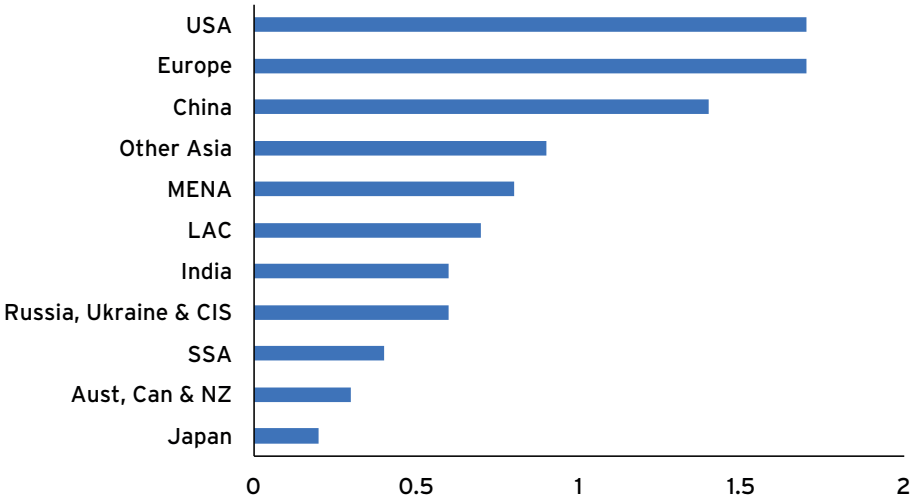
A fair initial allocation of the remaining carbon budget should take into account several elements. The most important of these are how much countries have contributed to the historical burden, their emissions per capita today, their level of income per capita and their natural endowments.

Alternatively, one could think of a more radical approach involving a convergence in emissions per capita at a level consistent with the planetary climate target. An allocation rule based on uniform emissions per capita would strengthen the point made above that emerging and developing economies will not be able to travel the same 'brown road' to prosperity as the rich countries did. Instead, they would need to leapfrog directly to a net zero, clean energy era. Financing this transition in emerging and developing economies would require large capital flows from wealthy to poor countries. Capital would need to go from 'North to South' and much of this capital would need to take the form of grants. According to McKinsey (2022) estimates, advanced economies will account for about 42% of the required spending for transition to net zero and China for another 15%. However, these are also countries with large economies. Consequently, required investment as a share of GDP in these countries ranges between 4% and 6%. There are instead several and low- and middle-income countries that will require expenditures ranging between 9% and 21% of GDP (Figure 2.9).

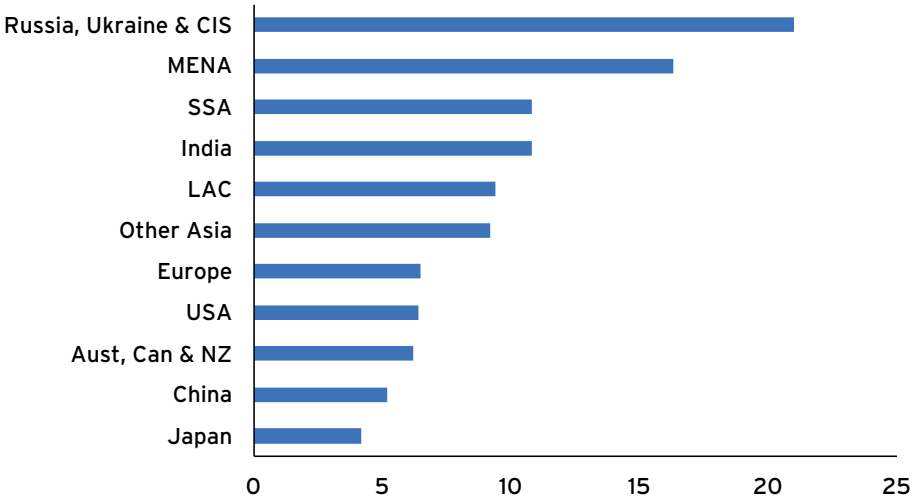
Table 2.2 describes the main targets discussed in this chapter and matches them with policies and financing instruments.

FIGURE 2.9: **SPENDING ON PHYSICAL ASSETS FOR ENERGY AND LAND-USE SYSTEMS UNDER NGFS NET ZERO 2050 SCENARIO**

a) Billions of US dollars per year



b) Share of GDP



Source: Own elaboration based on data from Exhibit 24 in McKinsey (2022).

TABLE 2.2 **CLIMATE TARGETS AND INSTRUMENTS**

Target	**Focus/geography**	**Policies/financing**
Planetary emissions limit *(in Gt CO_2e, absolute)*	Priority: reduce the absolute amount of global emissions to net zero quickly; focus on large emitters	Mitigation: CO_2 taxes (or pricing instruments) in all large emitters Transformation financing: investment in clean technology and infrastructure mostly in China, the US and Europe
Adaptation	Focus on countries and regions that have high exposure to climate risk and on adaptation measures (climate vulnerability is higher in developing and emerging economies)	Climate adaptation policies (e.g., building regulation, zoning laws) and investment (upgrades to physical infrastructure, irrigation, coastal protection) Climate finance instruments (including instruments containing an element of fiscal support).
Conservation	Preservation of large carbon sinks; reduce LULUCF (mostly in developing and emerging and developing economies) Conservation of biodiversity hotspots across the world	Global carbon trading Nature based-solutions Limit global warming (planetary target)
Fairness *Fair contributions, relative (Subject to net-zero global constraint)*	All countries need to get to net zero, but the high per capita emitters bear a larger responsibility for financing at home and abroad	International flows to emerging and developing economies Investment in clean technology and infrastructure

CHAPTER 3

Fiscal constraints

This chapter presents a set of facts on public debt and its linkages with climate problems that we will draw on in the remainder of the report.

Public debt is at historically high levels in both advanced and emerging and developing economies. Even as public debt levels rose, declining interest rates led to a fall in interest costs in advanced economies. Middle-income and low-income countries, however, benefited from these declines to a lesser degree, and interest costs have recently increased in many of these countries. The combination of new borrowing, the pandemic shock and tighter financial conditions in the last year has pushed many of these countries to the brink of debt distress (and sometimes over that brink).

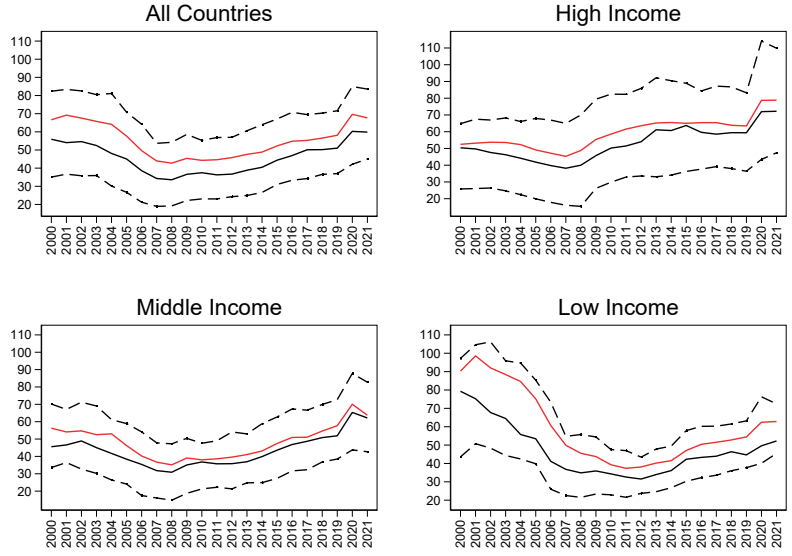
The links between debt and climate create a catch-22 situation for many developing countries. Climate change adds to debt distress through the costs of natural catastrophes and because climate risks push up borrowing costs and make them more sensitive to domestic and global shocks. As a result, climate adaptation – policies and public investment that makes these countries less vulnerable to climate change – is essential and economically efficient in many countries. But the fiscal cost of adapting to climate change is also high – in some countries, prohibitively so. As a result, many developing countries will not be able to afford climate adaptation without some form of fiscal support (rather than just lending) from advanced countries.

3.1 THE RECENT EVOLUTION OF PUBLIC DEBT AND BORROWING COSTS

The median debt level in advanced economies decreased from approximately 50% of GDP at the beginning of the new millennium to about 38% in 2007. However, the global financial crisis and the Covid pandemic led to a quick ramp-up of debt, with median debt in advanced economies reaching 72% of GDP at the end of 2021 (top-right panel in Figure 3.1). The pattern is similar in emerging economies. Debt ratios kept increasing throughout 2008–2020 and the median debt-to-GDP ratio more than doubled (from 31% to 65%) during this period (bottom-left panel in Figure 3.1).[13]

13 The evolution of debt ratios documented in Figure 3.1 is not caused by a few outliers; the full distribution has shifted to the right.

FIGURE 3.1 **EVOLUTION OF THE DEBT-TO-GDP RATIO**



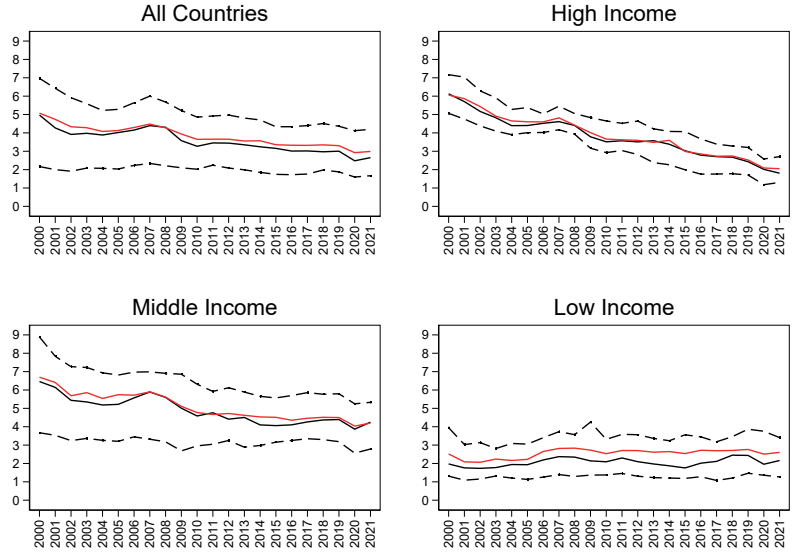
Note: This figure plots the evolution of the average (red line) and median (black line) debt-to-GDP ratio for different groups of countries, together with the year-specific interquartile range (dashed lines)

Debt developed somewhat differently in low-income countries. Thanks to the Heavily Indebted Poor Countries (HIPC) Initiative and Multilateral Debt Relief Initiative (MDRI) (and the conditionality associated with these initiatives), these countries kept reducing their debt levels until about 2012 on average. After that, however, debt ratios started increasing rapidly, and median public debt now stands at 52% of GDP (bottom-left panel in Figure 3.1).

Advanced economies differ from developing and emerging market economies in terms of their cost of borrowing. The average interest rate paid on the stock of public debt issued by advanced economies fell from about 6% in 2000 to 1.8% in 2021 (top-right panel of Figure 3.2).[14] Average interest rates also decreased slightly in emerging economies, but by much less than in advanced economies (bottom-left panel of Figure 3.2). In low-income economies, instead, average interest rates are now higher than they were in 2000, although they remain much lower than in middle-income countries, reflecting borrowing from the official sectors (bottom-right panel of Figure 3.2).

14 This is not the average of the marginal interest rate, but the average of the average interest rate (obtained by diving total interest payments over the total stock of debt).

FIGURE 3.2 **AVERAGE INTEREST RATE**

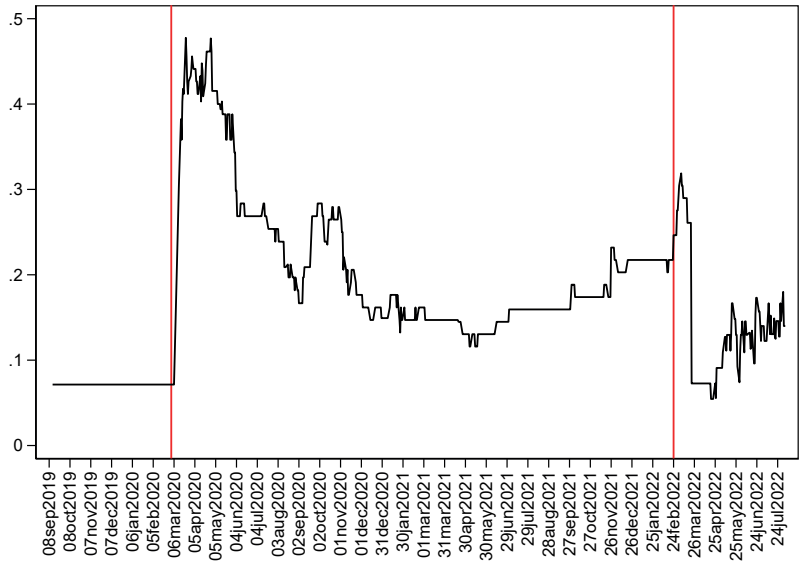


Note: This figure plots the evolution of the average (red line) and median (black line) interest rate on public debt (this is based on the country-year specific average interest rate on public debt and not the country-specific marginal interest rate) for different groups of countries, together with the year-specific interquartile range (dashed lines). Even with high levels of debt, thanks to low interest rates, high-income economies were able to reduce their total interest payments from 3% of GDP in 2000 to 1.3% of GDP in 2021. Interest payments as a share of GDP have instead recently increased in both emerging economies and low-income economies. Higher interest payments in low-income economies are partly due to a change in the debt composition of these countries, which now borrow less from the official sector at subsidised rates and borrow more domestically (often at high rates) and on the international capital market. There is also substantial heterogeneity across countries here. Volz et al. (2021) focus on 18 rated sovereign issuers in sub-Saharan Africa and document a rapid increase in interest payments (expressed as a share of government revenues) over 2015–2021.

Emerging and developing economies have intermittent access to the international credit market. At the end of 2019, more than 90% of emerging and developing economies that normally borrow on the international capital market were able to do so at a spread below 750 basis points (our threshold for loss of market access). However, nearly 50% of these countries lost market access in the immediate aftermath of the Covid shock (in March 2020). The situation normalised in mid-2020, but the share of countries without market access started to increase again in late 2021 and surpassed 30% when Russia invaded Ukraine (Figure 3.3).

After the explosions of the Covid-19 pandemic, rating agencies downgraded several countries in sub-Saharan Africa. However, the strong recovery in commodity prices and the likelihood of increased official lending funded by the issuance of Special Drawing Rights led to a number of rating upgrades (even though downgrades still outnumbered upgrades) and to large Eurobond issuances by several countries in sub-Saharan Africa. The debt sustainability situation remains precarious, however, especially because after the expiration of the Debt Service Suspension Initiative (DSSI) on 31 December 2021, countries will need to increase repayments to official creditors, and in some cases this increase will be above 2% of GDP (Volz et al., 2021).

FIGURE 3.3 **EMERGING AND DEVELOPING ECONOMIES WITH NO MARKET ACCESS**

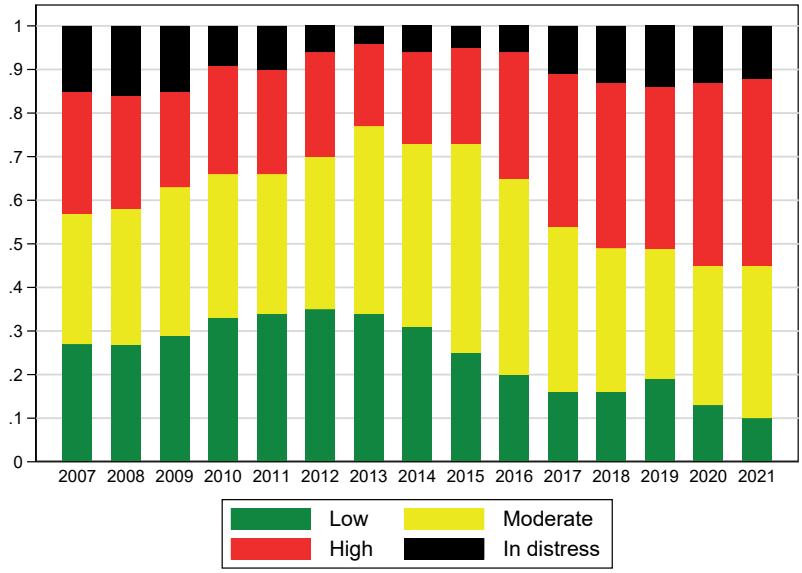


Note: This figure plots the evolution of the share (black line) of emerging and developing economies with no market access (lack of market access is defined as having a spread above 750 basis points)

The IMF–World Bank debt sustainability framework for low-income countries, which the IMF and World Bank apply to 72 low-income and lower-middle-income economies eligible for concessional lending, classifies economies into four categories: (1) low risk of debt distress, (2) moderate risk of debt distress, (3) high risk of debt distress and (4) in debt distress. In 2013, more that 30% of countries eligible for the Poverty Reduction and Growth Trust (PRGT) were classified as being at low risk of debt distress and more than 40% of them were classified as being at moderate risk of debt distress. Only 22% of countries were either at high risk of debt distress or in debt distress (Figure 3.4). Debt sustainability analyses conducted in 2021 found that only 10% of PRGT-eligible countries were at low risk of debt distress and another 30% at moderate risk. Nearly 60% of countries are now classified as being at high risk of debt distress or already in debt distress. In a recent interview, IMF Managing Director Kristalina Georgieva said that she expects that the share of PRGT-eligible countries which are either at high risk or are already in debt distress in 2022 will surpass the 60% threshold.

Sustainability problems go well beyond the low-income countries that were eligible for the G20-sponsored Debt Service Suspension Initiative and are now part of the Common Framework for debt treatments beyond the DSSI (see Box 3.1 for details). According to the United Nations Development Programme, there are 23 countries at high risk of external debt distress which are middle-income and are not eligible for debt relief under the Common Framework (Volz et al., 2021).

FIGURE 3.4 **DEBT SUSTAINABILITY OVER TIME**



Note: This figure plots the evolution of the share of PRGT-eligible countries (72 countries in total) classified as being at low, moderate, and high risk of debt distress on the basis of the External debt World Bank/IMF Debt Sustainability Framework.

3.2 SOVEREIGN SPREADS, DEBT LEVELS AND GLOBAL FACTORS

Emerging and developing economies are highly susceptible to external shocks. A way to formally show that this is the case is to regress borrowing costs (as measured by spreads on foreign currency debt) over the debt-to-GDP ratio and a global factor (obtained from the first principal component of the VIX index, the US dollar index, and the US Federal funds rate).[15]

Table 3.1 shows that spreads in both advanced economies and emerging markets respond to these domestic and global variables, but that the elasticity is much higher in emerging and developing economies. For instance, a one standard deviation increase in the global factor index is associated with a 24 basis point increase in the spread of advanced economies but a 130 basis point increase in the spread of emerging and developing economies. Similarly, a 1 percentage point increase in the debt-to-GDP ratio is associated with a 1 basis point increase in the spread of advanced economies (and this effect is not statistically significant if we control for country fixed effects) but a 10 basis point increase in emerging market spreads.

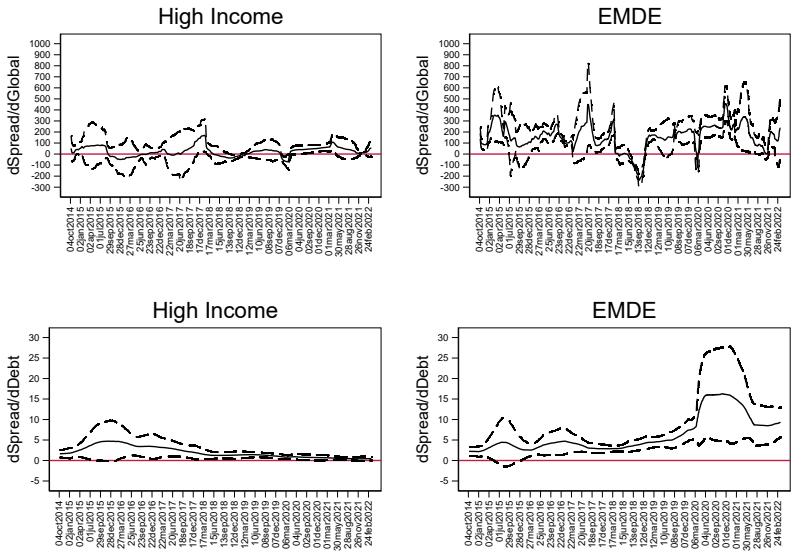
15 The role of the VIX Index and the US interest rate are well established din the literature on global shocks to emerging markets. For a discussion of the importance of the broad dollar index see (Shin, 2016). The index ranges between -1 and 2.2, it has mean zero, and a standard deviation of 0.5.

TABLE 3.1 **SPREADS, GLOBAL FACTORS AND DEBT LEVELS**

	(1)	(2)	(3)	(4)
Global	48.53*** (11.31)	261.2*** (39.29)	49.25*** (11.71)	264.6*** (39.96)
DEBT/Y	1.082*** (0.246)	9.187*** (2.121)	0.845 (0.709)	11.41*** (2.653)
N. Obs	27,073	53,448	27,073	53,448
Year FE	Yes	Yes	Yes	Yes
Country FE	No	No	Yes	Yes
Sample	High Income	EMDE	High Income	EMDE

Note: This table reports a set of regressions where the dependent variable is the sovereign spread on foreign currency bonds, and the explanatory variables are a global factor (the first principal component of the VIX index, the US dollar index, and the US Fed funds rate) and the country-year specific debt to-GDP ratio. Spreads and global factors are at daily frequency, the debt-to-GDP ratio is at annual frequency. Standard errors are double-clustered at the country-year and day level.

FIGURE 3.5 **TIME-VARYING SENSITIVITY OF SPREADS TO GLOBAL FACTORS AND DEBT LEVELS**



Note: This figure shows the coefficients and 95% confidence intervals of a set of regressions in which foreign currency spreads are regressed on a global factor (the first principal component of the VIX index, the US dollar index, and the US Fed funds rate) and on country-year debt-to-GDP ratio. The regressions use daily data and are estimated over a 360-day window, separately for high income economies and emerging and developing economies. Standard errors are clustered at the country-year level. The figure plots the coefficient using the last day of the estimation window.

Not only is the elasticity to global and domestic factors higher in emerging markets, it is also more volatile. Figure 3.5 plots the evolution of the correlation (estimated over a 360-day window) between sovereign spreads and each of the global factor index and the debt-to-GDP ratio. In advanced economies, the correlation between spreads and debt levels

has been decreasing over time and is no longer statistically significant in the post-Covid period. The opposite is true in emerging and developing countries, where the correlation has been increasing over time and became very high (albeit less precisely estimated) after March 2020.

3.3 SOVEREIGN SPREADS AND CLIMATE RISK

There is limited but growing research on the links between sovereign spreads and climate risk.[16] While credit rating agencies mention climate as a potential source of credit risk, no major downgrade has been attributed to climate risk and no major credit rating agency explicitly includes climate risk in its methodology.[17] Beirne et al. (2021b) and Agarwala et al. (2021) discuss six possible channels through which climate change can affect sovereign spreads: (1) impact on natural capital; (2) climate-related natural disasters; (3) adaptation and mitigation expenditure; (4) financial crises associated with the presence of stranded assets; (5) reduction in trade and higher capital flow volatility; and (6) political instability. While institutions such as the IMF and the World Bank have established links between debt and climate risks in their policy advice, this has been based on case studies.[18]

Kling et al. (2018) use an unbalanced panel that covers 38 countries (seven advanced economies and 31 emerging and developing economies) over 1998–2018 to conduct an econometric exercise aimed at estimating the link between borrowing costs and climate risk. They find that exposure to climate risk leads to a significant increase in borrowing costs (the average effect is close to 120 basis points). Beirne et al. (2021a) focus on Southeast Asia and, using country-specific models, show a strong positive correlation between climate vulnerability and sovereign spreads. Beirne et al. (2021b) use a structural VAR and a modified version of the climate risk indicators used by Kling et al. (2018) to show that climate vulnerability is associated with higher spreads in emerging economies, but that climate vulnerability has no effect on spreads in advanced economies. These authors conclude that adaptation investment that helps mitigate climate risk would lead to lower spreads and thus increase fiscal space.

We build on the work of Kling et al. (2018) by exploring the role of different indicators of climate risk, using a different set of control variables and only focusing on developing and emerging economies, while also expanding on the sample of these countries. Specifically, we use monthly data for a balanced panel of 67 emerging and developing economies covering the period 2013 to 2022.

16 For short surveys of this incipient literature, see Beirne et al. (2021a, 2021b) and Agarwala et al. (2021).
17 For details, see United Nations Environment Programme (2018). For a discussion of the rating methodology the three major agencies, see Panizza (2017).
18 For example, the IMF/World Bank Climate Change Policy Assessments point to climate-induced debt sustainability risks in several small island economies.

While Kling et al. (2018) measure climate risk using a set of time-varying indicators built by the Notre Dame Global Adaption Initiative (ND-GAIN, see Chen et al., 2015), we use data from the second edition of the Climate Vulnerability Monitor (CVM) (DARA, 2011). The CVM focuses on both 2010 and 2030 and classifies countries into five groups based on their vulnerability: (1) low vulnerability to climate change; (2) moderate vulnerability to climate change; (3) high vulnerability to climate change; (4) severe vulnerability to climate change; and (5) acute vulnerability to climate change.

We use this classification to create two dummy variables – one for 2010 and one for 2030 – that take a value of zero for countries classified as having low or moderate vulnerability and a value of one for countries classified as having high, severe, or acute vulnerability. Other variables of climate risk that have been used in previous research include the World Risk Index (Welle and Birkmann, 2015) and the Physical Risks – Climate-driven risk index assembled by the International Monetary Fund based on INFORM data.[19] These various indicators are positively and significantly, albeit not perfectly, correlated with each other (Table 3.2).[20]

We use the CVM indicators for two reasons. First, while many commonly used indicators are based on past events, the CVM indicators focus on future risk. Second, CVM indicators were built in 2011, so they cannot be influenced by the successive evolution of sovereign spreads. While we cannot claim exogeneity, we are confident that the CVM indicators are not driven by the observed evolution of sovereign risk.

TABLE 3.2 **CORRELATION AMONG INDICATORS OF CLIMATE RISK**

a) All countries

	Clim Risk 2030	Clim Risk 2010	Vuln. WRI	Vuln. ND	Clim. Risk IMF
Clim Risk 2030	1.0000				
Clim Risk 2010	0.6831 (0.000)	1.0000			
Vuln. WRI	0.7176 (0.000)	0.6803 (0.000)	1.0000		
Vuln. ND	0.7238 (0.000)	0.6667 (0.000)	0.9075 (0.000)	1.0000	
Clim. Risk IMF	0.6315 (0.000)	0.5282 (0.000)	0.8642 (0.000)	0.7760 (0.000)	1.0000

19 See https://climatedata.imf.org/pages/fi-indicators
20 The correlation between the IMF risk and the other indexes is fairly low when the sample is restricted to developing and emerging economies.

b) Emerging and developing economies

	Clim Risk 2030	Clim Risk 2010	Vuln. WRI	Vuln. ND	Clim. Risk IMF
Clim Risk 2030	1.0000				
Clim Risk 2010	0.6049 (0.000)	1.0000			
Vuln. WRI	0. 5487 (0.000)	0.6399 (0.000)	1.0000		
Vuln. ND	0.6123 (0.000)	0.6355 (0.000)	0.8613 (0.000)	1.0000	
Clim. Risk IMF	0.3892 (0.000)	0.4043 (0.000)	0.7781 (0.000)	0.6961 (0.000)	1.0000

Note: These tables plot the correlation among different indicators of climate risk (p values in parentheses). The top panel uses all countries and the bottom table only uses data for emerging and developing economies. The indicators considered in the tables are climate risk indicator computed by Dara (2011) for 2010 and 2030 (Clim Risk 2010 and Clim Risk 2030) coded as 0 for low or moderate vulnerability countries and 1 for high to acute vulnerability countries; the 2019 World Risk Indicator for assessing human vulnerability to climatic hazards and natural hazards (Vuln WRI); the Notre Dame GAIN vulnerability Indicator for 2019, and the IMF climate risk indicator for 2020-21.

Table 3.3 reports a set of panel data regressions in which monthly spreads are regressed over a set of domestic fundamentals, the global factor described above, and the CVM climate risk index for 2010 and 2030. The first column uses only advanced economies. As already mentioned, in this sample of countries there is limited sensitivity of spreads to local and global variables (this regression does not include the climate risk variable because there is limited cross country variations within the sample of high-income economies). Column 2 estimates the same model for emerging and developing economies and corroborates our previous results that spreads are more sensitive to fundamentals (especially growth, inflation, debt levels and international reserves) and global conditions in emerging and developing economies.

Columns 3 and 4 control for climate risk and show that higher climate risk is associated with higher spreads. The point estimates suggest that the effect of climate risk in 2030 is larger than the effect of climate risk in 2010 (65 versus 50 basis points). This is expected given that the data are for the period 2013–2022. Column 5 includes both measures of climate risk in a horserace regression and confirms that the effect of climate risk in 2030 dominates that of climate risk in 2010. Column 6 interacts the climate risk variable with a dummy that takes a value of one for the 2013–2017 period (PRE) and a dummy variable that takes a value of one for the 2018–2022 period (POST). It shows that climate risk has a larger effect on spreads in the post 2017 period.

