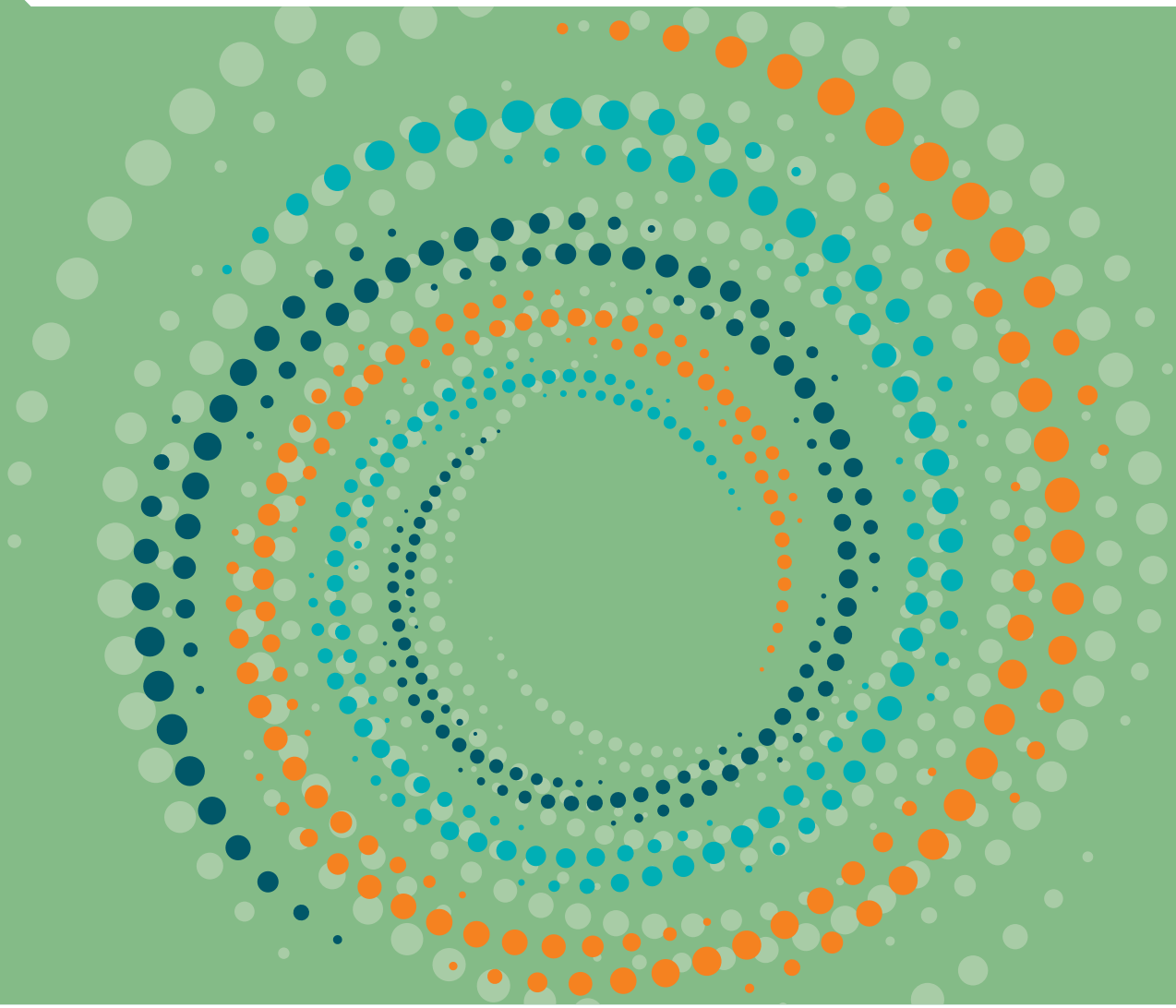
Building Financial Resilience to Climate Impacts

A FRAMEWORK FOR GOVERNMENTS TO MANAGE THE RISKS OF LOSSES AND DAMAGES



OECD

Building Financial Resilience to Climate Impacts

A FRAMEWORK FOR GOVERNMENTS TO MANAGE THE RISKS OF LOSSES AND DAMAGES

OECD
BETTER POLICIES FOR BETTER LIVES

Please cite this publication as:
OECD (2022), *Building Financial Resilience to Climate Impacts: A Framework for Governments to Manage the Risks of Losses and Damages*, OECD Publishing, Paris, https://doi.org/10.1787/9e2e1412-en.

ISBN 978-92-64-92067-5 (print)
ISBN 978-92-64-80119-6 (pdf)
ISBN 978-92-64-92446-8 (HTML)
ISBN 978-92-64-60938-9 (epub)

Photo credits: Cover © Maro Haas/MH Design.

Corrigenda to publications may be found on line at: www.oecd.org/about/publishing/corrigenda.htm.

Foreword

In a world with mounting impacts of climate change on livelihoods and the broader economy, governments play an increasingly critical role in managing the adverse impacts. As the climate changes, and losses and damages increase, governments are required to increase their resilience and develop strategies for dealing with financial risks of climate change. With a focus on the impacts of climate-related disasters including extreme weather events on the fiscal framework of central governments, this report proposes policy solutions on how governments can reduce, manage and address these climate-related financial risks. It offers a strategic framework that elaborates on the role of governments in the identification and assessment of climate-related physical risks and their impacts on public finances, the mitigation of those risks through investments in risk reduction and risk management, and the development of financial strategies to fund government expenditure needs. The report and its recommendations take into consideration the differences in fiscal resources and borrowing capacities that may exist across countries, assessing the adequacy of different financial and budgetary tools for climate risks of varying frequency and severity and in different national contexts.

The report is intended to support decision-making and action at the national and international levels, particularly among governments in emerging market and developing economies that face increasing climate-related risks. It concludes with a discussion of the way forward in the promotion of global financial resilience, through shared international action and mobilisation of additional development finance for greater collaboration and coherence.

The report benefited from the oversight of three OECD committees: the Environment Policy Committee (EPOC) and its Working Party on Climate, Investment, and Development (WPCID), the Insurance and Private Pensions Committee (IPPC) and the Senior Budget Officials (SBO) Committee. The analytical framework builds on the 2021 OECD report *Managing climate risks, facing up to losses and damages*, and is informed by the *OECD Recommendation on Disaster Risk Financing Strategies*, the *OECD Recommendation on Budgetary Governance, the OECD Recommendation on the Governance of Critical Risks,* complemented by the *G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing*.

Acknowledgements

This report is the result of a collaborative effort by the OECD Environment Directorate (ENV), the Public Governance Directorate (GOV), and the Directorate for Financial and Enterprise Affairs (DAF) respectively headed by Jo Tyndall, Elsa Pilichowski and Carmine Di Noia. It reflects cooperation by three teams from the Environment Transition and Resilience Division, the Public Management and Budgeting Division, and the Consumer Finance, Insurance and Pensions Division respectively headed by Walid Oueslati, Jon Blondal and Flore-Anne Messy. The report was authored by Balazs Stadler (ENV), Titouan Chassagne (GOV), Alexandre Leroy (GOV) and Leigh Wolfrom (DAF), under the supervision of Timothy Bishop, Stéphane Jacobzone and Marcia Rocha.

The authors are grateful for the oversight, review, information and comments provided by country delegates from the Environment Policy Committee (EPOC) and its Working Party on Climate, Investment, and Development (WPCID), the Insurance and Private Pensions Committee (IPPC) and the Senior Budget Officials (SBO) Committee, as well as for comments received from a range of private and public sector stakeholders, including InsuResilience, in particular Daniel Stadtmüller and Kay Tuschen, and the World Bank, in particular Olivier Mahul, Tatiana Skalon and Michaela Mei Dolk. Marina Helou provided useful research and analytical support.

The authors would also like to thank the following OECD colleagues for their insightful comments and review: Andrew Blazey, Juan Casado Asensio, Catherine Gamper and Nicolina Lamhauge.

The report was prepared for publication with support from Nassera Belkhiter from the OECD Environment Directorate.

Financial support from and collaboration with the German Federal Ministry for Economic Cooperation and Development (BMZ) and input provided by various programmes of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, in particular from Martin Kipping, are gratefully acknowledged.

Table of contents

Tables

Figures

Boxes

Executive summary

Key findings

The increasing frequency and severity of climate change-related extreme events, including cyclones, floods, and wildfires, are resulting in increasing damages to homes, building and infrastructure with significant implications for livelihoods and the broader economy. Governments have a critical role to play in supporting relief, recovery and reconstruction in the aftermath of climate-related extreme events, to address the resulting financial losses, and in creating an enabling environment that encourages adaptation, risk reduction and financial resilience. This creates pressures on public finances and can result in fiscal risks. Identifying and assessing such climate-related fiscal risks, mitigating these risks across society and ensuring sufficient funding to respond to events when they occur will become an increasingly important component of public financial management and economic policy.

This report provides an analytical framework for governments to support the financial management of climate-related risks, in particular the exposure of governments to economy-wide losses and damages from physical risks linked to climate change. The goal is to support enhanced decision-making and action at the national and international levels, with the aim of helping governments, particularly in emerging market and developing economies facing budgetary and financing constraints, better manage the financial risks that they face from the expected increase in frequency and intensity of climate-related extreme events.

The report addresses the public financial management challenges that these climate-related risks present to governments in terms of fiscal risks. It examines the role of different public schemes, including budget reallocations, risk retention (e.g. reserve funds), risk financing (e.g. official finance, public debt issuance) and risk transfer mechanisms (e.g. insurance, catastrophe bonds) in managing fiscal risks, with due recognition to potential differences in fiscal resources and repayment capacities and other key factors that may influence financial strategies for climate risk, such as data availability, technical expertise, and the structure of fiscal arrangements across levels of governments.

The framework is structured in two parts:

- The first part is about strengthening governments' financial management of climate-related risks at the **national level**. Climate-related physical risks, first, need to be identified and better understood in terms of their components (hazards, exposure and vulnerability) and sources. Once the physical risks and their sources are identified, opportunities to mitigate financial losses through adaptation and risk reduction should be examined. A key step is to ensure that incentives for risk reduction are established across society to encourage risk reduction actions by households, businesses, financial sector and sub-national governments. Residual physical risks will remain, even after the best efforts to reduce them. These remaining physical risks will result in financial losses, which will need to be absorbed by the economy and which will translate into fiscal and financial risks, which will need to be integrated into public financial management frameworks. The next step is to ensure sufficient funding and buffers to respond effectively to these fiscal risks, through coherent and integrated multipronged government financial strategies.

- The second part discusses the importance of promoting **global climate financial resilience**. Building financial resilience to climate impacts requires that development partners promote integrated strategies to strengthen financial resilience at the country level, through multiple channels. It is also important to promote coordinated action in terms of international development cooperation to effectively improve global climate financial resilience.

The framework builds on the OECD report, Managing climate risks, facing up to losses and damages (2021), and is informed by the OECD Recommendation on Disaster Risk Financing Strategies, the OECD Recommendation on Budgetary Governance the OECD Recommendation on the Governance of Critical Risks complemented by the G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing. It aims to provide guidance for central governments, regulators and international development community on preparing for climate-related losses and damages from a public financial management perspective, including for:

- Identifying and assessing climate-related risks, financial vulnerabilities, and financial implications for government;
- Reporting climate-related fiscal risks to promote transparency in public financial management;
- Promoting, investing and financing risk prevention, risk reduction and adaptation to reduce exposure and vulnerability;
- Protecting households and businesses through insurance and access to credit;
- Aligning incentives across levels of government by encouraging active risk management;
- Ensuring clarity in public financial assistance arrangements for households and businesses to mitigate future financial losses;
- Assessing budgetary capacities to fund relief, recovery, and reconstruction, including through budget reallocation;
- Assessing debt market borrowing capacities, including speed of access; and,
- Optimising financial tools under budgetary and financing constraints, within integrated frameworks of disaster risk management and reduction.

This report has the potential to provide insights to discussions at international fora, such as the UN, the G7 and others on climate resilient development. For instance, recognising and acting on the challenges posed by the greater need for coordination on these issues has been a priority for both the previous and current G7 presidency. Germany has made strengthening the climate and disaster risk finance and insurance architecture in a systematic, coherent and sustained way a priority in its G7 presidency.

1 Key recommendations

This chapter provides a summary and overview of the strategic framework for government action to manage the risks of losses and damages developed in this report. The goal of the strategic framework is to provide guidance for central governments, regulators and international development community on how to manage climate-related financial risks, from a public financial management perspective.

Table 1.1. Key recommendations and actions for the financial management of losses and damages from climate change

1. STRENGTHENING FINANCIAL MANAGEMENT OF CLIMATE-RELATED RISKS	
1. Identify, assess and report on climate-related risks and their financial implications for government	
Identifying and assessing climate-related risks, financial vulnerabilities, and financial implications for government	• Map existing and emerging climate-related physical risks, by identifying vulnerabilities of exposed communities and assets to extreme weather events and their financial implications for the economy and for the public finances: identify potential for extreme weather events, their severity and frequency; identify households, businesses or subnational governments potentially exposed; assess their capacity to absorb the losses and damages through savings, borrowing or insurance coverage and any financial vulnerabilities that may emerge. • Clearly distinguish between explicit and implicit contingent liabilities, consider second-order effects, such as revenue loss and prepare through explicit *ex ante* arrangements for cost-sharing, financial support and compensation. • Estimate the potential fiscal impact, including explicit and implicit contingent liabilities and revenue effects, using available measurement methods (direct estimates, probabilistic modelling, stress test and sensitivity analysis). • Integrate climate risk for government into fiscal risks assessments through long-term fiscal sustainability analysis. • Identify national capacities for gathering the relevant data to better understand i climate-related physical risks, gaps and ways to bridge those gaps.
Reporting climate-related fiscal risks to promote transparency in public financial management	• Identify and disclose funding and financial plans for managing climate risks, including how residual risk is addressed, either through the budget reporting process or as part of the fiscal risks management strategy.
2. Mitigate financial losses from climate-related risks and their implications for governments	
Promoting, investing and financing risk prevention, risk reduction and adaptation to reduce exposure and vulnerability	• Assess risk reduction investments through decision support tools such as cost-benefit and cost-effectiveness analysis. • Integrate climate risk in public investment management to promote climate-resilient projects, including a whole-of-life (i.e. capital, operating expenditure, decommissioning) cost assessment to capture adaptation benefits • Extend the timeframe on public sector discount rates to create incentives for integrating adaptation measures to reflect the long-term resilience benefits of public investments and factor them fully into project appraisals. • Integrate resilience considerations and use public procurement strategically to increase the resilience of procured goods, services and public works. Levy the use of existing infrastructure and services, such as electricity, drinking water and transport, to fund future resilience activities, such as the relocation of assets. • Leverage risk reduction and climate adaptation financing through thematic bond markets.
Protecting households and businesses through insurance and access to credit	• Raise awareness of the climate-related physical risks that households and businesses face. • Evaluate the overall availability and affordability of insurance coverage for potential climate-related hazards and identify any segments of society that could be left uninsured and financially vulnerable. • Support the availability of affordable insurance through insurance regulation, by leveraging international reinsurance markets and encouraging take-up. • Consider the potential contribution of catastrophe risk insurance programmes to broadening the availability of affordable insurance coverage while managing potential fiscal risks. • Support access to insurance for vulnerable segments of society. • Assess the potential impact of climate change on the future availability of affordable insurance coverage.
Aligning incentives across levels of government	• Promote cost-sharing of impacts to help sub-national governments through well-designed cost-sharing mechanisms, by defining clear and explicit reimbursement conditions (e.g. eligibility criteria) for disaster-related costs and setting transparent ceilings on financial assistance to provide incentives to subnational governments to manage residual risk. • Promote cost-sharing mechanisms between sub-national governments and communities, such as through targeted rates on property, to ensure that that revenue is gathered from those directly benefiting from resilience investment (and removes any future risk of moral hazard).
Ensuring clarity in public financial assistance arrangements for households and businesses to mitigate future financial losses	• Ensure the availability of basic compensation and post-disaster financing to reduce economic/social hardship. • Provide clarity on scope, level of support, eligibility and ceilings for financial assistance arrangements.

3. Prepare integrated multipronged government financial strategies	

Assessing budgetary capacities to fund relief, recovery, and reconstruction, including through budget reallocation	• Develop integrated government financial strategies, coordinated with fiscal risk assessment, that take into account the funding needed, when that funding is needed, as well the relative costs and benefits of different approaches (risk reduction and climate adaptation, risk retention, risk financing, risk transfer).
	• As a starting point, consider government capacity to manage climate-related financial risks facing the public sector within the budgetary and fiscal framework, for instance through possible contingency reserves or budgetary reallocations. Dedicated reserve funds, in which funds are accumulated over time, may be established to meet disaster costs.
	  ○ **Contingency reserves:** Governments with budgetary flexibility and capacity should set up contingency provisions in their budget to absorb high-frequency but low-severity climate-related events (e.g. localised floods and droughts) and cover immediate disaster relief and response needs.
	  ○ **Reserve funds:** For relatively high-severity, low-frequency climate disasters, reserve funds would be more appropriate than a general contingency reserve; depending on ease and cost of access to public debt financing.
	  ▪ The amount of funds set aside for climate-related contingent liabilities should be determined based on climate risk assessment and estimates of annualised cost.
	  ▪ Contingency and reserve funds should be designed to maximise speed of access.
	  ○ **Budget reallocations:** Budgetary frameworks for emergencies should allow for the rapid reallocation of funds to cover immediate post-disaster funding needs. Legislative authorities should be informed of reallocations even if their approval is not required. The executive branch should regularly report on the overall impact of reallocations to the legislature.

Assessing debt market borrowing capacities, including speed of access	• Assess capacity to meet funding needs through public debt financing markets:
	  ○ Debt financing can be an efficient source of financing for governments with low borrowing costs and robust access to international bond markets.
	  ○ Debt financing might not be a viable option for countries with low credit standing or limited access to international bond markets.
	  ○ For countries facing high-levels of climate risk, debt financing costs may increase as climate risk is incorporated into credit ratings and credit models.