TABLE 3.3 **THE DRIVERS OF SPREADS AND VULNERABILITY TO CLIMATE RISK**

	(1)	(2)	(3)	(4)	(5)	(6)
Real GDP Growth	-5.762 (3.695)	-13.91*** (4.854)	-14.91*** (4.986)	-14.76*** (5.078)	-14.98*** (5.025)	-14.34*** (5.044)
Inflation	-2.010 (5.403)	21.18*** (3.656)	21.09*** (3.695)	21.60*** (3.632)	21.45*** (3.675)	21.80*** (3.629)
Gov. Bal/GDP	-2.736 (1.844)	-2.671 (4.221)	-2.840 (4.255)	-2.715 (4.184)	-2.827 (4.201)	-2.629 (4.190)
Curr. Acc./GDP	-0.718 (1.076)	1.704 (2.688)	2.040 (2.780)	2.039 (2.756)	1.995 (2.760)	1.950 (2.727)
DXR	47.69 (103.2)	85.89 (163.9)	82.72 (163.6)	82.05 (161.9)	85.22 (162.2)	74.84 (162.9)
ln(GDP PC)	52.22*** (15.36)	-119.2*** (15.65)	-104.0*** (18.17)	-99.22*** (17.04)	-93.57*** (17.78)	-98.17*** (16.94)
DEBT/Y	1.329*** (0.377)	3.558*** (0.594)	3.424*** (0.601)	3.472*** (0.592)	3.427*** (0.599)	3.450*** (0.585)
Int. Res/Y	1.786 (1.251)	-12.24*** (4.279)	-13.03*** (4.496)	-12.83*** (4.449)	-12.86*** (4.455)	-13.04*** (4.459)
Rule of Law	-119.7*** (13.55)	-61.14*** (17.07)	-57.90*** (17.23)	-63.46*** (17.03)	-61.63*** (17.21)	-63.78*** (17.15)
Global	11.25 (13.80)	190.9*** (48.08)	193.4*** (49.34)	193.6*** (49.45)	193.3*** (49.56)	194.8*** (49.35)
Clim Risk 2010			50.12** (23.81)		23.81 (29.38)	
Clim Risk 2030				65.03*** (21.00)	56.23** (25.98)	
CR 2030xPRE						39.81 (25.96)
CR 2030xPOST						93.26*** (30.74)
N. Obs.	3,328	6,774	6,627	6,627	6,627	6,627
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	No	No	No	No
Sample	High Income	EMDE	EMDE	EMDE	EMDE	EMDE

Note: This table reports a set of regressions where the dependent variable is the sovereign spread on foreign currency bonds, and the explanatory variables include a set of domestic controls (real GDP growth, inflation, Government balance over GDP, current account balance over GDP, change in the bilateral exchange rate, log of GDP per capita in constant PPP dollars, debt-to-GDP ratio, international reserves over GDP, and Rule of Law), a global factor (the first principal component of the VIX index, the US dollar index, and the US Fed funds rate). The regressions also year fixed effects), a dummy variable measuring climate risk for 2010 and 2030 and the interaction of this dummy with a dummy that takes value one for pre and post 2017. Spreads and global factors are at monthly frequency, the local variables are at annual frequency (with the exception of the climate risk dummy which is time-invariant). The first column only includes high income economies and columns 2-2 only includes emerging and developing economies. Standard errors are double-clustered at country-year and month levels.

TABLE 3.4 **SENSITIVITY TO LOCAL AND GLOBAL FACTORS AND VULNERABILITY TO CLIMATE RISK**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Real GDP Growth	-30.57***	0.950	-27.35***	3.646	-7.333	-8.420*	-7.285
	(5.987)	(5.893)	(7.852)	(4.609)	(4.727)	(4.637)	(4.750)
Inflation	26.84***	12.82***	26.41***	12.88***	24.56***	24.21***	24.56***
	(4.012)	(3.867)	(4.523)	(3.155)	(3.547)	(3.759)	(3.573)
Gov. Bal/GDP	24.40***	-21.52***	19.32***	-4.404	2.764	4.670	2.681
	(5.412)	(4.811)	(7.156)	(3.645)	(3.906)	(3.844)	(3.913)
Curr. Acc./GDP	-3.079	6.030*	7.909**	8.382**	8.728***	9.155***	8.759***
	(2.183)	(3.352)	(3.750)	(3.550)	(2.812)	(2.949)	(2.812)
DXR	-141.7	102.5	-95.89	-34.40	-9.053	-10.00	-7.362
	(171.1)	(223.2)	(174.3)	(145.5)	(116.6)	(121.0)	(117.6)
ln(GDP PC)	-184.0***	-82.08***	-356.0	-244.7	-380.9**	-248.5	-372.3*
	(48.98)	(17.81)	(283.2)	(235.8)	(191.9)	(183.1)	(191.0)
DEBT/Y	3.154***	4.706***	1.378	9.875***	1.881	6.518***	2.143
	(0.798)	(0.735)	(3.770)	(1.787)	(2.722)	(1.936)	(2.858)
Int. Res/Y	-13.07**	-9.054	-13.03***	-12.75***	-16.44***	-16.86***	-16.54***
	(5.780)	(5.589)	(4.513)	(4.032)	(3.555)	(3.719)	(3.559)
Rule of Law	-51.27**	-87.27***	-280.0*	-278.8*	-229.6**	-258.0**	-231.5**
	(22.21)	(27.84)	(165.5)	(146.5)	(113.4)	(116.1)	(112.8)
Global	91.57*	269.7***	91.85*	279.7***	206.9***	145.7***	181.1***
	(46.31)	(44.76)	(48.21)	(54.71)	(52.53)	(52.25)	(52.88)
CR30x DEBT/Y					5.580**		5.184**
					(2.539)		(2.603)
CR30xGlobal						99.30*	42.48
						(52.53)	(53.63)
N. Obs.	2,627	4,000	2,627	4,000	6,627	6,627	6,627
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	Yes	Yes	Yes	Yes	Yes
Sample	EMDE Low CR	EMDE High CR	EMDE Low CR	EMDE High CR	All EMDE	All EMDE	All EMDE

Note: This table reports a set of regressions which only include emerging and developing countries. The dependent variable is the sovereign spread on foreign currency bonds, and the explanatory variables include a set of domestic controls (real GDP growth, inflation, Government balance over GDP, current account balance over GDP, change in the bilateral exchange rate, log of GDP per capita in constant PPP dollars, debt-to-GDP ratio, international reserves over GDP, and Rule of Law), a global factor (the first principal component of the VIX index, the US dollar index, and the US Fed funds rate) , and the interaction between dummy variable measuring climate risk for 2030 and each of the debt-to-GDP ratio and a local factor (these interactions are only present in columns 10-12 Columns 1 and 3 only include countries with low climate risk and columns 2 and 4 only include countries with high climate risk. Columns 5-7 include all EMDE. Standard errors are double-clustered at country-year and month levels.

Table 3.4 studies whether climate risk affects the sensitivity of spreads to domestic and global factors. Columns 1 and 2 estimate a model similar to that of column 2 in Table 3.3 by splitting the sample into countries with low and high climate risk. They show that the elasticity of spreads to debt and global factors tend to be higher in countries with high climate risk. Columns 3 and 4 show that this result becomes stronger if we control for country fixed effects.

Columns 5 to 7 use the full sample of EMDEs and interact climate risk with debt levels and global factors. They show that the increase in the correlation between spreads and each of domestic and global factors associated with climate risk documented in the previous columns is statistically significant (columns 5 and 6), but that in a horserace regression the effect of debt dominates that of global factors (column 7).

3.4 THE FISCAL COSTS OF CLIMATE ADAPTATION

Climate change risk is materialising rapidly and will continue to do so for the foreseeable future because the accumulated GHGs in the atmosphere are warming the planet by about 1°C over pre-industrial levels. Therefore, the intensity of climate related disasters will increase, storms and droughts will become more frequent, and sea levels will likely rise – even if the world gets to net zero emissions by 2050. As shown in Chapter 2, most exposed are the developing and emerging countries.

All countries, but particularly highly exposed countries, will need to invest in climate adaptation – for example, making building and physical infrastructure more resilient to natural catastrophes, building dams and natural barriers to buffer storm surges, protecting the vulnerable from extreme heat, reducing water usage, adapting farms and food supply, and managing the retreat from shorelines and seaside settlements. Rapid adaptation investment now can limit stranded assets and reduce the cost to lives and livelihoods. There is wide consensus that the economic returns to such investments are very high, with average return estimates in the region of 80–100% and returns for specific investment (e.g., storm protections) rising to 1,000% or more (see Aligishiev et al., 2022 for a survey).

But unfortunately, climate adaptation will also be fiscally costly in many countries. This is suggested by the adaptation cost estimates of 46 countries that included them in their Nationally Determined Contributions following the Paris Agreement – about 1.5% of GDP annually from 2015 until 2030, with large variations across countries (Buchner et al., 2019).

These estimates are fraught with uncertainty because they do not use a common definition or a common methodology, but recent research conducted at the IMF leads to the same conclusion. For example, Aligishiev et al. (2022) focus on (1) cost-effective upgrading of public infrastructure (both existing assets and planned projects) to raise their resilience to floods and storms; and (2) costs of coastal protection (where protection needs are

defined as the cost of reaching a protection level that minimises the sum of construction and maintenance costs and residual flood damage). They find that the average annual cost of upgrading public infrastructure between 2021 and 2025 is about 1.2% of GDP in emerging economies and 0.6% of GDP in low-income economies (reflecting the lower level of infrastructure assets in the latter). The cost of coastal protection is estimated to be about 0.1% of GDP annually for 15 years for emerging economies and 0.4% for low-income economies, but much higher in small developing states (in the order of 1.9% of GDP annually for 15 years). Consistent with these estimates, the IMF (2020) puts annual adaptation costs in Pacific Island Countries at about $1 billion every year for the next ten years, which corresponds to 6.5–9% of GDP (Aligishiev et al., 2022, Box 2).

Fiscal adaptation costs may exceed the fiscal space of many developing countries, even if they undertake fiscal adjustment and economic reform. This group includes the most vulnerable island countries, but likely also several other emerging and developing economies that have limited fiscal space and/or are at high risk of debt distress while also facing large fiscal adaptation costs. According to Aligishiev et al. (2022), this group includes Angola, Costa Rica, Fiji, India, Iran, Lao PDR, Malaysia, Pakistan and Uganda. Chamon et al. (2022) undertake a back-of-the envelope calculation that compares the present value of debt with the threshold level that would put countries at high risk of debt distress, according to the IMF–World Bank's debt sustainability framework for low-income countries (LIC-DSF). Of 64 low-income economies for which data are available, 33 have fiscal space of less than 10% of GDP, while in 28 cases fiscal space is negative. By this measure, self-reported adaptation cost estimates exceed the available fiscal space for 22 out of 29 low-income economies that have submitted such estimates in their NDCs.

It follows that many developing countries are unlikely to be able to afford economically efficient adaptation investment without international support. Providing such support is one of the roles of climate finance, a topic that we return to below.

BOX 3.1 RECENT MULTILATERAL INITIATIVES

Debt Service Suspension Initiative (DSSI)

In March 2020, the President of the World Bank and the Managing Director of the IMF proposed a Debt Service Suspension Initiative (DSSI) aimed at helping a group of 73 low-income countries to deal with the consequences of the Covid-19 pandemic. The initiative was adopted by the G20 on 15 April 2020. It was originally set to expire at the end of 2020, but it was extended twice and expired at the end of 2021.

The objective of the initiative was to provide a holiday from official bilateral debt and the hope that the private sector – via exhortation – would voluntarily follow suit in providing equivalent relief. While countries were initially hesitant in applying for relief because they were afraid of negative market repercussions associated with DSSI participation, it became immediately evident that there were no such repercussions (Lang et al., 2022). Forty-eight out of 73 eligible countries participated in the initiative, which is estimated to have suspended nearly $13 billion in debt-service payments to bilateral creditors. Out of these 48 countries, 41 are classified as being in debt distress or at high risk of debt distress. No private creditor participated in the initiative.

That the DSSI was unlikely to lead to private sector participation was anticipated by Bolton et al. (2020), who proposed a mechanism to implement a debt standstill that would free significant resources while also giving private creditors incentives to participate. While this proposal had built-in incentives for creditors, Bolton et al. (2021) highlight that a well-working system requires both carrots and sticks. With this objective in mind, they put forward the notion of 'legal air cover' aimed at temporarily protecting countries against lawsuits during the restructuring period.

One challenge faced by countries that need to restructure their debt is increased creditor diversity. In 2006, 83% of the external debt of DSSI-eligible countries was owed to either multilateral institutions (55% of the total) or Paris Club bilateral creditors (28% of total). This share has now decreased to 68%. China now accounts for 18% of total external debt (more than all Paris Club countries put together) and external bonded debt accounts for about 10% (Chabert et al., 2022).

Common Framework

While the DSSI allowed member nations to delay payments to official creditors, it did not lead to a reduction in the net present value (NPV) of their debt. In November 2020, the G20 endorsed a Common Framework for debt treatments beyond the DSSI which targets the same 73 countries that were eligible for the DSSI. The objective of the Common Framework is to create a mechanism that coordinates and guarantees equal treatment of Paris Club and other G20 bilateral creditors and also involves private creditors, which are expected to provide debt treatments on terms that are as least as favourable as those provided by bilateral creditors. Debt treatments are based on an IMF-World Bank debt sustainability analysis. After an eligible country applies for debt treatment under the Common Framework, a Creditors' Committee is formed which negotiates the specific conditions of the treatment with the debtor country. Negotiations are coordinated by the Paris Club secretariat with the support of the World Bank and the IMF.

BOX 3.1 **(CONTD.)**

So far, only three countries – Chad, Ethiopia, and Zambia – have applied for a treatment under the Common Framework. "Financing assurances" (a general commitment of the creditor committed to provide the needed debt relief, allowing the IMF to disburse) have so far been provided to Chad (in June 2021) and to Zambia (in July 2022), but no actual memoranda determining the level of debt relief have yet been agreed for any Common Framework country. Several observers, including IMF and World Bank officials, have noted that negotiations are moving at too slow a pace and that this might have dissuaded many other countries at high risk of debt distress from engaging with the process.[21] They have also suggested improvements. The IMF's Georgieva and Pazarbasioglu (2021) argue for more clarity on the expected timelines, a debt service standstill while negotiations are taking place, and more clarity on how comparability of treatment of the commercial creditors is determined. The World Bank's Gill (2022) wants to bring commercial creditors into the negotiating room from the get-go and establish a mathematical formula for burden sharing between official and commercial creditors (see also Rivetti, 2022).

While some of these suggestions may help, the difficulties with the application of the Common Framework likely run deeper. As Georgieva and Pazarbasioglu (2021) observe, these difficulties may reflect the fact that the underlying problems that motivated the creation of the Common Framework – in particular, difficulties in coordinating Paris Club and non-Paris Club creditors, who may not be fully convinced that playing by the rules of the Paris Club is always in their best interests – have not disappeared overnight. They also reflect slow decision-making inside some of these countries. In China, for example, the decision to participate in a specific Common Framework restructuring requires approval from the highest government body, the State Council. Until these obstacles are reduced, restructurings under the Common Framework are likely to be slow going. This said, there is no obvious alternative at this point.

Resilience and Sustainability Trust (RST)

On 1 May 2022, the IMF created a new Resilience and Sustainability Trust (RST) to help low-income and vulnerable middle-income countries address long-term challenges such as the pandemic and climate change. The RST offers low-cost loans with a 20-year maturity and 10½-year grace period to developing countries using Special Drawing Rights (SDRs) donated by wealthy countries.

By August 2021, the IMF had allocated $650 billion in SDRs, of which about $230 billion went to low- and middle-income countries and more than $400 billion went to advanced countries. Many of the advanced countries are not in need of these additional reserves and may pledge SDRs in support of lower-income countries. The previously established Poverty Reduction and Growth Trust also collects donations of SDRs but it can only lend to the poorest countries. In contrast, about three-quarters of the IMF's country membership will be eligible for RST financing. The Fund seeks to mobilise $45 billion for the RST.

21 There are more than 40 countries classified as being in debt distress or at a high risk of debt distress and, according to Chabert et al. (2022), another 20 or so countries that are likely to breach the threshold for being classified at high risk of debt distress in 2022.

CHAPTER 4

Debt for climate: Sustainability-linked and green bonds

Climate finance instruments are transactions that extend financing – and sometimes fiscal support – conditional on climate-related actions or outcomes (for example, use of proceeds, a project, or an emissions level). The recipient of the financing could be a private entity, such as a corporation, or a sovereign. Financing could take the form or a loan, bond, credit, grant or debt relief. This chapter focuses on **conditional lending instruments** – bonds or loans. In terms of volume, this is by far the largest climate finance category. The next two chapters will discuss carbon credits (Chapter 5), conditional grants, debt–climate swaps, and comprehensive debt restructuring (Chapter 6).

One relevant distinction in this category is by creditor – official (e.g., governments or multilateral development banks such as the World Bank) versus private. Within the private creditor category, there are 'green', 'sustainability' and 'sustainability-linked' bonds or loans. The 'green' and 'sustainability' labels refer to the intended use of proceeds, namely, spending or projects linked to environmental or sustainable development objectives (whether these are credible and enforceable commitments is a question that we return to in the next section). In contrast, 'sustainability-linked' bonds or loans do not seek to restrict the use of proceeds but instead link the financial terms of the instrument to specified performance indicators (for example, CO_2 emissions). For this reason, they are sometimes also referred to as 'performance-linked'. Sustainability-indexed issuance is far behind green or sustainable issuance. For example, as of May 2022, there was only one sovereign sustainability-indexed bond among about 120 ESG sovereign bonds issued since 2016 (a $2 billion placement by Chile in March 2022, whose coupons are linked to Chile's emissions and renewable electricity generation targets).

4.1 THE ECONOMICS OF GREEN SOVEREIGN BONDS

Most green bonds are issued by corporates, banks or municipal issuers. The role of green bonds for these issuers has been to tie the funds raised to specific green projects. How the funds are to be used is generally specified in the prospectus and, in theory, verified by third parties. Green bond issuance has increased dramatically in recent years, but it still represents a tiny fraction of the global bond markets.

Central questions about green bonds include: Why are they needed? What do they contribute? Companies could simply issue a regular bond to fund their green projects. Why seek funding through a new instrument, which presumably involves higher transaction costs (the use of funds raised with green bonds must be specified, verified and monitored)? One answer from practitioners is that there is appetite for green bonds from investors. Green bond issues are often oversubscribed. The growing ESG investor clientele demands more ESG assets, and the supply of green bonds is not keeping up with demand.

Basic economics suggests that when demand exceeds supply, the price increases to clear the market. Accordingly, it has been suggested that the attraction for issuers in raising funds through a green bond is a lower cost of capital. Plausible as this hypothesis is, there is little evidence of the presence of a '*greenium*' (i.e., a lower interest rate) for green bonds (Baker et al., 2022). ESG investors may prefer to invest in a green bond other things equal, but the pricing of the bond still mostly reflects credit risk and liquidity.

If there is no significant price advantage to issuing a green bond, it is unclear why companies and investors bother. One important answer for corporations identified by Flammer (2021) is that, while green bond prices do not differ significantly from comparable conventional bond prices, the issuer of a green bond might benefit by seeing its stock price jump following the announcement of a green bond issue. In other words, it is the shareholders that benefit from the green bond issue. Their company is able to signal its green credentials by issuing a green bond, thereby bolstering its green reputation and attracting more interest from ESG equity investors.

Why sovereign green bonds?

This mechanism makes sense for corporations. It is less relevant for municipalities and sovereigns, unless they see a similar signalling benefit from issuing green bonds. But voters in local elections are likely to be informed directly about the green projects undertaken by their municipality, so that one would expect to see little informational content in the announcement of a green municipal bond issue.

Similarly, national governments can announce their green policies directly to their citizens. They would not be expected to promote their green credentials by raising funds through green sovereign bond issues. Another difficulty with green sovereign bonds is that government spending decisions are typically made by a legislative body. Spending decisions are typically not negotiated with lenders or tied to specific debt funding sources. Indeed, the Climate Bonds Initiative's *Sovereign Green, Social, and Sustainability Bond Survey* (CBI, 2021) quotes the Head of Investor Relations at the German Debt Management Agency, Alexandra Beust, as stating that: "[a]ccording to German law, all expenditures are subject to parliamentary decision and therefore, our green bond issues are designed to finance expenditures that have already been carried out". Sovereigns that have issued green bonds have generally not set up separate accounts in which the proceeds can be placed and earmarked for specific green expenditures. As CBI (2021) points out: "In the

corporate world, it is a frequent practice to open a separate account to manage the funds raised from [green] bonds, but most governments do not allow this." Consistent with this, when we analyse the documentation of a large number of sovereign and quasi sovereign bonds below, we find that almost none of them commits the issuer to allocate the raised funds to green expenditures.

If signalling green credentials is not a central motive for issuing green sovereign bonds, what are the reasons behind some sovereigns' decisions to issue green bonds? This is an important question to answer because it could help determine whether the growth of green bonds is likely to translate into significant climate change efforts.

Dealogic Data includes 909 sovereign or quasi sovereign bond issuances over the 2012–2021 period, for a total amount of nearly $450 billion. Nearly half of these bonds (45%) were issued by international organisations. The most active issuers are the World Bank Group (16% of total issuances), the European Investment Bank, which pioneered the green bond market (13% of issuances), the German development bank KfW (6% of total issuance), the European Bank for Reconstruction and Development (6% of total issuances), and the Asian Development Bank (4% of total issuances).

Local government and sovereign-backed institutions are also active in the market for green bonds and account for nearly one-quarter of issuances each (222 bonds issued by local governments and 235 issued by sovereign-backed institutions, including 56 by KfW).

TABLE 4.1 **SOVEREIGN OR QUASI SOVEREIGN BONDS ISSUED OVER 2012-2021**

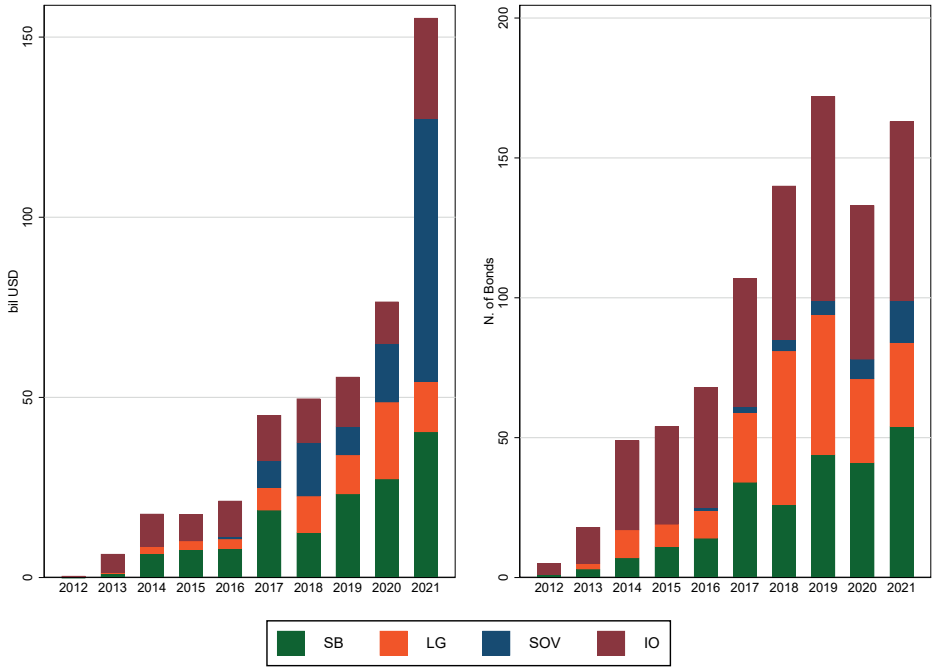
	Number of issuances	Total amount (billion USD)
The World Bank Group	145	16.8
of which		
IBRD	91	9.2
IFC	54	7.6
EIB	120	47.7
KfW	56	51.5
EBRD	53	6.4
AsDB	39	9.3
Other issuers	497	317.6
of which		
International organisations	63	30.9
Local governments	221	72.0
Sovereign-backed institutions	179	94.3
Sovereigns	34	120.4
Total	909	449

There are large differences in average size. While the World Bank Group is the largest issuer in terms of number of bonds, it has raised much less funding than KfW and the EIB. With just 34 issuances, sovereigns account for less than 5% of the market in terms of the number of bonds, but for more than 25% in terms of the amount raised.

Sovereigns are also the fastest growing segment of the market (Figure 4.1). While many countries have been issuing sovereign-guaranteed green bonds since at least 2007, Poland was the first country to issue a central government green bond in 2015. At the time of writing, central government green bonds represent about 0.2% of government bonds issued by advanced economies, with France being the largest issuer to date (Ando et al., 2022).

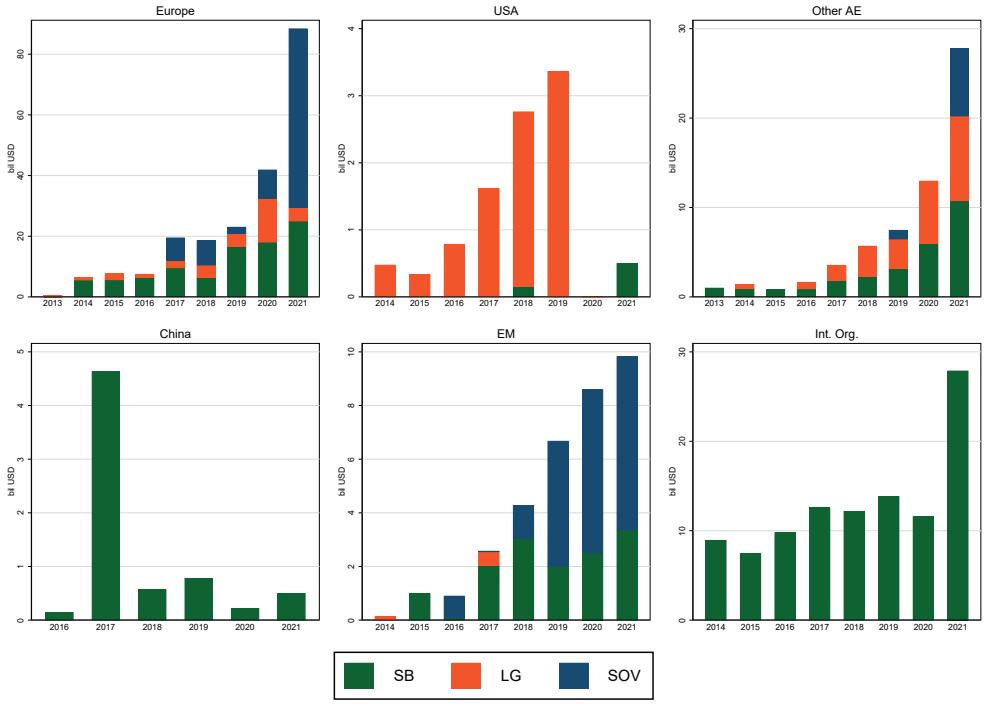
In terms of currency, about 60% of sovereign and quasi-sovereign green bonds are denominated in euros (driven by the fact that most sovereign issuers are in Europe; Figure 4.2) and 20% in US dollars.[22]

FIGURE 4.1 **SOVEREIGN AND QUASI-SOVEREIGN BOND ISSUANCES**



22 There are also two sovereign bonds denominated in RMB, two in British pounds (both issued by the British government), one in Japanese yen (issued by Hungary), one in Swedish kronas (issued by Sweden), and one in Nigerian nairas (issued by Nigeria).

FIGURE 4.2 **SOVEREIGN AND QUASI-SOVEREIGN BOND ISSUANCES BY GEOGRAPHIC AREA**



The elusive quest for a sovereign greenium

As has been suggested for corporate or municipal green bonds, could it be that sovereign green bonds are cheaper for the issuer? Multiple press accounts suggest that investors are willing to charge lower rates when lending to issuers promising to undertake green projects.[23] However, researchers have found mixed evidence for the presence of a sovereign *greenium*. Note that the greenium is sometimes defined as the difference between the yield of a green bonds and that of a conventional bond, and other times defined in the opposite way. In the former case, a positive greenium indicates that green bonds have a higher yield than similar conventional bonds. In the latter, a positive greenium indicates that green bonds have a lower yield than similar conventional bonds. In what follows, we use the second definition. A positive greenium will thus denote that, from the issuer's point of view, green bonds are cheaper than conventional bonds with similar characteristics.

The key challenge in estimating the presence (or absence) of a sovereign greenium relates to finding conventional government bonds with parameters which are comparable to those of the green bonds issued by the same country.

23 See "Squeeze on 'Greenium' as ESG Bond Investors Demand More Value", *Financial Times*, 10 October 2021); "Greenium Set to Stay, Say Sovereign Debt Issuers", OMFIF, 7 February 2022 (www.omfif.org/2022/02/greenium-set-to-stay-say-sovereign-debt-issuers/); "Green Pricing in the Primary Market H1 2021" (www.climatebonds.net/2021/09/greenium-remains-visible-latest-pricing-study); "Denmark to Discover its 'Greenium' with First Green Bond Sale", Bloomberg 18 January (www.bloomberg.com/news/articles/2022-01-18/denmark-to-discover-its-greenium-with-first-green-bond-sale?sref=wvo74VD0).

There are two possible strategies to deal with this issue. The first strategy consists of focusing on twin or quasi twin bonds (i.e., bonds issued by the same sovereign on the same day and with the same maturity and duration). The main advantage of this strategy is it allows to precisely estimate the possible presence of greenium. The main disadvantage of this strategy is that the sample of exact matches is limited to a few issuers, all located in advanced economies. The alternative is to compare green bonds with conventional bonds with similar but not identical characteristics. While this strategy is bound to lead to less precise estimations of the potential greenium, it has the advantage of being applicable to a larger number of green bonds, including green bonds issued by emerging economies.