Optimising financial tools under budgetary and financing constraints, within integrated frameworks of disaster risk management and reduction	• Where there is limited fiscal and/or debt financing capacity or other financing constraints, such as speed of debt market access or debt sustainability, consider other financial tools to ensure sufficient resources for responding to climate-related risks, including official finance, reserve funds, commercial lending, and risk transfer.
	  ○ Governments with pre-arranged access to official financing should aim to maximise such financing to meet funding needs that cannot be efficiently met through contingency and reserve funds.
	  ○ Reserve funds can support risk retention and fiscal response capacity.
	  ○ Commercial bank credit arrangements may be an option for countries that do not have the capacity to access international bond markets.
	  ○ Risk transfer to insurance or capital markets can provide secure funding, particularly for countries facing credit market constraints. This form of funding will be more cost-efficient where risks are first pooled and if coverage is calibrated to less frequent payouts (i.e. more severe events).

2. PROMOTING GLOBAL CLIMATE FINANCIAL RESILIENCE	
1. Promote integrated strategies to strengthen financial resilience at the country or regional level	
Supporting the development of fiscal risk assessments that take climate into account	• Development partners should assist with the development of fiscal risk assessments that integrate potential impacts of climate change and assess potential financial vulnerabilities. Such assessments should provide a sound basis for targeting investments in risk reduction and adaptation and developing a strategy to ensure adequate funding for recovery and building back better.
Promoting financial and fiscal resilience through funding risk reduction and supporting sound insurance markets	• Promote integrated approaches to include the potential contributions of investments towards risk reduction, mitigation and adaptation • Leveraging the possible role of insurance markets when feasible in protecting households, businesses and subnational governments. • Promote investment in risk analytical tools to support the development of risk assessment and fiscal analysis as well as insurance underwriting. • Promote insurance market development when feasible, promoting availability and affordability of insurance coverage for climate-related loss and damage.

Facilitating funding strategies to strengthen financial resilience, including through innovative approaches	• Focus on facilitating adequate funding strategies for climate risks as identified in the fiscal risk assessment at the country or regional level. • Link support from international organisations and other official creditors for risk financing and risk transfer facilities to beneficiary countries' fiscal risk assessment and identified funding needs.
2. Mobilise development co-operation to strengthen global financial resilience	
Promoting increased coherence among, and co-ordination across development partners	• Promote coordinated and coherent approaches to development co-operation, from the strategic to operational and technical levels, to ensure greater levels of funding and make the availability of funds less volatile, thus easier to plan (from a partner country perspective). • Consider current and future climate risks and fiscal capacities as part of development cooperation projects • Streamline processes to ease access to finance.
Promoting increased coherence between humanitarian strategies and approaches to address climate risks	• Promote greater coherence across approaches towards climate risk management and humanitarian assistance. • Promote holistic approaches, for example by explicitly considering the trade-off between immediate relief and long-term investment in development and resilience.

2 Risks of losses and damages from climate change: context for action

This chapter provides a short overview of current and projected losses and damages from climate change globally, including physical impacts, as well as their short-term and longer-term economic consequences, summarising the latest evidence. It also briefly discusses the options for managing the public financial consequences of climate risks through risk financing.

2.1. Losses and damages from climate change are already happening

Half of the world's population today is highly vulnerable to the risks of climate change, which pose a severe threat to development gains and economic prosperity, including through the potential for significant damage to lives, livelihoods, human health, culture, nature and biodiversity, among others (IPCC, 2022[1]). Global mean temperature has increased by 1.09°C compared to pre-industrial levels (Masson-Delmotte et al., 2021[2]), with significant variation across the Earth's surface. Current levels of action on climate change are inadequate; further warming and long-lasting changes are projected in many components of the Earth system, which will amplify current risks and generate new risks. It is today unequivocal that climate change has started to disrupt human and natural systems (IPCC, 2022[1]).

This report discusses the risks of losses and damages from climate change from a financial management perspective, specifically the approaches and tools that governments can use to assess, reduce and fund the spending needs that are likely to arise as a result of extreme weather events. It builds and elaborates on the discussion on risk financing in the *Managing Climate Risks, Facing up to Losses and Damages* report (OECD, 2021[3]). It is important to differentiate between economic losses and damages[1], referred to in the present report which come from a disaster risk management perspective, from the Loss and Damage (with upper case) discussion under the UNFCCC (see Box 2.1 for a summary of recent progress on Loss and Damage under the UNFCCC).

Climate-related extreme events have created significant losses and damages. For instance, the 2018 droughts, floods and storms in India caused around USD 6 billion in damages (Guha-Sapir, Below and Hoyois, 2021[4]). Hurricane Dorian caused economic impacts that are estimated at a quarter of the Bahamas' GDP (Zegarra et al., 2020[5]). The 2019-20 Australia wildfire season resulted in 19 million hectares of land being burned, with the economic impacts estimated at AUD 20 billion (Filkov et al., 2020[6]). More recently, the floods caused by heavy rainfall in Western Europe in 2021 led to widespread economic damage (Dewan, 2021[7]). In addition, the extreme temperature events of 2021 and 2022 (e.g. the North American heatwave, the European winter heatwave, the Indian heatwave) demonstrate how the intensity of the extremes is already changing at 1.09°C of warming (OECD, 2021[3]). There is robust scientific evidence that climate change made these events more likely, and many types of extreme weather events are more likely to occur as a result of climate change (Shultz et al., 2020[8]; Hunt and Menon, 2020[9]; van Oldenborgh et al., 2021[10]; Kreienkamp et al., 2021[11]).

Box 2.1. Loss and Damage under the UNFCCC

The Alliance of Small Island States (AOSIS) initiated discussions on Loss and Damage from climate change within the UN climate process in the early 1990s. This discussion emerged in the context of compensation for losses in these countries from sea-level rise and other climate change impacts. The Warsaw International Mechanism (WIM) was established in 2013 with a mandate to "address loss and damage associated with impacts of climate change, including extreme events and slow-onset events in developing countries that are particularly vulnerable to the adverse effects of climate change" (UNFCCC, 2022[12]). The Paris Agreement in its Article 8 further states that "Parties recognize the importance of averting, minimising and addressing loss and damage associated with the adverse effects of climate change [….]" (Paris Agreement, 2015[13]).

The discussions on Loss and Damage within the UN climate process focus on developing countries. The impacts due to climate change are conditional on exposure and vulnerability, which primarily depend on historical processes and national decision making. Given the political difficulties that surround the issue of responsibility for Loss and Damage, this report does not attempt to define or provide direct guidance on this issue. It is important to note that the Paris Decision "agrees that Article 8 of the Agreement does not involve or provide a basis for any liability or compensation (UNFCCC, 2016[14])".

The recent Conference of the Parties (COP26) at Glasgow saw two important steps in the negotiations under Loss and Damage. First, the Glasgow Dialogue "to discuss the arrangements for the funding of activities to avert, minimise and address loss and damage associated with the adverse impacts of climate change" was established (UNFCCC, 2021[15]). The Dialogue will run until 2024. Second, the functions of the Santiago Network were agreed as "catalysing demand-driven technical assistance, including of relevant organizations, bodies, networks and experts, for the implementation of relevant approaches to averting, minimizing and addressing loss and damage in developing countries that are particularly vulnerable to the adverse effects of climate change".

Source: Expanded from (OECD, 2021[3])

Efforts in both climate mitigation and adaptation are key to reducing and managing risks from climate-related losses and damages, along with other interventions including disaster risk reduction, disaster risk finance and humanitarian assistance. This includes taking a precautionary approach by aiming to limit the temperature increase to 1.5ºC, by accelerating transition to net zero and short-term targets and plans, as well as creating a more ambitious international development co-operation landscape supporting efforts to reduce and manage current impacts and projected risks of losses and damages. Relatedly, there is a need to strengthen the global architecture for climate and disaster risk finance, through enhancing the availability and access to financial protection instruments and increasing the co-ordination of international support (OECD, 2021[3]). The present report aims to address these latter points.

2.2. Projected risks of losses and damages

The risk of losses and damages can be seen as the result of the interactions of climate-related hazards, exposure of people and assets and their vulnerability to hazards (IPCC, 2018[16]). Each of these closely interlinked components require separate analyses and projections, which are complex. For hazards, some of the key parameters are unknown and local or regional projections are incredibly difficult. In addition, for exposure and vulnerability the projections are also difficult, because socio-economic developments are

not subject to laws of physics like the climate projections, but are the results of economic and demographic changes, and current and future policy choices.

Climate-related hazards are divided into three broad categories by the IPCC (IPCC, 2018[16]): extreme events, slow-onset event, and tipping points. Extreme events are events in weather which are considered rare for a particular time and place[2] (IPCC, 2018[16]). Examples could include strong cyclones, heatwaves or floods. By contrast, slow-onset events are "phenomena caused or intensified by anthropogenic climate change that take place over prolonged periods of time – typically decades, or even centuries – without a clear start or end point" (Schäfer et al., 2021[17]), for example sea-level rise or temperature change. Finally, climate system tipping points are "critical threshold[s] beyond which the system reorganises, often abruptly and/or irreversibly" (Chen, 2021[18]). Examples would be the Atlantic overturning circulation or the melting of the Greenland ice sheet (OECD, 2021[3]). Slow-onset events and tipping points, are outside the scope of the present report beyond a brief discussion in Box 2.2.

In addition, events can be categorised as either "extensive", or chronic, versus acute. The 'extensive events' has received attention in the disaster risk literature.[3] Extensive events are more frequent, more localised and result in less severe hazard events than extreme events, but can still result in substantial losses over time. As they are less severe, they cannot be described as 'extreme', but they have high localised impacts, and may have consequences for local public budgets and, where insurance markets are present, for the cost and coverage of insurance in the affected areas.

Projections show that the frequency and severity of *extreme events* will increase, which is already observable for heatwaves and floods (Masson-Delmotte et al., 2021[2]). If extreme events will become more frequent, the window for recovery and rebuilding will become shorter, and relief efforts will draw away resources from investments in long-term resilience, and will increase government debt unless revenue generation measures are put in place. In 2019, for example, Mozambique was hit by Tropical Cyclones Idai (March) and Kenneth (April). This pushed government debt to 103% of gross domestic product (GDP) that year. Mozambique was hit again by two major cyclones in January and February 2021; debt is projected to reach 125% of GDP by the end of 2021 (IMF, 2021[19]). In a sense, such events can turn into real "black swan" events, with cascading and unpredictable economic effects if they result in broader supply chain disruptions.

Box 2.2. Possible economic impacts of slow-onset events and tipping points

In addition to extreme and extensive events, *slow-onset events* are also slowly materialising, with projections indicating an increasing risks. The impacts of slow-onset changes such as temperature increase or sea-level rise might be over time even larger than those of extreme events (Kalkuhl and Wenz, 2020[20]) (Haer et al., 2013[21]). For example, several studies showed stark impact of year-to-year temperature changes on macroeconomic outcomes, such as GDP (Burke, Hsiang and Miguel, 2015[22]). Sea-level rise will likely challenge existing financial risk management practices. Moreover, different types of hazards interact. For example, sea-level rise is likely to make coastal flooding following hurricanes more severe (Knutson et al., 2021[23]). Slow onset events can also result in the gradual disappearance of major lakes due to desertification, resulting in lack of irrigation, economic deprivation and migration.

The existence of *tipping points* is also a cause for concern. There is evidence that the world is heading towards crossing some of the tipping points for example, the Atlantic Meridional Overturning Circulation (AMOC), which has dramatically slowed in recent years (Liu et al., 2020[24]). The collapse of the AMOC would significantly alter the climate of several regions around the world and affect ecosystems, human health, livelihoods, food security, water supply and economic growth at a global scale. This has the potential to give rise to new climates and novel hazards which countries have little or no experience in dealing with.

Regarding *extensive events*, while individual events are smaller scale and do not lead themselves to severe losses and damages, the fact that they are multiple and over certain periods of time, can lead to important impacts. Indeed, more than 70% of deaths caused by floods in the last forty years have been caused by extensive floods (Chen et al., 2020[25]). Projections show that extensive events will also become more frequent and severe (Masson-Delmotte et al., 2021[2]).

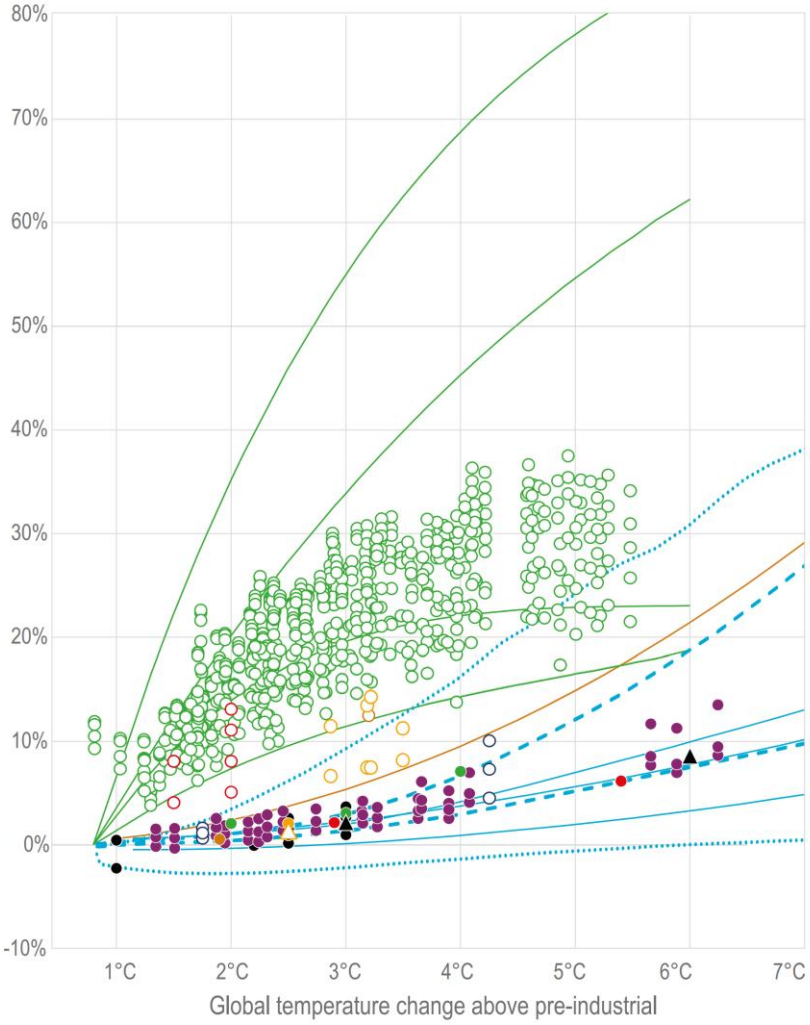
2.2.1. Global estimates of economic costs of climate impacts

Given their political relevance, questions around the quantification of economic costs associated with climate impacts have occupied scientists and economists for decades, albeit with strong methodological challenges. The Summary of the Working Group II contribution to the IPCC Sixth Assessment report (AR6) states that “global aggregate economic impact estimates are generally found to increase with global average temperature change, as well as vary by other drivers, such as income and population and the composition of the economy”. The report notes that estimates are higher than in its Fifth Assessment Report, suggesting the global costs of aggregate impacts could be higher than previously estimated. Due to the lack of comparability across methodologies (including statistical, structural and meta-analysis), however, AR6 concludes that a range of estimates cannot be provided with confidence (O’Neill, 2022[26]).

Figure 2.1 summarises the range of estimates currently available in the literature, as reviewed by the IPCC. The figure shows a wide range of estimates, including for today's level of global warming (1ºC), stemming from differences in methodologies and scope which hinder the comparability of these estimates. For example, estimates from statistical methodologies tend to be higher than estimates obtained from structural methodologies. The wide ranges may be attributed to a number of factors, including for example assumed persistence of impacts, different types of hazards modelled, assumed stronger adaptation responses, differences in impacts included as well as different societal assumptions, with different models assuming different ways societies might evolve, respond and interact. The large majority of estimates in Figure 2.1 show a non-linear relationship between temperature and losses, with some studies suggesting higher (convex lines) and others a declining (concave lines) marginal economic impacts with higher

temperature. The drivers for this non-linearity are not well understood, with potential influencing factors that include methodology, assumptions and data (O'Neill, 2022[26]).

Figure 2.1. Global estimates of the economic costs of climate impacts



Note: Estimates of global aggregate economic costs of climate impacts by global warming level expressed in terms of annual % global GDP loss relative to GDP without additional climate change for each degree of warming. The figure includes estimates form three distinct methodologies types: (a) statistical modelling, (b) structural modelling and (c) meta-analyses. Lines represent functions, with dashed and dotted lines 5th and 95th percentile functions from structural modelling.
Source: (O'Neill, 2022[26])

Despite uncertainties, these estimates provide an indication of the level of pressure climate change could exert in terms of losses and damages. Adaptation strategies can help reduce costs in the short to medium term, while climate change mitigation has an important role to play in avoiding higher levels of warming and in the longer run is the safest option for avoiding costs. Mitigation and adaptation are therefore complementary and are both necessary.

2.3. Managing the public financial consequences of climate risks through risk financing

The economic costs of climate change loss and damage will likely put increased pressure on government finances. There are multiple possible channels. Governments will face higher costs for relief and recovery and rebuilding publicly-owned building and infrastructure in the aftermath of more frequent or severe extreme events as well as increased costs related to investing in adaptation. They will also likely face increasing demands for financial support from households, businesses and sub-national governments impacted by extreme events. For example, spending on unemployment insurance is larger in the years following an extreme event (Deryugina, 2017[27]).