Studies that focus on exact matches include Ando et al. (2022), Grzegorczyk and Wolff (2022), and EIB (2021). Ando et al. (2022) study the secondary market for German twin bonds and find evidence for a greenium that ranges between 2 and 5 basis points.[24] Grzegorczyk and Wolff (2022) expand the sample of exact matches to ten twin bonds issued by seven EU countries and find a statistically significant greenium for all ten bonds, using secondary market data.[25] For the German bonds, their results are consistent with Ando et al., whereas for the remaining bonds, they find somewhat larger greeniums (in the range of 5–15 basis points). EIB (2021) focuses on primary market pricing for the climate awareness bonds issued by the European Investment Bank and concludes that there is no strong evidence of a greenium [26]

Studies that do not use exact matches can be divided into (1) analyses that use matched bonds with similar characteristics in terms of issuer, currency and maturity (CBI, 2021; Doronzo et al., 2021; Ando et al., 2022; Grzegorczyk and Wolff, 2022); and (2) studies that generate synthetic matches with an asset pricing model (Fatica et al., 2021). The evidence is mixed. Doronzo et al. (2021) compare bond prices for France, Belgium, Ireland, and the Netherlands. Consistent with the findings for corporate and municipal green bonds, they find that sovereign green bond yields are essentially indistinguishable from the yields of conventional government bonds. However, they find a small difference between primary and secondary markets. Primary market data indicate that, on average, green bonds have a higher yield than comparable conventional bonds (the greenium is thus negative, according to our definition). The average value of this green primary market penalty is 3.8 basis points and is statistically significant. Secondary market data instead indicate a very small greenium of 0.5 basis points. CBI (2021) confirms the presence of a greenium for German bonds but does not find evidence of a greenium for other issuers.

24 It should be noted that even the twin bonds are not really 'twins' as the two types of bonds have different size, with the issuance of the conventional bonds being much larger.

25 Grzegorczyk and Wolff (2022) use twin bonds issued by Germany (four twin bonds), Austria, Belgium, Denmark, France, the Netherlands, and Spain (one twin bond for each country).

26 The executive summary of the report states that "[t]here is some evidence of 'greenium' on CABs in the primary market, but it is not systematic and conclusive. Primary market pricing of the latest EUR and USD CAB issuances evidences some prevalence of greenium (ranging from 5 to 10 bps). However, due to methodological constraints, the evaluation cannot establish the existence and scale of greenium with certainty" (EIB, 2021, p. 5).

Besides focusing on exact matches, Ando et al. (2022) and Grzegorczyk and Wolff (2022) also use synthetic matching yields. While Grzegorczyk and Wolff do not find evidence of a greenium, Ando et al. find that the average greenium for euro-denominated government bonds is about 3.7 basis points and that for US dollar-denominated government bonds is close to 30 basis points. The greenium seems to be larger for sovereign bonds issued by emerging market countries. When Ando et al. focus only on emerging market countries, they find a 50 basis point greenium for bonds denominated in US dollars and a 13 basis point greenium for bonds denominated in euros.

Fatica et al. (2021) do not focus on sovereign issuers, but study the primary market for green bonds issued by private and supranational borrowers. They find a greenium for bonds issued by supranational institutions and non-financial corporates, but no greenium for bonds issued by non-supranational financial institutions. The finding of a greenium for supranational borrowers is somewhat in contrast to the results of EIB (2021), which, as mentioned above, finds no strong evidence of a greenium for green bonds issued by the European Investment Bank.

We contribute to this literature by building a dataset of sovereign and sovereign-guaranteed bonds and matching them with comparable conventional bonds. Note that we rarely have exact matches, but we do match the issuer and currency (hence, we control for credit and exchange rate risk) and use bonds which have similar maturity (maximum difference of one year). Table A1 in the appendix to this chapter lists 63 sovereign and sovereign-guaranteed bonds for which we could find matching yields for conventional bonds and compute a greenium at issuance.

On average, the bonds included in our sample have a negative greenium (i.e., the green bonds have a higher yield with respect to comparable conventional bonds) of 4.8 basis points (Table 4.3). This negative greenium is statistically significant at the 5% confidence level. The top panel of the table shows that this penalty is higher in advanced economies and it is close to zero and not statistically significant in emerging markets (however, the difference between the two groups is not statistically significant). The second panel of Table 4.3 suggests that the negative greenium is driven by sovereign-guaranteed issuers, with no significant greenium for sovereign issuers. Consistent with the finding that the green penalty is higher in advanced economies, we also find that the penalty is higher among highly rated issuers (issuers with a rating of at least AA-). Focusing on euro and US dollar bond issuances, we find that green penalty is not statistically significant, while it is larger (6.6 basis points) and statistically significant for bonds issued in other currencies.

Taken together, the results in Table 4.3 indicate that there is no strong evidence of either a greenium or a green penalty for sovereign bonds or sovereign-guaranteed bonds issued in euros or US dollars. However, we do find a green penalty for bonds issued by sovereign-guaranteed entities and bonds denominated in other currencies. The penalty seems particularly high for guaranteed bonds denominated in Swedish kronas, while Japanese bonds issued in yen have a very small greenium (0.5 basis points).

TABLE 4.3 **THE GREENIUM**

	EM	AE	Difference	All
Greenium	-2.70	-5.48*	2.78	-4.77*
Std. err	(3.83)	(2.35)	(4.60)	(1.99)
No. obs	16	47		63
	Sovereign	**Guaranteed**	**Difference**	**All**
Greenium	-1.57	-6.27*	4.70	-4.77*
Std. err	(3.07)	(2.54)	(4.27)	(1.99)
No. obs	20	43		63
	High Rated	**Medium Rated**	**Difference**	**All**
Greenium	-5.24*	-3.98	-1.26	-4.77*
Std. Err	(2.37)	(3.64)	(4.17)	(1.99)
No. obs	40	23		63
	Euro	**USD**	**Difference**	**All**
Greenium	-5.29	-1.53	-3.76	-4.19
Std. Err	(3.09)	(3.61)	(5.35)	(2.42)
No. obs	34	14		48
	Euro & USD	**Other currencies**	**Difference**	**All**
Greenium	-4.19	-6.6*	2.44	-4.77*
Std. err	(2.42)	(3.26)	(4.70)	(1.99)
No. obs	48	15		63

Notes: This table reports average values for the greenium for different group of bonds. A negative value indicates that green bonds have a higher yield. 'EM' denotes bonds issued by emerging markets and 'AE' bonds issued by advanced economies; 'sovereign' denotes sovereign bonds and 'guaranteed' denotes sovereign guaranteed bonds; 'high rated' denotes bonds with a credit rating of at least AA- and 'medium rated' denotes bonds with lower ratings; 'euro' denotes bonds issued in euro and 'USD' bonds issued in dollars; 'other currencies' denotes bonds issued in other currencies. *Statistically significant at the 5% confidence level.

Both Doronzo et al. (2021) and the Climate Bonds Initiative survey of sovereign green bond issuers (CBI, 2021) point out that a primary reason for issuing green sovereign bonds for some issuers was to help create a broader green bond market. Doronzo et al. (2021) argue that "sovereign GBs can provide a high-quality market benchmark, enhance the green segment's liquidity and encourage other issuers to get into this industry", and the Climate Bonds Initiative (2021) survey states that "[f]or most countries, a key motivation for issuing a sovereign GSS bond was to support the growth of a local green bond market". Grace Wong from the Hong Kong Monetary Authority is quoted in the survey and explains that: "Hong Kong's main consideration in setting up a green bond issuance program was to demonstrate the government's support for sustainable development and to promote

the development of a green bond market as there were no significant funding needs. The government has placed huge priority on green and sustainable finance aiming at the shift of financial flows to sustainable projects and to raise awareness, not just in the city but also in the whole region."

As Yuan (2005) and Dittmar and Yuan (2008) have argued, one benefit of the creation of a sovereign bond market is that it helps the emergence (or expansion) of a corporate bond market, by providing hedging options for country-level aggregate risks (e.g., currency and commodity price risk), liquidity and price discovery. Conceivably, such benefits might be present when introducing sovereign green bonds. However, since all the countries that have issued green sovereign bonds already had conventional bonds outstanding, and since corporate green bonds are close substitutes for conventional corporate bonds, these benefits are unlikely to be significant. More likely, the benefit is in drawing in new investors, that is, ESG-focused investors who want green bonds but would not consider investing in corporate green bonds unless they could also diversify into sovereign green bonds. Whether it is these hypothetical 'new' investors who are buying the green bonds, however, is not known. And then there is the question of whether, if they were not investing in green bonds, they would be using those resources for other environmentally beneficial activities instead.

It is important also to distinguish between developed market and emerging market issuers. The former face few funding constraints, while the latter may be close to their debt sustainability limits when they decide to issue green sovereign bonds. The developed market group of issuers may benefit primarily from greening its financial system, while the emerging market group of issuers may be able to also expand its borrowing. Egypt, for example, issued a first green bond in September 2020, intending to raise $500 million, but the issue was nearly ten times oversubscribed, so that it ended up raising $750 million (CBI, 2021). Table A1 suggests that there is a 13 basis point greenium associated with Egypt's issuance.[27]

Another possible distinction is between countries at high and low climate risk. To test whether the greenium is higher in countries that are more exposed to climate risk, we regress the greenium on a set of bond characteristics (credit rating, face value, and a dummy that differentiates sovereign from sovereign-backed bonds), the log of GDP per capita, year fixed effects, and three measures of climate change vulnerability. Specifically, we use a time-invariant dummy that takes a value of one for countries that are classified by DARA (2011) as having high, severe, or acute vulnerability to climate risk in 2030; a time-invariant continuous measure of exposure to climate risk from the Notre Dame Global Adaption Initiative (ND-GAIN; see Chen et al., 2015) and a time-varying measure of climate vulnerability also from ND-GAIN.

27 The greenium for Egypt is a puzzle in that it is not obvious to us why it should have a greater greenium than other issuers. Egypt's green bond, to our examination, does not have promises that are more credible and enforceable than other issuers doing green issuances. As for reputation, there is no reason that we are aware of to think that Egypt would be viewed as more likely to behave ethically than other issuers of its type.

TABLE 4.4 **THE GREENIUM AND CLIMATE RISK**

	(1)	(2)	(3)
Upper-medium grade	-5.486 (11.70)	-12.80 (11.90)	-9.074 (11.22)
Lowed grade	9.020 (7.953)	3.971 (9.280)	0.338 (9.877)
Sovereign	-2.346 (9.523)	11.62 (11.80)	4.135 (7.538)
ln(face value)	1.352 (2.166)	0.262 (2.194)	0.984 (1.578)
Maturity	0.455* (0.234)	0.482** (0.230)	0.524** (0.218)
ln(GDP PC)	0.888 (6.708)	2.073 (5.850)	10.85 (6.396)
Clim risk 2030	0.456 (4.267)		
Exposure ND		144.9* (71.37)	
Vulnerability ND			187.6** (88.62)
Constant	-47.18 (100.2)	-100.2 (80.28)	-206.9* (100.6)
Observations	61	62	62
R-squared	0.111	0.231	0.214

Notes: This table reports a set of regressions where the dependent variables is the 'greenium' (defined as the difference between average sovereign yields and the yield on sovereign green bonds) two dummy variable that takes values 1 for upper medium grade (ratings from A to A-) and lower grade bonds (below A-; the excluded group is high-grades bonds (AAA to AA-), a dummy for sovereign issuers (the excluded group is sovereign backed issuer; bonds issued by local government are not included in the analysis), the log of face value, bond maturity (in years), the log of GDP per capita, a dummy for countries with high climate risk, a continuous measure of exposure to climate risk and a time varying measure of vulnerability to climate risk. Robust standard errors clustered at the country level in parenthesis.

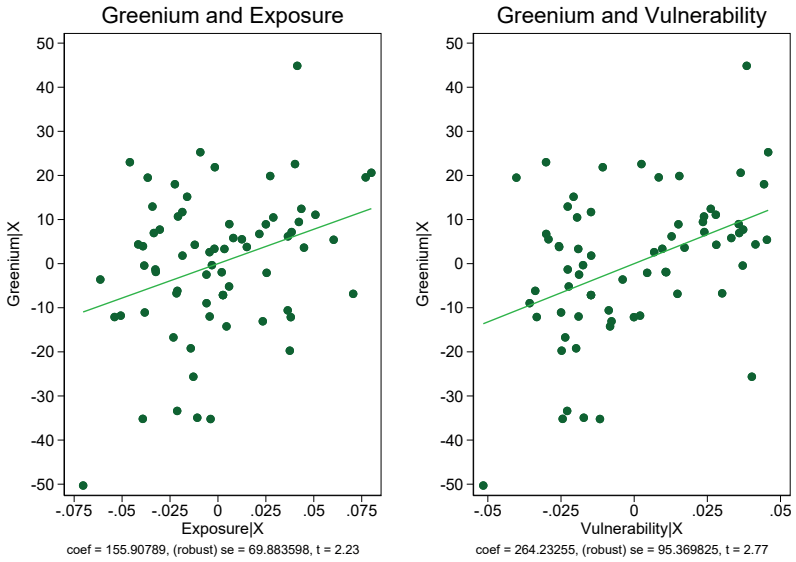
We find that climate vulnerability is always positively correlated with the presence of a greenium and that the coefficient is statistically significant when we use the ND-GAIN indicators (Table 4.4). The point estimates indicate that a one standard deviation increase in climate exposure is associated with an 8 basis point increase in the greenium, and a one standard deviation increase in climate vulnerability exposure is associated with an 11 basis point increase in the greenium.[28] To interpret the results, start from the observation that, in our sample, the average green penalty is close to 5 basis points (the greenium is -4.77), while column 3 of Table 4.4 implies that a one unit increase in the climate vulnerability

28 It is also interesting to note that bond maturity is positively associated with the greenium, indicating that, other things equal, long-dated bonds have a higher greenium. This finding is consistent with the idea that climate change is a long-run risk. In future research, it would be interesting to explore whether emerging market countries can use green bonds to extend the maturity of their debt.

index is associated with a 187 basis point increase in the greenium. Given that the climate vulnerability index ranges between 0.28 and 0.45 and has an average value of 0.32, the regressions indicate that, other things equals, a high vulnerability country would have 20 basis point greenium (-4.77+187*(.45-.32)=19.5).

Figure 4.3 plots the partial correlation between the greenium and climate risk and shows that the results of Table 4.3 are not driven by outliers.

FIGURE 4.3 **PARTIAL CORRELATION BETWEEN THE GREENIUM AND CLIMATE RISK**



Note: This figure plots the partial correlation between greenium and climate risk based on the results of columns 2 and 3 of Table 4.3

To summarise, this section has three main empirical takeaways. First, the greenium, if it exists, does not 'jump out' from the data. A good faith effort to find it in a sample of 63 pairs of bonds from the same issuer, in the same currency and with roughly the same maturity (within one year) did not succeed. Second, comparing 'twin bonds' (of identical maturity) issued by EU countries suggests that there is a statistically significant greenium, but also that this is small – in the single digit basis point range. Third, we see a statistically significant correlation between the greenium and climate risk. This suggests that for very climate-vulnerable countries (more than one standard deviation away from the mean), the greenium may in fact be in double digits.

These findings are not necessarily inconsistent. They suggest that the greenium is generally small – if it exists at all – except, possibly, in countries that are highly exposed to climate change (for example, island countries suffering from frequent hurricanes)

Interpreting these findings is tricky, however.

The finding that the greenium is small or zero could be read in very different ways. First, investors may not actually care much about the green investments that these bonds are meant to finance. Second, investors might genuinely care, but may not be prepared to pay a greenium because they think that buying green bonds does not make much of a difference to whether or not a country undertakes the promised investment. They might believe this for quite different reasons. They may think that the proceeds of the bond will not be used in the promised way. Alternatively, they may think that the promised project would have happened even without the green bond issuance. As argued above, the latter is a plausible story for democracies that have political commitment devices – laws, electoral promises, coalition agreements – which may envisage certain environmental actions that are not contingent on a particular form of financing.

From a policy perspective, distinguishing between these stories is very important. If the reason why the greenium is zero or small is that investors do not particularly care about green projects – except perhaps for show ('greenwashing') – then green finance would not seem to be a very promising tool for promoting good climate policies, regardless of how green bonds are designed. The same would hold true if investors are convinced that this form of finance has no impact on the propensity of a government to undertake a green investment.

If, however, the reason for the small greenium is that investors are distrustful that the proceeds of the bond will be spent on green projects, then green finance would look more promising – or at least could not be dismissed out of hand. It may be possible to tighten the bond contract in a way that makes investors less distrustful, and hence raises the greenium.

Consider next the correlation between the greenium and climate risk. This does suggest that investors care about green projects, at least in some circumstances – namely, in very climate-vulnerable countries. But why *should* they care? It is tempting to think that it might be because the green investment that the bond is supposed to finance reduces climate vulnerability, and hence credit risk. But if this is true, it should have no impact on the greenium, because it would also benefit the creditworthiness of standard bonds, which make no green investment promises, of the same issuer. Hence, if there really is a substantial greenium for climate-vulnerable countries, it must exist for altruistic and/or image reasons: investors find it attractive to support green investment and are prepared to give up some return for it because this improves the world and/or benefits a vulnerable country, and maybe also because it makes the investor look good as a result. To observe a greenium, this effect must be present over and above any impact that the green investment may have on credit risk.

Hence, the second finding is inconsistent with a purely cynical interpretation of the first finding – that investors don't care at all. At least in climate-vulnerable countries, investors seem to be willing to sacrifice some return for green investment. That we do not detect the same willingness for advanced country bond issuances (or much less so) could reflect the fact that investors are *only* willing to make the sacrifice for countries that are very climate vulnerable. But it could also be because they are not sure that green bonds, at least as currently drafted, make a difference to green investment in advanced countries.

4.2 THE LAW OF GREEN BONDS: EXPLORING BOND CONTRACTS

One way to test whether investors care about green 'use of proceeds' promises is to ask what assurances they receive to ensure that such promises will be kept. Are there, for example, monitoring mechanisms in place such that the issuer will face penalties if certain green benchmarks are not met during the term of the loan? If we assume that investment firms are willing to give up a few basis points to issuers who slap the word 'green' on their bonds as a marketing gambit and do not really intend to invest in anything green, then we would not expect to see contractual terms in the green bond that specify penalties for failing to meet specific green performance metrics. Conversely, if we assume that investors are wary of such greenwashing and do care about whether green promises are kept, then we would expect to see costs associated with the failure to keep green promises.

We hence study which green promises in this growing market are backed up by legal liability, the most explicit way of making promises credible. Our sample consists of 150 sovereign, quasi sovereign and supra sovereign bonds issued during the past decade (2012–2022) that explicitly designate themselves as green. Within each of these bonds, we look at four features in the sales documents (prospectuses and offering circulars):[29]

1. **Use of proceeds**. Most bonds have traditionally had a 'use of proceed' section. As its name suggests, this describes how the money raised through the borrowing will be used. In modern sovereign bonds, the provision will typically say something vague such as "for general governmental purposes". The question in the green bond context, therefore, is whether the 'use of proceeds' sections now say something more precise, such as: "We will use 50% of the proceeds of the loan to repair the damage to the coral reefs in X that was caused as a result of Hurricane Maria". With a promise of this specificity, creditors who discover that the borrowed money is being used to fund the refurbishment of the presidential palace instead can perhaps sue for breach of the contractual promise. But the promise has to first be made for there to be a right to sue. We examine the bonds in our sample to see whether credible and specific enough green promises are being made in the bonds such that suit could be brought for failure to perform.

29 We sourced our data from the website Filingsexpert.com, which has a database for green bonds, within which one can search for green supranational, sovereign and municipal bonds.

2. **Events of default**. 'Events of default' are early warning signals. Typically, they allow creditors to withdraw ('accelerate') their funds if there are indications that the debtor is going down an unsustainable path. A common event of default in sovereign bonds issued in foreign currencies is a default on any other debt also in a foreign currency and traded on an exchange. One might imagine, therefore, that similar types of early warning indicators could be constructed with respect to green promises. For example, there could be a requirement that the project be evaluated at regular intervals by some credible and independent environmental organisation, where the creditors would have the right to ask for their money to be returned to them on an accelerated basis if the appropriate approval from the neutral evaluator is not received. Alternatively, investors could contract for the debtor to pay a higher rate of interest (a 'step-up') in the event that the neutral third party determines that the money is not being used for the appropriate green purposes. We examine each of the bonds to see whether there are either events of default tailored to the green promises or the equivalent of a step-up in the interest rate in the event of a failure to keep to the promise of being green.

3. **Risk factors**. Most international bonds have detailed risk factor sections where investors are informed of the risks inherent in their investment. For example, Russian international sovereign bonds issued after the 2014 invasion and acquisition of Crimea disclose prominently the risks of Russia being the subject of further sanctions. With green bonds, therefore, one might expect there to be disclosure regarding the risk that the issuer might fall short of investing the borrowed money in adequately green projects. Or there might be disclosures regarding the likelihood that there would be legal recourse for investors for broken green promises.

4. **Restructuring provisions**. Among the most important legal features of a garden variety sovereign or quasi-sovereign bond are its restructuring provisions. They specify how, in the event of a crisis where the sovereign is no longer able to fulfil its original financial commitments, those commitments can be renegotiated. For example, sovereign bond contracts typically specify that these promises to satisfy key financial terms can be modified downward only if the debtor gains the approval of 75% or more of the creditors in principal amount.[30] Assuming that the promises to carry out green activities involve significant expenditures, one would expect issuers to prepare for scenarios where, because of a crisis, they are no longer able to fund green projects to the same extent that they were doing before. And one would also expect investors who care about the green promises being fulfilled to wish to put in place mechanisms for a renegotiation of what is to be done. Finally, to the extent there are promises that the green obligations will in fact be senior to the regular debt obligations of the sovereign, we would expect that to be clearly specified as well.

30 We are oversimplifying how these provisions, known as 'collective action clauses', work in practice. For details, see Buchheit and Gulati (2020).

Our findings from hand-coding a randomly selected sample of 150 sovereign, quasi-sovereign and supranational issuers are straightforward. The green bonds promise little or nothing that would be legally enforceable. We take each of the features of the bonds – use of proceeds, events of default/step-ups, risk factors and restructuring provisions – in turn.

1. **Use of proceeds**. Most 'use of proceeds' sections in the green bonds in our sample are both broad and vague in terms of what they promise. For example, the provision might say that the proceeds will be used in one of a range of possible green areas such as renewable energy, clean transportation, green buildings and so on. Or the section might say that the issuer will use the proceeds for some purpose that fits within a green framework or equivalent it has set up, whose details are provided on the Ministry of Finance website or in an appendix to the prospectus. From a legal enforcement perspective, the vagueness of the promises in the 'use of proceeds' sections means that enforcement will be difficult. The reason for this is that, to enforce, the complaining investors will need to show that some specific promise was broken and that damages can be estimated to compensate for that breach. If the promise is too vague, courts are likely to either say that the promise was illusory or that no damages can be estimated for the breach.

2. **Events of default or step-ups**. Here, the bonds are consistent. There are no events of default that we have come across in any of the bonds in our sample that are tailored to enabling lenders to pull their financing if the relevant green projects are not being funded. In other words, there is no legal enforcement mechanism for investors to utilise until the bond matures. And then, as noted above, it is not clear what kind of damages the investor could sue for. Only one bond in our data – a Ukrainian government-guaranteed bond issued in November 2021 – has a step-up feature that kicks in to raise the interest rate on the bond if appropriate green investments are not made.[31]

3. **Risk factors**. For a number of the bonds in our sample, the rubber meets the road in the discussion of risk factors. There, we see issuers tell investors (usually, multiple times) that there is no assurance that their funds will in fact be used for the green purposes that were intended. Investors are also told explicitly that it will not be an event of default if the funds do not end up satisfying the green promises. Egypt's much touted, World Bank-assisted, 2020 green bond is an example of the

31 The step-up feature in this bond is somewhat convoluted. But, to the extent we understand it, a 35 basis point step-up gets applied if, in 18 months prior to maturity, it is determined that the issuer has failed to make progress towards the specified green goals. For the first three and a half years of the five-year bond, though, there is no step-up feature. Further, the triggers are to be adjusted if there are changes in local Ukrainian law (and this is a sovereign-guaranteed bond, where the Ukrainian sovereign gets to change the law) (see Ukrenergo (National Power Company), $825 million, 2021 bond, due 2026).

foregoing.[32] The risk factor section on its green promises tells investors in at least three different ways that no assurance or guarantee can be given that Egypt will keep its green promises, along with making it clear that failure to comply will not constitute an event of default.[33] Hungary's 2021 green bond is even clearer as to the quality of its promises:

> *While it is the intention of the Issuer to apply the proceeds from the placement to finance or refinance Eligible Green Expenditures, it is under no legal obligation to do so. There is also no legal obligation to ensure that such Eligible Green Expenditures will be available or capable of being implemented as anticipated and, accordingly, that the Issuer will be able to use the proceeds for such Eligible Green Expenditures as intended. In addition, there is no legal obligation to ensure that Eligible Green Expenditures will achieve the originally intended impacts (environmental, social or otherwise) or outcomes in the manner expected.*[34]

4. **Restructuring provisions**. The bonds in our sample are also consistent on this matter. There are no restructuring provisions for the green promises in any of the bonds, let alone provisions that enable green promises to be senior to regular obligations. Investors do not seem concerned about what will happen to the green promises the debtor made to them in the event that the debtor goes into crisis and has to restructure its obligations.[35]

32 Supposedly, the green label on this bond resulted in the coupon dropping from 5.75% to 5.25%, a staggering amount in the sovereign debt world (see www.worldbank.org/en/news/feature/2022/03/02/supporting-egypt-s-inaugural-green-bond-issuance).

33 Egypt 2020 Green Bonds, due 2025 (prospectus, pages 11-12). The prospectus also describes a neutral third party as providing verification of the greenness of the use of bond proceeds, but is explicit that no enforceable assurances are made about the quality of these assurances. Another much touted recent 'doing good' bond is Benin's 2021 Social Bond (issued July 2021). Like the Egyptian bond, it has a long set of disclaimers regarding liability for failure to satisfy its social and green promises. For discussion of the Benin bond and its supposed greenium, see "Benin Reaps Lowest Cost Yet With Africa's First Social Bond", Bloomberg, 16 July 2021.

34 For a discussion of a few more of these disclaimers, see Weidemaier and Gulati (2021).

35 As of this writing, the aforementioned Ukrenergo bond is being reprofiled (payments are being delayed) on account of the Russian invasion of Ukraine. Short shrift has been given, however, to the green promises – other than investors being told that they will have to be modified appropriately. The consent solicitation from 6 August 2022, which has passed, tells investors, somewhat obliquely:
"[I]n the case of the debt securities issued by Ukrenergo, [the Issuer] seek[s] amendments to the sustainability-linked elements of the securities to *defer testing and reporting dates in relation to the Ukrenergo's sustainability-linked key performance indicators and adding another adjustment event to account for the impact of the war, including the Russian invasion.*"
As we read it, the green promises have fallen by the wayside in the first restructuring of one of these bonds that we are aware of.

How to make the dog bark

The discovery that green bonds lack any explicit legal mechanisms to monitor and enforce green spending promises is sobering. If bond holders do not bother insisting that green promises are properly enforceable, one might be tempted to conclude that talk is cheap and that sovereign green bond issues are currently simply another form of greenwashing.

However, this is not the only possible interpretation. To be sure, finding that sovereign bonds *include* such enforcement mechanisms would have been evidence *for* the seriousness of green investors. At the same time, the fact that bonds lack such enforcement mechanisms is not proof that investors do not expect the promises to be carried out, or indeed that sovereigns making such promises might not be subject to investor discipline. The very expansion of green finance around the world, the massive oversubscription of emerging market sovereign green bond issues, by themselves constitute an implicit disciplining mechanism. The consequences of an egregious default, cutting the country off from the manna of green finance, could be too costly for a country to take this risk (Bolton and Scharfstein, 1990). In other words, reputation may drive performance even though there is no legally enforceable promise being made.[36] Perhaps for this reason, we see a greenium for at least some bonds – such as the bonds of highly climate-vulnerable countries, as argued in the previous section – even though these bonds lack explicit monitoring and enforcement just as much as those of advanced countries with zero or very low greeniums.

In light of this, our main empirical findings – that we do not see much of a greenium except for in the case of countries with high climate risk, and that green bonds are not enforceable – could have two interpretations.

First, the altruism of investors is kindled only for countries with sufficiently high climate risk. Only in such countries are they willing to give up yield as the price of supporting a green project – trusting that reputation (or perhaps some other motive) will lead the issuer to make good on its promise to invest the proceeds in a particular way, even if it cannot be forced to do so contractually. While the reputational channel might work for both high climate risk and low climate risk countries, investors only care about green projects in the former group.

Second, investors care about green projects in both high climate risk and low climate risk countries, but they think that green bonds will have an impact on green investment only in the high-risk group. This could be because low climate risk countries happen to have institutional mechanisms that commit them to undertake the green investments regardless of whether they raise funding through green bonds or through standard bonds. But it could also be because reputational enforcement is only effective if the greenium is high to begin with. In other words, there could be multiple equilibria:

36 Further, if we think that the green promises are being given an elevated or priority status, investors might expect that the country will, in the event of a crisis, selectively choose to default on conventional bonds rather than green bonds (on de jure versus de facto seniority, see Bolton and Jeanne, 2007).

- A low greenium (or zero greenium) equilibrium, in which investors do not expect use of proceeds to be as promised (and/or to be additional). Given that low expectation, markets will not punish government for not following up on a promise which markets do not expect to happen anyway. Governments hence do nothing (or nothing in addition to what they wanted to do anyway). This validates the initial investor expectation.
- A high greenium equilibrium, in which investors expect proceeds to be used as promised and with additionality. Given that high expectation, the reputational channel for enforcement works. Having paid a greenium, investors would be mad if governments broke their promise. Fearing the market, governments implement as promised, validating the initial investor expectation.

To illustrate the low greenium equilibrium, recall the Sherlock Holmes tale of the dog that did not bark (Conan Doyle, 1892). Holmes explains the significance of the dog not having barked:

> *Before deciding that question I grasped the significance of the silence of the dog, for one true inference invariably suggests others. The Simpson incident had shown me that a dog was kept in the stables, and yet, though someone had been in and had fetched out a horse, he had not barked enough to arouse the two lads in the loft. Obviously, the midnight visitor was someone whom the dog knew well.*

Applying the parable of the dog that didn't bark to the "Adventure of the Missing Greenium" is, as Sherlock Holmes might have said, elementary. The dog isn't barking (i.e., the market isn't offering much of a greenium) because the beast is perfectly acquainted with the intruder (i.e., the market knows the green promises are for the most part illusory).[37]

Another way to characterise the low greenium equilibrium is to recall an old Soviet-era joke: "They pretend to pay us, we pretend to work".

As explained above, the multiple equilibrium story is not the only one that can explain why we see a greenium for some bonds but not others. But if it is true, it would suggest one way to get out of the bad equilibrium might be to introduce a few issues that make concrete and legally enforceable green promises – in other words, genuine green bonds (GGBs). If that happens, and there emerges a separation between those debtors who make illusory promises and those who make enforceable ones, investment firms – if they need to be able to report to their investors what type of green bonds they are investing in – will have to start distinguishing among green bonds.

37 This is not to say that green promises cannot be made credibly, with enforcement mechanisms built in. The recent Belize (2021) restructuring has credible promises and enforcement mechanisms built in to the transaction structure, perhaps because the primary driver of the restructuring – The Nature Conservancy – cares deeply about ensuring green outcomes (see Section 6).

Key elements of such an enforceable GGB would include the following:

1. a clear, specific and objectively verifiable use of proceeds clause obligating the sovereign issuer to deploy the borrowed funds for some environmentally friendly purpose;
2. a mechanism for independent monitoring of the issuer's compliance with the prescribed use of proceeds; and
3. some form of contractual sanction or penalty in the event that the issuer fails to do so.

Only a bond with these three characteristics would test the willingness of the investor community to sacrifice some income (in the form of what we have been calling a greenium) in return for an enforceable promise by the sovereign issuer to help save the planet.

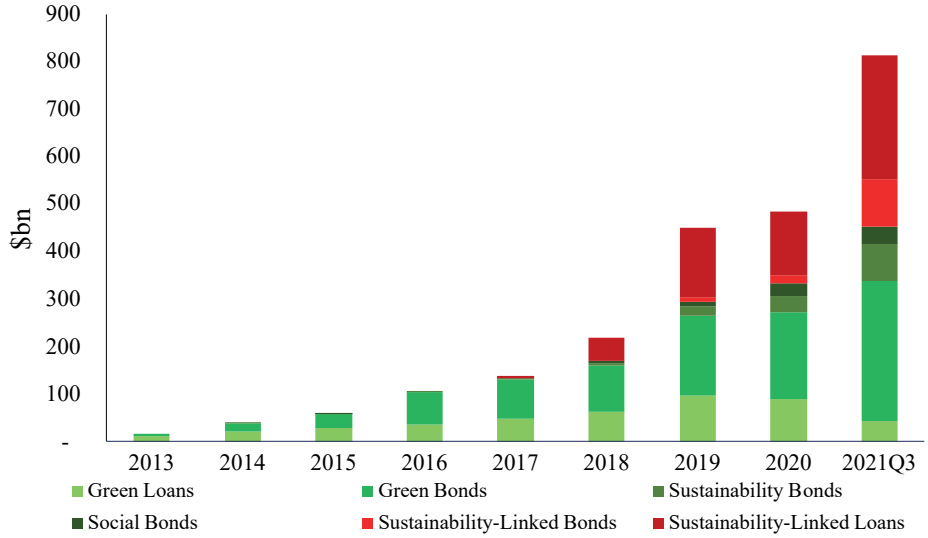
The majority of so-called 'green' sovereign bonds in the market today are deliberately opaque in how the borrowed money will be spent. In many cases, the sovereign does little more than recite its good intention to become carbon neutral by a comfortably distant date in the future or some similar aspiration. A GGB would require a use of proceeds commitment that more resembles the undertaking in a project finance transaction; that is, a promise to use the money for a specific project or to fund a targeted environmental programme. It would also specify that the green commitment is a matter which, like the debtor's payment obligations, cannot be modified without supermajority creditor approval and, if warranted, removal of the green label.

The appropriate contractual penalty for failing to comply with the green use of proceeds commitment may depend on how the investors view their participation in the overall transaction. Were the investors to take the position that they would not have lent money to the sovereign absent the green commitment, then it would be logical to treat a breach of that undertaking by the issuer as an event of default entitling the bondholders to accelerate the bond and demand immediate repayment. Alternatively, if investors would have lent the money even without a green commitment but would have insisted on a higher interest rate for a straight bond, then the logical penalty for the issuer falling off the green wagon would be to increase the interest rate on the bond to that higher rate — in effect, reinstating the greenium. The question of which of these options (or something else, like a step down in the interest rate if the issuer is performing well on its green promises) is best will depend on what investors are willing to pay for and what issuers are willing to do. Right now, we have nothing indicating credibility.

4.3 ARE SUSTAINABILITY-LINKED SOVEREIGN BONDS THE WAY FORWARD?

In recent years, corporate green bond issuance has been increasingly displaced by sustainability-linked bond issuance. Sustainability-linked bonds differ from green bonds in that the debt-servicing terms are contingent on attaining prespecified environmental impact targets. The International Capital Market Association (ICMA) defines a sustainability-linked bond as a bond that specifies impact performance targets, payment terms that are contingent on reaching these targets, and a reporting and verification mechanism for impact performance.[38] Unlike green bonds, sustainability-linked bonds do not necessarily tie the bond issue to a specific green investment project; rather, like an incentive contract, they tie payment terms to impact outcomes.

FIGURE 4.4 **THE CORPORATE SUSTAINABLE DEBT MARKET**



Source: Barbalau and Zeni (2021).

The issuance volume of corporate sustainability-linked bonds and loans has risen sharply in the last few years (Figure 4.4). While there is so far only one example of a pure sovereign sustainability-linked bond – a $2 billion bond linking the coupon to emissions and renewable energy targets issued by Chile in March 2022 – basic economic principles suggest that these could work for sovereigns under certain conditions.

As noted above, sovereign green bonds are not tied to specific investment projects and their proceeds are not separated in any way from the government budget. In this latter respect, sovereign green bonds are more like sustainability-linked bonds (which do not channel proceeds into a separate account). By specifying payment terms that are contingent on

38 See www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/sustainability-bond-guidelines-sbg/.

attaining certain climate or environmental goals, such bonds would be appropriate in any situation where a sovereign can intervene to meet a given environmental protection objective. Such bonds would be a way of providing financial incentives and rewards to sovereigns that act to protect the environment.

The fly in the buttermilk is designing a mechanism by which credible verification can occur in a manner that the sovereign cannot manipulate the numbers. So far, the mechanisms designed for the couple of sovereign sustainability bonds have not inspired confidence.[39] But with the right monitoring and verification mechanism, it may be possible for such bonds to actually help bring about climate action – namely, by helping sovereigns commit to do the right thing.

4.4 GREEN BONDS, CENTRAL BANKS AND FINANCIAL STABILITY

The popularity of green bonds has been such that one might wonder whether this could be the beginning of a green lending boom, potentially bringing about imbalances that could threaten financial stability. Even if some investor clienteles are willing to pay extra for a green label or project, we are still far from a green lending boom. According to a study by Spinaci (2022) for the European Parliament, the green bond market still only represents around 3–3.5% of total bond issuance. Moreover, there is no evidence so far of a greater rate of default for green bonds than for conventional bonds.

The relatively small size of the green bond market is also the main reason why debates over central bank bond purchases, whether there should be a tilt towards green bonds, remain somewhat academic. It has been shown that the bonds purchased by central banks, or that serve as collateral for central bank lending, tend to be from brown issuers (Papoutsi et al., 2022). Therefore, to maintain a neutral environmental impact stance, central banks need to shift the composition of their balance sheets more towards green bonds. On the con side, the argument against purchasing green bonds has been that central banks should not interfere in the capital allocation process. On the pro side, however, if central banks do not align their asset holdings with net zero targets, they would in effect introduce a bias in the capital allocation process by default. We therefore argue that removing this bias, far from interfering in the capital allocation process, would be a way of re-establishing a neutral stance for a sustainable economy that is no longer dependent on fossil fuels. That said, even if central banks decided to correct an unintended bias towards brown issuers, they are likely to be constrained in the short run by the lack of availability of green bonds.

39 Nor has the experience with Argentina's GDP warrants (listen to the podcast "Argentina's Never-Ending GDP Warrant Saga, Clauses and Controversies" with Mitu Gulati and Mark Weidemaier at https://podcasts.apple.com/us/podcast/ep-76-ft-vladimir-werning/id1528208049?i=1000566283693).

Appendix

TABLE A1 **SOVEREIGN AND SOVEREIGN-GUARANTEED GREEN BONDS**

Country	Issuer	YTM	Issued	Maturity	Curr.	Greenium	Rating
AUS	BNG	2.98	23-Jan-19	31-Jul-29	AUD	-4.70	AAA
BEL	Government	1.29	26-Feb-18	22-Apr-33	Euro	-4.00	AA
CAN	Exp. Dev. Canada-EDC	0.88	23-Jan-14	30-Jan-17	USD	-9.40	AAA
CAN	Exp. Dev. Canada-EDC	1.34	1-Dec-15	10-Dec-18	USD	-2.36	AAA
CAN	Exp. Dev. Canada-EDC	1.67	24-May-17	1-Jun-20	USD	-9.23	AAA
CHL	Government	3.53	17-Jun-19	25-Jan-50	USD	-9.70	A+
CHL	Government	3.53	17-Jun-19	25-Jan-50	USD	-9.70	A+
CHL	Government	0.83	25-Jun-19	2-Jul-31	Euro	-26.00	A+
CHN	China Dev. Bank (HK)	0.64	2-Sep-21	9-Sep-24	USD	-18.20	AA-
EGY	Government	5.32	29-Sep-20	6-Oct-25	USD	13.00	B
FIN	Municipality Finance	0.78	26-Sep-17	7-Sep-27	Euro	-7.50	AA+
FIN	Municipality Finance	0.05	5-Jul-19	6-Sep-29	Euro	-0.50	AA+
FIN	Municipality Finance	-0.20	6-Oct-20	14-Oct-30	Euro	-4.70	AA+
FRA	Ag. Franc.de Dev. - AFD	1.49	10-Sep-14	17-Sep-24	Euro	6.56	AA
FRA	Ag. Franc.de Dev. - AFD	0.54	10-Sep-18	31-Oct-25	Euro	-23.70	AA
FRA	Ag. Franc.de Dev. - AFD	-0.25	10-Feb-20	25-Mar-25	Euro	-3.80	AA
FRA	Bpifrance Fin. SA	-0.01	29-Apr-21	25-May-28	Euro	-18.80	AA
FRA	La Poste SA	1.47	23-Nov-18	30-Nov-30	Euro	-67.60	A
FRA	Government	1.74	24-Jan-17	25-Jun-39	Euro	12.60	AA
FRA	Government	0.53	16-Mar-21	25-Jun-44	Euro	24.70	AA
FRA	SNCF	0.71	7-Apr-20	17-Apr-30	Euro	-15.20	AA-
FRA	SNCF Reseau	2.30	20-Jul-17	20-Dec-47	Euro	1.50	AA
FRA	SNCF Reseau	0.99	14-Jan-19	22-Jan-29	Euro	6.90	AA
FRA	SNCF Reseau	0.86	27-Jun-19	25-May-36	Euro	-31.90	AA
FRA	SNCF Reseau	0.76	25-Sep-19	20-Dec-47	Euro	11.00	AA
FRA	Soc. de Fina. Local-SFIL	-0.24	13-Nov-20	23-Nov-28	Euro	-10.90	AA-
GER	Government	-0.46	2-Sep-20	15-Aug-30	Euro	-0.20	AAA
GER	Government	0.39	11-May-21	15-Aug-50	Euro	6.80	AAA
HUN	Hungary	1.96	2-Jun-20	5-Jun-35	Euro	4.00	BBB
IDN	Perusahaan Penerbit SBSN	3.75	22-Feb-18	1-Mar-23	USD	-7.20	BBB
IDN	Perusahaan Penerbit SBSN	3.90	12-Feb-19	20-Aug-24	USD	9.50	BBB+
IRL	Government	1.40	10-Oct-18	18-Mar-31	Euro	8.70	BBB+
ITA	Government	1.55	3-Mar-21	30-Apr-45	Euro	-0.80	BBB
JPN	Japan Housing Fin. Ag.	0.55	11-Jan-19	20-Jan-39	JPY	1.70	A+
JPN	Japan Housing Fin. Ag.	0.06	10-Sep-19	20-Sep-29	JPY	-2.80	A+

Country	Issuer	YTM	Issued	Maturity	Curr.	Greenium	Rating
JPN	Japan Housing Fin. Ag.	0.33	13-Nov-20	20-Nov-35	JPY	1.10	A+
JPN	Japan Housing Fin. Ag.	0.31	4-Dec-20	20-Dec-35	JPY	3.00	A+
JPN	Japan Housing Fin. Ag.	0.34	14-May-21	20-May-36	JPY	1.20	A+
JPN	Japan Housing Fin. Ag.	0.00	3-Dec-21	16-Dec-26	JPY	2.00	A+
JPN	Japan Rail. - JRTT	0.23	17-Nov-17	26-Nov-27	JPY	-1.50	
KOR	Korea Dev. Bank - KDB	0.02	2-Jul-19	10-Jul-24	Euro	-3.40	AA
KOR	Korea Dev. Bank - KDB	0.89	18-Oct-21	25-Jan-25	USD	36.10	AA
KOR	Korea Water Res. Corp	3.89	8-May-18	15-May-23	USD	-1.70	AA
NLD	Nederlandse Waterschapsbank	0.74	26-Jun-14	3-Jul-19	Euro	-39.97	AA+
NLD	Nederlandse Waterschapsbank	1.06	26-Aug-15	3-Sep-25	Euro	-4.90	AA+
NLD	Nederlandse Waterschapsbank	2.41	18-Mar-16	24-Mar-26	USD	-1.90	AAA
NLD	Nederlandse Waterschapsbank	2.19	7-Nov-17	15-Nov-21	USD	-1.66	AAA
NLD	Nederlandse Waterschapsbank	1.51	17-Jan-18	24-Jan-28	SKR	-16.00	AAA
NLD	Nederlandse Waterschapsbank	3.15	27-Nov-18	5-Dec-22	USD	-8.91	AAA
NLD	Nederlandse Waterschapsbank	0.22	5-Jul-19	9-Jul-25	SKR	-0.10	AAA
NLD	Nederlandse Waterschapsbank	0.11	23-Sep-19	2-Oct-34	Euro	4.30	AAA
NLD	Nederlandse Waterschapsbank	0.58	19-Apr-21	26-Apr-51	Euro	7.30	AAA
POL	Government	0.63	13-Dec-16	20-Dec-21	Euro	-17.73	BBB+
POL	Government	1.15	31-Jan-18	7-Aug-26	Euro	13.00	BBB+
POL	Government	1.06	28-Feb-19	7-Mar-29	Euro	-13.60	A-
POL	Government	2.07	28-Feb-19	8-Mar-49	Euro	-11.60	A-
SRB	Government	1.26	16-Sep-21	23-Sep-28	Euro	0.00	BB+
ESP	Government	0.97	7-Sep-21	30-Jul-42	Euro	19.60	A
SWE	SEK	0.21	10-Sep-20	15-Sep-25	SKR	-1.50	AA+
SWE	SEK	0.62	23-Feb-21	14-Apr-25	SKR	-45.60	AA+
SWE	Government	0.09	1-Sep-20	9-Sep-30	SKR	-16.40	AAA
UK	Government	0.87	21-Sep-21	31-Jul-33	GBP	-14.20	AA
UK	Government	1.42	21-Oct-21	31-Jul-53	GBP	-5.80	AA

CHAPTER 5

Credit for climate: The promise of carbon offsets

National debt sustainability constraints limit the capacity of countries to finance climate change mitigation and adaptation. These constraints can be relaxed either by cutting existing debt obligations or by expanding (indebted) countries' revenues. One promising source of revenue for many poor countries is carbon offsets (also referred to as carbon credits). Many poor and middle-income countries have large nature-based carbon sinks, which they have so far been urged to preserve essentially without compensation. They also have capacity for reforestation and expansion of other nature-based carbon sinks.

As Figure 2.4 on biodiversity hotspots highlights, the largest forests and other nature-based carbon sinks to be preserved are in sub-Saharan Africa, South America, and Central and Southeast Asia. Multiple countries in these regions are already highly indebted or are currently going through debt crises. If these countries were able to monetise their nature-based carbon sinks, they might be able to not only service their debt obligations but also undertake crucial mitigation and adaptation investments.

To get a sense of the financial potential of carbon offset markets, and some orders of magnitude, consider the revenues raised by the European Union from auctioning carbon emission allowances through the EU Emissions Trading System (EU ETS). The estimated total revenue between 2012 and June 2020 from these auctions exceeded €57 billion.[40] But in the last two years, revenues are likely to have exceeded €15 billion per year, as the EU Allowance (EUA) price has risen substantially (the EUA futures price breached the €30 per tonne of CO_2 level in 2020 and briefly rose to above €90 per tonne in the spring of 2022) and a greater fraction of emission allowances have been auctioned rather than granted directly to the companies under the EU ETS.[41] These revenues are used by member states mostly to fund the energy transition.

The EU ETS works by restricting how much companies are allowed to emit and by requiring them to purchase additional allowances when their emissions exceed their quota. The supply of allowances comes from two sources: unused allowances from companies that are emitting below quota, and allowances auctioned off by the EU ETS.

40 https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/auctioning_en
41 https://carboncredits.com/carbon-prices-today

There is no reason a priori to restrict the supply of allowances to these two sources. In principle, allowances could be supplied by anyone. Any carbon emission reduction anywhere in the world could be used to offset emissions that exceed a given quota. The overall effect on global emissions would be the same.

To be sure, the EU ETS allows companies subject to emissions limits to offset emissions in excess of quotas with carbon credits (Certified Emission Reductions, or CERs) under the Clean Development Mechanism in addition to ETS allowances (Ellerman et al., 2016).[42] The Clean Development Mechanism was established under the Kyoto Protocol to set up a carbon credit system registering emission-reduction projects in developing countries so that they could be sold as offsets to developed countries.[43] From inception in 2001 until 2018, the Clean Development Mechanism certified over 8,000 projects in 111 countries, which have resulted in 2 billion tonnes of CO_2e in avoided emissions and generated $304 billion in sustainable development projects (United Nations, 2018).

Similarly, there is no reason a priori to restrict who can buy EU ETS allowances. In principle, these allowances could also be used as voluntary offsets for emissions outside the EU ETS.[44] Any buyers outside the EU ETS would drive up the price of allowances, presumably bringing the EUA price closer to the social cost of carbon.[45] One potential concern with EUA purchases by buyers other than compliance buyers could be that this could distort competition. But ETS market rules could be adapted to address this risk if it materialises.

The broader point of these observations is that, in principle, ETS markets could be integrated with (voluntary) carbon credit markets to form a well-functioning and scalable global carbon offset market. Economists have long argued that an efficient carbon tax should be global because carbon emissions are a global externality. An integrated global carbon offset market would bring the world economy one step closer to this ideal. It would also institutionalise permanent large financial flows from rich countries (that need to bring down their emissions and fulfil their net zero commitments) to poor countries that reward the preservation of nature-based carbon sinks and the supply of emission-reduction projects (and also help finance sustainable development).

There is much controversy around voluntary carbon credits. Climate activists have argued that they offer an easy way out for corporations unwilling to reduce their emissions. Other commentators have implied that without adequate verification and monitoring, carbon offsets are just another form of 'greenwashing' (this is especially true for 'avoidance offsets', discussed below). Yet, the pathway to net zero will necessarily involve carbon credits

42 https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/use-international-credits_en
43 https://unfccc.int/process-and-meetings/the-kyoto-protocol/mechanisms-under-the-kyoto-protocol/the-clean-development-mechanism
44 Currently, eligible bidders are either so-called 'compliance buyers' or financial intermediaries bidding on own account or on behalf of clients (www.eex.com/fileadmin/EEX/Downloads/Products/Emissions_Primary_Auctions_-_Archive/Guidance_for_Bidders/eex-piiiauctions-guidance-pdf-data.pdf).
45 Interestingly, at least one non-profit initiative has been set up to purchase ETS allowances as carbon offsets. Climate Vault offers essentially to anyone to buy ETS allowances for them (see https://climatevault.org/climate-vault-approach/).

because some essential economic activities will continue to cause carbon emissions. Some sectors will be able to decarbonise much faster than others, so that it makes sense to encourage those sectors that can decarbonise at a faster rate to do so by allowing them to sell carbon credits. Even if the global economy can completely wean itself off carbon emissions, so much carbon dioxide is already in the atmosphere that carbon capture and sequestration on a large scale will continue to generate huge mitigation benefits.

But this promise of a global carbon offset market is predicated on two fundamental conditions. First, carbon offsets must be fully credible and trustworthy. This requires a whole market infrastructure to verify, register, monitor, audit (to avoid double-counting), aggregate and standardise carbon credits. Second, comprehensive mandatory decarbonisation must be accelerated and properly enforced. This will have the effect of increasing the demand for offsets, raising their price, and thereby creating its own supply. Once a deep global market for offsets exists, a major obstacle to decarbonisation is removed: given the choice to decarbonise either directly or through the purchase of offsets, every company in every sector and every activity will be in the same position of being able to fulfil its net decarbonisation obligations. If the cost of direct carbon reductions is too high, it can purchase offsets. If it is lower, it can not only reduce emissions directly, but also exceed its net carbon reduction obligations and sell the excess as a carbon credit.

The world has reduced its dependence on fossil fuels too late and started to decarbonise too slowly. One reason is that too many companies have responded by saying that it is either impossible to reduce emissions directly in the short run or it is too costly. Faced with this pushback, regulators have often delayed tighter carbon emission regulations, or simply relented. This has both emboldened business lobbies and destroyed the credibility of decarbonisation policy initiatives. In the presence of a deep carbon offset market, one might hope that companies would no longer be let off the hook so lightly. If they were to choose not to reduce their emissions directly, they could always do so indirectly by purchasing carbon offsets. Of course, for this approach to be fully effective all economic activities that generate carbon emissions should be required to decarbonise (on a net basis!). All companies operating in the same sector should face the same net decarbonisation requirement to maintain a competitive level playing field.

As we discuss below, there are currently several private sector carbon offset market initiatives besides the UN-led Clean Development Mechanism. These markets are highly fragmented, lack credibility, and remain largely embryonic. Another important limitation of these markets is that participation is voluntary. Unless decarbonisation (on a net basis) is mandated, offset markets cannot reach full scale, and offset prices cannot rise to a sufficient level to provide adequate financial incentives to developing countries to preserve and grow their nature-based carbon sinks.

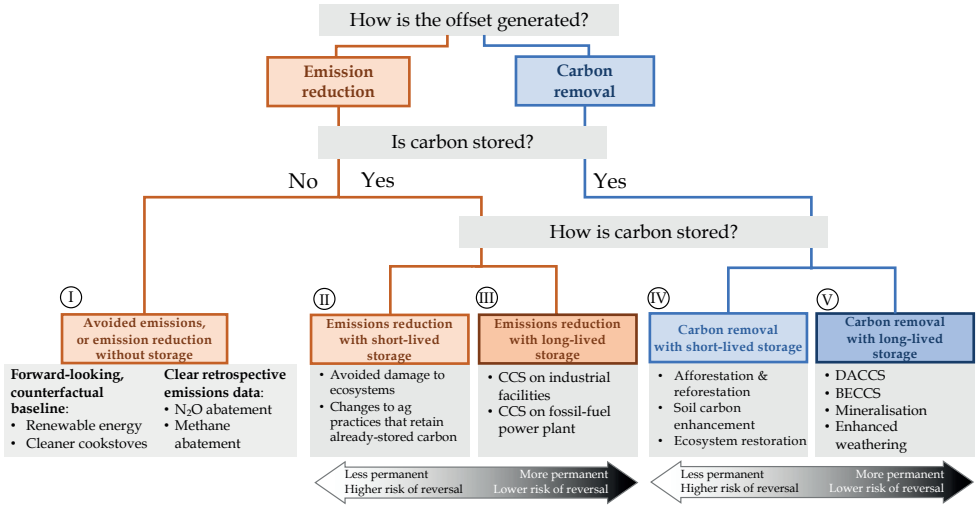
5.1 CARBON CREDITS AND NATURE-BASED CARBON SINKS

Carbon offsets come in many forms of varying quality (Figure 5.1). A common distinction is between avoidance and removal offsets.

Avoidance offsets are credits for emission reductions. For reasons explained by Comello et al. (2022), they are controversial: "avoidance offsets are based on a counterfactual claim, thereby leaving unresolved the question of 'additionality' of the mitigating action". Thus, avoidance offsets may not necessarily reduce the flow of CO_2 emissions from existing sources. Even if they don't, however, they could still contribute to financing green investment in poor countries, enabling them to leap directly to clean energy and thus bypass a future based on fossil fuels with higher emissions as their economy grows.

At the other end of the spectrum, **offsets for carbon removal with long-lived storage** are considered to be the gold standard because this directly removes carbon dioxide from the atmosphere which can then be sequestered permanently. Next in quality to these removal offsets are nature-based carbon sinks (afforestation, reforestation, soil carbon enhancement, oceans, and ecosystem restoration). These offsets cannot be assumed to sequester carbon forever; the carbon capture may be reversed. This is why they are referred to as **carbon removal with short-lived storage offsets**.

FIGURE 5.1 **TAXONOMY OF CARBON OFFSETS**



Source: *Oxford Principles for Net Zero Aligned Carbon Offsetting* (Allen et al., 2020)

These offsets cover the same category of natural assets as those that have been included in debt-for-nature swaps. They are highly relevant for a small group of countries, including the so-called high-forest/low-deforestation (HFLD) countries such as Gabon, Republic of the Congo and Guyana, and countries with other potential nature-based carbon sinks. To be clear, nature-based carbon sinks are not the be all and end all of climate change mitigation, but as Matthews et al. (2022) have shown, they are an important complement to global decarbonisation efforts.

Yet, the countries with the largest carbon sinks are currently not adequately compensated for the public good they provide to the world in maintaining or building these natural resources. There have been many efforts to build mechanisms to compensate these countries for maintaining or expanding their carbon sinks, including the UN REDD+ initiative.[46] Yet, the financial compensation countries have received through these programmes remains small. As Lee and Pistorius (2015) have shown, REDD+ has amounted to relatively small funding for many countries involved in the programme. Importantly, as Norman and Nakhooda (2015) argue, funding has been limited because most of it (90%) is public sector funding from a few rich countries.

Incentives are so perverse that it may be advantageous to burn down a forest in order to then replant it and receive financial compensation in the form of carbon credits for planting trees. Additionality is a notoriously difficult issue with the monetisation of the protection of nature-based carbon sinks. Should countries receive financial compensation from the sale of carbon offsets tied to their forests' natural carbon sinks if they have no intention of deforesting in the first place? To the extent that no additional carbon emissions have been absorbed, it would seem that no carbon offsets have been generated. Still, it would be even more perverse to induce deforestation to claim carbon offsets from reforestation.

As Hank Paulson has recently pointed out, "[t]oo often [reforestation] programmes are used by governments looking for carbon offsets when they are unwilling to take more difficult steps to protect existing ecosystems or to provide the necessary financial incentives or regulatory framework. As a result, the hoped-for benefits may prove to be illusory."[47] Moreover, many reforestation programmes do not deliver the promised carbon capture. As Paulson further describes: "[in] China's attempt at seeding a 'Great Green Wall' to mitigate against the erosion of the Gobi Desert, up to 85 per cent of the new trees died because they were not native to the region".

Another concern with reforestation, or forest preservation, is that the carbon capture is not permanent; it can be reversed deliberately or by accident. If carbon offsets are based on the preservation of a nature-based carbon sink, but that carbon sink no longer exists (say, because of a wildfire), what would be the worth of the carbon credit? As Aldy and Halem (2022) argue, the non-permanence of carbon sinks raises the question of the

46 See https://redd.unfccc.int/.
47 "Planting trees is not a panacea—we need to save existing forests", *Financial Times*, 7 July 2022.

nature of carbon credits that are backed by them. Are they like a *commodity* or like a *debt* claim? "Is an emission offset similar to a commodity, like emission allowances under cap-and-trade programs, or more like a bond? In effect, does the buyer bear any liability for the environmental integrity of the offset project?" (Aldy and Halem, 2022, p. 18).

What is at stake here is the question of who bears the liability for the evaporation of the carbon that was stored in the carbon sink. More generally, an important aspect of carbon credits is their underlying quality and the measurement of that quality. As with corporate bonds, what is needed is a rating scheme for carbon offsets, with ETS allowances or offsets equivalent to *carbon removal with long-lived storage offsets* receiving an A rating and *carbon removal with short-lived storage offsets* only receiving a B rating, with downgrades when an offset is impaired.

For now, a deep global carbon credit market is largely a promise. The ecosystem of carbon credits is highly fragmented. Besides the UN's Clean Development Mechanism, there are a few other registries that certify carbon credits such as Gold Standard, Verified Carbon Standard, American Carbon Registry or Climate Action Reserve. There are also online exchanges for carbon credits such as Xpansiv-CBL and AirCarbon Exchange (ACX). The Taskforce on Scaling Voluntary Carbon Markets (TSVCM) is a standard-setting initiative including over 250 member institutions which seeks to further combine and standardise these different registries and exchanges.[48] Despite the efforts of the TSVCM, however, different certification and verification mechanisms are still being used. There is as yet no integrated exchange for carbon credits. Also, carbon offsets are often traded in over-the-counter markets with very little liquidity, and prices for similar offsets can vary considerably.