For governments, addressing climate-related risks requires a systematic approach. The report, *Managing climate risks, facing up losses and damages* (OECD, 2021[3]), outlined a way in which risks to public finances can be approached, dividing key functions into risk reduction, risk retention and risk transfer. The following section outlines the approach of the 2021 study, and how the present report takes it forward.

Risk reduction, mainly through prevention and adaptation, is central in the framework. This includes improving the resilience of public assets such as infrastructure and supporting climate resilient development (IPCC, 2022[28]) as well as enabling households and businesses to reduce their own risks, for example through building appropriate incentives into regulatory frameworks. The enabling environment might include the provision of disclosures and relevant information, so the adaptation needs and capacities are clear, and also a stable economic policy with strong property rights. For example, providing information on flood risks decreases the willingness to live in properties at risk (hence reducing exposure) (Hino and Burke, 2021[29]). Private finance for risk reduction and adaptation may also be leveraged by addressing regulatory, cost and market barriers, for example via public-private partnerships (IPCC, 2022[28]). Crucially, risk reduction can decrease the governments' contingent liabilities (as the insurer of last resort) and thus the risk to public finances.

As climate change progresses, losses and damages will increase for the economy, and human and natural systems might reach adaptation limits. Risk reduction by itself may not be enough to manage financial impacts of climate change. The financial impacts of climate-related events may have to be absorbed (risk retention) or otherwise transferred to those willing to assume the risk (risk transfer). In practice, risk retention means that the government, household or business assumes the risk it faces, and must find the necessary funds to address impacts, be it through their own funds or by means of external financing. For governments, this can be arranged *ex ante* (e.g. contingent credit), but can also be arranged *ex post* (e.g. budgetary reallocations), with possibility of corresponding delays and increasing impacts. For larger loss events, budgetary tools and public debt financing may be employed to cover financial impacts, if there is cheap and ready access to international financial markets.

If access to international financial markets is difficult, risk transfer may also potentially be considered for larger loss events. Risk transfer involves risks being transferred to a different entity or group of entities such as insurance companies or capital markets through catastrophe bonds. Such risk transfer mechanisms may benefit from further transfer to reinsurance markets or sharing through risk pooling, in some cases with the support of development finance. Insurance can be acquired either at individual level, by citizens and private businesses, or at the collective level, through governments purchase, such as sovereign parametric insurance. Governments considering risk transfer should first consider their own financial capacity to absorb and manage the risks they face (see analytical framework in Chapter 4).

While there is no one-size-fits-all solution to these problems, Chapter 4 sets out an analytical framework through which the impacts of climate events on public finances and related financial strategies can be examined. The appropriate mix of risk reduction, retention and transfer will vary according to relative costs and benefits of the different measures in relation to the climate impacts they help avoid or mitigate, along with country-specific factors and preferences. The suitable set of measures will depend on the financial

vulnerabilities as well as the budgetary and financing capacities of the country, among other country-specific factors. Furthermore, measures may be tailored to specific risks. Developing countries – and particularly lower income developing countries – will clearly face greater challenges in accessing necessary funding through fiscal frameworks, debt financing and risk transfer than developed countries with greater fiscal capacity and access to capital markets.

The importance of quick and reliable access to funds must be underlined. Governments need to ensure that financing will be available when needed – and that operational procedures are in place to disburse the funds effectively; otherwise, recovery and reconstruction will be delayed and prolonged, and macroeconomic impacts will deepen. Box 2.3 expands on the importance of adequate funding arrangements. Insofar as contingency reserves prove inadequate, developed countries might have access to international financial markets and can issue debt readily, tapping into domestic or foreign savings. For other countries, which might face financing constraints, for example, due to high levels of public debt or a low capacity to introduce revenue-generating measures (e.g. taxes), quickly securing adequate funds might often require alternate financing arrangements.

The report builds on the 2021 OECD report (2021[3]) by providing a deeper examination of the challenges and trade-offs that the central governments face in responding to the fiscal challenges arising from climate losses and damages. It also moves beyond purely conceptual considerations and examines how different financial risk management strategies and instruments are applied in practice and how they could complement each other. It explores the advantages and disadvantages of each instrument, their nature and interrelationship, the possible impediments or disincentives for their creation or use. Further, it discusses the options for managing climate risks within public finance frameworks, in OECD countries as well as in countries with lower levels of insurance market development and more limited or volatile access to international debt and capital markets.

Box 2.3. The role of adequate funding arrangements in reducing economic and social impacts

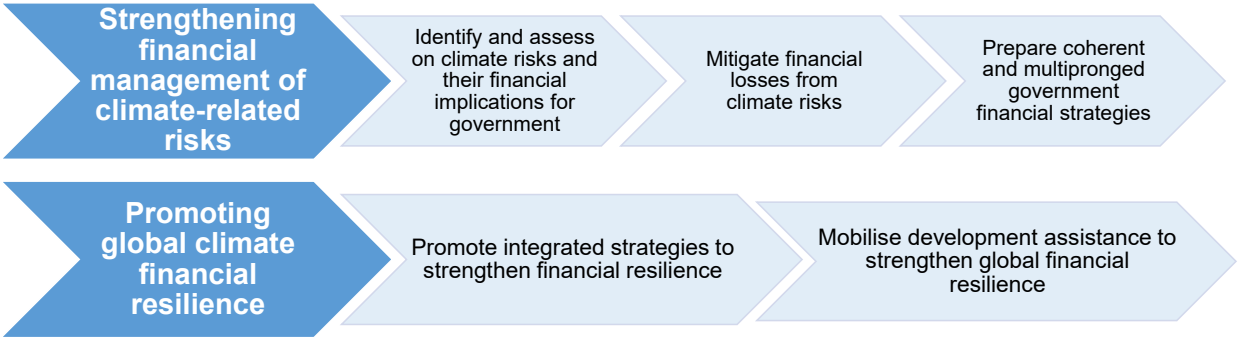
Ensuring adequate funding to support relief, recovery and reconstruction may play an important role in reducing the economic and social impacts of catastrophe events. For example, a number of examinations of the impact of broad insurance coverage to post-event economic recovery have shown that countries with high-levels of insurance (and reinsurance) coverage usually recover more quickly (Melecky and Raddatz, 2011[30]) (Von Peter, Von Dahlen and Saxena, 2012[31]), (OECD, 2018[32]), (Cambridge Centre for Risk Studies and AXA XL, 2020[33]), (Fache Rousová et al., 2021[34]) – which may be at least partly explained by the availability of insurance funding to support reconstruction (Fache Rousová et al., 2021[34]). Inadequate access to funding in the aftermath of a catastrophe event may slow recovery and reconstruction and increase the macroeconomic cost of the event. For example, GDP in Honduras was estimated to be 6% lower five years after the impact of Hurricane Mitch in 1998 relative to pre-event projections, potentially as a result of widespread difficulties in repairing public infrastructure and assisting private sector recovery (Hochrainer-Stigler et al., 2014[35]). In Madagascar, the government was only able to fund an estimated 13% of recovery and reconstruction needs after the 2008 cyclone season which resulted in a decline in macroeconomic performance (Hochrainer-Stigler et al., 2014[35]).

Figure 2.2 provides an overview of the analytical framework developed for this report. It has two parts, which proceed in consecutive steps. The first part is about strengthening the public financial management of climate-related risks by government at the national level. Climate-related physical risks, first, need to be identified and better understood in terms of their components (hazards, exposure and vulnerability) and sources. This includes both data about past risks, disclosures about current risks and projections about future ones. Once the risks and the sources of the risks are identified, there is scope for mitigating financial

losses from climate risks, through investment in adaptation and risk reduction. Investments in risk reduction and adaptation will be necessary across all segments of society, requiring appropriate incentives are in place to encourage such investment by households, businesses and sub-national governments. Risks will remain even after the best efforts to reduce them. The next step is to ensure sufficient funding to respond to these residual risks, through coherent and integrated multipronged government financial strategies.

The second part discusses the importance of promoting global climate financial resilience. Development partners should promote integrated strategies to strengthen financial resilience at the country or regional level, through multiple channels. It is also important to promote coordinated action in terms of international assistance, with the overarching goal of promoting global climate financial resilience.

Figure 2.2. Stylised illustration of the framework for action



The next chapter examines governments' financial exposure and vulnerabilities arising from climate-related extreme events. Chapter 3 provides an overview of the budgetary and financial instruments available for governments to respond to these events. Chapter 4 will draw up and discuss the framework for action, offering key recommendations and illustrate good practices, including concrete applications of risk management instruments in different country contexts and international co-operation.

References

Burke, M., S. Hsiang and E. Miguel (2015), "Global non-linear effect of temperature on economic production", *Nature*, Vol. 527/7577, pp. 235-239, https://doi.org/10.1038/nature15725. [22]

Cambridge Centre for Risk Studies and AXA XL (2020), *Optimising Disaster Recovery: The Role of Insurance Capital in Improving Economic Resilience.*, Cambridge Centre for Risk Studies at the University of Cambridge Judge Business School, https://axaxl.com/-/media/axaxl/files/optimizing-disaster-recovery.pdf (accessed on 20 October 2020). [33]

Chen, B. et al. (2020), "Intensive Versus Extensive Events? Insights from Cumulative Flood-Induced Mortality Over the Globe, 1976–2016", *International Journal of Disaster Risk Science*, Vol. 11/4, pp. 441-451, https://doi.org/10.1007/s13753-020-00288-5. [25]

Chen, D. (2021), "Framing, Context, and Methods.", in Masson-Delmotte, V. (ed.), *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. [18]

Deryugina, T. (2017), "The Fiscal Cost of Hurricanes: Disaster Aid versus Social Insurance", *American Economic Journal: Economic Policy*, Vol. 9/3, pp. 168-198, https://doi.org/10.1257/pol.20140296. [27]

Dewan, A. (2021), *Germany's deadly floods were up to 9 times more likely because of climate change, study estimates*, https://edition.cnn.com/2021/08/23/europe/germany-floods-belgium-climate-change-intl/index.html. [7]

Fache Rousová, L. et al. (2021), *Climate Change, Catastrophe and the Macroeconomic Benefits of Insurance*, European Insurance and Occupational Pensions Authority. [34]

Filkov, A. et al. (2020), "Impact of Australia's catastrophic 2019/20 bushfire season on communities and environment. Retrospective analysis and current trends", *Journal of Safety Science and Resilience*, Vol. 1/1, pp. 44-56, https://doi.org/10.1016/j.jnlssr.2020.06.009. [6]

Guha-Sapir, D., R. Below and P. Hoyois (2021), *EM-DAT: The CRED/OFDA International Database*, http://www.emdat.be (accessed on 7 April 2021). [4]

Haer, T. et al. (2013), "Relative sea-level rise and the conterminous United States: Consequences of potential land inundation in terms of population at risk and GDP loss", *Global Environmental Change*, Vol. 23/6, pp. 1627-1636, https://doi.org/10.1016/j.gloenvcha.2013.09.005. [21]

Hino, M. and M. Burke (2021), "The effect of information about climate risk on property values", *Proceedings of the National Academy of Sciences*, Vol. 118/17, p. e2003374118, https://doi.org/10.1073/pnas.2003374118. [29]

Hochrainer-Stigler, S. et al. (2014), "Funding public adaptation to climate-related disasters. Estimates for a global fund", *Global Environmental Change*, Vol. 25/1, pp. 87-96, https://doi.org/10.1016/J.GLOENVCHA.2014.01.011. [35]

Hunt, K. and A. Menon (2020), "The 2018 Kerala floods: a climate change perspective", *Climate Dynamics*, Vol. 54/3-4, pp. 2433-2446, https://doi.org/10.1007/s00382-020-05123-7. [9]

IMF (2021), *World Economic Outlook Database*, IMF Publishing, https://www.imf.org/en/Publications/WEO/weo-database/2021/April (accessed on 1 September 2021). [19]

IPCC (2022), *Climate Change 2022: Impacts, Adaptation and Vulnerability. Working Group II Contribution to the IPCC Sixth Assessment Report*, https://www.ipcc.ch/report/sixth-assessment-report-working-group-ii/. [28]

IPCC (2022), "Summary for Policymakers", in H.-O. Pörtner et al. (eds.), *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change . In Press.*, Cambridge University Press. [1]

IPCC (2018), "Annex I: Glossary [Matthews, J.B.R. (ed.)]", in Masson-Delmotte, V. et al. (eds.), *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change*…. [16]

Kalkuhl, M. and L. Wenz (2020), "The impact of climate conditions on economic production. Evidence from a global panel of regions", *Journal of Environmental Economics and Management*, Vol. 103, p. 102360, https://doi.org/10.1016/j.jeem.2020.102360. [20]

Knutson, T. et al. (2021), "Climate change is probably increasing the intensity of tropical cyclones", *ScienceBrief*, Vol. March, pp. 1-7, https://sciencebrief.org/uploads/reviews/ScienceBrief_Review_CYCLONES_Mar2021.pdf. [23]

Kreienkamp, F. et al. (2021), *Rapid attribution of heavy rainfall events leading to the severe flooding in Western Europe during July 2021*, https://www.worldweatherattribution.org/wp-content/uploads/Scientific-report-Western-Europe-floods-2021-attribution.pdf. [11]

Liu, W. et al. (2020), "Climate impacts of a weakened Atlantic Meridional Overturning Circulation in a warming climate", *Science Advances*, Vol. 6/26, https://doi.org/10.1126/sciadv.aaz4876. [24]

Masson-Delmotte, V. et al. (eds.) (2021), *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf. [2]

Masson-Delmotte, V. et al. (eds.) (2018), *Annex 1: Glossary*, Intergovernmental Panel on Climate Change (IPCC), https://www.ipcc.ch/sr15/. [36]

McPhillips, L. et al. (2018), "Defining Extreme Events: A Cross-Disciplinary Review", *Earth's Future*, Vol. 6/3, pp. 441-455, https://doi.org/10.1002/2017ef000686. [37]

Melecky, M. and C. Raddatz (2011), "How Do Governments Respond after Catastrophes? Natural-Disaster Shocks and the Fiscal Stance", *Policy Research Working Paper*, No. 5564, World Bank, https://openknowledge.worldbank.org/bitstream/handle/10986/3331/WPS5564.pdf?sequence=1&isAllowed=y (accessed on 22 March 2018). [30]

OECD (2021), *Managing Climate Risks, Facing up to Losses and Damages*, OECD Publishing, Paris, https://doi.org/10.1787/55ea1cc9-en. [3]

OECD (2018), *The Contribution of Reinsurance Markets to Managing Catastrophe Risk*, OECD, http://www.oecd.org/finance/the-contribution-of-reinsurance-markets-to-managing-catastrophe-risk.pdf (accessed on 23 January 2019). [32]

O'Neill, B. (2022), "Key Risks Across Sectors and Regions", in H.-O. Pörtner, D. (ed.), *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. [26]

Paris Agreement (2015), *15 December 2015*, United Nations Treaty Collection Certified True Copies (CTCs) of Multilateral Treaties Deposited with the Secretary-General Chapter XXVII.7.d, https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27 (accessed on 28 April 2020). [13]

Schäfer, L. et al. (2021), *Slow-onset Processes and Resulting Loss and Damage – An introduction*, https://www.germanwatch.org/sites/default/files/FINAL_Slow-onset%20paper%20Teil%201_20.01.pdf. [17]

Shultz, J. et al. (2020), "Double Environmental Injustice — Climate Change, Hurricane Dorian, and the Bahamas", *New England Journal of Medicine*, Vol. 382/1, pp. 1-3, https://doi.org/10.1056/nejmp1912965. [8]

UNFCCC (2022), *Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts (WIM)*, https://unfccc.int/topics/adaptation-and-resilience/workstreams/loss-and-damage/warsaw-international-mechanism (accessed on 17 May 2022). [12]

UNFCCC (2021), *Decision -/CMA.3: Glasgow Climate Pact*. [15]

UNFCCC (2016), *Decision 1/CP.21: Adoption of the Paris Agreement*. [14]

van Oldenborgh, G. et al. (2021), "Attribution of the Australian bushfire risk to anthropogenic climate change", *Natural Hazards and Earth System Sciences*, Vol. 21/3, pp. 941-960, https://doi.org/10.5194/nhess-21-941-2021. [10]

Von Peter, G., S. Von Dahlen and S. Saxena (2012), "Unmitigated disasters? New evidence on the macroeconomic cost of natural catastrophes", *BIS Working Papers*, No. 394, Bank for International Settlements, https://www.bis.org/publ/work394.pdf (accessed on 22 March 2018). [31]

Zegarra, M. et al. (2020), *Impact of Hurricane Dorian in The Bahamas: A View from the Sky*. [5]

Notes

[1] *Damages* refer to physical assets that are totally or partially destroyed in affected areas, measured in physical units (i.e., the number of damaged houses, roads, crops, land, etc.) with monetary values assigned based on replacement costs according to prices prevailing just before the event. *Losses* refer to changes in economic flows arising from the event, from the date of occurrence until full economic recovery and reconstruction has been achieved. Typical losses include the decline in output in productive sectors such as agriculture, industry and services.

[2] Definitions of 'rare' vary over studies, but usually an event is considered rare if it is rarer than the 10th or 90th percentile of an estimated probability distribution (IPCC, 2018[36]).

[3] Some definitions of extreme events also cover extensive events (McPhillips et al., 2018[37]). The IPCC (2018[16]) definition is unclear on this point, thus the report considers it a separate hazard.

3 Government exposure, financing needs and current and future vulnerabilities

Climate hazards affect public expenditures and revenues in multiple ways and across different levels of government. Following a disaster, revenues can fall due to declining economic activity while, at the same time, expenditures increase due to immediate relief needs and longer-term recovery costs. This chapter provides a deeper understanding of government exposure and the impact of climate hazards on public finances in terms of climate-related fiscal risks, while underlining the difficulties in identifying the full costs borne by public finances. It discusses the role of private insurance coverage of losses and damages from climate hazards across different countries, highlighting the linkage between higher insurance coverage and lower demands for social protection and government compensation. It then discusses the integration of climate change in fiscal risk assessment, including in fiscal forecasting and reporting, across OECD countries.