As Comello et al. (2022) explain, "[i]n 2021, the transaction prices for carbon offsets in the voluntary carbon markets varied anywhere from $2 to $800 per tonne of CO_2, with the median price near $5 per tonne". There is also considerable geographic dispersion in carbon credit prices. Aldy and Halem (2022) report that in 2020 the average offset price was around $4 per tonne of CO_2e in Africa and Latin America, $2 in Asia, $9.5 in Europe, $7 in North America, and over $20 in Oceania. First of all, these prices are far lower than EUA prices; second, they provide a clear indication of the lack of integration in offset markets, which currently do not effectively serve the role of facilitating sustainable finance flows from rich to poor countries.

According to a 2021 McKinsey report, global demand for voluntary carbon credits reached 100 billion tonnes of CO_2 in 2020 and is likely to grow to 1.5–2 gigatonnes of CO_2 by 2030, and to 7–13 gigatonnes of CO_2 by 2050 (a 100-fold increase from 2020) if the world can stay on the NGFS 1.50 pathway. To get there, fundamental institutional transformations will of course be required. Most importantly, a deep global carbon offset market can only be built

48 See https://www.iif.com/tsvcm.

on the introduction of comprehensive mandatory carbon emission reduction policies for all large emitters. Carbon emission reduction regulations will assure decarbonisation in the aggregate and sustain a predictable aggregate demand for offsets from those emitters that are not immediately able to directly reduce their emissions as required.

Under such comprehensive regulations, the global demand for offsets will be much larger than predicted in the McKinsey (2021) report and will generate a huge source of income for the HFLD and other nations that have large nature-based carbon sinks, provided of course that this natural capital can be monetised through the sale of carbon credits. To be sure, under existing carbon capture and sequestration technologies, most of the carbon capture credits will continue to be nature-based credits. The rising demand for carbon offsets from the private sector will thus represent a massive source of funding for developing countries that have carbon sinks (McKinsey's high-end 2021 estimate is $50 billion by 2030, which dwarfs the $10 billion of public funding for REDD+ between 2006 and 2014 calculated by Norman and Nakhooda, 2015). These countries would be able to service their debt, develop, and raise their living standards by preserving nature rather than by cutting down trees.

5.2 CARBON CREDIT MARKET FOUNDATIONS

The EU ETS, which, after several major adjustments, has now matured into an efficient carbon emissions allowance market, provides an institutional template for a global carbon offset market. The EU ETS is now built on solid institutional foundations guaranteeing the integrity of the carbon emissions allowance market, with a single registry (the Union Registry managed by the European Commission) that verifies and tracks the ownership of allowances. Ideally, to buttress a global carbon credit market, a single global registry and supervisory agency would be created – let's call it the International Carbon Agency (ICA) – to certify, verify, and audit carbon credits as well as the reporting of net carbon emissions by the buyers of carbon credits participating in this market. This agency could also be charged with reporting the state of global carbon emissions (publishing a *World Carbon Outlook*) and with supervising compliance with NDCs and net zero commitments.

Failing that, the current disparate ecosystem of ETS and carbon credit registries could be further integrated and expanded to allow a global carbon offset market to reach scale. For example, the EU ETS could build on the precedent of including CER credits among carbon emission allowances to expand both the set of carbon credits and the companies and activities that it supervises. Of course, it is crucial that demand for carbon credits expand at a higher rate than the supply of credits such as CER, to ensure that the price of carbon offsets is in line with the EUA price and continues to rise. Otherwise, the risk for the EU ETS of expanding the set of carbon offsets is to undermine the integrity of the EU ETS market.

Another important issue is how to structure carbon credits around existing nature-based carbon sinks. Harris et al. (2021) estimate that over the period 2001 to 2019, global forests absorbed on net 7.6 gigatonnes of CO_2e. In principle, all these reductions in carbon emissions could be monetised through the sale of carbon credits. To repeat, this of course only makes sense if globally targets for net carbon reductions are several multiples larger than this amount. Otherwise, allowing companies to purchase these credits without requiring any direct carbon reductions would just be a way of letting them off the hook, and would bring about a collapse in carbon credit prices. But assuming that there will be a large global demand for such offsets, how should they be structured and accounted for? As Harris et al. (2021) and others have shown, it is possible to measure net carbon absorption in nature-based carbon sinks through geospatial supervision. In principle, one could therefore assess the flow of CO_2 reduction in the atmosphere over a given period in a given area and sell this as a flow carbon credit. This would be tantamount to rental income on natural capital.

An even bolder step (but conceptually equivalent to granting carbon credits for CO_2 reductions through absorption) would be to count as carbon credits emission reductions that are larger than those required by net zero regulations. These would be carbon credits based on avoided emissions relative to a net zero pathway. Such carbon credits are similar to carbon emission allowances traded on ETS. They would provide an incentive to those emitters that can do so to reduce their emissions at a faster rate than the net zero pathway of their country, or industry. Allowing such credits would also create space for even more ambitious decarbonisation pathways, as companies that cannot decarbonise quickly can fulfil their net zero obligations by purchasing offsets. Moreover, the sellers of these offsets can then accelerate their energy transition by partly financing the costs of switching to renewable energy with the sale of carbon credits. There are potentially massive economic gains from allowing such trades. For example, Adrian et al. (2022) estimate that when avoided emissions are priced at the social cost of carbon, the present value of the net global benefits from phasing out coal (along the NGFS decarbonisation pathway compatible with a 1.5oC temperature rise objective) and replacing it with renewable energy is around $77.89 trillion.

CHAPTER 6

Debt relief for climate? Fiscal support and climate-friendly debt restructuring

Suppose that the instruments described in the previous two chapters – sustainable finance and carbon credits – are insufficient to generate the fiscal space that emerging and developing economies need to undertake efficient mitigation and adaptation in investments. This leaves two other channels of fiscal support: grants and debt relief.

This chapter focuses on two questions. First, what is the best way of delivering fiscal support to developing countries in support of specific public spending – grants or debt relief (and if debt relief, of what sort)? Second, to the extent that debt relief is used, how should this be designed for maximum impact (where 'impact' could refer to climate objectives, but also to debtor welfare more generally)?

Grants typically come from official (bilateral or multilateral) sources, although they have also been supplied by NGOs. The volume of climate-linked grants is an order of magnitude smaller than that of the loans or bonds linked to climate objectives discussed in Chapter 4, but it is not negligible. According to the OECD (2021), official climate-related grants in 2019 amounted to $16.7 billion.

As to debt relief, it is useful to distinguish between two forms in which such relief has typically been delivered in the past.

The first class is debt restructurings in response to debt distress. These may have the effect of increasing fiscal space for public investment but have typically not been conditional on specific spending commitments by the debtor. Restructurings of this type are generally the result of a debtor–creditor negotiation aimed at restoring debt sustainability while inflicting minimal losses on creditors. According to Cruces and Trebesch (2013), there were 187 restructurings of this type between 1970 and 2013, with a total restructured volume of almost $1.1 trillion in face value of sovereign debt.[49] The average 'haircut' (i.e., investor loss) was about 40% (or somewhat lower if based on the present value rather than

49 Detailed and updated data are available at https://docs.google.com/spreadsheets/d/1yUUMPAEF9uKbYV6bG3dLZ6dzDQnkJqcS/export?format=xlsx

face value of the outstanding debt).[50] Since 2014, there have been about a dozen additional debt restructurings (IMF, 2020), including large operations involving Argentina, Ecuador and Ukraine. Several emerging market countries are currently in default (Lebanon, Sri Lanka, Suriname, Venezuela), and several low-income countries have applied for debt relief under the G20 Common Framework (see Chapter 3).

The second class of operations is transactions known as 'debt-for-something' swaps (or debt swaps for short) in which a creditor or class of creditors (e.g., bondholders) agree to give up or reduce a debt claim in exchange for a spending and/or policy commitment on the side of the debtor (for example, with the aim of nature conservation). Debt swaps may or may not occur in distressed debt settings. Unlike the previously discussed debt restructurings, many debt swaps have been voluntary in the sense that the alternative to agreeing to the swap may have been repayment in full. In the simplest type of operation, an official bilateral creditor (for example, the Agence Française de Développement, or AFD) forgives outstanding debt on the condition that part of the original debt service is redirected to an agreed conservation or sustainable development purpose.[51]

Another type of operation, referred to as a 'trilateral debt swap', involves the repurchase or renegotiation of commercial debt. An NGO raises cash, uses this cash to purchase commercial debt at a discount, and 'swaps' (returns or cancels) the repurchased debt for a commitment to fund conservation projects (typically of a lesser nominal value than the original debt service commitment). According to Sheikh (2018), there have been about 90 bilateral and at least 50 trilateral debt-for-nature swaps (debt swaps for conservation purposes) since the first trilateral debt swap, involving Conservation International and Bolivia, in 1987. However, the average size of these transactions, and hence the total volume of debt swapped, has been small – $2.6 billion in total, according to UNDP (2017), funding about $1.2 billion in nature- or development-related spending.[52] Adding the most recent debt–nature swaps would raise the total volume to perhaps $3.5 billion.

50 There are two main conventions for measuring investor losses. The academic literature tends to follow an approach originally proposed by Sturzenegger and Zettelmeyer (2005, 2007), which is based on the comparison of the "market value of the new instruments, plus any cash payment received, to the net present value (NPV) of the remaining contractual payments on the old instruments (inclusive of any principal or interest arrears), discounted using the yield of the new instruments (r_{new}) immediately after the results of the exchange became public information" (Sturzenegger and Zettelmeyer, 2005, p.5):

$$H_{SZ} = 1 - \frac{NPV(new, r_{new})}{NPV(old, r_{new})}$$

The alternative approach, used by market practitioners, uses the same formula except that $PV(old, r_{new})$ is replace by the face value of the existing debt. This tends to be higher than the net present value, and as such generally leads to higher haircuts. For results based on these concepts and additional discussion, see Asonuma and Trebesch (2016), Cruces and Trebesch (2013), Meyer et al (2022), Mitchener and Trebesch (2022), Gelpern and Panizza (2022) and Panizza et al. (2009).

51 For details, see https://www.afd.fr/en/c2d-mechanism-relieve-indebted-countries

52 See also Reilly (2006) for a discussion. This estimate does not reflect some recent operations such as the 2021 Belize debt exchange, which retired a bond of face value $553 million (see last chapter for details), and a bilateral debt swap between the AFD and the Democratic Republic of Congo.

Over the same period, according to Cruces and Trebesch (2013) and IMF (2020), standard distressed debt restructurings 'treated' about $700 billion. Hence, with respect to their volume and impact on the debt burden of developing countries, debt swaps have been insignificant in comparison.

Recently, an influential set of papers published by NGOs, academics and multilateral institutions (ESCWA, 2022; Picolotti et al., 2020; Steele and Patel, 2020; Volz et al., 2021; Chamon et al., 2022) have argued for debt–climate swaps, that is, a variant of debt–nature swaps focused on climate change adaptation or mitigation. Most of these authors lament the small scale of debt swap operations in the past and propose ways to increase their scale.

6.1 HOW TO DELIVER FISCAL SUPPORT

As discussed above, fiscal transfers to developing countries have traditionally been delivered in three ways: as conditional grants (broadly defined to include grant/loan combinations or concessional lending), debt restructuring or debt swaps. The latter two differ in two ways. First, unlike most debt restructurings, debt relief associated with debt swaps is largely 'earmarked' to benefit specific spending categories (though it can, and has generally has, exceeded new spending commitments). Second, the debt restructuring perimeter (the types of debt and hence share of debt restructured) has been much broader in standard debt restructurings than in debt swaps. This is because the former have almost always occurred in distressed debt situations. When debt restructurings are expected to inflict major losses on creditors, creditors will typically not agree to the operation unless there is wide participation – so that the burden is shared, resulting in lower losses per creditor.[53]

Based on this distinction, it is possible to imagine a fourth category of fiscal support which sits between debt swaps and traditional comprehensive debt restructurings: comprehensive restructurings that are conditional on the same type of policy actions and spending commitments (e.g., on climate adaptation) that might be envisaged by debt–climate swaps. This category does not exist yet, but as we will argue, this should change – and is likely to change.

53 The fact that the creditor burden is collectively minimised when all creditors participate but individually minimised when an individual creditor does not participate gives rise to a classic free-rider problem. Buchheit et al. (2019) describe the processes, institutions and legal devices that have been used to solve this problem in practice.

Following Chamon et al. (2022), we answer the question of which form of fiscal support is best through a set of pairwise comparisons: between conditional grants and debt swaps, between comprehensive debt restructurings with and without climate conditionality, and between debt swaps and comprehensive debt restructurings (with or without climate conditionality). The answer that emerges from these comparisons is that the best form of fiscal support depends on the underlying problem that is to be solved – that is, on the objectives of the operation.

To start, suppose that the sole objective is to create fiscal space for climate investment – not to reduce debt levels or debt risks. In this setting, the instrument of choice is generally climate-conditional grants. The reason is that these can be designed to ensure that grant support work serves only its intended purpose – to pay for a particular investment – and is not diverted for debt service. In contrast, debt–climate swaps provide fiscal support by lowering debt. This frees local resources for climate investment. But as long as debt remains risky, the climate expenditure commitment generally will also remain risky. If there are sufficient resources to both repay the remaining debt and honour the expenditure commitment, all is well. But if this is not the case, scarce resources will need to be shared between debt service and the climate expenditure. The only exception is a setting in which the debt–climate swap is structured in a way that makes the climate commitment de facto senior. While not impossible – the recent (2021) Belize debt–nature swap has features that go in this direction (see below) – this is much harder to do than through a conditional grant, in which disbursements happen only if and as the investment is executed.

What if there are two objectives: to make climate investment happen and to lower debt – as might be the case if there is a debt sustainability problem on top of the climate problem? This would seem to give the edge to debt–climate swaps. While climate-conditional grants are typically set to cover *at most* the cost of the investment, debt–climate swaps typically offer debt relief beyond the additional expenditure commitments, lowering debt risks. However, the *combination* of traditional debt restructuring and a separate climate-conditional grant would still be generally superior to debt-climate swaps. The grant component makes the climate commitment senior to debt service, while the restructuring components can result in as much debt relief as may be needed to restore debt sustainability. So, even if one introduces debt reduction as an extra objective, debt–climate swaps may not be the best instrument.

This leads to two questions:

1. Is there ever a case for climate-conditional debt restructuring – whether of the debt swap kind (the third category in the four categories of fiscal support outlined at the beginning of this section) or the comprehensive kind (the fourth category)?

2. If so, is there ever an argument for delivering climate-conditional debt relief in the form of debt swaps (covering only a part of the debt stock) rather than comprehensive climate-conditional debt restructuring, covering as wide a debt perimeter as possible?

The answers are 'yes' and 'yes' – under specific conditions.

Climate-conditional debt relief might be a good idea for two reasons.

First, it might be the only feasible way to provide climate-friendly fiscal support. The theoretically superior alternative of climate-conditional grants plus general debt relief might not be available – or at least not in sufficient amounts. The pool of climate-conditional grants is limited, and standard debt relief is hard to obtain unless the debtor obviously lacks the ability to pay (and sometimes even when the debtor lacks that ability). In such a situation, conditional debt relief could offer a way to expand fiscal support for climate investments. For example, some creditors may be prepared to offer more debt relief to a distressed debtor if this comes with a climate investment commitment than if it does not. The prima facie case for doing so is that such commitments involve good externalities for the rest of the world (Box 6.1). And even if commercial creditors are not amenable to opening their purses a little further if a distressed debtor commits to climate action, the official sector (multilateral development banks and/or bilateral development finance corporations) may be amenable to partial guarantees or insurance commitments that lower the credit risk of instruments issued in the course of climate-conditional debt relief. The 2021 Belize debt–nature swap is a case in point.

The second argument is based on economic considerations. When the debtor's climate actions have an appreciable impact on its creditworthiness, these is an efficiency argument for linking climate action and debt relief. The most plausible setting is a situation where climate adaptation investments reduce the risk of future debt crises in climate-vulnerable countries (for example, by shielding the economy from natural catastrophes, such a hurricanes or wildfires, or from sea level rise). It is then in the interests of all creditors to require climate adaptation as a condition for debt restructuring.

Table 6.1 offers some supportive evidence for the link between climate and debt risks, complementing the evidence presented in Chapter 3. It shows the effect of climate-related natural disasters – drought, extreme temperature, flood, glacial lake outburst, landslide, storm, wildfire – on the fiscal deficit, using data covering 7,518 disasters in 212 countries during the 2000–2022 period, taken from the International Disaster Database of the Université Catholique de Louvain (EM-DAT). For about one-third of the events (2,590 events), we have information on total estimated economic damages, and for about two-thirds of the events we have information on the number of affected people and the number of deaths. We use these data to build three measures of the annual cost of climate-related natural disasters. For the first measure, we simply tally up the information on total damages reported by EM-DAT at the country-year level. For the

other two, we estimate total damages using information on event characteristics and number of affected people.[54] After adding these costs at the country-year level, we scale them by GDP. For comparability purposes, we also rescale the two estimate variables so that they have the same mean as the variable based on actual reported damages.

TABLE 6.1 **THE EFFECT OF CLIMATE CHANGE-RELATED NATURAL DISASTERS ON THE FISCAL DEFICIT**

	(1)	(2)	(3)	(4)	(5)	(6)
DEF_{t-1}	0.507*** (0.0579)	0.508*** (0.0579)	0.508*** (0.0580)	0.435*** (0.0668)	0.436*** (0.0669)	0.435*** (0.0670)
$COST1_{t-1}$	0.0941* (0.0530)			0.133*** (0.0308)		
$COST2_{t-1}$		0.416** (0.200)			0.508*** (0.151)	
$COST3_{t-1}$			0.285 (0.201)			0.361** (0.170)
GR_{t-1}	-0.0752* (0.0381)	-0.0745* (0.0380)	-0.0745* (0.0380)	-0.0560 (0.0374)	-0.0547 (0.0375)	-0.0548 (0.0374)
$Ln(GDP\ PC_{t-1})$	0.844* (0.509)	0.869* (0.504)	0.871* (0.503)	0.853 (0.572)	0.884 (0.565)	0.890 (0.565)
N.obs	2,256	2,256	2,256	1,719	1,719	1,719
Sample	All	All	All	EMDE	EMDE	EMDE

Note: This table reports a set of regression where the dependent variable is the government budget deficit over GDP and the explanatory variables are the lagged deficit, three measures of the economic cost of climate related natural disasters scaled by GDP, real GDP growth, and the log of GDP per capita. All regressions control for year and country fixed effects. Robust standard errors clustered at the country level in parenthesis.

The point estimates suggest that a climate-related event with damages of 1% of GDP is significantly associated with an increase in the fiscal deficit and that this effect is particularly strong in emerging and developing economies (columns 4–6).[55] As long as the economic cost of climate-related disasters is contained, and/or countries are far from their debt limits, this will not push countries into unsustainable debt. But for countries whose debt is already high and that are frequently subject to natural disasters, climate change will have a first-order impact on debt risks and debt sustainability.

54 In the first methodology, we regress total damages on the number of people affected, the number of deaths, a dummy for the type of event (drought, extreme temperature, flood, glacial lake outburst, landslide, storm, wildfire) and the interaction between this dummy and the number of people affected and number of deaths. We then use the regression's coefficients to predict the cost of the event. In the second methodology, we also interact the number of affected people and the number of deaths with country fixed effects.

55 In this group of countries, a climate-related event with a cost of 1% of GDP is associated with an increase in the government deficit that ranges between 0.13% and 0.51% of GDP.

BOX 6.1 **DEBT DISTRESS AND GREENHOUSE GAS EMISSIONS**

If countries in debt distress or at risk of debt distress are relatively large GHG emitters, then offering a commitment to lower such emissions could raise the willingness of creditor governments, multilateral development banks or civil society to provide and/or subsidise debt relief. To see if this is the case, we use the residuals of a regression of the log of per capita GHG emissions over the log of PPP GDP per capita for all emerging and developing economies to classify low-income (PRGT-eligible) countries into countries with abnormally high (these are countries with positive residuals) and abnormally low per capita emissions. There are 28 countries (42% of total) with abnormally high emissions (Table B6.1).[56] Almost all countries in debt distress (six out of seven) have abnormally high emissions; 27% of countries at high risk of debt distress have abnormally high emissions; and between 43% and 48% of countries at low or moderate risk of debt distress have abnormally high emissions.

TABLE B6.1 **PRGT COUNTRIES BY CARBON EMISSIONS AND RISK OF DEBT DISTRESS**

DSA outcome	Carbon emissions		Total	Share with high carbon emissions
	High	Low		
In debt distress	6	1	7	86%
High risk of debt distress	8	22	30	27%
Moderate risk of debt distress	11	12	23	48%
Low risk of debt distress	3	4	7	43%
Total	28	39	67	42%

Importantly, the presence of a strong link between climate risk and debt risks does not argue for just any sort of climate-conditional debt relief; it argues specifically for comprehensive climate-conditional debt relief (rather than debt swaps involving only one creditor or class of creditors). And indeed, the potential impact of the required investment and policy actions on debt risks have not been the motivation for debt swaps in the past. However, as climate change begins to have first-order implications for debt risks in a growing number of developing countries, climate-conditional comprehensive debt restructurings could become much more relevant in the future. Indeed, it is relevant in highly climate-vulnerable countries, such as fragile island states, even today.

This leads to the final question of this section. Other than for pragmatic reasons – that is, to provide a support vehicle to donors that prefer debt relief to grants – is there any argument for debt swaps? Or are they always dominated by some combination of conditional grants and (possibly climate-conditional) comprehensive debt restructurings? The answer is that they are not always dominated, because comprehensive debt restructurings may be costlier – economically and perhaps politically – than a debt swap that deals with a more

56 The 28 countries are: Central African Republic, Cameroon, Lao People's Democratic Republic, Marshall Islands, Papua New Guinea, South Sudan, Samoa, Zambia, Congo, DRC, Grenada, Mozambique, Somalia, Chad, Zimbabwe, Cambodia, Myanmar, Uzbekistan, Burkina Faso, Congo, Guinea, Guyana, Liberia, Niger, Nicaragua, Salomon Island, Timor Leste, Tanzania and Vanuatu.

limited debt perimeter. To the extent that creditors participating in the debt swap do so voluntarily, it may not have any adverse reputational implications. The other side of the coin is, of course, that its impact on debt and debt sustainability will be more modest than in a comprehensive debt restructuring, but it may still be material, particularly when debt swaps are not fully voluntary. Again, the 2021 Belize restructuring operation – an unusually large debt-nature swap backed by collective action clauses – offers an example (Box 6.2).

The main results of this section can be summarised as follows:

1. When the objective of fiscal support is to generate resources for a specific public investment, grants are generally superior to debt swaps.
2. When the objective is to restore debt sustainability, then the instrument of choice is generally a comprehensive debt restructuring.
3. When debt is unsustainable and climate adaptation can materially lower debt risks, the right instrument is a comprehensive debt restructuring conditional on debtor climate action.
4. Debt-climate swaps make sense in two circumstances:
   a. when conditional grants are unavailable in the needed amounts, and debt–climate swaps can mobilise extra resources to generate fiscal space for efficient climate investment; or
   b. when the objective is to both support specific public investment and to lower debt risks, but a comprehensive debt restructuring is an unnecessarily heavy-handed way to achieve these objectives. This would be the case if debt is sustainable, albeit with high risks, and where the swap is expected to materially reduce these risks.

It bears emphasis that settings that fit the last condition will likely be few and far between – indeed, it is unclear if there is any historical example. Hence, the theoretical case for debt-climate swaps needs to be handled with great care, as it may simply serve as an excuse to put off a needed comprehensive debt restructuring. The pragmatic case for debt-climate swaps (point 4.a) seems more plausible.

6.2 DESIGNING CLIMATE-CONDITIONAL DEBT RELIEF

This section presents some ideas on how climate-friendly restructurings should be designed in practice. As before, it distinguishes between two types of operations: debt-for-climate swaps (or debt-for-nature swaps; we use these terms interchangeably) and comprehensive debt restructurings embodying climate conditionality.

Designing debt-climate swaps

As mentioned in the last section, debt–nature swaps have a very long history. During this history they have suffered from two main problems, both of which can be regarded as efficiency problems of different stripes. One has to do with ensuring that the debt relief has the intended benefits. We refer to this as 'effective targeting'. The second relates to the small scale of swaps. This could have to do with their (mostly) voluntary nature, but also with high transaction costs associated with structuring and implementing these operations.

Effective targeting

The purpose of debt–nature swaps is to create fiscal space by lowering debt service commitments. But this generally makes the remaining debt service commitments safer, which implies a sort of 'kickback' to the creditors. When there is just one creditor this is not a problem, as this creditor bears the cost of debt relief but also receives a benefit in return. For the same reason, there is no issue when all creditors participate in the debt relief in the same proportion. Typically, however, there are several creditors, some of which (or even all, in the case of a donor-financed debt buy-back) do not participate in the debt relief. In that case, debt–nature swaps subsidise the non-participating creditors, to the detriment of the rest (and the debtor). This feature has been noted and criticised by economists since the first very first debt–nature swap with Bolivia in 1987. For example, Bulow and Rogoff (1988) show that all debt buybacks of distressed debt are a bad deal for the distressed borrower. As argued above, climate-conditional grants do not have this problem, as they typically ensure that the grants can only be spent on the intended purpose.

There are two design features of debt-nature swaps that can help minimise the subsidy to non-participating creditors and ensure that the funds spent by donors or participating creditors support climate investment.

First, debt–nature swaps should not take the form of debtor-conducted debt buybacks in secondary markets. Assuming that the market understands the purpose of these buybacks, they will lead to an increase in the secondary market price of debt, which represents a capital gain for the creditors and reduces the debt relief (the difference between buyback value and nominal value) for the debtor. Instead, debt-nature swaps involving commercial debt should be conducted in either of two ways:

- An offer to exchange existing debt for a bundle of new instruments, including cash and/or new debt of lower value (including green or performance-linked instruments), where the value of that bundle is determined by negotiation rather than by the market. To minimise the holdout problem, this offer should be supported by the usual inducements and contractual devices that can be helpful in debt restructurings, including collective action clauses (Buchheit et al., 2019).

- A donor/creditor conducted buyback of commercial debt, which is subsequently swapped back to the debtor in exchange for a climate or conservation commitment. As long as the intention of swapping back the debt is not known at the time of the buyback, this should not affect the market price (assuming the market is liquid and the buyback is not comprehensive), or at any case less than if the market realises that the purpose is to partly forgive debt. Hence, this approach will result in greater debt relief.

The offer to exchange debt for new instruments should be the method of choice in settings where debt is significantly distressed, and debtors have already lost market access. When debtors retain market access, however, they may be reluctant to implement a debt–nature swap through a debt exchange. The main reason for this reluctance is the fear that credit rating agencies would classify the exchange as 'distressed', leading to a downgrade. In that case, a donor-conducted buyback may be a good alternative.

Second, when debt risks are elevated, the transaction should ensure – as far as possible – that the climate commitment takes precedence over remaining debt service in the event of an economic downturn in which the debtor may be forced to restructure some of its payment commitments. If this is done well, it would remove the main disadvantage of debt–climate swaps relative to climate-conditional grants. Indeed, it could even make debt–climate swaps superior to conditional grants, since it implies that in a bad state of the economy, when debtor resources are insufficient to both repay the debt and undertake the climate investment, the latter would be partly financed by reducing the debt service to creditors that do not participate in the debt swap (Chamon et al., 2022, Annex I).

In principle, one can imagine two strategies for making the conservation commitment de facto senior to debt service:

- One would be to create a structure that implies that reneging on the conservation commitment is politically or economically more painful than restructuring debt. This may be the case if the conservation commitment is made to an official creditor that holds considerable sway over the debtor country.

- Alternatively, or in addition, it may be possible to immunize the conservation commitment from future debt crises by pre-funding it. In the context of a trilateral agreement, this could be achieved by raising more funds from donors or market sources than are required for the buyback or debt exchange offer. The balance is placed into an escrow account, which is disbursed if and only if the debtor shows receipts or bills documenting spending with the desired purpose. In that case, conservation spending would be protected from sovereign risk using the same mechanism that is in effect when spending is supported using a conditional grant.

Box 6.2 describes a modern-day debt-for-nature swap that combines some of these features. It was conducted through a debt exchange offer backed by a collective action clause, rather than a debt buyback in the secondary market. It entailed some (albeit not full) pre-funding of the conservation commitment. And it was structured in a way – using a US government insurance – that implies that in a future economic crisis, Belize might prefer to restructure its remaining debt service before it reneges on its conservation commitment.

BOX 6.2 THE 2021 BELIZE RESTRUCTURING[57]

Belize's 2021 debt restructuring was a partial sovereign debt workout incorporating environmental conditionality. Belize had issued only one US dollar-denominated bond (dubbed the 'Superbond') in the international capital markets. The bond, issued in 2007, had already been restructured three times before Belize's economy was hit by the Covid-19 pandemic and needed a fourth restructuring. While negotiations with bondholders were underway, Belize reached an understanding with The Nature Conservancy (TNC) under which a TNC affiliate would raise money in international capital markets (through a 'blue bond') and on-lend the proceeds to Belize ('blue loan') to fund a repurchase of the Superbond in its entirety at a price of 55 cents on the dollar, while committing to use a portion of the savings from the transaction ($ 23 million, equivalent to 1.3% of 2020 GDP) to create a TNC-administered endowment to fund marine conservation projects in Belize. In addition, Belize committed to a set of 'Conservation Milestones' – policy actions in support of marine conservation, mainly in the form of conservation easements over portions of the barrier reef, as well as conservation funding payments of $4.2 million per year on average over the next 20 years. According to press reports, these commitments contributed to the bond holders' acceptance of the heavily discounted cash repurchase price.[58]

While the Belize workout had some of the typical features of a 'trilateral' debt-nature swap – an NGO finances a commercial debt-buyback, which is subsequently exchanged for a loan of lesser face value together with a conservation commitment – it was unusual in several respects. Most obviously, with a face value of $553 million, it was unusually large in both absolute and (especially) relative terms, leading to the retirement of the entire bonded debt of a country (around 30% of GDP). According to the IMF (2022a), this was not large enough to restore debt sustainability in Belize, but it was enough to justify a ratings upgrade to B- by Standard & Poor's.