3.1. Understanding government exposure and the impact of climate hazards on public finances

3.1.1. Government expenditure needs

Climate risks affect government expenditures (as explicit and implicit contingent liabilities) and revenues in different ways. Revenues can fall due to the decline in economic activity. A reduction in tax revenues may be automatic given legislation (e.g. mechanisms triggered to lower the tax burden on individuals and businesses to compensate for losses and damages). It may also have discretionary causes such as targeted tax cuts as a way to cushion the impact on affected populations and businesses. Climate-related disasters generally cause an upward pressure on public expenditures. There may be costs incurred for rebuilding damaged assets and infrastructures. There may also be emergency costs from providing emergency support and relief for displaced people and impacted businesses.

Some of these costs may stem from explicit liabilities while others arise implicitly. There may be explicit commitments to bear the costs of climate losses and damages stemming from legal obligations, such as public compensation or financial assistance arrangements in place to support affected segments of society. Other examples of explicit contingent liabilities materialising include losses stemming from public (re)insurance arrangements or government guarantees and costs related to emergency management and public asset reconstruction. Institutional responsibilities for bearing the costs of climate hazards are often determined in public financial management frameworks (OECD/The World Bank, 2019[1]). However, in other instances, when acting as *de facto* insurers of last resort, governments can also face implicit contingent liabilities as they may feel politically obligated to bear disaster-related costs.

There is also a multilevel governance dimension to how the impact of extreme weather events affects public finances, either at central or subnational government level. Central governments may bear the losses and damages to public assets owned or managed by subnational levels. In such circumstances, local governments in affected areas generally ask for support from the central government to compensate for their losses, and particularly those generated by damages to public assets such as roads, bridges or other infrastructures. Countries often have rules governing the distribution of cost-bearing across levels of governments.

Box 3.1. Responding to climate-related losses and damages: the role of social protection and financial compensation programmes

Climate-related events can lead to damages to homes and business premises and losses in terms of lost income, business interruption and extra expense, including among the self-employed and agricultural producers. In many countries individual citizens may be able to mitigate some of these losses through access to social protection and/or financial compensation programmes.

Social protection programmes

Social protection programmes, including social assistance, social insurance and labour market programmes, play a critical role in protecting individuals from poverty and deprivation (whether long-term or temporary). While most social protection programmes have been designed to address chronic or longer-term poverty and/or vulnerability, these programmes provide a mechanism to respond to some of the financial vulnerabilities that may arise in the aftermath of a climate-related event - particularly where the availability or take-up of insurance coverage is limited (see below):

- Social assistance programmes such as expenditure-financed cash and in-kind transfers can play a critical role in meeting the basic needs of vulnerable households that have been displaced or face livelihood disruptions in the aftermath of climate-related catastrophes. These types of programmes are in place in many countries (developed and developing) to avert chronic poverty and/or food insecurity (Costella et al., 2021[2]) and can be expanded, in terms of reach and/or level of support, in the aftermath of climate-related catastrophes to meet the needs of displaced households (including those that are not normally covered by such programmes) and reduce the pressure on households to resort to harmful coping strategies (O'Brien et al., 2018[3]), (Costella et al., 2021[2]), (OECD, 2021[4]).
- Social insurance programmes such as (contribution-based) unemployment insurance (Costella et al., 2021[2]) are critical for those that face a loss of employment as a result of a climate-related catastrophe, which may be more likely if there are low levels of insurance coverage for business interruption losses. Some unemployment insurance programmes are partially-funded by government expenditure and benefits can be expanded in response to large-scale disruptions from climate (and other types of catastrophes) - as occurred in many countries in response to the COVID-19 containment measures.

Vulnerable households in most (if not all) developed economies have access to social assistance and social insurance programmes such as unemployment insurance. In developing countries, access to social protection varies more widely across countries/regions with much more limited protection available in low and lower middle-income countries (Costella et al., 2021[2]). One estimate suggests that approximately 2.1 billion people in developing countries benefitted from social protection programmes in 2012 although with more limited access to social insurance relative to social assistance programmes (Lowder, Bertini and Croppenstedt, 2017[5]).

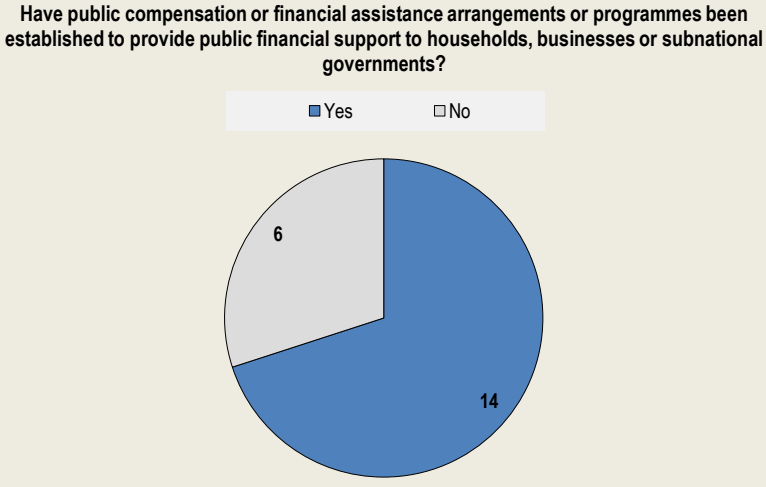
Financial compensation programmes

While social assistance and social insurance programmes can provide (some) support for basic needs and livelihood disruptions, this type of support is not normally targeted (and is not sufficient) as a source of funding for reconstruction of damages to homes or businesses. In many developed countries, governments have established financial compensation programmes to provide financial support to households (and sometimes businesses) for reconstruction after catastrophic events, either established as standing programmes or on an *ad hoc* basis in response to a specific event (see Figure 3.1). The financial support may be provided as tax deductions (e.g. in Czech Republic after flooding in 2013 (Radu,

2021[6])], grants [e.g. Disaster Financial Assistance Arrangements in Canada (OECD/The World Bank, 2019[1])] or low-interest rate loans [e.g. United States' Small Business Administration (SBA, n.d. [50])) – which have different implications in terms of government expenditure accounting. In some countries, compensation is only available for damages that are not insured (e.g. United States) or not insurable (e.g. Canada). Some countries have established dedicated compensation programmes for specific perils for which household insurance is not available (e.g. flood-related damages in Hungary and the Netherlands (Radu, 2021[6])).

A number of developing countries (particularly upper middle-income countries) have also provided financial compensation to affected households in the aftermath of climate events. For example, the government of Dominica provided the equivalent of USD 4 100 to all households impacted by Hurricane Maria in 2017 (USD 116 million in aggregate, equivalent to approximately 60% of general government revenues in 2017) (Government of the Commonwealth of Dominica, 2017[7]). Local governments in Bosnia & Herzegovina provided approximately USD 1.7 million to households after floods in Bosnia in 2014 (Government of the Federation of Bosnia and Herzegovina, 2014[8]). In Georgia, the Tbilisi municipal government provided USD 10.7 million in compensation to support recovery among households after flooding in 2015 (Government of Georgia, 2015[9]). In Thailand after the 2011 floods, the government provided approximately USD 165 to all affected households (with an additional USD 66 for households in need of additional support). A further USD 6 600 (maximum) was offered to households with partially damaged homes and USD 9 900 to households with homes that were completely damaged by the floods (for a total of approximately USD 52 million) (World Bank, 2012[10]). However, governments in low income and lower middle income countries may not have the financial capacity to provide financial compensation to households or businesses impacted by climate-related events, particularly in the context of severe events or when faced with frequent climate losses and damages to households.

Figure 3.1. Financial compensation programmes in OECD countries



Source: Responses to the *OECD survey for assessing implementation of the OECD Recommendation on Disaster Risk Financing Strategies*.

There are a number of challenges to deriving accurate estimates of the fiscal impact of past climate-related extreme events. Estimates of the fiscal impact of climate losses and damages tend to be incomplete. Accounting systems do not directly record disaster-related expenditures as they take place across entities, functions and programmes (OECD and World Bank, 2019[11]). Similarly, reporting systems cannot fully

account for budget transfers that take place to finance emergency relief. For example, some expenditures may be financed from transfers of unspent funds of other budget lines. Finally, expenditures are scattered across levels of government which may not be consolidated to reflect the comprehensive burden of climate losses and damages borne by public finances.

For some major past events, governments or multilateral development organisations (multilateral development banks, UN agencies) have developed post-disaster needs assessments that aim to quantify the damages and losses of the event across all sectors, usually with a separation between damages and losses affecting public and private assets. Some of these assessments also provide estimates of the financial needs for recovery and reconstruction[1], sometimes with a separation between public and private funding needs. Table 3.1 provides an overview of damages, losses and recovery needs for a selection of climate-related catastrophes.

Table 3.1. Past climate catastrophes: loss, damage and recovery need estimates (USD millions)

Event	Damage and loss		Recovery and reconstruction needs (% public, where available)	Needs as a share of GDP	Estimated share of damages and losses insured
	Public	Private			
Storms (El Salvador, 2020)	60 (17%)	301 (83%)	1 212	4.9%	
Hurricane Dorian (Bahamas, 2019)	337 (11%)	2 845 (89%)	2 945	22.4%	71%
Cyclone Idai (Mozambique, 2019)	929 (33%)	1 867 (67%)	2 900	18.8%	4%
Kerala floods (India, 2018)	1 871 (49%)	1 948 (51%)	4 392	0.2%	10%
Hurricane Maria (Dominica, 2017)	467 (36%)	845 (64%)	1 368	253.3%	
Cyclone Winston (Fiji, 2016)	206 (16%)	1 121 (84%)	1 958	39.7%	9%
Floods (Sri Lanka, 2016)	71 (10%)	653 (90%)	959	8.0%	9%
Cyclone Pam (Vanuatu, 2015)	139 (31%)	310 (69%)	316 (52% public)	42.4%	1%
Tbilisi Floods (Georgia, 2015)	21 (73%)	8 (27%)	118	0.8%	
Bosnia floods (Bosnia & Herzegovina, 2014)	687 (25%)	2 064 (75%)	2 386	9.5%	
Floods (Thailand, 2011)	4 711 (10%)	42 759 (90%)	49 632 (26% public)	13.4%	33%
Elbe floods (Germany, 2002)	5 591 (56%)	4 383 (44%)			21%

Source: (Gobierno de El Salvador, 2021[12]), (Bello et al., 2020[13]), (Government of Mozambique, 2019[14]), (Government of Kerala, 2018[15]), (Government of the Commonwealth of Dominica, 2017[7]), (Government of Fiji, 2016[16]) , (Ministry of Disaster Management and Ministry of National Policies and Economic Affairs, 2016[17]), (Vanuatu Prime Minister's Office, 2015[18]), (Government of Georgia, 2015[9]), (Government of the Federation of Bosnia and Herzegovina, 2014[8]), (World Bank, 2012[10]), (Mechler and Weichselgartner, 2003[19]). Data on GDP is from (IMF, 2021[20]). Data on average annual losses is from (Swiss Re sigma, 2020[21])(OECD calculations).

Table 3.2. Recovery and reconstruction funding needs (USD millions)

	Recovery (% of total)	Reconstruction (% of total)	Other needs in USD millions	Basis
Cyclone Winston (Fiji, 2016)	100 (11%)	800 (87%)	14 (resilience)	Recovery needs
Bosnia floods (Bosnia & Herzegovina, 2014)	345 (14%)	2 041 (85%	2 (financial compensation)	Government expenditure needs
Tbilisi Floods (Georgia, 2015)	76 (64%)	32 (27%)	11 (financial compensation)	Government expenditure needs

Source: (Government of Fiji, 2016[16]), (Government of the Federation of Bosnia and Herzegovina, 2014[8]), (Government of Georgia, 2015[9]).

For some events, a breakdown of funding needs (or specifically government expenditure needs) for recovery and reconstruction is provided (see Table 3.2). While the sample of events included above remains small, a few observations can potentially be derived:

- In most cases, the largest share of damages and losses are incurred to private assets (more than two thirds of damages and losses in eight of the twelve events included were identified as private sector);
- While a breakdown between public and private funding needs was only available for two events, in both cases, the public sector share of funding needs was larger than the public sector share of incurred damages and losses, suggesting that public sector funding needs include costs beyond the replacement/repair of public assets (i.e. the public sector funding needs likely include funds that will also be used to respond to private sector damages and losses, including reconstruction);
- As might be expected, expenditure needs for reconstruction are significantly greater than expenditure needs for recovery, suggesting that a large share of funding for post-event response may not be required in the immediate aftermath of an event (although this does not diminish the need to ensure rapid funding for relief and recovery as a means to mitigate the impact of climate events on livelihoods);
- While governments in OECD and upper middle income countries have provided financial compensation to households to support recovery and reconstruction, it is not clear that governments in low income and lower middle income capacity have sufficient financial capacity to provide this type of support.

3.1.2. The role of private insurance coverage and other financing tools for households and businesses in mitigating climate-related fiscal risks

In many countries, particularly (but not exclusively) developed countries, households and businesses can often acquire insurance to provide financial protection against climate-related losses and damages (although, as discussed below, coverage for many climate-perils is not automatically included in property insurance policies in many countries). There are a number of "survey" types of insurance coverage that provide some financial protection against the losses and damages that households and businesses could face as a result of a climate-related event:

- Households can acquire property (or fire) insurance coverage for their homes (and/or possessions) that will cover some of the cost of rebuilding (or relocating) their home and/or replacing their possessions. Some residential property insurance policies include coverage for temporary living expenses if the policyholder's home is inhabitable or inaccessible.
- Businesses (including infrastructure owners) can acquire property (or fire) insurance coverage for their offices/facilities/infrastructure assets along with their machinery, equipment and inventories that will cover some of the cost of rebuilding property and replacing equipment. Some commercial

property insurance policies include (usually as an optional addition) coverage for business interruption losses that replace lost revenue or profit while the policyholders business activity is disrupted.

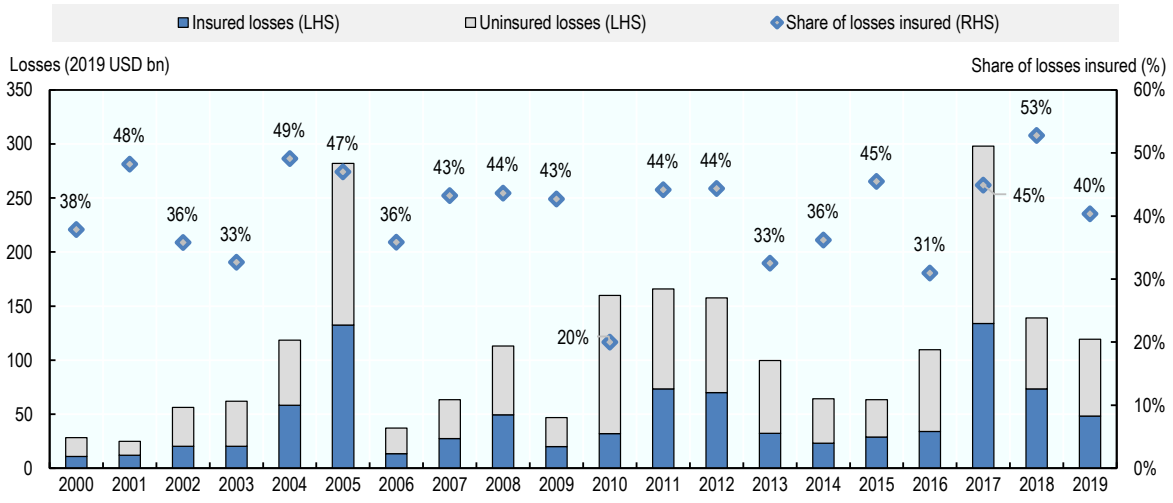
- Agricultural producers can acquire agriculture insurance coverage that protects against lost income as a result of weather-related (and sometimes market-related) reductions in yield or revenues/prices.

In many countries, micro-insurance products have been developed to provide some coverage for climate-related losses and damages for households, (small) businesses and agricultural producers, including various types of crop and livestock insurance coverages, property damage coverage and business interruption covers (Milliman, 2021[22]). Micro-insurance policies tend to provide more limited payouts than "traditional" property and agricultural insurance which lowers the cost of coverage and increases access for low-income households, small businesses and agricultural producers.

High levels of insurance coverage that respond to climate-related damages and losses can reduce the need (and demand) for social and financial support or compensation programmes from the government, thus mitigating the pressures on public finances in the aftermath of a major event. While there are no comprehensive examinations of this link, some studies have found evidence that higher levels of insurance coverage lead to lower post-event public expenditure. For example, one examination of specific past large events estimated that an increase in insurance penetration of 1 percentage point is linked to a reduction in post-disaster government expenditure equivalent to 22 percentage points of the damages incurred (Lloyd's, 2012[23]). Similarly, government expenditures on post-disaster recovery and reconstruction (as assessed by the OECD and World Bank (2019[1])) appears to have been much higher in Japan (approximately 81% of economic losses) relative to Australia and Canada (approximately 40% and 22% of economic losses, respectively) where the share of losses insured was significantly higher.[2] The role of insurance in mitigating the fiscal implications of climate-related catastrophes has also been recognised by the major sovereign credit ratings agencies (Standard & Poor's Ratings Service, 2015[24]), (Moody's, 2021[25]).

However, in many countries, developed and developing, there is a significant gap between insured losses and the overall (or economic) losses and damages resulting from climate-related events – i.e. a significant share of overall losses are uninsured and therefore absorbed by households, businesses and governments (where social protection, financial support or compensation is provided) (see Figure 3.2).