57 This box is based on Bolton et al. (2022), Chamon et al. (2022) and The Nature Conservancy (2022). For additional details on the Belize 2021 restructuring, listen to "Lee Buchheit and Mitu Gulati on Debt for Nature Swaps" (https://soundcloud.com/user-311970225/an-interview-with-lee-buchheit-and-mitu-gulati-on-debt-for-nature-deals); "Jennifer Morris on COP26 and the Importance of Nature" (https://podcasts.apple.com/us/podcast/sovereign-debt-with-jill-dauchy/id1590877150?i=1000542667626); and "From Commercial Bank Loans to Blue Bonds, Clauses and Controversies" (https://podcasts.apple.com/us/podcast/ep-56-ft-antonia-stolper/id1528208049?i=1000547433276).

58 See, for example, "Belize Leans on Coral Reefs to Drive Bargain with Bondholders", *Financial Times*, 18 September 2021 and "Belize Offers Ocean 'Blue' Print with Ocean Debt-for-Reef Swap", Reuters, 5 November 2021.

BOX 6.2 **(CONTD.)**

In addition, the transaction had several unusual features that arguably side-stepped, or at least mitigated, some of the disadvantages of debt swaps compared to conditional grants discussed in the text. First, the modality for retiring this debt was not a debt buyback in the secondary market, but rather a bond-for-cash exchange offer at a fixed price backed by a collective action clause Second, a portion of the expenditure commitments undertaken by Belize as part of its package of overall commitments were pre-funded (by creating a dedicated endowment fund that would pay for these expenditures). Third, the transaction benefitted from an insurance provided by the US Development Finance Corporation (USDFC) which lowered the credit risk taken by the TNC affiliate and consequently the cost of the blue bond. Since these savings were passed on to Belize through the terms of the blue loan, the US government contributed to the debt relief achieved under the operation.

The first of these features prevented the appreciation typically associated with debt buybacks, while achieving full participation.[59] The second and third reduced the risk that the marine conservation spending that Belize committed to in the transaction might become the victim of a future fiscal crisis, hence arguably creating a form of de facto seniority over debt service. Much like a conditional grant, the endowment fund created a dedicated source of funding for conservation that cannot be pooled with the country's general resources for debt service. And the presence of the USDFC insurance implies that a failure of Belize to live up to the conservation agreement may eventually force the US government to make a payment, raising the political costs of not living up to the conservation commitment.[60]

Larger scale

The aggregate volume of debt relief that has taken place in the form of debt–nature swaps since the 1980s has been very small – a little over $3 billion, if the unusually large Belize (2021) transaction is included. One reason for this, as pointed out by Bolton et al. (2022), is that debt–nature swaps rely mainly on altruism on the side of creditors or donors. This explains why the total volume of debt relief provided in the form of distressed debt restructurings – where providing debt relief is a way to minimise losses – is orders of magnitudes larger. Relying a bit less on altruism and a bit more on mechanisms that have been used successfully to achieve broad participation in debt exchanges – including collective action clauses, as in the Belize (2021) deal, and bilateral creditor coordination through institutions such as the Paris Club – is hence one way to expand scale.

59 Set just above the price at which the bond was trading before details of the transaction became known, the offer price was sufficiently attractive to lead to an 85% acceptance rate, above the 75% threshold required to modify the payment terms of the Superbond.

60 The fact that a debt-nature swap benefits from a combination of NGO and government funding is not new: for example, the US and TNC shared the costs of debt-for-nature swaps with Belize (2001) and Panama (2003) (Sheikh, 2018). However, the form in which the subsidy was provided in Belize (2021) – and its potential effect in reducing the riskiness of the conservation commitment – appears to be new.

But debt–nature swaps have been small even when compared to climate- or conservation-conditional grants, which are also altruism-driven. One reason why this might be the case is that debt–nature swaps – particularly 'trilateral' swaps involving commercial debt – are complicated operations involving three or four parties. Furthermore, most of them have focused on financing small-scale individual projects.

Chamon et al. (2022) discuss ways in which the scale of debt–climate swaps could be increased through measures that focus on the use of funds rather than on creditor coordination. One is to link debt relief to specified categories of budgetary expenditures, which could in turn fund a large set of mitigation- or adaptation-related investments (see also Steele and Patel, 2020). Another would be to swap existing debt into sustainability-indexed (i.e., performance-linked) bonds. By using existing monitoring and enforcement mechanisms that may have been created for the purposes of new sustainability-linked bond issuance, this could greatly reduce the transactions costs, and help increase the scale, of new debt–climate swaps.

Making comprehensive debt restructurings climate-friendly

We now turn to the second class of climate-conditional debt restructurings introduced at a conceptual level in the previous section. These are operations that are primarily motivated by the desire to restore debt sustainability in countries that lack it. Debt sustainability is typically necessary for budgetary support by the IMF, the World Bank and other multilateral bodies. And lack of debt sustainability has also been traditionally treated as a necessary (if not sufficient) condition for debt relief by official bilateral creditors, particularly the advanced country creditors organised through the Paris Club.

For the reasons argued in Chapter 2 – both efficiency and fairness – future debt restructurings aiming to restore debt sustainability should be sufficiently deep and comprehensive to create fiscal space for the financing of essential mitigation, adaptation or conservation investment. The quid pro quo for this is to include climate conditionality in the debt restructuring operation, along with any of the usual macro conditionality. The latter is necessary because the investments benefit not only the debtor but also the creditors and the world at large. Hence, the willingness of creditors to fund those investments through debt relief – and the willingness of multilateral agencies and climate funds to pitch in with official support – will depend on ensuring that the climate or conservations investments actually happen. In practice, this requires two steps.

First, the fiscal costs of climate adaptation, mitigation and transition need to be accounted for in the baseline macroeconomic assumptions of the debt sustainability analysis that guides debt restructurings. Given the critical role of the IMF in determining the debt restructuring envelope in distressed debt cases, it is essential that the debt sustainability frameworks of the IMF (for market access countries) and the IMF and World Bank (for low-income countries) are adapted to achieve this. Indeed, the IMF has already developed the tools to do so in its new debt sustainability framework for market access countries (IMF, 2022b). Use of the climate adaptation module (a method that helps IMF staff to

think properly about the potential fiscal costs of climate adaptation) is compulsory for IMF staff in debt restructuring cases. The existing IMF–World Bank debt sustainability framework for low-income countries, developed about five years ago, is less explicit in this regard, but is sufficiently long-term (20 years) and contains the flexibility to incorporate the fiscal costs of climate change.

Second, the debt restructuring exercise will need enforceable climate conditionality to ensure that the agreed-upon climate expenditure takes place or that predetermined climate target are reached. One way to put this conditionality in place is to exchange the conventional bonds that are being restructured with appropriately defined sustainability-linked green bonds (see Box 6.3 for a proposal along these lines). Another way to achieve it is through climate conditionality in longer-term IMF and MDB supported reform programmes. An important step in this regard is the IMF's new Resilience and Sustainability Trust (RST), which can both finance climate action and serve as an organising framework for climate-based debt relief and climate-conditional grants.

Using climate-conditional debt restructuring to issue sustainability-indexed bonds could also lead to positive market creation externalities. The presence of fixed costs linked to instrument design and verification mechanisms and the need to coordinate among market participants are important obstacles to the creation of welfare improving innovative instruments. This suggests that the official sector can play an important role in promoting such instruments (Borensztein et al., 2005). Like the Brady exchanges, which created a vibrant market for emerging market bonds (including those of countries that did not default on their debts), well-structured sustainability-linked bonds issued under the supervision and with the guidance of the international financial institutions could help all countries (including those that do not face debt sustainability problems) to issue these types of instruments.

Beyond these general ideas, the precise design of the climate-friendly debt restructuring will of course depend on the type of constraint faced by the country that needs to restructure its debt. For example, Bolton et al. (2022) discuss a proposal which is directly applicable to countries that face a tight external constraint but have some flexibility in terms of domestic fiscal resources. Countries with no domestic fiscal space could adopt budgetary neutral policies (such as green investment financed by a carbon tax, reallocation of brown government expenditures towards green expenditure, or environmentally friendly regulatory reforms), or could receive outright transfers from bilateral donors or international institutions.

BOX 6.3. A PROPOSAL FOR LINKING DEBT RESTRUCTURING TERMS TO CLIMATE CONDITIONALITY

Bolton et al. (2022) propose that in an exchange offer the sovereign debtor could have the option to discharge a portion of the foreign currency debt service due on the new bonds through local currency payments aimed at funding a climate-friendly project monitored and administered by an independent third party, within its own territory and approved in advance by the lenders.

The following example illustrates the plan. Assume that the Republic of Ruritania needs to restructure a stock of sovereign debt that requires $16 million in coupon payments. There is substantial uncertainty as to the level of Ruritanian debt that will restore market access, but sustainability analyses suggest that Ruritania could afford coupon payments that range between $10 million and $8 million.[61] The bonds issued under the debt restructuring require a $10 million coupon payment (the upper limit of the debt sustainability range) but provide that, at Ruritania's option, up to $2 million of each of those coupon payments may be used in local currency by funding a creditor-approved climate-friendly project in Ruritania. Failure to fund the project on any coupon payment date under the bonds means that Ruritania must pay the full $10 million – in US dollars – to its bondholders.

In Bolton et al. (2022), a subset of us discuss the benefits of these projects in terms of improved debt sustainability, potential 'greenium' and approbation by the international community. We also point to potential trade-offs associated with this restructuring technique. In a conventional debt restructuring negotiation, the lenders would ask for the full $10 million and take the risk that they were pressing Ruritania too hard (if that risk materialises, the creditors know that they, or their successors in title, may need to undergo yet another bout of debt restructuring). For its part, the sovereign debtor could be expected to insist on a cap of $8 million, arguing that it would be the Ruritanian citizens who will pay the highest price if the lenders' optimism proves unfounded. And if history is any guide, the result may be many months of stalemated negotiations. The technique described above would allow the parties to bridge the $2 million difference in their assessments of sustainability. Ruritania pays – in hard currency – only the safer $8 million figure. By allowing Ruritania to discharge the additional $2 million through a local currency funding of an approved environmental project, the lenders simultaneously reduce the likelihood of the need for a subsequent debt restructuring and wrap the new restructured bonds in indelible ESG resplendence.

The sustainability of Ruritanian debt, and hence the success of its restructuring, involves a series of self-fulfilling prophecies and local currency debt tends to be less subject to such self-fulfilling runs (Bolton and Huang, 2018; De Grauwe, 2012).[62] Allowing a portion of Ruritania's restructured debt service to be discharged in local currency and invested in suitable projects in the country thus acts as a safeguard against the risk that scepticism about the adequacy of the debt relief provided by the restructuring may trigger a self-reinforcing downward spiral. Ruritania's external debt dynamics are improved, albeit at some fiscal cost to the domestic budget.

61 It is in situations of uncertainty regarding the ability to pay where the proposed technique may be of greatest help. After all, if both sides of the negotiating table were certain that Ruritania could afford $10 million in coupon payments, the creditors would have no incentive to accept anything less than $10 million; the prospect of ESG glory notwithstanding. Alternatively, if everyone were certain that Ruritania could under no circumstances afford more than $8 million, the Ruritanian authorities could not responsibly sign an agreement promising to pay more and the creditors would be reckless to ask for more.

62 At the cost of possibly leading to credibility problems (Calvo, 1988).

CHAPTER 7

Conclusion

This report analyses the question of how to design and choose between fiscal instruments to achieve four objectives:

- mitigation of carbon emissions consistent with maintaining the global temperature rise below 1.5°C;
- adaptation to minimise the economic and social costs of unavoidable climate change;
- conservation of biodiversity; and
- fairness – ensuring that less developed countries do not disproportionately suffer from climate change caused predominantly by the rich countries.

We focus on two angles. The first is financial instruments as a means of incentivising and committing governments to do the right thing. The second is providing fiscal space for climate investment in countries that could not otherwise afford it. Related to the first angle, we devote one chapter to the design of sovereign bond contracts that channel private funding to climate projects or link financial terms to climate outcomes. Related to both the first and the second angles, we discuss carbon credits, climate-conditional grants, debt–climate swaps and climate-friendly comprehensive debt restructuring.

The analysis leads to six main proposals and policy recommendations.

1. **Develop a clear legal framework and verification mechanisms that will enhance the credibility of green sovereign bonds**. This will require the issuance of sovereign bonds with credible enforcement mechanisms that ensure that actual environmental protection results. The current state of green bonds, we worry, might not be resulting in anything meaningful because they promise little or nothing that would be legally enforceable. There is thus the risk that the market for green sovereign bonds will end up in a situation where asset managers pretend that they are buying green bonds and issuers pretend that they are doing green things with the funds. We suggest addressing this issue by developing bonds with concrete and legally enforceable green promises and describe the key element that should be included in such genuine green bonds: (i) a clear, specific and objectively verifiable 'use of proceeds' clause obligating the sovereign issuer to deploy the

borrowed funds for some environmentally friendly purpose; (ii) a mechanism for independent monitoring of the issuer's compliance with the prescribed use of proceeds; and (iii) a form of contractual sanction or penalty in the event that the issuer fails to do so.

2. **Set up a climate information and monitoring system to support the development of sustainability-linked sovereign bonds.** Use of proceeds requirements associated with green bonds can be difficult to both implement (because they have to go through the legislative process) and verify. Moreover, by detailing specific types of expenditure or projects, traditional green bonds do not allow for experimentation or innovation. Sustainability-linked bonds contingent on attaining pre-specified environmental targets rather than on expenditures on specific projects are more flexible and incentive-compatible. Multilateral development banks and NGOs can help develop the sustainability-linked bond market by contributing to their design and by monitoring performance indicators.

3. **Create an institutional framework for a carbon credit market based on mandatory direct and indirect carbon emission reduction requirements for all large emitters.** While most emissions stem from rich countries, carbon sinks tend to be concentrated in poorer countries with limited debt carrying capacity. These countries are currently not compensated adequately for the public good they provide to the world in maintaining or building these natural resources. While there have been efforts to build mechanisms to compensate these countries for maintaining or expanding their carbon sinks, the financial compensation countries have received through these programmes remains small. A well-functioning global carbon market could generate substantial flows from rich to poor countries and help monetise the natural assets that these countries hold. Carbon credits earned from investing in nature preservation (afforestation, reforestation, soil carbon enhancement, oceans and ecosystem restoration) are a potential avenue for a sovereign to finance green investment without running into unsustainable debt. A well-functioning market for carbon credit is also required on efficiency grounds. Some essential economic activities will continue to cause carbon emissions and some sectors will be able to decarbonise much faster than others. It is thus efficient to provide incentives to sectors than can decarbonise at a faster rate by allowing them to sell carbon credits. However, this will not happen as long as the market for carbon credit remains fragmented and voluntary. Currently, there is no integrated exchange for carbon credits. The market consists of many small suppliers that use a diverse array of certification and verification mechanisms and that trade carbon offsets over the counter with limited liquidity and price discovery. Two sets of actions are required to achieve the needed scale: (i) mandatory direct and indirect CO_2e emission reduction requirements for all large emitters; and (ii) the creation of a comprehensive monitoring and certification infrastructure,

the standardisation of carbon credits and a registry of traded carbon credits. Emission reduction requirements will guarantee a predictable aggregate demand for offsets from those emitters that cannot directly reduce their emissions. Market infrastructure will guarantee liquidity and efficient price discovery.

4. **Commit to an annual target for fiscal support for adaptation, mitigation and transition expenditures in developing and emerging market countries**. Public investment costs for adaptation in emerging markets and developing countries are estimated to be in the order of $500 billion per year, or about 0.4% of advanced country GDP (Aligishiev et al., 2022). This estimation does not include the costs of mitigation, or investments that may be needed to leapfrog to low-emission technologies and avoid the fossil-fuel model of development that has been followed by today's large emitters. Advanced and high-emitting upper-middle-income countries will need to provide fiscal support at least for those countries whose mitigation and adaptation costs exceed their fiscal capacity; and they should go beyond this minimum on fairness grounds. They should agree on an annual target for fiscal support, expressed as a share of donor GDP, and a set of spending objectives (i.e., criteria for identifying adaptation or mitigation investments that would count towards this targeted fiscal support for combatting climate change). Subject to these conditions, donors would be free to provide support thorough centralised funds such as the GCF, bilateral conditional grants or conditional debt relief.

5. **Improve the design of debt-for-nature swaps**. Debt–nature swaps could be linked to budgetary spending categories or climate performance commitments that allow for greater scale with respect to the case in which swaps are linked to individual projects (for example, by swapping discounted conventional debt for well-designed green bonds or sustainability-indexed bonds). To maximise fiscal space, debt–nature swaps should avoid debtor-conducted buybacks in secondary markets, and instead rely either on negotiated debt exchange offers backed by collective action clauses or donor-conducted debt buybacks. The structure of debt–nature swaps should seek to ensure that climate- or conservation-related expenditure commitments are honoured even if the debtor is forced to restructure its commercial debt. This could be achieved by (i) pre-funding the expenditure commitments (for example, through a fund or escrow account whose resources are disbursed only if the planned projects are realised); and/or (ii) making MDBs or bilateral development agencies party to the swap, through insurance or partial guarantees that trigger a payment if the expenditure commitment associated with the swap are not met.

6. **Include climate-conditionality in comprehensive debt restructurings addressing unsustainable debt.** Future debt restructurings should be based on debt sustainability analyses that explicitly account for the fiscal costs of climate-related expenditures and include enforceable climate conditionality. One way

to achieve this objective is by exchanging the conventional bonds that are being restructured with appropriately defined sustainability-linked bonds. The IMF (2022b) has already developed the tools to do so in its new debt sustainability framework for market access countries.

No single instrument is right for all countries or at all times. Instead, it is essential to deploy multiple instruments, as described above, bearing in mind their limitations and the potential trade-offs among them. It is also essential to recognise that addressing climate change will require large-scale fiscal support as well as resource flows, funded by private sources, from richer to poorer countries. The latter is especially important if developing and emerging countries are to leapfrog to green technologies without taking the same 'brown path' followed by today's large emitters. Making these transfers happen requires substantial political will not only in the richer countries that have benefitted from brown development and created the problem, but also in the developing countries that must commit to not repeating these mistakes. Both sides must rise to the challenge of supporting a fair and rapid transition to a net zero economy.

Discussions

BACKGROUND AND CONCEPTUAL FRAMEWORK

Chaired by Agnès Bénassy-Quéré, (French Treasury, Paris School of Economics)

Stijn Claessens, *BIS*

I would like to take a step back and raise a few general questions to give additional context to this report. What economic issues do we face when we talk about climate change? What are the externalities and market failures? What goals do we need to achieve to address climate change? Which tools should we employ to tackle this issue at a global scale? While external financing is part of the solution, I think it comes too early in the report and may only play a minor role. Then, we need to discuss about the specific role of sovereign financing in addressing climate change issues, and especially think about the role of public versus private interventions and the modalities of climate finance. In fact, this report is about debt and climate, but the focus should be on climate; debt should only be a small piece of the puzzle. An implication for this report is that climate goals, externalities, and the credit risk credibility analysis should all come before the discussion about external financing.

The elephant in the room is therefore the identification of the key climate change-related economic risks and issues. Obviously, a key issue is the failure of global and national agents to act effectively, leaving us today with second- or even third-best alternatives for the world. We need to address the real sector issues first. Fiscal and regulatory authorities need to set the appropriate signals to prompt a reallocation of resources from brown to green projects and to boost investments in climate adaptation and mitigation, which will hopefully be driven by the private sector. The report needs to clarify that a ramp up of mitigation and adaptation investments is the primary goal, and that the markets will not naturally deliver on these promises. The role of sovereign financing should also come at the very end. First, more economic analysis is needed to determine the policies required to achieve the climate targets. Once this is clarified, one should think of the available globally efficient solutions. Will we be able to shield all countries from the consequences of climate change or should we think of the means to displace vulnerable populations? How can we transfer technologies more cheaply to other countries? These questions need to be addressed first before thinking of how and when money will need to be disbursed. Then, we need to think harder about the missing incentives and political pressures to achieve the climate targets. While we observe more public responses as countries get richer, this trend alone will not be sufficient.

Finally, in cases in which large-emitting countries are simultaneously severely exposed to the consequences of climate change, incentives to invest in climate mitigation and adaptation solutions may be better aligned. Yet again, this reasoning is unlikely to be applicable at a global scale given the geographical concentration of climate vulnerability.

Sovereign financing in its traditional form may also not be the solution. Broadly speaking, debt financing is not solving the large externalities related to climate change. Instead, the typical economic answer to externalities includes taxes, net transfers, and possibly some domestic financing. Additionally, high physical and transition climate risks call for contingent forms of financing in lieu of traditional debt financing. While it is not easy to implement, the first call of this report should be to emphasise the necessity for risk-sharing mechanisms including equity instruments and contingent bonds. Finally, the report needs to clarify whom and what should be financed. Should the necessary investments be fully financed by national governments? Alternatively, can the private sector contribute with possible public support in the form of subsidies? Which globally efficient solutions should we finance?

Sovereign financing may also not solve long-term fundamental issues. Major debt reliefs, new financing packages, or debt-for-nature swaps are likely to lead to the same issues five years from now. Instead, and as suggested, the key is to enhance countries' creditworthiness, and this is where the type of tools we use to reach the climate targets matter. Tools such as climate-conditional grants are likely to be efficient because they do not deteriorate fiscal positions while setting the right incentives for countries to deliver on the climate targets. On the other hand, the case for debt buybacks and debt restructuring is less compelling and may lead to free-riding behaviours unless meticulously designed. Such tools need coercion, complete coverage, and collective action clauses, without which benefits may be primarily captured by creditors and free-riding behaviours may prevail. In the end, only a subset of tools may be globally efficient to deliver on the climate targets. However, one would argue that, at the margin, all available tools should be used given the state of the climate crisis. Yet again, not only could some policies be counterproductive but, most importantly, repeated restructuring failures and persistent greenwashing concerns may severely undermine donors' and agencies' trust in such policies. The optimal policy path should therefore be credible with clear forward guidance on the policies that need to be implemented in the future.

The empirical analysis in this report is very informative but needs to provide more context for the reader. In essence, using sovereign spread data limits the scope of the conclusions to market-access countries, whereas tools like the IMF Debt Sustainability Analysis (DSA) also cover low-income countries, which meet their external financings needs mostly through concessional resources. In the report, the authors note that within this specific subset of market-access countries, spreads increase with global factors and debt levels, but these results should be linked more clearly to the particular issue of climate change. Is the increase in sovereign spreads driven by climate change or economic fundamentals?

Greenwashing is obviously a key risk here. One should not underestimate that the market is very confused about it. The authors rightfully made this point by investigating a large sample of green bond legal documentations and highlighting that the legal contingencies in case of noncompliance with green actions are ineffective.

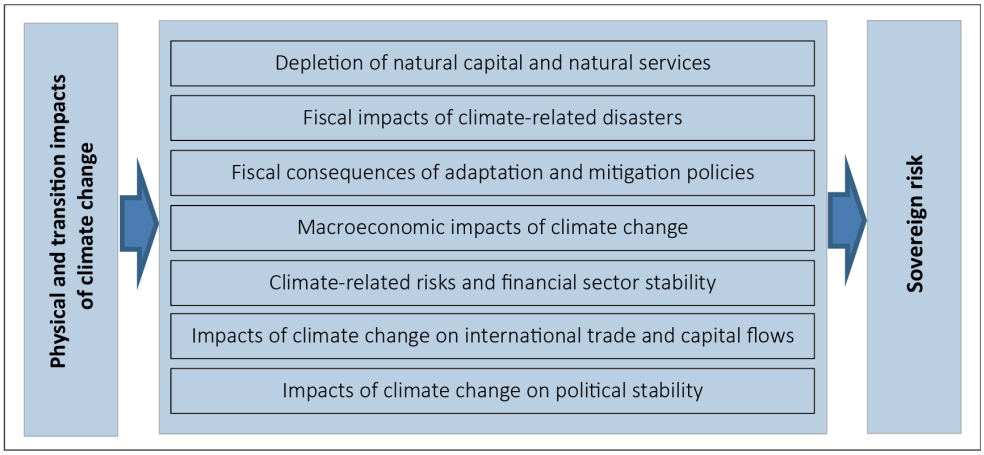
Finally, on the financing needed for a sustainable transition, new initiatives such as the IMF Resilience and Sustainability Trust (RST) seem promising, but a key aspect is to provide more clarity to financial markets by working on more and better tools such as ESG standards.

Ulrich Volz, *SOAS*

I would like to make three points. The first point is on the nexus between climate change, sovereign risk, and the cost of capital. The second is about environmentally friendly debt restructuring. Finally, the last point is on green bonds and state-contingent instruments.

On the first point, I was pleased to observe that the empirical analysis in this report confirms existing findings in the literature. However, I believe that the empirical analysis needs to be embedded more in the literature that has evolved over the last couple of years and the implications of these findings should be emphasised more. Governments and firms in climate-vulnerable countries incur a risk premium on their debt, which holds back crucial investments in climate adaptation and resilience. This issue is of high concern and the report should discuss in more details the linkages between physical and transition impacts of climate change and sovereign risk to draw policy recommendations. Volz et al. (2020a), for example, looked at the various transmission channels through which climate vulnerability can increase sovereign risk and drive up the cost of capital (see Figure 1).

FIGURE 1 **TRANSMISSION CHANNELS FROM CLIMATE CHANGE TO SOVEREIGN RISK**

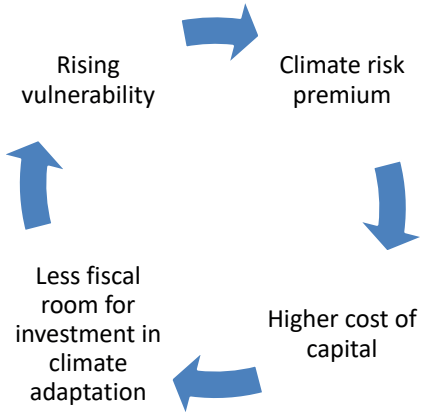


Source: Volz et al. (2020a).

Implications should also be discussed more clearly. The problem can be seen as a vicious circle (see Figure 2). Climate vulnerable countries incur a risk premium on their sovereign debt precisely because of their vulnerability (Buhr et al., 2018; Kling et al., 2018; Beirne et al., 2021b). Consequently, higher cost of capital constrains fiscal space, which in turns reduces investment capacity in climate adaptation and increases the country's

vulnerability to climate shocks. Over time, and as climate change gets worse, financial markets become ever more aware of the climate risks, which get more explicitly priced in interest rates. Unless countries invest massively in resilience and adaptation, climate risk premium are bound to increase.

FIGURE 2 **THE VICIOUS CIRCLE OF CLIMATE VULNERABILITY AND THE COST OF CAPITAL**



Source: Volz (2018).

Climate vulnerability therefore seriously threatens debt sustainability. As the report rightly mentions, the Covid-19 crisis has worsened the debt situation further. The IMF estimates that around 60% of low-income countries currently have severe debt problems and several emerging economies are also under significant stress. The war in Ukraine, which has bolstered inflationary pressures through increases in commodity and food prices, and the corresponding tightening monetary environment seem to brew up a perfect storm. Systemic risks call for systemic solutions. Tools like debt-for-nature swaps are certainly not going to solve this issue because transaction volumes are small, transaction costs are high, and they result in a de facto bailout of private creditors. If we agree that there is a systemic debt problem, systemic solutions need to involve private creditors. Therefore, and as the report suggests, complete restructuring solutions with climate conditionalities need to be discussed seriously because any piecemeal approach would not do justice to the situation.

Another point to emphasise is that we currently live in the year 2022, and the 2020s were supposed to be the decade of actions according to the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change. However, heavy debt burdens prevent countries from investing massively in climate adaptation and mitigation. Some countries cannot even afford investments to build back better after the pandemic, which worsens even further the prospects for debt sustainability. In the status quo, we can

basically forget about the 2030 Agenda and, broadly speaking, climate action in the Global South. For the vast majority of developing countries, climate action should focus on adaptation solutions. While adopting cheaper renewable energy solutions also makes economic sense, resilience and adaptation investments need to be the focal point.

Proposals for addressing the debt crisis looming in the Global South should hence take into account the links between climate vulnerability and debt sustainability, and connect debt relief with policies that strengthen climate resilience and sustainable development more broadly. A detailed proposal that shows how debt relief could facilitate a green and inclusive recovery has been developed by Volz et al. (2021).

Finally, while green bonds are an effective tool in signalling, they are unlikely to make a difference for the climate. Instead, state-contingent bonds seem much more promising. Risk-linked securities, sovereign debt instruments with disaster clauses, sustainability-linked bonds, nature performance bonds and the like (see Table 1) are the type of instruments we should promote for climate actions.

TABLE 1 **A TAXONOMY OF STATE-CONTINGENT DEBT INSTRUMENTS**

	Instruments featuring continuous adjustment of debt service payments	Instruments involving discrete adjustment of debt service payments
Debt instruments linked to macroeconomic and price variables	Inflation-linked bonds Commodity-indexed bonds GDP-linked bonds Wage-indexed bonds Revenue-indexed bonds	
Debt instruments linked to the occurence of specific events		Risk-linked securities Sovereign debt with distaster clauses
Debt instruments linked to the sustainability outcomes		Sustainability-linked bonds Nature performance bonds

Source: Volz (2022).

Floor discussion

Valerie Cerra (IMF) commented on the enforceability of climate action conditions and suggested that additional climate actions may be hard to verify if they are already part of an overall development strategy.

Ugo Panizza (Geneva Graduate Institute) acknowledged the fungibility issue and reiterated the views expressed in the report that state-contingent debt instruments are better suited to address it.

Patrick Bolton (Columbia University) echoed this view and noted that the additionality issue is relevant across the board for all green bond markets including for sovereign, corporate, and banking sector debt markets.

Angel Ubide (Citadel LLC) remarked that the report focuses mostly on developing countries, but emphasised that developed countries will also issue a large share of green sovereign debt, which should generate a green risk premium. He raised the question whether green debt issuances should be in addition to or in lieu of more traditional debt issuances needed to finance other projects. He also asked how one should deal with the green risk premium.

Beatrice Weder di Mauro (Geneva Graduate Institute) explained that the report focuses on low-income and emerging countries due to the looming debt crisis these countries face.

Jeromin Zettelmeyer (IMF) indicated that bailouts or debt guarantees are two possible solutions if climate investments lead to unsustainable levels of debt. As the report suggests, developed countries should finance developing countries bailouts under such circumstances. This mechanism is also likely to be applicable in political and economic unions such as the European Union, which would be an argument for debt mutualisation. However, if rich countries cannot afford a bailout, the only solution left on the table is fiscal adjustment.

Aitor Erce (UPNA) questioned the efficiency of conditional grants for countries with high levels of debt, as such countries may struggle to borrow to make the necessary investments to meet climate-related performance indicators in the first place. He also raised concerns about the integration of climate change-related costs into the DSA, arguing that it may jeopardise the reliability of the framework and open the door for further political interference. Erce also asked why borrowing costs in low-income countries are flat over time.

Jeromin Zettelmeyer acknowledged that seniority implementation is easy for grants but more difficult when the fiscal transfer happens through conditional debt relief. In the latter case, the seniority implementation requires a legal or political structure. For example, following on from the sovereign debt-swap in Belize, the country has a commitment to existing creditors principally on a bilateral basis and a marine commitment. In case of an economic downturn, to ensure a restructuring of the existing debt happens before the country reneges on its marine commitment, political and economic costs on the marine commitments should be set higher than the bilateral debt restructuring costs. Such a device exists in the Belize debt-swap deal but is controversial and not legally enforceable. The mechanism uses a political risk insurance from the US International Development Finance Corporation. Under certain conditions, a default on the marine commitment amounts to a default on the corresponding loan, which in turns may trigger an insurance payment from the US government. Under such circumstances, restructuring other bilateral debt may be less costly and create a de facto seniority.

Ugo Panizza explained that flat borrowing costs in low-income countries can be explained by changes in the funding composition. For low-income countries, borrowing costs are either low because the latter do not borrow much from markets or remain constant because they borrow a little bit more from markets.

Ulrich Volz (SOAS) agreed that DSAs are complex, but one cannot ignore the biggest risks such as climate and nature risks. There are two ways to integrate such risks in DSAs. The first is to factor adaptation spending in fiscal expenditures. A second way is to incorporate climate and nature shocks on top of macroeconomic shocks in scenario analyses. Volz suggested that one should not only look at how to address debt problems as they arise but also think about how to better manage climate risks in public finances and integrate them in the frameworks. Debt instruments such as state-contingent debt should also help countries dealing with these exogenous shocks. The role of public insurance mechanisms is also key.

Gong Cheng (BIS) commented on the inconsistencies of incentives related to the comprehensive debt restructuring solutions conditional on climate performance. Broadly speaking, countries in the Global South tend to be more vulnerable to exogenous climate risks, although these risks do not result from their own actions. At the same time, the financing solutions to tackle climate change have an impact on countries' fiscal balances, which are endogenous. While countries in the Global South can make pledges for climate actions, they are unlikely to have the capacity to contribute much to the climate targets, but they would still need some form of restructuring. How should these two objectives be aligned?

Jeromin Zettelmeyer agreed with that a climate shock is exogenous but adaptation investments are endogenous. Although a country cannot control rising temperatures, it can limit the intensity of the damages to the economy with resilience investments.

Jean-Pierre Danthine (EPFL) picked up on the point made by Stijn Claessens on biodiversity. While pleasantly surprised by the inclusion of biodiversity in the debate, he suggested that the authors spend more time clarifying the link with the climate targets and why biodiversity should – or should not – be a second-level problem.

Beatrice Weder di Mauro observed that discussions on climate change have hovered around greenhouse gas emissions but not so much around biodiversity. However, very important links between biodiversity and climate change exist. The first link is causality. Biodiversity is one of the global services provided to the rest of the world that is most at risk from climate change. Climate experts' predictions suggest that entire ecosystems will likely disappear under current rising temperature forecasts. Biodiversity services such as conservation services tend to be concentrated on some geographical areas such as the tropics, Latin America, and Africa. Countries in these areas can provide such services to

the rest of the world. The second link is between biodiversity and carbon sinks. Preserving carbon sinks and preventing land-use change is crucial. For example, the process of palm oil plantations alone produces as much carbon dioxide per year as half of the global aviation industry.

Ulrich Volz followed up and highlighted that nature is also of paramount importance for the global economy. A recent report from the World Bank (2021) simulated partial nature collapse scenarios and concluded that such events can lead to massive decreases in GDP. Such scenarios have de facto dire consequences on debt sustainability.

Stijn Claessens (BIS) noted that conditionality on mitigation and adaptation commitments are different. Adaptation investments are likely to happen in some countries regardless of the incentives, unlike the case of mitigation investments. One should think carefully about what needs to be achieved.

Fiona Frick (Unigestion SA) mentioned that debt forgiveness in the context of debt-for-nature swaps has a negative connotation and asked whether global services such as biodiversity should be treated as a compensation from low-income and emerging countries in a debt restructuring agreement.

Beatrice Weder di Mauro agreed that global climate services including biodiversity and carbon sinks should be priced in as they are global public goods. However, she noted that mitigation and adaptation investments do not necessarily have this property as they mostly relate to local public goods.

Anthony Smouha (Atlanticomnium SA) asked if the World Bank would be the appropriate institution to provide and centralise the conditions to deal with climate issues.

Patrick Honohan (Trinity College Dublin) remarked that some links between climate change and over-indebtedness in the report are not fully brought to light, especially on fairness. What does the fairness argument encompass? Is the debt tainted because it is held by investors in countries responsible for the current situation? Is this an argument the report supports? Honohan also wondered whether the international community may use over-indebtedness as a leverage to enforce climate actions in low-income and emerging countries.

Beatrice Weder di Mauro commented that fairness is crucial as low-income and emerging markets need to catch with advanced economies in economic terms but should not catch up in terms of emissions.

Ulrich Volz argued that any institution imposing climate conditionality forcing mitigation actions is politically impossible. Instead, finance ministers from the Vulnerable Twenty (V20) group have called for debt restructuring linked with climate adaptation because it is at the very core of their economic interests and because they do not have the resources to invest themselves. Therefore, the debate about the climate and the debt crisis needs to link debt sustainability with adaptation and resilience investments.

Jeromin Zettelmeyer described three main roles for international organisations in the climate transition. First, independent international organisations such as NGOs can help with the monitoring of emissions and the implementation of climate conditionality. Pushing for instruments such as performance linked bonds cannot happen without a strict monitoring regime at the international level. Second, multilateral development banks (MDBs) can support the economic transition with blended finance, subsidies, and partial guarantees. Concessional lending not only helps to address a fiscal problem, it also addresses climate externalities. Then, the role of the IMF is to determine the restructuring envelope. For restructurings to result in sufficient fiscal space for climate action, the IMF needs to incorporate the climate dimension in macroeconomic frameworks, which is something that other international organisations cannot do. However, climate conditionality is largely viewed as debtor country advocacy. While the climate dimension is a priority, debt-distressed countries are only likely to listen to international organisations if they consider them neutral. Therefore, the IMF cannot play a progressive role in this situation.

Jean-Pierre Landau (Sciences Po Paris) pointed out that advanced economies are also highly indebted, and policymakers should carefully assess how best to use additional resources to achieve climate targets. Policymakers need to determine the best marginal climate effects and the distributional effect of an additional unit of currency spent.

Patrick Bolton suggested that there is no clear answer to the most efficient ways to invest additional resources because the world is already facing a crisis and immediate action is needed. Even if the world managed to reach net zero emissions, temperature and sea levels are bound to increase further, which will require massive adaptation investments. Policymakers need to deal with the immediate consequences of the climate crisis while also anticipating and preventing what is coming next. Bolton raised concerns over the ability of technologies alone to solve the climate issue because of scalability issues and long development times. He suggested that regulation can also help imposing mitigation investments on the private sector.

Stijn Claessens reacted by suggesting that sometimes policymakers should not respond to an immediate shock because it would mean using resources that could be better used in the prevention of even worse future situations.

Patrick Bolton argued that while economists tend to anticipate, plan, and trade off, politicians are drawn in by events and need to respond as climate shocks unfold.

Beatrice Weder di Mauro added that a global carbon tax of $100–250 today would solve the climate problems, move the needed technologies forward, and allow climate targets to be achieved. However, this scenario is too optimistic, and this is the reason why the report discusses solutions in a second- or even third-best world.

Jean-Pierre Landau (Sciences Po Paris) noted that recent technologies such as mRNA vaccines, which developed at unprecedented speed during the global pandemic, call for optimism and attest to a general underestimation of their potential.

Ulrich Volz noted that climate mitigation actions need to happen in predominantly rich countries and that virtually all technical solutions to achieve the climate targets are available and commercially viable today. Transformation in energy systems, solutions to end energy poverty, and the scale-up of renewable energy can be implemented. Thus, when talking about debt sustainability in emerging countries, the focus should be on adaptation and resilience investments.

Bill Janeway (Cambridge University) followed up on the technological availability of effective mitigation, suggesting that energy storage technology constitutes a colossal reverse salient despite the enormous decline in the cost of renewable energies. While the mRNA vaccine is a brilliant example of technological prowess, it is important to recognise that it was a function of 10–20 years of fundamental scientific research, which was primarily financed by the National Institute of Health (NIH) in the US and augmented by advanced purchase commitments by the American state. Janeway therefore called for caution in believing that the markets are going to deliver on the technologies needed. There is ample room and ample need for focused state investments.

Joshua Ostry (Geneva Graduate Institute) raised concerns over the possibility of accurately estimate emissions reductions. He inquired about the trade-offs between green bonds and state-contingent bonds in terms of emissions reduction and implementation feasibility.

Agnès Benassy-Quéré (French Ministry of the Economy, Finance and Recovery) added that countries may borrow more than needed because of the difficulty of monitoring the costs of climate-related projects, which could even become a form of greenwashing.

Patrick Bolton concurred that monitoring climate actions is a critical technical issue. Reversal risks are high so monitoring needs to happen over very long horizons. Technologies such as satellite imaging are helpful in the monitoring process but the right incentives to achieve climate targets in the long term must be set.

Agnès Benassy-Quéré suggested that possible debt restructuring conditionalities such as cutting brown energy subsidies might actually have neutral or even positive impacts on the fiscal balance. However, she pointed that the risk of policy reversal in such cases is high. Benassy-Quéré also noted that climate policies can have a negative impact on debt sustainability as they reduce potential growth if they are compared to actual growth rates and not an estimated counterfactual. She also argued that returns to adaptation investments are extremely high when compared to a counterfactual. She could not understand the rationale for a market failure if investors compare such investments with other opportunities using the same counterfactual.

Patrick Bolton concurred with Agnès Benassy-Quéré's point but observed that cutting subsidies to brown energy has not materialised because ultimately it is a political problem. He acknowledged that if reducing brown energy subsidies is not doable via mandate, it may be economically sensible to achieve it through other means as getting rid of the damage caused by brown energies may result in a higher payoff. On climate mitigation and growth, Bolton explained that the impact of climate change mitigation on growth all comes down to the counterfactual, which needs to be defined. Mitigation investments will limit growth compared to business as usual. However, considering the severe damages related to climate change that lies ahead, the current net present value of adaptation investments is significantly positive. On adaptation and the market failure, Bolton suggested that the market failure is due to the difficulty of generating positive cash flows from investing in long-term avoidance of climate disasters. Broadly speaking, the source of the market failure is the limited liability of fossil fuel companies for the damage they have caused. With unlimited liability, such companies would invest heavily in adaptation to limit long-term damages.

Beatrice Weder di Mauro added that the market failure also exists because the damage is not only concentrated regionally but also within countries, which implies that the counterfactual for investors cannot be the same.

Alain Robert (UBS) noted that converging political interest is key to address climate change and asked whether the unique situation could foster more international cooperation or further support recent deglobalisation trends as exemplified by sanctions and other acts of individual interests.

Martin Kessler (Finance for Development Lab) indicated that renewable energy projects are capital intensive and have low marginal costs. Thus, solutions to lower interest rates on invested capital are likely to render renewable energy more competitive than traditional fossil fuel energies. He also asked about the institutions or markets needed to address the market failure of global climate services provided by some developing countries.

Ulrich Volz highlighted that adaptation mostly covers investments in public goods, which explains the limited inflows of private capital. As many governments in developing countries will not have the means to invest in adaptation, MDBs will be key in providing international transfers. Rich countries have notably agreed to provide meaningful amounts of climate finance as part of the Paris Agreement. However, even the most comprehensive debt restructuring including climate clauses will not provide all the financing needed for developing countries to invest sufficiently in climate actions. Therefore, other forms of climate financing will be needed. Volz also noted that a large portion of the 650 billion of Special Drawing Rights (SDRs) allocated last year sit in the accounts of advanced countries. Nonetheless, only a small fraction of these funds has been rechannelled to developing countries. The UK counted its SDR donations for its Official Development Assistance (ODA) while at the same time cutting ODA. In Germany, the Bundesbank received the SDRs but is not able to give any development aid, although it is not using

the funds. Therefore, with political will, countries could provide much more financial support by channelling funds to development banks, which could invest massively in climate actions. Many countries in the Global South not only face a lost decade but are also likely to lose more decades of development if they are not able to invest sufficiently in adaptation and resilience. Finally, Volz highlighted that climate change is deeply unjust. However, he noted that considering climate change as a regional issue is short-sighted as it will also cause massive migration movements.

Jeromin Zettelmeyer clarified that the report refers to comprehensive climate conditional debt restructuring as an agreement that includes all participating creditors, but which is specific to each individual country. Another way to think of comprehensive debt restructuring is to have a group-based debt relief initiative for several countries at the same time. However, the report supports comprehensive fiscal transfers to developing countries that cannot pay for high adaptation needs but not in the form of a comprehensive debt relief. Zettelmeyer also briefly reminded how climate conditionality is implemented for green bonds, performance-linked bonds, and state-contingent bonds. Climate conditionality on green bonds is typically implemented via the use of proceeds in bond contracts. Performance-linked bonds let governments decide how to implement policies to reach the climate targets. Finally, state-contingent bonds incorporate automatic debt relief mechanisms if the borrowing country is hit by a climate shock. Zettelmeyer noted that if countries can have a significant influence on the economic damages of an exogenous climate shock through adaptation investments, the case for state-contingent instruments is less convincing unless they include climate performance features at the same time.

Ulrich Volz agreed with the benefits of using sustainability-linked bonds especially to mitigate the risks of moral hazard. However, he argued that even with the best adaptation investments, a country may still suffer severely from a climate shock, which makes a case for state-contingent instruments especially as resources for adaptation are limited.

POLICIES FOR GREENING SOVEREIGN DEBT

Chaired by Nicolas Veron, Bruegel and Peterson Institute

Valerie Cerra, *IMF*

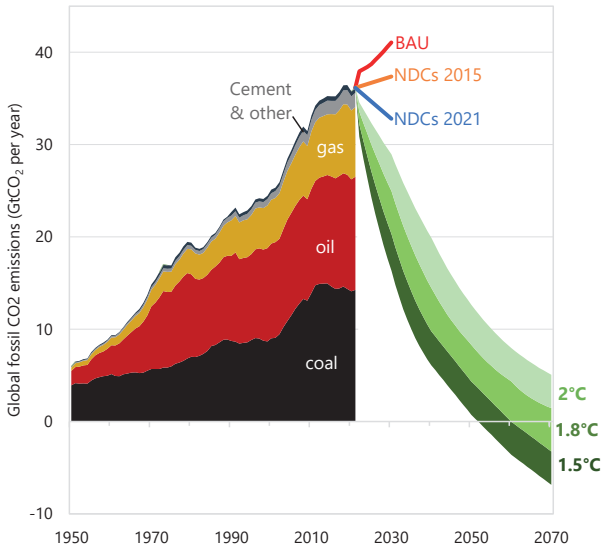
This has been an excellent report to read. It fills several gaps in the debate, especially concerning debt instruments, 'greeniums', and the existence and efficacy of enforcement mechanisms. I want to take a different perspective and represent the Fiscal Affairs Department of the IMF, where I'm doing some work on climate.

As we discussed today, we are significantly off track on emissions reduction. We need a complete reversal, and it is hard to see how we are going to get there. Large emitters need to focus on mitigation, but for most countries, it is an issue of vulnerability and the need to adapt for what is coming. This was nicely shown in the report, where you see the developing world really at risk. Vulnerability means that there is a significant amount

of adaptation investment needs. There is a whole range of estimates out there, but the numbers can be huge – for instance, there are estimates of climate investment needs of $7 trillion now, rising to $15–30 trillion by 2040. Small island states are particularly vulnerable and suffer damages due to natural disasters of up to 9% of GDP per year. In addition, those estimates are on top of developing needs of developing countries.

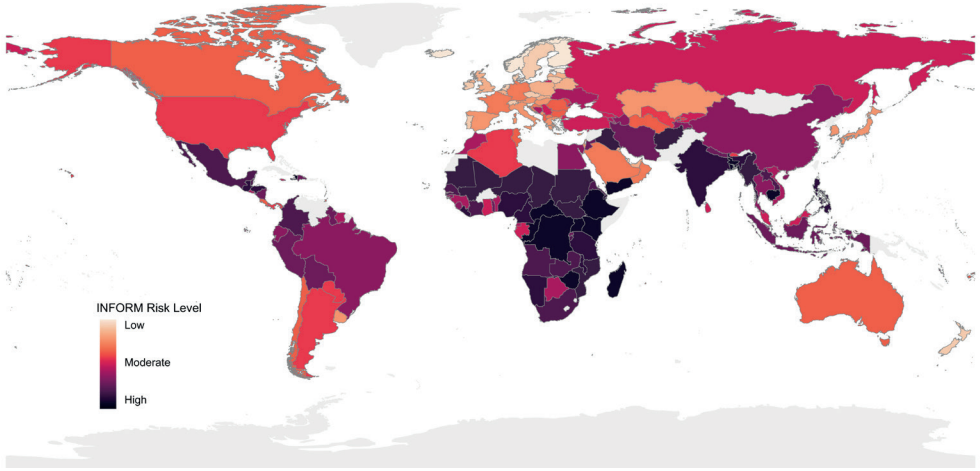
FIGURE 1 **OFF TRACK ON EMISSIONS REDUCTION; DEVELOPING COUNTRIES MMOST VULNERABLE TO CLIMATE CHANGE**

a) Global CO_2 emissions, Nationally Determined Contributions (NDCs) and temperature targets



Source: IMF Staff Climate Note 2021/005.

b) Climate vulnerability



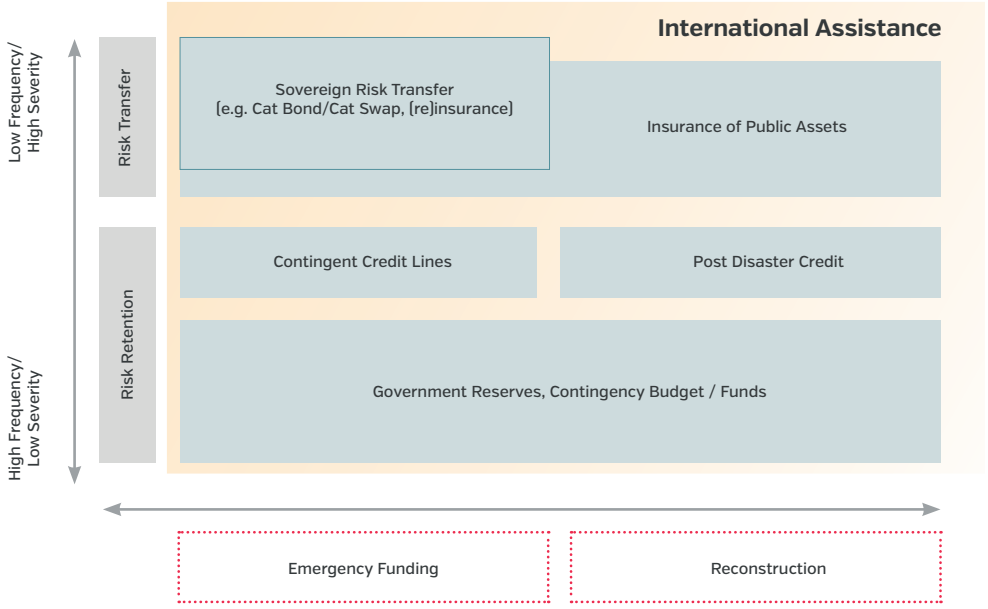
Source: Geneva Report on the World Economy 25, Figure 2.2

At the IMF we are trying to mainstream climate in many ways, including through our assessments. The Climate Macroeconomic Assessment Program (CMAP) is one of these ways. The aim of the programme is to look at the climate issue in a comprehensive way. We look at different angles and strands of analysis, and ultimately bring them together to see debt projections and look at different strategies on mitigation and adaptation. The CMAP shows us the importance of considering climate when looking at debt dynamics.

There are key aspects that should be included in climate and debt discussions. One of these aspects is that debt relief and grants remain first-best solutions for certain countries. Another aspect relates to fairness; richer countries that have caused a lot of climate-related problems should be contributing more. However, is there anything developing countries can do regarding climate?

Our work at the IMF also considers different kinds of climate impacts through risk layering, a concept that draws upon the World Bank's methodology. High-frequency and low-severity impact can be addressed by governments' own resources (budget and debt), and low-frequency but high-severity types of issues can be better tackled through insurance. Using this analytical framework, countries can better decide how much risk to retain and how much to transfer. We should consider different frequencies and severities of climate events and impact and use appropriate instruments accordingly. We should also think about catastrophic bonds as part of the equation of climate and debt.

FIGURE 2 **CLIMATE RISK LAYERING**

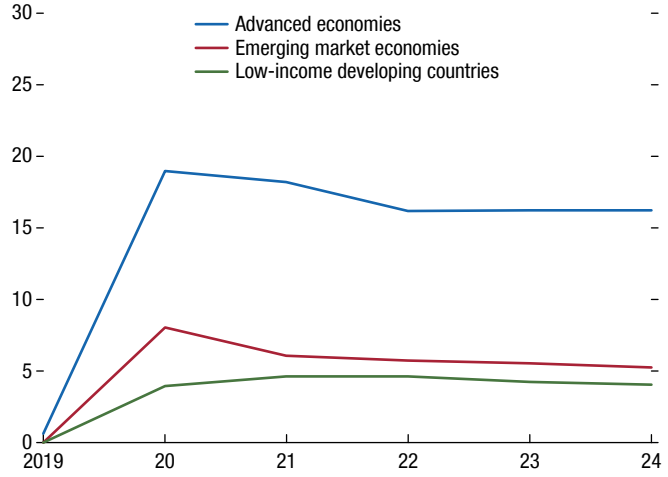


Source: World Bank (2014).

As mentioned in the report, many countries are facing major debt issues. Covid has changed projected debt levels. Although advanced economies experienced a more pronounced impact on their debt projections due to their ability to respond, developing countries were also hit. A significant number of low-income countries are in or near debt distress, therefore debt cannot be an option to deal with climate impact.

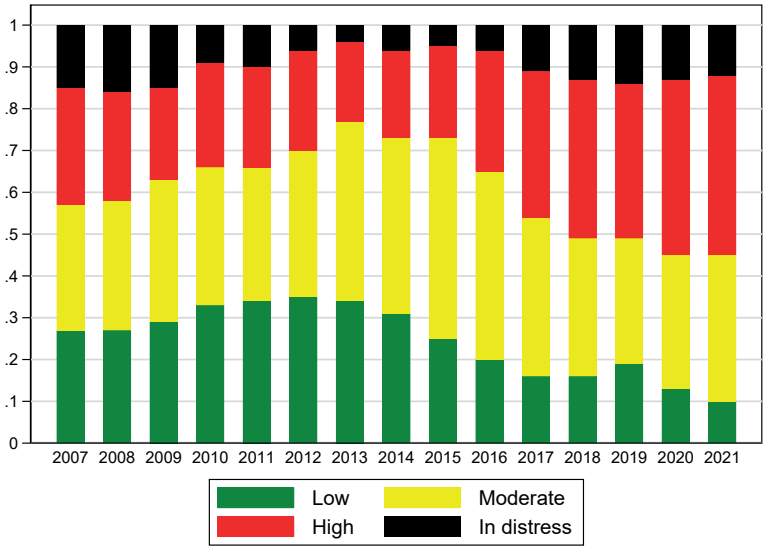
FIGURE 3 **INCREASED DEBT AND VULNERABILITIES**

a) Central government gross debt (change relative to pre-pandemic projections, % of GDP)



Source: Fiscal Monitor and IMF World Economic Outlook database, October 2021.

b) Debt sustainability over time



Note: This figure plots the evolution of the share of PRGT-eligible countries (72 countries in total) classified as being at low, moderate, and high risk of debt distress on the basis of the External debt World Bank/IMF Debt Sustainability Framework.

Source: Geneva Reports on the World Economy 25, Figure 3.4.

Other options should also be contemplated in the policy package and discussed more specifically in the report – even if they may be politically more difficult to implement. For instance, removing energy subsidies can generate significant fiscal gains and carbon pricing has the potential to increase fiscal revenues. Mobilising domestic revenues and improving efficiency of public investments should also be considered.

Schwan Badirou Gafari, *Paris Club*

The report was one of best I have read on the issue. It rightly indicates that linking debt to climate is not a silver bullet to address both debt sustainability and addressing the consequences of climate change. In what follows, I will focus my comments on three main fronts: (1) the disadvantages of debt–climate swaps; (2) the circumstances under which such instruments can be useful; and (3) potential contradictions in trying to address debt sustainability and climate investment simultaneously.

From a borrower's perspective, debt instruments are mostly used to address debt issues – to provide liquidity or address solvency issues. It is not obvious that debt–climate swaps will provide a margin for manoeuvre. In fact, depending on how swaps are designed, they can even further undermine debt sustainability. For instance, they can significantly extend the time needed to address debt sustainability issues. The lengthier the debt treatment is, the less effective it becomes. Also, these swaps could mean prioritising climate spending over other types of spending – for instance, key social spendings or payment services.

From a global perspective, debt–climate swaps can increase the risk of moral hazard behaviour, as the most-indebted countries would have less incentive to implement sound fiscal management policies. Also, regarding efficiency at the global level, there is no reason to assume that the allocation of scarce resources for climate financing should be based on indebtedness levels. For these reasons, I agree with what Jeromin Zettelmeyer said this morning, that grants should be prioritised over debt–climate swaps if the objective is to address debt sustainability and climate investments.

Nonetheless, I do not mean that debt–climate swaps cannot be an interesting instrument. Through the HIPC Initiative, Paris Club members used debt swap instruments, sometimes in exchange for climate-related projects – the case of the Seychelles in 2015 is presented in this report. Therefore, we do use debt swaps, but as an additional effort. In fact, debt–climate swaps can be useful in bridging the gap between what creditors want and what borrowers are willing to commit.

On the circumstances under which such instruments can be useful, we need to distinguish whether debt treatment is necessary to address debt sustainability issues. If debt treatment is necessary, conditionalities are more appropriate to address debt sustainability issues and climate-related issues at the same time. It can be similar to the HIPC initiative, where poverty reduction strategies needed to be designed and implemented in exchange for debt relief – these strategies did not necessarily mean incurring extra spending.

However, if debt treatment is not necessary to address debt sustainability, it comes down to whether donors choose debt–climate swaps or climate-related grants. The preferable option depends on what makes more sense from the governance and political perspectives of the donor.

On the potential contradictions in trying to address debt sustainability and climate investments simultaneously, the report does not cover cases in which the two objectives are in contradiction. For instance, this might happen when a country is a net exporter of fossil fuels, and its debt sustainability mainly depends on exporting oil or gas. In such a case, there is a clear trade-off between achieving stability and contributing to fighting climate change.

Frédéric Samama, *S&P Global Sustainable1*

I prepared three main set of comments on (1) the complex situation of emerging market economies, (2) financial instruments to tackle climate change, and (3) additional objectives and how investors have pursued them.

The report presents very clearly the complex situation in which emerging market economies currently are, thus I will not spend time on this.

Regarding my second set of comments, on financial instruments to tackle climate change, let me start by saying that green bonds and sustainability-linked bonds are no different from any bond with a precise use of proceeds. These bonds do not say anything about how the issuer is exposed to climate change risks. Thus, they are not about risks, they are only about how one communicates about the use of proceeds.

Green bonds – and sustainability-linked bonds as well – are subject to three frictional forces determining prices: costs related to reporting and certification, liquidity premium, and demand. To a large extent, these three forces depend only on the issuer. For the issuer, green bonds are a way of breaking silos across government institutions – for instance, through green bonds the Treasury and Ministry of Environment can better work together to address funding needs for climate-related projects. For investors, green bonds can send a signal of their preferences. However, there is nothing about risk assessment in these types of bonds.

Focusing on zero-net carbon and deforestation, we need carbon capture, but the magnitude of the problem is far from what our current carbon capture market can offer.