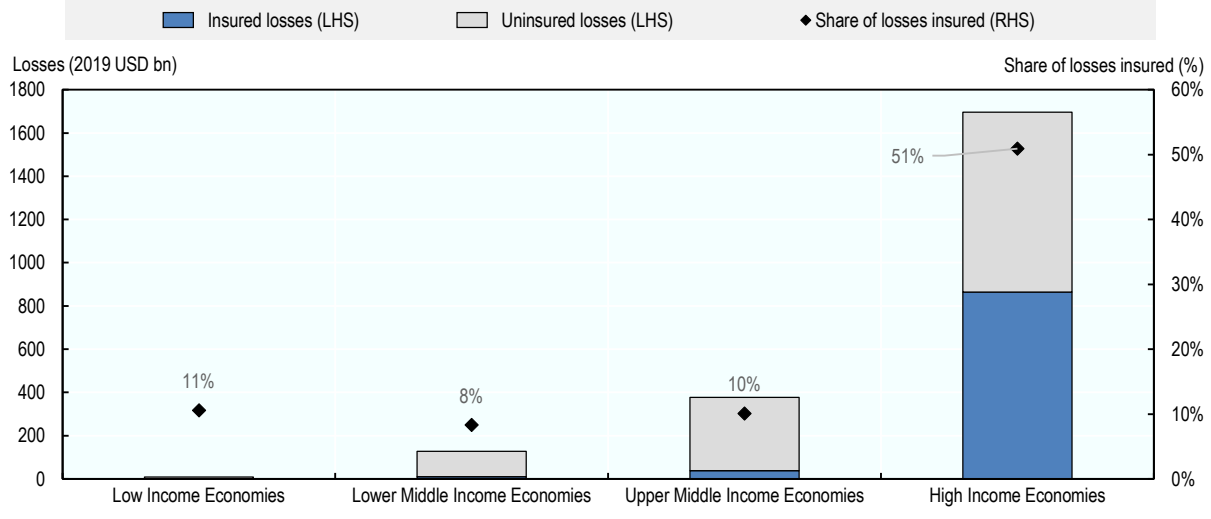
Figure 3.2. Insurance coverage of climate-related catastrophe damages and losses (2000-2019, all countries)



Note: Includes catastrophe events classified as drought/bushfire/heatwave, flood, storm (as main peril) and only events with both an economic and insured loss estimate.
Source: OECD calculations based on (Swiss Re sigma, 2020[21]).

While data is more limited for lower-income countries (relative to high-income countries), there is clearly a much more significant gap between insured and overall losses in lower-income countries (see Figure 3.3), reflecting lower levels of financial and insurance market development.

Figure 3.3. Insurance coverage of climate-related catastrophe damages and losses (by income level, all countries)



Note: Includes catastrophe events classified as drought/bushfire/heatwave, flood, storm (as main peril) and only events with both an economic and insured loss estimate. Countries were classified by income group based on (World Bank, 2021[26]).
Source: OECD calculations based on (Swiss Re sigma, 2020[21])

However, transferring even the vast majority of climate-related risks from households and businesses to insurance companies will not completely eliminate fiscal risks as governments may still face exposures to loss if (individual) insurance companies do not have sufficient financial capacity (including in terms of risk transferred to reinsurance markets) to absorb the losses they face in the aftermath of a significant climate catastrophe. High-levels of uncertainty leading to significant underestimation of the impact of climate change on the magnitude of losses and damages covered by insurance companies could potentially lead to insufficient reserves within the insurance sector although a robust insurance regulatory and solvency framework – along with the establishment of resilient insurance guarantee schemes[3] – may reduce the risk that insurers' commitments to policyholders will not be met.

Access to credit can also provide an important source of funding for households and businesses impacted by climate-events (and therefore potentially reduce fiscal risks) – particularly where insurance coverage of the resulting damage and losses is limited. Studies have shown that access to credit is linked to quicker recovery after natural disasters as countries that are less constrained by credit limitations have access to the funding needed to invest in recovery and reconstruction (McDermott, Barryy and Tol, 2014[27]). In Nepal, one study that examined the impact of livelihood restoration loans after the 2015 earthquake found that – by 2018 – those that had received the loans had income levels that exceeded their pre-earthquake income while non-beneficiaries had yet to recover (Ozaki, 2019[28]).

3.2. Identifying and integrating climate change in fiscal risks assessment

3.2.1. Identification and quantification of climate-related fiscal risks

Climate losses and damages constitute a fiscal risk insofar as they can cause fiscal outcomes to deviate from the forecasts. The OECD Principles on Budgetary Governance recommend that countries clearly identify, classify and quantify fiscal risks, including contingent liabilities (OECD, 2015[29]). For these risks to be governed and managed, their sources first need to be identified. The identification of fiscal risks can provide governments with an idea of the potential financial commitments the government will have to make if climate hazards materialise. In this way, risk assessments inform the allocation of resources to manage climate losses and damages. Many countries perform some form of national climate risk assessment by building on existing experience with overall national risk assessments (OECD, 2018[30]).

However, there are two challenges in identifying and quantifying climate-related fiscal risks. First, national risk assessments are mostly qualitative in nature. The United Kingdom may be an exception to this. While the risks identified in the United Kingdom's 2017 Climate Change Risk Assessment (CCRA) were mostly not quantified, they are quantified in the 2021 report (Sayers et al., 2020[31]). For example, the expected annual damages from floods should increase from GBP 2 billion currently to GBP 2.7-3.0 billion in the 2080s under a 2°C increase and to GBP 3.5-.9.0 billion under a 4°C increase. The second challenge is to move from a physical quantification of risks into a practical application of how they may impact public finances, and thus constitute fiscal risks.

In many instances, the fiscal impact of climate risks is discussed through broader macroeconomic analyses, notably of potential pressures to long-term fiscal sustainability. These analyses are prepared as part of overall sound fiscal management. The assessment of potential fiscal costs in macroeconomic modelling helps countries outline realistic budget targets and develop sound fiscal strategies. Underestimating structural budget challenges related to climate-related risks, on the other hand, would impair fiscal credibility and have negative consequences for debt sustainability in the longer run.

Whether qualitative or quantitative, fiscal risk assessments can be used as a first step towards the quantification of climate risks and fiscal risks assessment. For example, in Switzerland, the Federal Department of Finance publishes a yearly Long-Term Fiscal Sustainability Outlook. In its 2016 report, it dedicated a qualitative analysis of the relationships between climate change and public finances. In 2021,

the analysis remained qualitative but the report suggested to move to a quantitative analysis of the impact of climate change and public finances in further work. It also indicated that "a review of all the budgetary risks would prevent other risks falling under the radar and rank the risk of climate change in relation to the other risks" (Swiss Federal Department of Finance, 2021[32]).

While climate-related fiscal risk measurements rarely draw from broader climate or natural disaster risk assessments, some countries have made the choice of bridging the two together (e.g. New Zealand, United States, United Kingdom, Canada). This is the case for the United Kingdom: the 2021 Fiscal Risks Report by the Office for Budget Responsibility (OBR) extensively refers to the country's latest CCRA. In New Zealand, the government produced a national Climate Change Risk Assessment in August 2020 which identifies 43 risks from climate change. New Zealand is currently preparing a National Adaptation Plan to develop its response to the risks identified in the National Climate Change Risk Assessment. The Treasury's 2021 Half-Year Economic and Fiscal Update explains that the National Adaptation Plan that is being developed in response to the CCRA will identify sources of fiscal risk (New Zealand Treasury, 2021[33]). The CCRA considers "risks to governments from economic costs associated with lost productivity, disaster relief expenditure and unfunded contingent liabilities due to extreme events and ongoing, gradual changes" as one of its ten most urgent risks. In the United States, such analysis is undertaken both within the executive branch by the Office for Management and Budget (OMB) and by the Independent Congressional Budget Office (CBO) and has explored the fiscal impact of climate losses and damages (see Box 3.2).

Box 3.2. Efforts to identify and quantify climate-related fiscal risks in the United States

Office for Management and Budget

The Office for Management and Budget (OMB) announced in 2021 that it will produce, as part of the 2023 budget, a discussion of potential impacts of climate risks in the Long-term Budget Outlook as well as an evaluation of the federal government's climate risk exposure. Prior to this, a 2016 OMB report discussed the effect of climate change on public finances (Office for Management and Budget, 2016[34]). The report draws from analyses made in the National Climate Assessment. The report concentrates on climate risks to five specific programmes: crop insurance, health care, wildfire suppression, hurricane-related disaster relief, and Federal facility flood risk. Fiscal risks are understood in the report as "increases in expected multi-year average costs due to unmitigated climate change, holding demographic, economic, and policy factors constant or in line with current trajectories". Mitigation and adaptation measures (e.g. preventive investments) were not taken into account in the assessment.

Congressional Budget Office

The US Congressional Budget Office (CBO) was also active in the identification of fiscal risks stemming from climate hazards and extreme weather events. It published, in 2016, a study of fiscal damage (i.e. the combined impact of higher spending and lower revenues) caused by higher intensity hurricanes and higher sea level, which fed the OMB report that was produced the same year.

A similar study was produced in 2019, focusing on hurricane winds and storm-related flooding. In 2021, the CBO published a qualitative assessment, brief but broader in scope than the precedent publication, of the effect of climate change on the budget.

Note: This box aims at presenting some examples of quantification of fiscal impact of climate risks rather than an exhaustive list.
Source: (Office for Management and Budget, 2016[34]; Vahlsing and Yagan, 2021[35]; Congressional Budget Office, 2021[36])

Once sources of risk are identified, the potential size of impact can then be estimated, including from a fiscal standpoint. The OECD suggests two approaches to estimate the size of disaster-related contingent

liabilities: direct estimation and estimation via probabilistic modelling (OECD and World Bank, 2019[11]). The first method consists in deriving estimates from historical data on past hazards. Such information may be obtained from data repositories, payouts from relief funds, disclosed data on the spending to respond to hazards and disasters as well as from insurance programmes. Japan is notable in this regard as it records *ex post* disaster-related expenditures and also records the expenditure invested *ex ante* into prevention efforts (OECD and World Bank, 2019[11]).

The costs of climate-related losses and damages can also be estimated via a modelling of losses based on the probability of a catastrophe. Such methods can complement direct estimates of contingent liabilities but also serve to estimate the cost of extreme events that have not previously occurred. Models of losses from climate change, similar to overall natural disasters, are fragmented across the public and the private sector. For example, (re)insurance companies, intermediaries and specialised catastrophe modelling firms have developed probabilistic models to estimate potential losses and damages for many climate perils, with broad coverage in countries with high-level of insurance coverage for those perils (OECD, 2021[37]). These models have been developed for use by insurance and reinsurance companies in underwriting and pricing the coverage that they provide and could potentially be applied in modelling fiscal risk (although these models have not been designed for that purpose).

Catastrophe modelling can also be developed in the public sector. In Mexico, the Federal Risk Loss Estimation System (R-FONDEN) was developed to quantify probable losses of low-impact frequent events for public assets (OECD, 2017[38]). This probabilistic catastrophe risk assessment system was created in 2007 as a result of a partnership between the country's Ministry of Finance and the Mexican Natural Disasters Fund (FONDEN), which was discontinued in 2020 (Helfgott, 2021[39]). It focused on the losses and damages on public assets caused by four types of disaster, including climate-related risks: earthquakes, floods, tropical cyclones and storm surges. In its 2016 study, while it used probabilistic modelling to estimate the contribution of stronger hurricanes and higher sea levels to total expected damage, the US CBO used historical data on Federal disaster relief to measure the expected Federal fiscal cost caused by climate change (Office for Management and Budget, 2016[34]). The Philippines Catastrophe Risk Model was developed in 2014 to provide probabilistic estimates of total losses from typhoons and earthquakes, on an annual long-term average basis (World Bank, 2021[40]). In Colombia, the Government has developed probabilistic risk assessments for a number of climate-related perils, including floods, wildfires and tropical cyclones. The results of the probabilistic risk assessments are published in a risk atlas ("*Atlas de Riesgo de Colombia: revelando los desastres latentes*"), including estimates of expected average annual losses and probable maximum losses.

3.2.2. Integration of climate related losses in economic and fiscal forecasting

When integrating climate related risks in budget forecasts, planners should distinguish between the fiscal consequences of both climate change mitigation and adaptation.

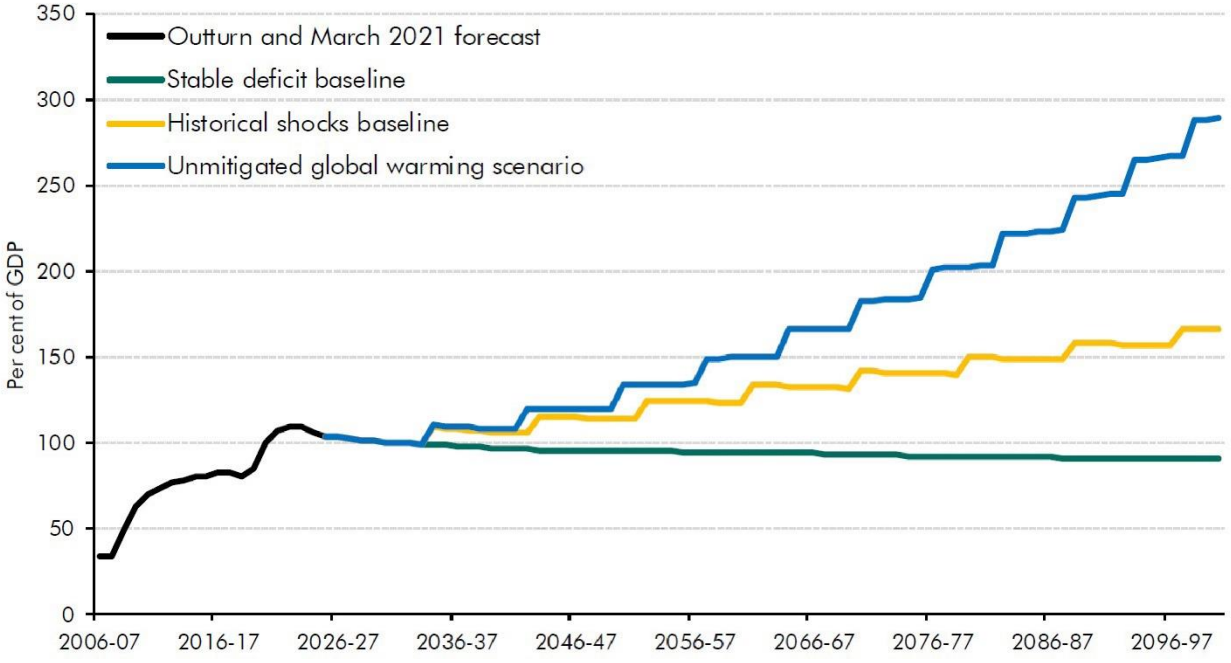
Among countries that have begun to incorporate the climate change transition into forecasts, either through their independent fiscal institutions or their Ministries of Finance, most have focused on mitigation costs**.** Mitigation costs arise from action to address the causes of climate change, mainly through programmes to reduce greenhouse gas emissions (e.g. through the use of electric vehicles) that have both a direct and indirect effect on the public finances. For example, mitigation costs have been incorporated in short-term forecasts in Denmark, Belgium, United Kingdom and New Zealand, among others. In New Zealand, fiscal forecasts include various revenue and spending flows from the country's emissions trading scheme as well as provisions from government agencies to respond to natural hazard events (New Zealand Treasury, 2021[33]). Long-term forecasts of transitions risks are often performed through scenario analysis: a number of countries examine the budgetary costs of achieving their climate targets under different horizons.[4]

Adaptation costs, which represent an investment for the future, on the other hand, are often neglected. Adaptation investments are associated with adjusting the economy and public finances to climate-related

losses that cannot or have not been prevented. Incorporating adaptation investments into budget planning assumptions can be complex, uncertain and resource intensive. Estimates of physical risks to public finances are still scarce. As part of its Long-Term Budget Outlook, the US CBO only includes physical risks in its macroeconomic model to forecast GDP (Council of Economic Advisers and Office for Management and Budget, 2022[41]). Among other things, US executive agencies are currently working towards measuring the financial risks and exposure to unmitigated climate change. The European Commission's 2021 European Fiscal Sustainability Report recently estimated the fiscal impact of physical risks on 13 European countries (European Commission, 2022[42]). The federal government of Mexico has developed a strong capacity in monitoring shorter to longer term macroeconomic risks, including those stemming from specific natural disasters (OECD and World Bank, 2019[11]). In the past, such assessments were used to feed the budgeting decisions of Mexico's major disaster fund, FONDEN. In the Philippines, catastrophe risk modelling is used to assess the government's potential losses and inform the design of risk transfer instruments to adequately finance disaster and climate risks. In Colombia, probabilistic risk assessments are enhanced by an analysis of social vulnerability and resilience (e.g. unemployment, unsatisfied basic needs, risk management capacity) to provide an integrated risk index that supports the prioritisation of risk reduction and preparedness investments.

Mostly due to the complexity of the calculations, estimates of adaptation costs remain relatively rare, even in developed countries. The UK is developing its capacity to estimate the financing needs associated with adapting to the acute and chronic impacts of climate change. In illustrating the adaptation costs from climate change, the UK OBR departed from its traditional methodology of scenario analysis (e.g. on transition risks from climate change). In its scenario for the fiscal impact of unmitigated climate change, the UK's Independent Fiscal Institution made two assumptions. First, adaptation costs increase by 0.3% of GDP per year for each additional temperature degree. Second, the size and frequency of extreme weather events gradually rise with global warming and double in both respects by 2100, as compared with the baseline of historical shocks. This is illustrated in Figure 3.4.