Lastly, we can learn from previous investors experiences. For instance, IFC used a two-front approach to promote green financing in developing markets. IFC created a $2 billion fund to invest in green bonds to finance infrastructure projects, while at the same helping countries to secure grants to set up their own technical facilities. Furthermore, passive investment vehicles have been designed to tackle the biodiversity challenge. There are also examples of investors engaging directly with corporates to understand their objectives to address climate-related challenges. This direct engagement improves price discovery, and if it can work for corporates, it can also work for sovereigns.

In conclusion, climate awareness has already been achieved. Now it is the time for large-scale solutions. We need to think of how to get investors to set up new products and enter new markets.

Floor discussion

Gong Cheng (BIS) alluded to the discussion in the report about the signalling effect of green bonds. He mentioned a recent report published by the Networking for Greening the Financial System (2022), which provides further insights into this signalling effect. He argued that the market might still be too fragmented to provide a standardised definition of what makes a bond green and how to report on it. However, he wondered whether sovereigns could play a role in signalling best practices by choosing for instance the procedures for green external reviews, and the types of certifications. Going forward, Cheng thinks that sovereigns should signal to the market the importance of impact reporting and their related disclosures.

Patrick Bolton (Columbia University) concurred that sovereigns can play an important role in promoting reporting standards. In fact, one of the most recent policy initiatives on this front is the proposal by the US Securities and Exchange Commission (SEC) to expand disclosure requirements to environmental impact.

Nicolas Veron (Bruegel and Peterson Institute) added that it would be important to give a sense of the global landscape in the report and to try to avoid being too US-centric. There are initiatives and bodies outside of the US such as the European Green Bond Standard and the International Sustainability Standards Board, to name two. He also suggested having a descriptive box in the report giving a sense of the fast-changing landscape for climate rating services.

Agnès Bénassy-Quéré (French Ministry of Economy, Finance and Recovery) stressed that the report focuses on the legal aspects of these green bonds, especially enforceability, but the authors argue that the reputation of issuers does not seem to be a concern for investors. However, at least in advanced economies, there is an ecosystem that is costly. For instance, there are initiatives to standardise good practices and principles for green bonds. There are also rating agencies, second-party option providers, and other stakeholders. She wondered whether these different actors and their respective efforts generate any change. She was particularly puzzled about rating agencies and why they matter for financial performance, but not for ESG performance.

Patrick Bolton emphasised that countries like France and Germany are shaping the ecosystems. Regarding credit rating agencies, his understanding is that they are mainly concerned with rating credit risk. Other rating agencies, such as MSCI, produce many ratings on ESG performance. However, it was unclear to him whether they consider in their ratings whether a company is in compliance with what it promised to invest.

Frédéric Samama (S&P Global Sustainable1) supported the view that credit rating agencies only assess the risk of default of the issuer. He explained that what the issuer does with the proceeds is part of the issuer's overall strategy. From a financial point of view, it is only if the issuer is affected by climate change that the risk profile can be assessed.

Patrick Bolton suggested that if the carbon credit market goes in the direction of thinking of the carbon credit more like a bond rather than a commodity, then it would be good to have credit rating agencies assessing the quality of offsets.

Martin Kessler (Finance for Development Lab) commented that the report and discussions taking place during the conference give the impression that green bonds are not doing very well with respect to the use of proceeds. However, Chinese bonds, for instance, possess certain characteristics guaranteeing that proceeds are used in specific projects, and that in an event of restructuring, green aspects of the projects are prioritised. He concluded by raising the question whether there is a way to issue project-specific bonds ensuring that funds go to the intended objectives instead of issuing general government green bonds, as has been the practice in many countries.

Nathan Sussman (Geneva Graduate Institute) provided further insight to Kessler's comment, mentioning the case of special purpose bonds in the 19th century, which differed from general purpose bonds. He used the example of Russian government-owned railway companies. The government had a project and created a public company that issued bonds. The default rate of these bonds was much lower than default rate of general purpose bonds. Underwriters were responsible for monitoring and enforcing contractual terms. He concluded that a similar role of monitoring and enforcement could be reinvigorated again.

Bill Janeway (Cambridge) reminded panellists about US municipal revenue bonds. These are bonds with explicit contractual clauses ensuring that interest and principal are repaid from the proceeds of the project that the bond is financing. It is very restrictive, and very much overseen by the rating agencies and by the investors.

Gong Cheng noted that Hong Kong's bonds are also examples of bonds that are working. Although earmarking is not possible in Hong Kong, the government matches the amount of funds raised in the market with new projects.

Beatrice Weder di Mauro (Geneva Graduate Institute) explained that the discussion about certain characteristics of green bonds is linked to the question the authors pursued at length in the report, namely, whether a greenium should exist in the first place. In other words, do green bonds differ in their price or their impact from normal bonds? The question is rather elusive because sometimes one can find the difference but other times it is not possible, and this inconsistency can be the result of several reasons. According to Weder di Mauro, there are four possibilities concerning the existence of a greenium and the impact of green bonds, and the report tries to distinguish them. The first possibility is that green bonds are merely greenwashing, especially because of the

issues with enforceability. The second possibility is related to fungibility, as it is possible that green bonds are not generating additional funds because green projects would have been funded by the regular government budget even without green bonds. In these first two possibilities, there will be neither a premium paid for green bonds, nor an impact generated by them. There is a third possibility in which investors are willing to pay more for green bonds. However, it is not clear whether these bonds would result in impact. Lastly, there is a fourth possibility in which there is no premium, but there is impact – the case when green investment is done reducing the country's vulnerabilities to climate change, and consequently lowering the overall sovereign country risk.

Rosmarie Schlup (SECO) added that the existence of a premium for green bonds may also reflect other characteristics of ESG bonds, such as those related to governance and accountability, which in their case tend to be better than normal bonds. She also remarked that it seems that gross financing needs are being split in the budget and raised the question of whether the discussion about the impact of green bonds simply assumes additionality.

Beatrice Weder di Mauro reacted to Rosmarie Schlup's remark on additionality explaining that fungibility is a more severe issue for running costs rather than for large lumpy investments. In that sense, one should be less concerned about fungibility and non-additionality when dealing with larger investments and in the case of more fiscally constrained countries. Therefore, the argument of fungibility will depend on the project and the country.

Ugo Panizza (Geneva Graduate Institute) continued the discussion about characteristics of green bonds, mentioning that the report tries to provide a sketch of what a true green bond should look like and how it should be designed to be enforceable. However, he clarified that even if such a bond existed, it might be impossible to identify the greenium or the impact for the reasons given by Beatrice Weder di Mauro.

Jeromin Zettelmeyer (IMF) observed the need to be cautious and to avoid completely identifying enforcement with contractual enforcement. In his view, it is possible to have a bond with a contractual language that states clearly the intention of the government about what to do with the funds in such a way that it would never allow the government to be sued for breach of contract. Investors can exercise judgement over whether the government did the best it could according to the general intentions of the bond. Then, either through a regulatory structure or court of public opinion, the government can be punished for not doing what it had promised.

Patrick Bolton shared Jeromin Zettelmeyer's concerns and noted that including explicit clauses on use of proceeds in a sovereign green bond could be characterised as a violation of the constitution in some countries. However, at least in developed markets, building implicit expectations of how proceeds would be used is already common practice.

Mitu Gulati (University of Virginia) agreed with Patrick Bolton that in some cases domestic legislation might restrict how use of proceeds is specified, but certainly not in all cases. He indicated that this is definitely not true in the context of municipal issuers in the US. Additionally, he did not see variation in the use of proceeds as a function of domestic legal constraints. He acknowledged that there might be other reasons rather than formal legislative constraints in the case of sovereign and quasi sovereigns, but based on the data analysed, he did not see variation as a function of that.

Jeromin Zettelmeyer classified bonds into two groups: (1) project bonds, or very precise use of proceeds bonds as the case of railway bonds presented by Nathan Sussman during our discussion – which in turn raises a question of whether it is constitutionally possible; and (2) performance-linked bonds, to which ex ante, financial terms of the bond are built in ensuring that, for instance, the sovereign will have to pay more if it misses certain emissions targets. He suggested that when faced with these two extremes, the question that should be asked is whether it would still be worth trying to create a market for reputation to enforce regular green bonds if a market for performance-linked bonds already existed. He mentioned he was persuaded by Frédéric Samama's point that solutions in the corporate green bond world could be transposed to sovereigns, but then he wondered whether it is not simply a model that is just dominated by performance-linked bonds.

Mitu Gulati followed up on Jeromin Zettelmeyer's intervention and stressed that a contract that is only associated with certain benchmarks means very little from a legal point of view. Regarding whether reputation alone can ensure how proceeds will be used, he explained that only bonds issued by issuers who the market does not trust to pay back through reputation were used in the analysis. However, he did not completely dismiss that reputation can work.

Fiona Frick (Unigestion SA) asked what would be needed to give some credibility to the carbon credit market in order to ensure that proposed projects are monitored and that the funds channeled to these projects are contributing to climate mitigation.

Patrick Bolton clarified that the carbon offset market – or carbon credit market – is fragmentated just because it is in its infancy. The fragmentation comes from the fact that many of the offsets are quite small and heterogeneous in nature. Another source of fragmentation is the differences in the kinds of demands for offsets. There are the serious buyers who will only buy high-quality offsets, and there are also the non-serious buyers who will go for cheaper offsets that are not properly verified and monitored. According to Bolton, the market can be integrated and scaled up though bundling and securitisation. He also stressed that the size of this market will be partly driven by regulations to reduce carbon emissions.

For **Beatrice Weder di Mauro**, the problem with the market offsetting flights is not necessarily transparency, but whether it is mandatory. She agreed that the market is still developing and added that although the report does not claim that air traffic has the potential to be the most important contributor in terms of tonnes of carbon offset, it argues that the market is an important one and could be improved significantly and relatively quickly.

Patrick Honohan (Trinity College Dublin) indicated that the green bond market currently operates based on a 'pass or fail' concept. He mentioned that he did not see in the report a discussion on a potential taxonomy which could better classify bonds according to how 'green' they are.

Patrick Bolton agreed that, as of now, the market only classifies bonds as 'green' and 'not green'. However, the direction the market is headed is to have a finer breakdown, hence, providing a more nuanced classification of how green bonds are.

Vit Bárta (Czech National Bank) raised concerns about the role of central banks in buying green bonds. He raised the question of whether central banks should play a special role in buying bonds. He also asked how one should resolve a potential conflict of interest in the event that the policy of buying green bonds contradicts central banks' main mission of price stability and financial stability.

Patrick Bolton argued that on this issue, at a minimum, green bonds should not be excluded from allowable collateral for central banks just because they are green. He suggested that a more controversial question is whether central banks should give more weight to green bonds. However, in his opinion, this is not yet the time to have this discussion.

Ugo Panizza added that according to a recent survey with European economists by the Center for Macroeconomics, buying green bonds is not a problem as long as it does not affect the objective of inflation targeting.[63]

Beatrice Weder di Mauro further contributed to the discussion, highlighting that climate risks should be captured through the risk management system of any financial institution, including central banks, if they are important to certain assets. Therefore, to the extent that climate change can also represent a risk to the economy, central banks should also be looking at climate. At least, this is what the ECB concluded in its new strategy.

Ulrich Volz (SOAS) introduced findings of some of his own research on the role of central banks in addressing climate environmental risks. He argued that central banks should play a very proactive role. However, the notion that central banks should specifically try to stimulate the green bond market is a futile discussion. According to Volz, such an effort

63 Results available at https://cfmsurvey.org/surveys/ecb's-green-agenda.

would not be addressing any problem, at least in the euro area, because there is currently no shortage of demand for green bonds. In fact, there is a shortage of good green assets. On the other hand, he argued that certain central banks in advanced economies are currently providing better financing conditions to fossil fuel sectors through their corporate asset purchase programs. He concluded by suggesting that central banks should take into account climate risks and climate impacts and align their portfolios with climate goals – which in the case of the European Union is also a law.

Vit Bárta (Czech National Bank) suggested that other agents should deal with green bond markets given that central banks are the only policy institutions focused on price stability. He explained that he would prefer to see central banks keep their predominant task and fulfil it properly. In his view, this more conservative approach would avoid a situation in which the mission of central banks is challenged by other agendas.

Patrick Bolton noted that after the global financial crisis, the mandates of all central banks were already expanded to include financial stability along with price stability. Then, if one thinks in terms of financial stability, it is unavoidable that climate risk should be considered, as the financial system is exposed to climate change.

Thomas Harr (Danmarks Nationalbank) noted that green bonds are being priced with a premium compared to normal bonds, regardless of whether they are sovereign or corporate bonds. He also added that investors' demand is currently extremely strong. He wondered whether financial stability is at risk because of these forces.

Patrick Bolton reminded panellists that the report finds no systematic evidence of a greenium. Therefore, he does not think there is a potential for over-issuance of green bonds, which could eventually culminate with a crash.

Emily Sinnott (EIB) had a few remarks for a potential follow-up report. She explained that the EIB has mechanisms in place to ensure that the projects supported by green bonds are in fact green. However, these mechanisms are complex, need significant amount of information, and rely extensively on network and monitoring – which translate in very high costs. She raised the question of how these processes could be scaled up, what kind of governance countries should have, if the latter should rely on rating agencies, and whether rating agencies should be subsidised. Sinnott also mentioned that the EIB receives a greenium, which is passed on to projects. She suggested that a follow-up report should also look at how countries could ensure that the greenium is returned to projects.

Nicolas Veron (Bruegel and Peterson Institute) added to Emily Sinnott's remarks stressing that he would be interested to know whether there is a role for a supranational architecture to support this type of policy initiatives.

Patrick Bolton reacted to Emily Sinnott's and Nicolas Veron's interventions by citing the SEC proposal, which according to him will have an impact on all stakeholders, including in other jurisdictions. Regarding monitoring, scaling and costs involved, he also explained that the SEC proposal only focuses on disclosures on direct carbon emissions because it is a metric that is relatively easy and affordable to measure and report. Thinking ahead, one could consider globally full disclosure of carbon emissions. In fact, many companies are already doing that on a voluntary basis.

Harald Hau (University of Geneva) noted that the general theme of the conference is how to keep the financial system accountable to climate concerns. There has been a significant amount of discussion about market finance, but virtually none on the banking system, which also gives a fair amount of debt. Central banks in Europe have established so-called credit registers, which give full account of all the credit given to every company out there by European banks. In Hau's opinion, to be able to extend the accountability from a narrow financial market focus to an overall accountability focus, including bank lending, a good step would be to make these credit registries become public. This will also have beneficial side effects, including improving finance stability.

References

Adrian, T., P. Bolton, and A. Kleinnijenhuis (2022), "The Great Carbon Arbitrage", IMF Working Paper No. 2022/107.

Aldy, J.E. and Z.M. Halem, 2022), "The Evolving Role of Greenhouse Gas Emission Offsets in Combatting Climate Change", Lazard Climate Center Discussion Paper.

Aligishiev, Z., E. Massetti and M. Bellon (2022), "Macro-Fiscal Implications of Adaptation to Climate Change", IMF Staff Climate Note 2022/02.

Agarwala, M., M. Burke, P. Klusak, K. Mohaddes, U. Volz, and D. Zenghelis (2021), "Climate Change and Fiscal Sustainability: Risks and Opportunities", *National Institute Economic Review* 258: 28-46.

Allen, M., K. Axelsson, B. Caldecott et al. (2020), *The Oxford Principles for Net Zero Aligned Carbon Offsetting*, University of Oxford.

Ando, S., C. Fu, F. Roch, and U. Wiriadinata (2022), "Sovereign Climate Debt Instruments: An Overview of the Green and Catastrophe Bond Markets", IMF Staff Climate Note 2022/004.

Asonuma, T. and C. Trebesch (2016), "Sovereign Debt Restructurings: Preemptive or Post-Default", *Journal of the European Economic Association* 14(1): 75-214.

Baker, M., D. Bergstresser, G. Serafeim, and J. Wurgler (2022), "Financing the Response to Climate Change: The Pricing and Ownership of U.S. Green Bonds", NBER Working Paper No. 25194

Barbalau, A. and F. Zeni (2021), "The optimal design of green securities", working paper.

Beirne, J., N. Renzhi, and U. Volz (2021a), "Bracing for the Typhoon: Climate Change and Sovereign Risk in Southeast Asia", *Sustainable Development* 29: 537-551.

Beirne, J., N. Renzhi and U. Volz (2021b), "Feeling the heat: Climate risks and the cost of sovereign borrowing", *International Review of Economics & Finance* 76: 920-936.

Bolton, P. and H. Huang (2018), "The Capital Structure of Nations", Review of Finance 22: 45-82.

Bolton, P. and O. Jeanne (2007), "Structuring and Restructuring Sovereign Debt: The Role of a Bankruptcy Regime", *Journal of Political Economy* 115(6): 901–24.

Bolton, P. and D.S. Scharfstein (1990), "A Theory of Predation Based on Agency Problems in Financial Contracting", *The American Economic Review* 80(1): 93–106.

Bolton, P., L. Buchheit, P.-O. Gourinchas, M. Gulati, C.-T. Hsieh, U. Panizza and B. Weder di Mauro (2020), "Born Out of Necessity: A Debt Standstill for COVID-19", CEPR Policy Insight No. 103.

Bolton, P., M. Gulati and U. Panizza (2021), "Legal Air Cover", *Journal of Financial Regulation* 7(2): 189–216.

Bolton, P., L. Buchheit, M. Gulati, U. Panizza, and B Weder di Mauro (2022), "Environmental Protection and Sovereign Debt Restructuring", *Capital Markets Law Journal* (forthcoming)

Borensztein, E., M. Chamon, O. Jeanne, P. Mauro, and J. Zettelmeyer (2005), "Sovereign Debt Structure for Crisis Prevention", IMF Occasional Paper, 237

Buchheit, L.C. and M. Gulati (2020), "The Argentine Collective Action Clause Controversy", *Capital Markets Law Journal Volume* 15: 464-473.

Buchheit, L., G. Chabert, C. DeLong, and J. Zettelmeyer (2020), "The Restructuring Process", in S.A. Abbas, A. Pienkowski, and K. Rogoff (eds), *Sovereign Debt*, Oxford University Press.

Buchner, B., A. Clark, A. Falconer, R. Macquarie, C. Meattle, R. Tolentino, and C. Wetherbee (2019), "Global Landscape of Climate finance", Climate Policy Initiative.

Buhr, B., U. Volz, C. Donovan, G. Kling, Y. Lo, V. Murinde and N Pullin (2018), "Climate change and the cost of capital in developing countries", Imperial College London, SOAS University of London, and UN Environment.

Bulow, J. and K. Rogoff (1988), "The Buyback Boondoggle", *Brookings Papers on Economic Activity* 2: 675-704.

Calvo, G. (1988), "Servicing the Public Debt: The Role of Expectations", *The American Economic Review* 78(4): 647-661

Chabert, G., M. Cerisola, and D. Hakura (2022), "Restructuring Debt of Poorer Nations Requires More Efficient Coordination", IMF Blog, 7 April 7.

Chamon, M., E. Klok, V. Thakoor and J. Zettelmeyer (2022), "Debt-for-Climate Swaps: Analysis, Design, and Implementation", IMF Working Paper 2022/162.

Chen, C., I. Noble, J. Hellmann, J. Coffee, M. Murillo and N. Chawla (2015), "University of Notre Dame Global Adaptation Index: Country Index Technical Report", ND-GAIN.

CBI – Climate Bonds Initiative (2021), *Green Bond Pricing in the Primary Market: July - December 2021* (H2 2021).

Comello, S., J. Reichelstein, and S. Reichelstein, (2021), "Corporate Carbon Reduction Pledges: An Effective Tool to Mitigate Climate Change?" ZEW - Centre for European Economic Research Discussion Paper No. 21-052.

Conan Doyle, A. (1892), "The Adventure of Silver Blaze", in *The Memoirs of Sherlock Holmes.*

Cooper, H., S. Evers, P. Aplin et al. (2020), "Greenhouse gas emissions resulting from conversion of peat swamp forest to oil palm plantation", *Nature Communications* 11, 407

Cruces, J.J. and C. Trebesch (2013), "Sovereign Defaults: The Price of Haircuts", *American Economic Journal: Macroeconomics* 5(3): 85–117.

DARA (2011), *The Climate Vulnerability Monitor*, 2nd edition.

De Grauwe, P. (2012), "The Governance of a Fragile Eurozone", *Australian Economic Review* 45: 255-268.

Dittmar, R. and K. Yuan (2008), "Do Sovereign Bonds Benefit Corporate Bonds in Emerging Markets?", *The Review of Financial Studies* 21(5): 1983-2014

Doronzo, R., V. Siracusa, and S. Antonelli (2021), "Green Bonds: The Sovereign Issuers' Perspective", Bank of Italy Markets, Infrastructures, Payment Systems Working Paper No. 3.

ESCWA – Economic and Social Commission for Western Asia (2022), *A regional framework for a Debt Swap Mechanism and key performance indicators for climate action/SDGs progress in the Arab region*, Beirut.

EIB – European Investment Bank (2021), "Evaluation of the EIB's Climate Awareness Bonds".

Ellerman, A.D., C. Marcantonini and A. Zaklan (2016), "The European Union emissions trading system: ten years and counting", *Review of Environmental Economics and Policy* 10(1): 89-107.

Fatica, S., R. Panzica and M. Rancan (2021), "The pricing of green bonds: Are financial institutions special?", *Journal of Financial Stability* 54: 1-20.

Flammer, C. (2021), "Corporate Green Bonds", *Journal of Financial Economics* 141: 499-516.

Gelpern, A. and U. Panizza (2022), "Enough Potential Repudiation: Economic and Legal Aspects of Sovereign Debt in the Pandemic Era", *Annual Review of Economics* (forthcoming)

Georgieva, K., and C. Pazarbasioglu (2021), "The G20 Common Framework for Debt Treatments Must Be Stepped Up", IMF blog, 2 December.

Gill, I. (2022), "It's time to end the slow-motion tragedy in debt restructurings", World Bank blog, 1 March 1.

Grzegorczyk, M. and G. Wolff (2022), "Greeniums in sovereign bond markets", unpublished, Bruegel.

Harris, N. and D. Gibbs (2021), "Forests Absorb Twice As Much Carbon As They Emit Each Year", World Resources Institute, 21 January.

Harris, N.L., D.A. Gibbs, A. Baccini et al. (2021), "Global maps of twenty-first century forest carbon fluxes", *Nature Climate Change* 11: 234–240.

IMF – International Monetary Fund (2020), *IMF Fiscal Monitor*, October.

IMF (2022a), "Belize: Staff Concluding Statement of the 2022 Article IV Mission".

IMF (2022b), "Staff Guidance Note on the Sovereign Risk and Debt Sustainability Framework for Market Access Countries".

IPCC Working Group I (2021), *Climate Change 2021: The Physical Science Basis, contribution to the Sixth Assessment Report*, Intergovernmental Panel on Climate Change.

IPCC Working Group II (2022), *Climate Change 2022: Impacts, Adaptation and Vulnerability, contribution to the Sixth Assessment Report*, Intergovernmental Panel on Climate Change.

IPCC Working Group III (2022), *Climate Change 2022 –Mitigation of Climate Change, Summary for Policymakers*, Intergovernmental Panel on Climate Change.

Kling, G, Y.C. Lo, V. Murinde amd U. Volz (2018), "Climate Vulnerability and the Cost of Debt", Centre for Global Finance Working Paper, SOAS University of London.

Lang, V., D. Mihalyi, and A. Presbitero (2022), "Borrowing Costs after Sovereign Debt Relief", *American Economic Journal: Economic Policy* (forthcoming).

Lee, D. and T. Pistorius (2015), "The Impacts of International REDD+ Finance", UNFCCC Standing Committee on Finance.

Matthews, D., K. Zickfeld, M. Dickau, A.J. MacIsaac, S. Mathesius, C.-M. Nzotungicimpaye and A. Luers (2022), "Temporary nature-based carbon removal can lower peak warming in a well-below 2 °C scenario", Evergeen Alliance.

McKinsey (2022), *The Net-zero Transition: What it Would Cost, What it Could Bring*, McKinsey Global Institute

Meyer, J., C. Reinhart and C. Trebesch (2022), "Sovereign bonds since Waterloo", *Quarterly Journal of Economics* 137(3): 1–66.

Mitchener K. and C. Trebesch (2022), "Sovereign Debt in the 21st century: Looking Backward, Looking Forward", *Journal of Economic Literature* (forthcoming)

Network for Greening the Financial System (2022), *Enhancing market transparency in green and transition finance*.

Norman, M. and S. Nakhooda (2015), "The State of REDD+ Finance", CGD Climate and Forest Paper Series #5.

OECD (2021), *Climate Finance Provided and Mobilised by Developed Countries: Aggregate Trends Updated with 2019 Data*, OECD Publishing, Paris,

Panizza, U. (2017), "The Use of Corruption Indicators in Sovereign Ratings", Inter-American Development Bank Institutions for Development Sector Technical Note IDB-TN-1318.

Panizza, U., F. Sturzenegger, and Jeromin Zettelmeyer (2009), "The Economics and Law of Sovereign Debt and Default", *Journal of Economic Literature* 47(3): 65–98.

Papoutsi, M., M. Piazzesi and M. Schneider (2022), "How unconventional is green monetary policy?", working paper.

Picolotti, R., D. Zaelke, K. Silverman-Roati and R. Ferris (2020), "Debt-for-climate swaps", IGSD Discussion Document, August.

Reilly, W.K. (2006), "Using International Finance to Further Conservation: The First 15 Years of Debt-For-Nature Swaps", in C. Jochnick and F.A. Preston (eds), *Sovereign Debt at the Crossroads: Challenges and Proposal for Resolving the Third World Debt Crisis*, Oxford University Press.

Rivetti, D. (2022), "Achieving Comparability of Treatment under the G20's Common Framework", Equitable Growth, Finance & Institutions Note, World Bank.

Shin, H. (2016), "The bank/capital markets nexus goes global", speech at the London School of Economics and Political Science, 15 November.

Sheikh, P.A. (2018), "Debt-for-Nature Initiatives and the Tropical Forest Conservation Act (TFCA): Status and Implementation", Congressional Research Service.

Sjogersten, S. (2020), "Palm oil: research shows that new plantations produce double the emissions of mature ones", The Conversation, 22 January.

Spinaci, S. (2022), "European green bonds: A standard for Europe, open to the world", study for the European Parliament.

Steele, P. and S. Patel (2020), "Tackling the Triple Crisis. Using debt swaps to address, debt, climate, and nature loss post-COVID-10", IIED Issue paper.

Sturzenegger, F. and J. Zettelmeyer (2005), "Haircuts: Estimating Investor Losses in Sovereign Debt Restructurings, 1998–2005s", IMF Working Paper No. 05/137.

Sturzenegger, F. and J. Zettelmeyer (2007), *Debt Defaults and Lessons from a Decade of Crises*, MIT Press.

The Nature Conservancy (2022), "Belize debt conversion for marine for marine conservation", Case Study.

United Nations (2018), *Achievements of the Clean Development Mechanism: Harnessing Incentive for Climate Action*.

United Nations Environment Programme (2018), *Climate Change and the Cost of Capital in Developing Countries: Assessing the Impact of Climate Risks on Sovereign Borrowing Costs*.

Volz, U. (2018), "Climate Change and the Cost of capital in Developing Countries", presentation at the "Understanding Risk Finance Pacific Forum", Port Vila, 16-19 October.

Volz, U. (2022), "On the Potential of Sovereign State-Contingent Debt in Contributing to Better Public Debt Management and Enhancing Sustainability Outcomes", mimeo, SOAS, University of London.

Volz, U., J. Beirne, N. Ambrosio Preudhomme, A. Fenton, E. Mazzacurati, N. Renzhi and J. Stampe (2020a), "Climate change and sovereign risk", SOAS University of London, Asian Development Bank Institute, World Wide Fund for Nature Singapore, Four Twenty Seven.

Volz, U., S. Akhtar, K.P. Gallagher, S. Griffith-Jones, J. Haas and M. Kraemer (2021), "Debt Relief for a Green and Inclusive Recovery: Securing Private-sector Participation and Creating Policy Space for Sustainable Development", Heinrich-Böll-Stiftung, SOAS, University of London and Boston University.

Weidemaier, M. and M. Gulati (2021) "(Why) Are ESG Bonds (Such) Scams?", Credit Slips blog, 9 July.

Welle, T. and J. Birkmann (2015), "The World Risk Index – An Approach to Assess Risk and Vulnerability on a Global Scale", *Journal of Extreme Events* 2(01).

World Bank (2014), *Financial Protection Against National Disasters: An Operational Framework for Disaster Risk Financing and Insurance*.

Yuan, K. (2005), "The Liquidity Service of Benchmark Securities", *Journal of the European Economic Association* 3(5): 1156–80.

CENTRE FOR ECONOMIC POLICY RESEARCH

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Mitigating and adapting to climate change is both a matter of survival and of economic rationality. Investing in mitigation and adaptation will reduce the economic costs of climate change. In that sense, it saves money. But compared to an alternate world in which climate change does not exist, mitigation and adaptation will be expensive. Debt is needed to distribute the burden of climate action across generations. Even in a one-country world, the link between climate and debt leads to complicated questions. However, the planet consists of many countries, each with its own interests and resource limitations. This creates an additional challenge related to aligning individual country interests with the global interest of limiting temperature rises.

This report discusses these challenges by focusing attention on how climate mitigation and adaptation is paid for, and who pays for it. This requires thinking about instruments such as sovereign bonds, carbon credits, conditional official grants, and debt relief from both public and private sources. It points out that cross-country transfers are essential to effectively address climate change both because country-level actions can create global externalities but also for fairness reasons, as the countries that are most affected by climate change are generally not responsible for the stock greenhouse gases that causes the problem.

The report suggests that no single instrument is right for all countries or at all times and puts forward six proposals and policy recommendations that can jointly address climate change and debt sustainability by focusing on financial instruments as a means of incentivising and committing governments to do the right thing and providing fiscal space for climate investment in countries that could not otherwise afford it.

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