Figure 3.4. The OBR's scenario for unmitigated global warming



Source: (Office for Budget Responsibility, 2021[43])

In the rare cases where adaptation costs have been considered, forecasters have tended to focus on one source of climate risks or one sector of the economy. The Financial Accountability Office (FAO) of Ontario in Canada has recently been estimating the budgetary costs of climate hazards on public infrastructure (Financial Accountability Office of Ontario, 2021[44]). Its first report measured the effect of changes in extreme rainfall, extreme heat and freeze-thaw cycles on the long-term adaptation costs of public buildings and facilities at the provincial and municipal level. Various long-term scenarios are established. Their costs are presented in Box 3.3.

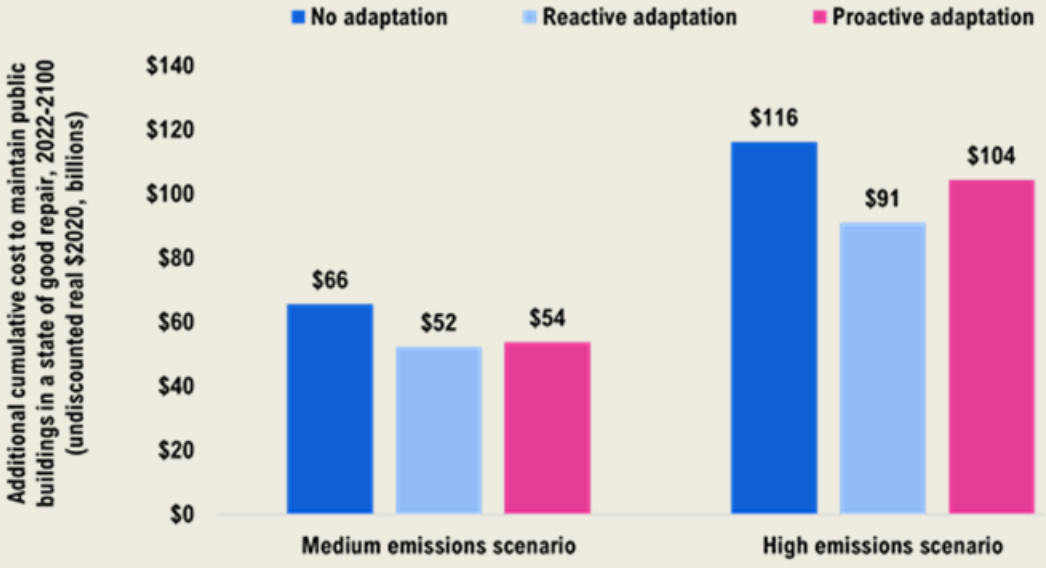
Box 3.3. The financial impact of climate adaptation on Ontario's public buildings

In the medium-term (2022-2030), the FAO argues that relevant climate hazards will add about CAD 6 billion to the existing baseline maintenance costs for public buildings and facilities.

In the long-term (until 2100), the extent of global warming (medium vs. high emissions scenarios) and the asset management strategy (proactive vs. reactive strategy) are the two main factors influencing the size of the impact on the maintenance costs of public buildings and facilities (see Figure below).

- In the high emissions scenario, the cumulative costs of maintaining the existing portfolio of public buildings in a state of good repair would increase by CAD 116 billion by the end of the century (i.e. an average of CAD 1.5 billion per year). This corresponds to a 14.5% rise above the baseline of what would have occurred in a stable climate.
- In a medium emissions scenario, the cost would increase by CAD 66 billion (i.e. an average of CAD 0.8 billion per year). This corresponds to an 8.2% rise over the baseline.

Figure 3.5. The long-term adaptation costs from climate change to maintaining Ontario's public buildings and facilities



Note: The estimates presented in the carts are to be added to the baseline costs.
Source: (Financial Accountability Office of Ontario, 2021[44])

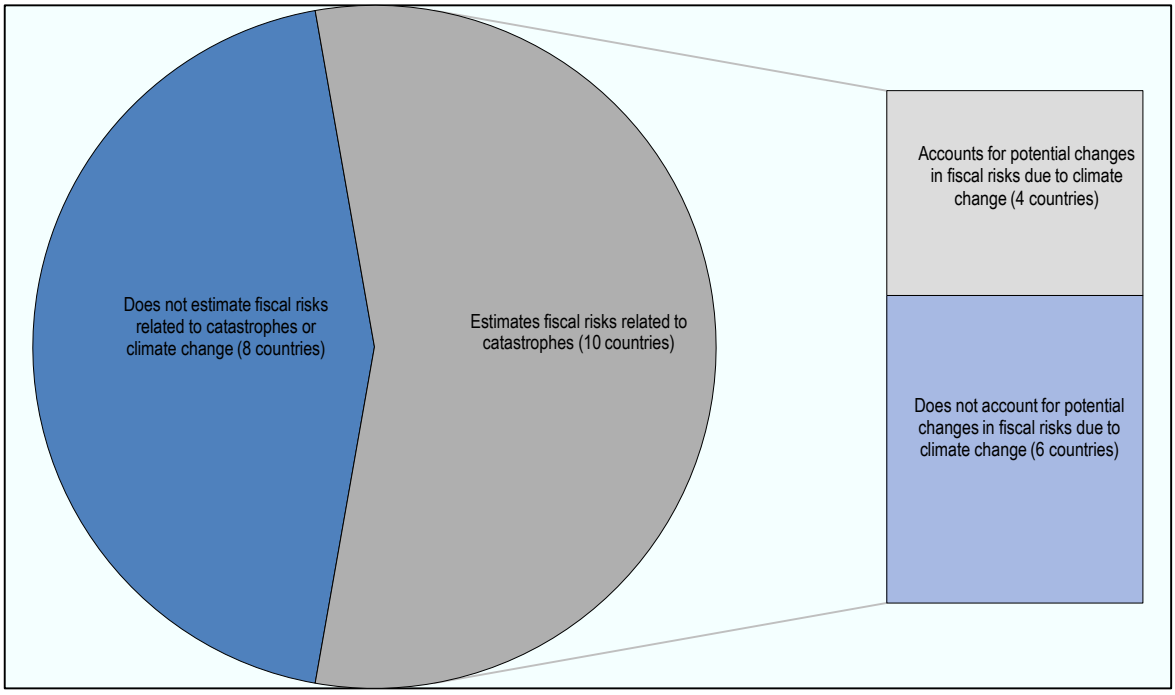
3.2.3. Integration of climate change in fiscal risks management and reporting

The reporting of disaster-related contingent liabilities, including related to climate change, is not yet widespread. Disclosure is usually achieved either as part of the budget reporting process or as part of the fiscal risk management strategy. Climate-related disaster risks may not need recognition as a contingent liability when losses are not of a major nature Notes to financial statements can be used to report and provide some details thereby providing transparency. In the European Union, reporting on disaster-related contingent liabilities is limited (Radu, 2021[6]). In Australia, there is no reference to climate change in the Statement of Fiscal Risks as part of the 2022-2023 budget documentation (The Commonwealth of Australia, 2022[45]). The Debt Statement however includes an analysis of the contribution of climate spending (mitigation and adaptation) to public debt. More generally, independent fiscal institutions and parliamentary budget offices can play a strong role in disclosing the potential impact of climate change on the economy and public finances, given their overall advisory role related to long term fiscal risks.

Still, countries with a generally strong fiscal risks management strategy tend to report these climate risks, whether for adaptation or mitigation, more than others. For example, in the United Kingdom, climate-related fiscal risks are discussed in the OBR's Fiscal Risks Report (Office for Budget Responsibility, 2021[43]). In New Zealand, climate-induced events are considered as fundamentally uncertain and therefore categorised as "general fiscal risks" rather than "specific" fiscal risks which can receive a dedicated analysis (New Zealand Treasury, 2021[33]). In the United States, the Office for Management and Budget announced in 2021 that, as part of next year's budget, it will produce a discussion of potential impacts of climate risks in the Long-term Budget Outlook as well as an evaluation of the federal government's climate risk exposure (Vahlsing and Yagan, 2021[35]). The CBO has already incorporated climate change considerations in its own Long-Term Budget Outlook (Council of Economic Advisers and Office for Management and Budget, 2022[41]).

Reporting on climate-related contingent liabilities can incentivise countries to disclose how such risks are managed and mitigated. Every autumn, the Finnish Ministry of Finance reports on the fiscal risks in the Overview of Central Government Risks and Liabilities. In 2017, climate-related liabilities were already classified as explicit contingent liabilities given the legal basis of the country's climate targets. The Autumn 2021 Overview of Central Government Risks and Liabilities indicates that additional measures are being prepared in the country's climate policy to meet climate commitments to the European Union (Finnish Ministry of Finance, 2022[46]). However, relatively few countries also report how climate risks are managed and mitigated. In its Statement of Specific Fiscal Risks, the New Zealand Treasury identifies multiple cost pressures on existing policies and government programmes emanating from climate change that it categorises as "specific fiscal risks" (New Zealand Treasury, 2021[33])

Figure 3.6. Integration of climate and catastrophe risk into fiscal risk assessment: OECD countries



Source: Responses to the *OECD survey for assessing implementation of the OECD Recommendation on Disaster Risk Financing Strategies*.

References

Bello, O. et al. (2020), *Assessment of the Effects and Impacts of Hurricane Dorian in the Bahamas*, Inter-American Development Bank, Washington, https://doi.org/10.18235/0002582. [13]

Cabinet Office (2016), *Disaster Management in Japan 2016: White Paper*, Government of Japan, https://www.bousai.go.jp/kyoiku/panf/pdf/WP2016_DM_Full_Version.pdf (accessed on 4 April 2022). [50]

Cameron, S., M. Lelong and L. von Trapp (2022), *More than words: Potential Roles for Independent Fiscal Institutions in Green Budgeting*, https://ec.europa.eu/info/sites/default/files/ifisgreenbudgeting-20220309.pdf. [47]

Congressional Budget Office (2021), *Budgetary Effects of Climate Change and of Potential Legislative Responses to It*, https://www.cbo.gov/publication/57019. [36]

Costella, C. et al. (2021), *Social protection and climate change: scaling up ambition*, Social Protection Approaches to COVID-19 Expert Advice Service (SPACE), DAI Global UK Ltd. [2]

Council of Economic Advisers and Office for Management and Budget (2022), *Climate-related Macroeconomic Risks and Opportunities*, https://www.whitehouse.gov/wp-content/uploads/2022/04/CEA_OMB_Climate_Macro_WP_2022.pdf. [41]

European Commission (2022), *Fiscal Sustainability Report 2021*, https://doi.org/10.2765/682828. [42]

Financial Accountability Office of Ontario (2021), *Costing Climate Change Impacts to Public Infrastructure*, https://www.fao-on.org/web/default/files/publications/EC2105%20CIPI%20Buildings/CIPI%20Buildings-EN.pdf. [44]

Finnish Ministry of Finance (2022), *Overview of Central Government Risks and Liabilities, autumn 2021*, https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/163939/VM_2022_17.pdf?sequence=1. [46]

Gobierno de El Salvador (2021), *Evaluation of the effects, impacts and needs El Salvador is facing due to the double incidence of the COVID-19 pandemic and the tropical Storms Amanda and Cristóbal*, Gobierno de El Salvador. [12]

Government of Fiji (2016), *Fiji: Post-Disaster Needs Assessment - Tropical Cyclone Winston February 2016*, Government of Fiji. [16]

Government of Georgia (2015), *Tbilisi Disaster Needs Assessment*, Government of Georgia. [9]

Government of Kerala (2018), *Kerala Post Disaster Needs Assessment: Floods and Landslides - August 2018*, Government of Kerala. [15]

Government of Mozambique (2019), *Mozambique Cyclone Idai: Post-Disaster Needs Assessment*, Government of Mozambique. [14]

Government of the Commonwealth of Dominica (2017), *Post-Disaster Needs Assessment Hurricane Maria September 18, 2017*, Government of the Commonwealth of Dominica. [7]

Government of the Federation of Bosnia and Herzegovina (2014), *Bosnia and Herzegovina Recovery Needs Assessment, Floods 14 – 19 May*, Government of the Federation of Bosnia and Herzegovina. [8]

Helfgott, A. (2021), *Adiós, FONDEN - Mexico's Approach to Natural Disaster Financing for Risk Reduction and Reconstruction*, https://www.wilsoncenter.org/article/adios-fonden-mexicos-approach-natural-disaster-financing-risk-reduction-and-reconstruction. [39]

IMF (2021), *World Economic Outlook Database, October 2021*, International Monetary Fund, https://www.imf.org/en/Publications/WEO/weo-database/2021/October (accessed on 20 May 2022). [20]

Lloyd's (2012), *Global underinsurance report*, Lloyd's, https://www.lloyds.com/news-and-risk-insight/risk-reports/library/understanding-risk/global-underinsurance-report (accessed on 15 June 2020). [23]

Lowder, S., R. Bertini and A. Croppenstedt (2017), "Poverty, social protection and agriculture: Levels and trends in data", *Global Food Security*, Vol. 15, pp. 94-107, https://doi.org/10.1016/J.GFS.2017.06.001. [5]

McDermott, T., F. Barryy and R. Tol (2014), "Disasters and development: natural disasters, credit constraints, and economic growth", *Oxford Economic Papers*, Vol. 66/3, pp. 750-773, https://doi.org/10.1093/OEP/GPT034. [27]

Mechler, R. and J. Weichselgartner (2003), *Disaster Loss Financing in Germany - The Case of the Elbe River Floods 2002*, International Institute for Applied Systems Analysis, http://pure.iiasa.ac.at/id/eprint/7060/ (accessed on 2 May 2022). [19]

Milliman (2021), *Making climate risk microinsurance work*, https://www.my-milliman.com/en-gb/insight/making-climate-risk-microinsurance-work (accessed on 22 March 2022). [22]

Ministry of Disaster Management and Ministry of National Policies and Economic Affairs (2016), *Sri Lanka: Post-Disaster Needs Assessment - May 2016 Floods and Landslides*, Government of Sri Lanka. [17]

Moody's (2021), *Research: Moody's - Physical climate risk is credit negative for most sovereigns, particularly in emerging markets*, Moody's, https://www.moodys.com/research/Moodys-Physical-climate-risk-is-credit-negative-for-most-sovereigns--PBC_1282314?cid=7QFRKQSZE021 (accessed on 18 November 2021). [25]

New Zealand Treasury (2021), *Half-Year Economic and Fiscal Update*, https://www.treasury.govt.nz/system/files/2021-12/hyefu21.pdf. [33]

O'Brien, C. et al. (2018), *Shock-Responsive Social Protection Systems Research: Synthesis Report*, Oxford Policy Management. [3]

OECD (2021), *Enhancing Financial Protection Against Catastrophe Risks: The Role of Catastrophe Risk Insurance Programmes*, OECD. [37]

OECD (2021), *Managing Climate Risks, Facing up to Losses and Damages*, OECD Publishing, Paris, https://doi.org/10.1787/55ea1cc9-en. [4]

OECD (2018), "National Risk Assessments: a Cross Country Perspective", https://doi.org/10.1787/9789264287532-en. [30]

OECD (2017), *OECD Toolkit for Risk Governance*, https://www.oecd.org/governance/toolkit-on-risk-governance/home/. [38]

OECD (2015), *Recommendation of the Council on Budgetary Governance*. [29]

OECD/The World Bank (2019), *Fiscal Resilience to Natural Disasters: Lessons from Country Experiences*, OECD Publishing, Paris, https://doi.org/10.1787/27a4198a-en. [1]

OECD and World Bank (2019), *Fiscal Resilience to Natural Disasters*, OECD Publishing, https://doi.org/10.1787/27a4198a-en. [11]

Office for Budget Responsibility (2021), *Fiscal Risks Report*, https://obr.uk/docs/dlm_uploads/Fiscal_risks_report_July_2021.pdf. [43]

Office for Management and Budget (2016), *Climate Change: The Fiscal Risks Facing the Federal Government*, https://obamawhitehouse.archives.gov/sites/default/files/omb/reports/omb_climate_change_fiscal_risk_report.pdf. [34]

Ozaki, M. (2019), *Microfinance Can Be a Powerful Force in Disaster Recovery*, Asian Development Bank Blog, https://blogs.adb.org/blog/microfinance-can-be-powerful-force-disaster-recovery (accessed on 4 September 2022). [28]

PBO (2016), *Estimate of the Average Annual Cost for Disaster Financial Assistance Arrangements due to Weather Events*, Parliamentary Budget Office, https://qsarchive-archiveqs.pbo-dpb.ca/web/default/files/Documents/Reports/2016/DFAA/DFAA_EN.pdf (accessed on 4 April 2022). [48]

Productivity Commission (2014), *Productivity Commission Inquiry Report Volume 2: Supplement - Natural Disaster Funding Arrangements*, Commonwealth of Australia, http://www.itsanhonour.gov.au (accessed on 4 April 2022). [49]

Radu, D. (2021), "Disaster Risk Financing: Main Concepts & Evidence from EU Member States", *European Economy Discussion Papers*, European Union, Luxembourg, https://doi.org/10.2765/504147. [6]

Sayers, P. et al. (2020), *Third UK Climate Change Risk Assessment (CCRA3) - Future flood risk*, Committee on Climate Change, https://www.ukclimaterisk.org/wp-content/uploads/2020/07/Future-Flooding-Main-Report-Sayers-1.pdf. [31]

Standard & Poor's Ratings Service (2015), *The Heat Is On: How Climate Change Can Impact Sovereign Ratings*, Standard & Poor's Ratings Service, https://www.agefi.com/uploads/media/S_P_The_Heat_Is_On_How_Climate_Change_Can_Impact_Sovereign_Ratings_25-11-2015.pdf (accessed on 22 March 2018). [24]

Swiss Federal Department of Finance (2021), *Report on the long-term sustainability of public finances in Switzerland*, https://www.efd.admin.ch/efd/en/home/fiscal-policy/report-long-term-sustainability-public-finances.html. [32]

Swiss Re sigma (2020), *Natural catastrophes and man-made disasters: 1990-2019 (dataset)*, Swiss Re. [21]

The Commonwealth of Australia (2022), *Budget Strategy and Outlook: Budget Paper n°1 2022-2023*, https://budget.gov.au/2022-23/content/bp1/download/bp1_2022-23.pdf. [45]

Vahlsing, C. and D. Yagan (2021), *Taking Action to Address Climate-Related Fiscal Risk*, https://www.whitehouse.gov/omb/briefing-room/2021/10/15/taking-action-to-address-climate-related-fiscal-risk/. [35]

Vanuatu Prime Minister's Office (2015), *Post-Disaster Needs Assessment: Tropical Cyclone Pam, March 2015*, Government of Vanuatu. [18]

World Bank (2021), *Lessons Learned: The Philippines Parametric Catastrophe Risk Insurance Program Pilot (Evaluation Report)*, World Bank, https://openknowledge.worldbank.org/handle/10986/36013. [40]

World Bank (2021), *World Bank Country and Lending Groups*, World Bank, https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (accessed on 15 July 2021). [26]

World Bank (2012), *Thai Flood 2011 : Rapid Assessment for Resilient Recovery and Reconstruction Planning*, World Bank. [10]

Notes

[1] *Recovery* needs are an estimate of the cost to achieve a given level of recovery and include all interventions necessary to rebuild livelihoods and infrastructure on a sector-by-sector basis. Recovery needs include relief, recovery and reconstruction.

[2] The share of natural catastrophe economic losses insured was estimated to be 56.8% in Canada (for events between 2005 and 2014), 55.6% in Australia (for events between 2002 and 2015) and 20.5% in Japan (for events between 2000 and 2016) (OECD calculations based on data provided by (Swiss Re sigma, 2020[21])). Public expenditure on post-event recovery was estimated to be equivalent to 21.8% of economic losses in Canada (central and subnational governments, based on an assumption of 90% federal share) (PBO, 2016[48]), 40.4% in Australia (central and subnational governments, based on an assumption of 80% federal share) (Productivity Commission, 2014[49]) and 81.0% in Japan (central government) (Cabinet Office, 2016[50]). However, the differences may be explained by differences in policy objectives for financial compensation and support across the three countries.

[3] Insurance guarantee schemes are arrangements established by governments or the insurance sector to ensure that policyholders are protected against the failure of their insurance coverage provider. These schemes will normally assume (some or all) of the obligations of the failed insurer to its policyholders by paying any outstanding claims or benefits and/or transferring the policy to a solvent insurance company. Such schemes exist in both developed and developing countries although to a more limited extent than deposit insurance arrangements (i.e. the banking sector equivalent for protecting bank deposits).

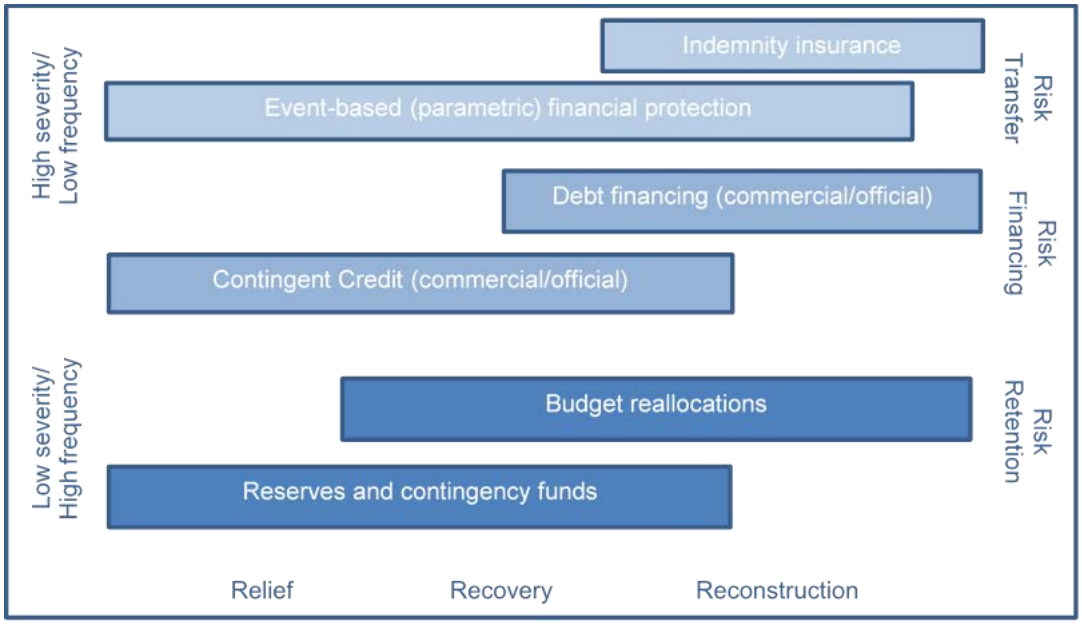
[4] Austria, Switzerland, the United States, the United Kingdom, the Netherlands are among the countries that have performed such exercises. In order to quantify the costs of climate change mitigation, the CPB Netherlands Bureau for Economic Policy Analysis forecasted the fiscal implications of a number of emissions target stringency assumptions to 2030 (Cameron, Lelong and von Trapp, 2022[47])

4 Public budgetary and financial instrument options

Governments face budgetary constraints that limit their capacity to invest in long-term resilience and ensure adequate funding to respond to climate-related losses and damages through budgetary tools. The materialisation of fiscal risks from climate change can require rapid and significant adjustments to the level and composition of government revenues and expenditures. This chapter discusses the range of tools that governments can use to manage disaster-related costs, including budgetary instruments, such as budget reallocations and contingency and reserve funds, public guarantees for catastrophe risk insurance programmes as well as financial instruments such as debt financing and risk transfer. The chapter also discusses the role of risk prevention investments to reduce risk exposure. The chapter discusses the adequacy of each tool in different national contexts and for climate risks of varying frequency and severity.

The materialisation of fiscal risks from climate change can require rapid and significant adjustments to the level and composition of government revenues and expenditures. Governments have a range of budgetary and financial tools for managing such disaster costs. The type of hazard and the magnitude of disruptions to economic activity (amongst other factors, as discussed below) determine a government's optimal post-disaster response. As shown in Figure 4.1, frequent events that cause minor economic disruptions are generally best absorbed using budgetary tools. Lower frequency, higher intensity (or severity) events might best be managed through the use of debt financing and risk transfer. However, not all countries are equivalent in terms of fiscal capacity, to mobilise their budget, use debt financing and access risk financing and risk transfer markets. Different countries will choose different solutions based on the conditions they face. Developing countries – and particularly lower income countries – face different challenges in terms of fiscal capacity and access to capital markets which impacts their ability to fund spending needs through fiscal frameworks and debt financing.

Figure 4.1. Funding approaches to cover contingent liabilities from disasters



Source: OECD

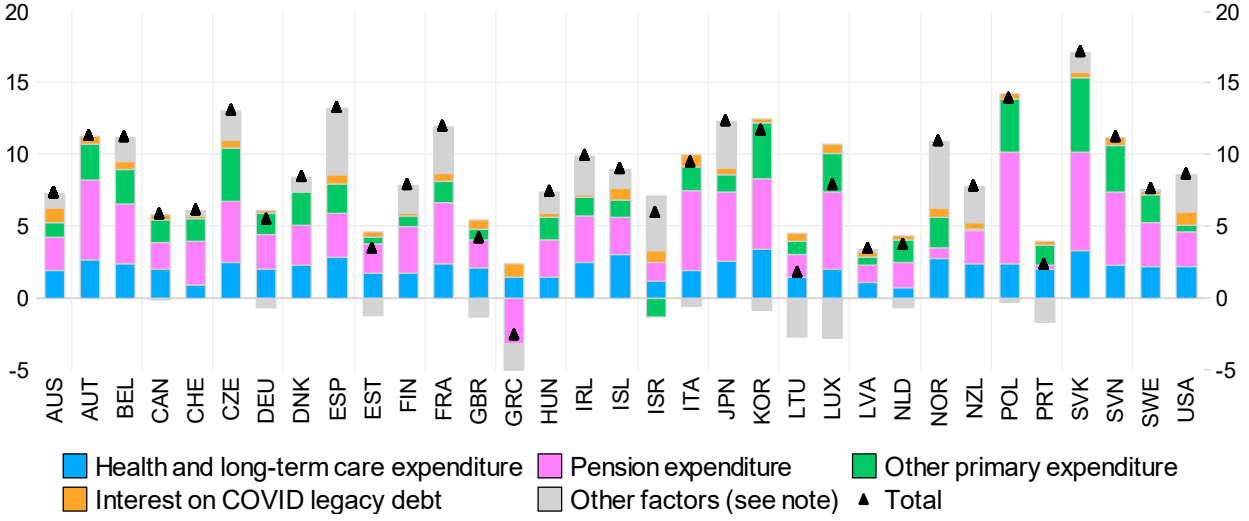
The extent to which governments can leverage these tools depends on rigidities in the budget as well as competing economic, social and political objectives. Considering these pressures, this section reviews the public financial management practices that governments can use to respond to climate-related shocks.

4.1. Long-term fiscal pressures on climate risk management

Countries in different income groups face different fiscal pressures. OECD countries face long-term pressures on public expenditures that are mostly due to their demographic structures. The OECD projects health and long-term care expenditures as well as pension expenditures to respectively increase by an average of 2.1 and 3 percentage points of GDP by 2060 (Figure 4.2). More broadly, public expenditures are expected to increase by about 8% of GDP on average across OECD countries. The demographic structures in lower income countries is however much different. By 2060, the medium-fertility scenario of the United Nations finds that the percentage of the total population above 60 years old will be 34% in high-

income countries but only 19% in lower-middle-income countries and 10% in low-income countries (United Nations, 2019[1]).

Figure 4.2. Change in fiscal pressure between 2021 and 2060, % points of potential GDP



Note: The chart shows how the ratio of structural primary revenue to GDP must evolve between 2021 and 2060 to keep the gross debt-to-GDP ratio stable near its current value over the projection period (which also implies a stable net debt-to-GDP ratio given the assumption that government financial assets remain stable as a share of GDP). The underlying projected growth rates, interest rates, etc., are from the baseline long-term scenario presented in section 2. Expenditure on temporary support programmes related to the COVID-19 pandemic is assumed to taper off quickly. The necessary change in structural primary revenue is decomposed into specific spending categories. The component 'Interest on COVID legacy debt" approximates the permanent increase in interest payments due to the COVID-related increase in public debt between 2019 and 2022. The component 'Other factors' captures anything that affects debt dynamics other than the explicit expenditure components (it mostly reflects the correction of any disequilibrium between the initial structural primary balance and the one that would stabilise the debt ratio). This projection excludes climate change adaptation as a source of expenditure pressure.
Source: (Guillemette and Turner, 2021[2])

A common budget constraint that countries of all income groups face is debt vulnerability, that is the knock-on effect that additional expenditures generated by climate hazards and extreme weather events would have on public finances, including in terms of additional debt (see section 4.4.2 below). Across OECD countries, general government debt increased from 52% of GDP in 2007 to 94.3% in 2020 (OECD, 2021[3]). The average net government debt without ageing costs of OECD countries is projected to reach about 145% of GDP by 2060 (Guillemette and Turner, 2021[2]). Lower income countries have experienced a parallel trend. The share of Least Developed Countries (LDCs) and Low-Income Countries (LICs) considered to be at high risk of debt distress or in debt distress by the IMF/World Bank Debt Sustainability Framework has increased from 30% in 2015 to 60% in 2022 (Inter-agency Task Force on Financing for Development, 2022[4]). Yet, little of this was due to the pandemic, as the fiscal response of countries in these income levels was limited. In Middle Income Countries (MICs) and Small Island Developing Countries (SIDS), however, the pandemic strongly contributed to an increase in debt levels. In the coming years, the United Nations expects developing countries' debt to remain high, supported by high financing needs and the ongoing impact of the pandemic on growth and incomes. Once the recovery from the COVID-19 crisis is well entrenched, fiscal consolidation pressures to reduce debt vulnerability are likely to hamper preventive investments and the use of contingency funds to manage climate risks in both higher and lower income countries. High debt levels not only limit the incentives of countries to make use of these instruments, they can, in some cases, limit the ability of countries to finance short-term recovery and relief. Narrow fiscal space already limited the financing of COVID-19 response measures in a number of middle and low-income countries.

The constraint on fiscal policy imposed by high debt levels is in fact more significant for lower income countries. While the public finances of OECD countries are also exposed to climate risks (Rawdanowicz et al., 2021[5]), LDCs, SIDS are disproportionately exposed to climate change due to their geographic locations and physical features, combined with more limited fiscal capacity (IPCC, 2018[6]; IPCC, 2019[7]). Such high exposure, combined with little fiscal space, makes lower income countries particularly vulnerable to climate hazards.

4.2. Budgetary tools to respond to climate hazards

4.2.1. Reserve and contingency funds

Contingency reserves and reserve funds are budget provisions or dedicated funding pools set aside to address unforeseen expenses. A contingency reserve is a provision within the annual budget that usually rolls over to the next year when not used whereas dedicated reserve funds, including climate or natural disaster funds, are funding pools that accumulate over time. Both of these tools can serve as fiscal buffers to mitigate climate-related risks. When a disaster strikes, governments can swiftly mobilise these reserves and provisions to finance their responses to climate catastrophes and extreme weather events (Radu, 2021[8]). Because they tend to be smaller, contingency reserves are best suited for high-frequency and low-severity disasters such as localised climatic shocks (e.g. floods and droughts) and to cover immediate relief needs (see Figure 4.1). On the other hand, dedicated reserve funds are most appropriate for climate-related hazards that are relatively less frequent and relatively more severe (though still less severe and more frequent than hazards that may be best addressed with debt financing and/or insurance) and to fund longer-term recovery and reconstruction expenses.

In the European Union, for example, most member states have set aside funds for climate-related contingencies. These buffers help countries absorb climate shocks while also supporting their fiscal targets and sustainability by reducing the need for additional borrowing. Governments can hedge their position by relying on a mix of contingency reserves and budgetary reallocations. When disaster costs exceed a country's reserve and contingency funds, budget reallocations can be used to cover residual expenses. At the same time, making the necessary fiscal savings to finance contingency reserves can discourage governments from overspending in periods of economic growth. Robust fiscal responsibility frameworks that promote these countercyclical savings are therefore particularly important in countries most exposed to climate hazards and extreme weather events (World Bank, 2019[9]).

Although climate disasters and extreme weather events are set to increase in frequency and magnitude, forecasting their precise macroeconomic impacts is uniquely difficult and influenced by a range of factors such as hazard type, affected location and risk management practices in place (as outlined in Chapter 3). As a result, determining the size of reserve and contingency funds can be challenging. Investing too little is costly when a major disaster strikes while investing too much comes at the cost of other expenditure priorities. Considering these trade-offs, governments should try to estimate the annualised relief and recovery costs of climate disasters and other contingencies (Phaup and Kirschner, 2010[10]). These estimates can be calculated from past spending data on disaster relief and recovery or through probabilistic modelling. However, further investments are necessary to implement probabilistic modelling at scale. Reserve funds can then be credited with an appropriation equal to this estimate. Lithuania, for example, has four contingency reserves that amount to around 0.5 percent of total expenditure as of 2017. In Malta, contingency reserves account for 0.1-0.5 percent of GDP and are invested in short-term liquid assets until they are needed (OECD, 2021[11]). Low income and lower middle income countries may have less capacity to set aside funds as contingency reserves or reserve funds given limited revenue generation and significant (and unmet) spending demands to support economic and social development.

Table 4.1. Reserve funds in selected countries

Country	Name	Contingencies covered	Details
Belgium	National Calamity Fund and National Agricultural Fund	Storm, earthquake, flood, public sewage overflow, landslides, ground subsidence	Purpose: providing assistance to public establishments and individuals. Drawdown procedure: prior to any disbursement, there must be a declaration of natural calamity made by the Director of Calamities based on scientific opinion. Approval from the Ministry of the Interior and the Council of Ministers is also required.
Austria	Austria Catastrophes Fund	Flood, avalanche, earthquake, landslide, hurricane, hail	Purpose: assuring the provision of adequate aid to injured persons and the reconstruction of damaged infrastructure. Disaster damage to private property is usually compensated by the states (bundeslander), for up to 20-30% of the loss suffered, and their compensation expenses are 60% reimbursable by the Fund. Damage to public infrastructure in the states or other local jurisdictions is financed up to 50% by the Fund. The Fund covers protective measures and provides financial assistance to victims of disasters (individuals, enterprises). It also contributes to the funding of equipment for disaster relief by the fire brigades. In the event of a disaster, additional funds can also be mobilized by the government for the compensation of losses.
China	Central Natural Disaster Livelihood Subsidy Fund	Drought, flood, typhoon, hail, freezing temperatures, snow, earthquake, rock avalanche, landslide, mudslide	Purpose: ensuring that affected populations can retain a basic living standard after a natural disaster. Size: the fund has an annual budget of CNY 13 billion.
Colombia	National Fund for Disaster Risk Management (FNGRD)	Natural disasters, national calamities	Purpose: funding disaster response costs at the national-level and supporting funding needs at the subnational level Departments have established subnational funds Fondos (Departamentales para la Gestión del Riesgo de Desastres) to support investment and funding needs within the jurisdiction of the department or other subnational authority. The establishment of reserve funds at departmental level is a legislative requirement with the allocation of funds linked to estimates of fiscal risks.
India	National Disaster Response Fund and State Disaster Response Fund (SDRF)	Natural calamities, cyclone, drought, earthquake, fire, flood, tsunami, hailstorm, landslide, avalanche, cloud burst, frost, cold wave, pest attack	Purpose: supporting affected individuals to meet immediate basic needs and regain livelihood. Financial assistance is provided on a case-by-case basis. Drawdown procedure: In order for the funds to be activated the natural calamity must be deemed severe. Currently there are no legislatively entrenched criteria or threshold for a natural calamity to be deemed as severe - the government of India has discretion to categories an event in this way. Funding: the SDRF is the responsibility of the Ministry of Home Affairs with the government of India contributing 75% of the funding for the states in the general category and 90% of the funding for the states in the special category
New Zealand	National Government Financial Support (CDEM Expense) Local Authority Protection Programme disaster fund	Earthquake, storm, flood, cyclone, tornado, volcanic eruption, tsunami, other disasters of a catastrophic nature	Purpose: providing funding to local governments to assist them with critical infrastructure and uninsurable essential services disrupted by a disaster. Local governments have established a Local Authority Protection Programme disaster fund (LAPP) which is a cash accumulation mutual pool operating since 1993 to help local authority members pay their share of infrastructure replacement costs for water, sewage and other generally uninsurable essential services if damaged by natural disaster. The LAPP is to cover a local authority's 40% share above the threshold set by central government for recovery assistance.

Country	Name	Contingencies covered	Details
Norway	National Scheme for Natural Damage Assistance	Flood, landslide, storm and tempest, earthquake, volcanic eruption, inundation Excluded: lightening, frost and drought	Purpose: providing assistance to affected populations for damages that cannot be insured through the insurance markets (e.g. damages to roads and bridges or agricultural land or forests). Compensation is capped at a maximum of 85% of total damages with a deductible of NOK 10 000 to be applied on the resulting sum.
The Philippines	National Disaster Risk Reduction and Management Fund	Natural disasters, national calamities	Purpose: funding immediate post-disaster needs. Funding: An annual allocation to the fund is set in the national budget; its size is based on recommendations from the National Disaster Risk Reduction and Management Council (NDRRMC) and subject to the approval of the President. Of the total allocation, 70% is mandated for disaster risk reduction and prevention while the remaining 30% are set aside in a Quick Response Fund available for relief, response, and recovery programmes. Size: PHP 20 billion were allocated to the fund in 2022.
Turkey	Disaster Reserve Fund	Natural disaster, earthquake, flood, tornado, hurricane	The Disaster and Emergency Management Presidency (AFAD) is authorized to allocate the disaster response and recovery budget to the related institutions and the local government in the scope of their needs. In addition to the AFAD budget, the Ministry of Finance has a Disaster Reserve Fund which can be used for the disasters during the period of recovery.
United States	Capital Fund	Extraordinary events, earthquake, flood, tornado, hurricane	Purpose: providing assistance to help rebuild public housing where existing insurance is exhausted or not available. The Capital Fund assists government departments and housing authorities to pay for reconstruction of public housing when insurance has been exhausted and there is no other federal assistance. The Capital Fund is for presidentially declared disasters and non-presidentially declared disasters for damages arising from extraordinary events.
European Union	EU Solidarity Fund	Major natural disasters	Purpose: providing assistance to EU member states facing large-scale disasters causing more than 3 billion EUR in damages or over 0.6% of gross national income in the affected country. Size: the Fund's annual budget is EUR 500 million. The maximum amount available for extraordinary regional disasters is limited to 7.5% of the Fund's annual budget. Drawdown procedure: the approval of the European Parliament and Council of the European Union are required prior to the release of the full grants. Advanced payments of up to 10% of the anticipated support package are available to eligible countries.

Source: Adapted from (OECD, 2015[12]), (European Commission, 2019[13])
Note: as discussed below, reserve funds can also be used to fund risk reduction.

The conditions for the disbursement of these reserves vary across countries – some reserve funds target contingencies in general while others have explicit criteria tying them to natural disasters in particular. In Malta, drawdowns from the contingency reserve can be made with the approval of the House of Representatives in case of "urgent, temporary and unforeseen circumstances". Disbursements from reserves that target more specific contingencies are generally underpinned by a legal provision or an official declaration of emergency by the government. In Belgium, for example, the Director of Calamities must make an official declaration of calamity based on scientific opinion prior to any disbursements from the National Agricultural Fund and the National Calamity Fund. Subsequent approvals by the Ministry of the Interior and the Council of Ministers are required and then followed by a Royal Decree signed by the monarch and published in the Belgian Official Gazette (OECD, 2015[12]).

The timely deployment of funds is essential to tackle the immediate challenges posed by climate disasters and extreme weather events. There is a need for proper operational preparedness, that is systems and processes to allow pre-arranged funding to flow to the targeted beneficiaries. The lack of such systems often results in delayed response (rather than the lack of funding) At the same time, fast-tracking the disbursement of reserves may create opportunities for the mismanagement of funds by compromising oversight mechanisms and routine audit exercises. To prevent the misallocation of emergency funds, countries can implement additional safeguards. For example, automatic triggers can allow for the rapid disbursements of contingency funds when certain measurable conditions are met (e.g. strong wind gusts, extreme temperatures, heavy rainfall…). Contingency reserves can also target specific expenses such as social security and health insurance rather than general disaster-related costs. However, earmarking disaster relief to specific expenses can also create fiscal rigidities. These constraints may be particularly challenging in the case of climate disasters as they can have unpredictable consequences on economic activity.

Ex ante budgetary tools (contingency reserves and reserve funds) act as fiscal buffers that provide quick liquidity to cover immediate post-disaster financing needs. Reserve funds can also help governments cover the longer-term costs of recovery and reconstruction efforts. They can help support economic growth by accelerating the implementation of rehabilitation projects in the aftermath of climate disasters. From 1999 to 2021, Mexico's FONDEN provided additional funds to states and local agencies that incurred disaster costs beyond their financial capacity. Research estimates that municipalities with access to FONDEN assistance grew 2-4 percent more than those without in the year following a natural disaster (de Janvry, del Valle and Sadoulet, 2016[14]).

Natural disaster funds are not without limitations. Setting aside part of the budget for an uncertain future creates an opportunity cost as the resources could be allocated elsewhere. When other spending needs are not met, these funds become politically costly. In addition, the rapid use of these funds in case of an emergency can expose governments to some critics, especially when oversight controls are relaxed. The opportunity cost in setting aside substantial funds for responding to climate-related events will be higher in low and lower middle income countries with significant other unmet spending demands.

4.2.2. Budgetary reallocations

In case of an emergency, appropriations set in the budget can be reallocated across programmes, budget lines and ministries, or even across local governments. Budgetary reallocations allow governments with some degree of budgetary flexibility to provide swift funding where it is most needed. They are the first line of response to high-frequency, low-intensity hazards such as localised weather events that cause moderate damage (e.g. localised floods, droughts, wildfires, excessive rain and heat…). Reallocations of resources allow a government to reshuffle expenditures within the bounds of its approved budget, therefore limiting the shock on fiscal targets. In the OECD, around 75 percent of countries allow for the re-allocation of funds across budget lines without parliamentary pre-approval (OECD and World Bank, 2019[15]). Slovenia, for example, has budgetary provisions in place to allow for the reallocation of funds in case of a natural disaster. In contrast, Finland is an example where no such flexibility exists, even if the country has a large stockpile of special public physical reserves which can be mobilised in case of an emergency. The budgetary framework for emergencies only allows for the reallocations of appropriations within the spending limits set over the medium term in a supplementary budget.

Research suggests that most countries have at least some room for manoeuvre in their budget (Hochrainer-Stigler et al., 2014[16]). According to estimates and government officials, diversions from the budget are usually limited to 10 percent of revenues (Ibid.). Still, countries can face tight budgetary conditions that make any shift from the budget impossible, especially in post-disaster contexts or during an economic crisis. Evidence suggest that budget reallocations are not an option for 15 percent of all

countries because of fiscal capacity constraints (Ibid). In developing countries, the reallocations of budgeted funds might be impossible given tight government financial constraints.

Depending on the size of the climate hazards to be absorbed, budget reallocations can be costly as they put other objectives at risk. Shifting resources from one spending priority to another can cause disruptions in the provision of public goods and services that play a critical role in supporting long-term economic growth and that also provide safety nets for affected households and businesses. In developing countries, the reallocations of budgeted funds can derail long-term economic and social investments and undermine development strategies. Rigidities in the budget can also make reallocations of resources challenging. For example, there is little room to manoeuvre in a budget dominated by mandatory spending on pensions, civil service wages and debt servicing. As a result, governments may be forced to cut discretionary spending and delay capital investments.

4.2.3. Catastrophe risk insurance programmes and public guarantees

Broader availability of affordable insurance coverage for losses and damages faced by households and businesses (as well as subnational governments) should reduce government expenditure needs. While there are a number of policy, regulatory and supervisory approaches that can enhance the availability of affordable insurance (as outlined in section 5.1.2), governments can also use balance sheet measures to address some of the challenges to the availability of affordable insurance.

In many countries, catastrophe risk insurance programmes have been established to broaden the availability of affordable insurance coverage for households (and often businesses) against climate-related risks. These programmes provide direct insurance, co-insurance, reinsurance – and often a government backstop – for climate-related risks (Table 4.2 provides selected examples of government-backed programmes[1] for climate-related perils).

Table 4.2. Catastrophe risk insurance programmes for climate risks: selected examples

Programme	Climate-related perils	Type of insurance coverage	Public sector involvement
Algeria (Compagnie Centrale de Réassurance)	Flood, storm and tempest, landslide	Reinsurance	CCR is a government entity backed by an unlimited government guarantee
Australia (Cyclone reinsurance pool) (under development)	Cyclone (wind and flood)	Reinsurance	Administered by ARPC, a government enterprise that benefits from a government guarantee for excess cyclone losses[2]
France (CATNAT)	Flood, landslide, mudslide, avalanche, subsidence and high winds	Reinsurance	CCR, the reinsurance provider that administers CATNAT, is a government entity backed by an unlimited government guarantee
Iceland (Natural Catastrophe Insurance of Iceland (NTI))	Landslides, avalanches, river, costal and glacial flood	Direct insurance	NTI is a government entity backed by an unlimited government guarantee (although overall indemnity limits apply per event)
Romania (Pool-ul de Asigurare împotriva Dezastrelor Naturale (PAID))	Flood, landslide	Co-insurance/ reinsurance	PAID may borrow funds from the Ministry of Public Finance if claims exceed the company's financial resources
Spain (Consorcio de Compensación de Seguros (CCS))	Flood, windstorm	Direct insurance	CCS is a government entity backed by an unlimited government guarantee (although self-financed with its own capital and reserves)
United States (National Flood Insurance Program)	Flood	Direct insurance	NFIP is administered by the Federal Emergency Management Agency (a government agency) The NFIP collects premiums and has the authority to borrow from the US Treasury. NFIP has transferred part of its risk to private reinsurance companies and capital market investors

Source: (OECD, 2021[11]), (OECD and World Bank, 2019[15]), (OECD, 2015[12]), (InsuResilience 2022)

In France, the state provides government-guaranteed reinsurance for a number of climate-related hazards (e.g. floods, severe storms and landslides) and other natural hazards (e.g. volcanic activity and earthquakes) for both public and private assets. The French CATNAT programme is funded by a mandatory insurance premium applied to all property insurance policies, fixed by the state at a uniform rate for all policies covering properties and motor vehicles. In case of a major disaster requiring insurance payouts beyond 90 percent of the special reserve and annual defined equalisation reserves, the government is required to step in (OECD and World Bank, 2019[15]). By bearing the residual costs of extraordinary climate disasters and extreme weather events, the government can prevent illiquidity while ensuring the provision of affordable insurance coverage. The mandatory nature of the insurance offer helps to ensure broad coverage and avoid adverse selection.

In Australia, the government has implemented a government-backed reinsurance pool for cyclone and related flood damage. The pool will promote resilience by promoting access to more affordable insurance (through the provision of lower cost government-backed reinsurance) for households, strata owners, and small businesses in areas prone to cyclones. Reinsurance premiums provide discounts for properties that have undertaken cyclone damage mitigation measures. This reinsurance pool is operated by the Australian Reinsurance Pool Corporation (ARPC) and is backed by an annually reinstated AUD 10 billion government guarantee. The guarantee ensures that the ARPC will be able to pay any liabilities in the case of a major cyclone event causing significant damage or in a year marked by multiple cyclones. The Australian government has designed the reinsurance pool to be cost-neutral over time, based on estimations of the cost and frequency of cyclone events. The government will also collect data on cyclone and flood related costs to inform natural disaster risk management policy.

Government-backing for these programmes as a contingent credit or guarantee provider creates potential fiscal risks should a programme not have sufficient financial capacity to meet its claims obligations. However, most of the programmes operate at a relatively high-level of financial resilience. The amount of premiums collected and reinsurance/retrocession protection acquired by many of the programmes has been significantly greater than insured losses from the largest events (since 1990) and only a few programmes have received loans or payments from governments.[3]

4.3. Risk prevention investments to reduce risk exposure to climate change

Governments can promote investments in climate change adaptation *ex ante* to reduce social and economic exposure to future losses and damages. This focus on *ex ante* risk prevention generally relies on a mix of different types of interventions. Risk prevention efforts may involve costly structural investments in physical public infrastructure to make it more resilient to climate change and extreme weather events. Other public sector interventions, known as non-structural measures, involve policies and regulations to reduce exposure and encourage private investment in climate-change adaptation (e.g. zoning regulations that outlaw construction in high-risk areas, building codes, etc.).

Returns on both structural and non-structural investments are generally high and can reduce losses from hazards. For example, 17 out of 20 responding countries to an OECD survey on flood risk financing asserted that structural investments in physical infrastructure contributed to a reduction in flood risks (OECD, 2017[17]). Calculations by a private reinsurance company indicate that EUR 2.2 billion investments in flood protection infrastructure since a storm surge hit the city of Hamburg in 1962 and caused losses of EUR 1.6 billion have protected the city from four coastal floods of similar magnitude and prevented EUR 17.5 billion of losses (Munich Re, 2012[18]). There is also some evidence that investments in resilience can support higher sovereign credit ratings and reduce borrowing costs (see subsection below on Risk financing: commercial lending markets in section 4.4.1).

Despite the benefits noted above, there is strong evidence that the share of expenditures to respond to disasters is still overwhelmingly higher than *ex ante* spending for risk reduction (OECD and World Bank,

2019[15]). Despite the financial benefits of undertaking investments to reduce climate-related risks, governments have few political incentives to do so. For voters, the material gains of such investments are much smaller than recovery and relief measures. In addition, a tight fiscal environment makes it more difficult to make structural investments in physical infrastructure. They directly add to budget deficits while their financial benefits are difficult to communicate as climate hazards are by nature unpredictable.

To minimise ex-ante spending for risk reduction, governments can further exploit their regular spending channels and notably public procurement expenditures which account for almost a third of annual total government expenditures across OECD countries (OECD, 2021[19]). Several countries are looking at mainstreaming climate change considerations into their purchasing decisions. For example, in the United States, the Federal Acquisition Regulations (FAR) Council has proposed changes to the Regulations to minimise the risk of climate change in Federal procurement through disclosure of GHG emissions reduction targets for suppliers or incentives for environmental innovation. This is a direct response to the Executive Order 14030 on Climate-Related Financial Risk (White House, 2021[20]). Other countries are implementing life-cycle costing techniques to inform decision-making when procuring goods, services and public works. These techniques allow for the accounting of direct and indirect costs in addition to the upfront price of purchasing which contributes to selecting products that display greater resilience to environmental externalities.

4.3.1. Funding for risk reduction and prevention

Countries can mobilise a number of policy and funding tools to promote investment aimed at reducing climate-related risks. Costa Rica, Mexico, Peru and Chile have, for example mainstreamed climate change and natural hazard considerations into public investment management systems. Mexico incorporated standardised sustainability criteria into cost-benefit analyses of public investment projects (Delgado, Eguino and Pereira, 2021[21]).

Responsibilities for managing and investing in risk prevention measures vary across countries. In Japan, responsibilities for disaster risk reduction and mitigation are shared across government levels. In Australia and New Zealand, local governments have primary responsibility for implementing structural and non-structural prevention measures. Some national governments have also established financial incentives for subnational governments to invest in risk reduction measures. This is the case in Austria, for example, where the central government provides co-financing up to 40% for physical risk reduction investments (OECD, 2017[17]). Such policies exist to reduce moral hazard and the expectation of subnational governments that central governments will bear the full costs of disasters.

Accumulated funds in reserve funds can provide a source of funding for risk reduction investments. Governments may also fund investments in hard infrastructure or general risk prevention projects through reserve funds. In Mexico, the FONDEN fund, which was a disaster management fund, had a sub-fund, FOPREDEN, devoted to *ex ante* risk prevention expenditures (OECD, 2013[22]). Both France (*Fonds de Prévention des Risques Naturels Majeurs or* Barnier Fund) and Austria (*Katastrophenfond*) have reserve funds that can be used to finance rehabilitation projects from climate hazards as well as invest in *ex ante* risk prevention projects.

Catastrophe risk insurance programmes in some countries also provide a source of funding for risk reduction investment. For example, in Switzerland, public insurers for real estate allocate approximately CHF 80 million annually to fund and subsidise loss mitigation efforts (both before and after a loss) in order to increase the resilience of buildings against natural perils (AECA, 2019[23]). In France, a portion of the surcharge applied to each policy for natural catastrophe risk (12%) is transferred into the Barnier Fund to finance risk reduction and prevention measures. The fund was initially established to support the acquisition of high-risk properties damaged by a catastrophe event although the scope of its activities (as well as the share of the premium surcharge allocated to the fund) has increased over time to include other

types of investments in risk reduction (Cazaux, Meur-Férec and Peinturier, 2019[24]). In 2021, the fund was integrated into the national budget with an expanded allocation to invest in risk reduction (OECD, 2021[25]).

In some countries, catastrophe risk insurance programmes have been designed to incentivise investment in risk reduction. For example, in the United States, the insurance coverage provided to households and businesses through the publicly-backed National Flood Insurance Program is only available in communities that implement specific floodplain management measures (Kousky, 2018[26]). In France, households and businesses face higher deductibles on their insured losses in cases where the property has suffered repetitive losses and if the municipality has not implemented a risk reduction plan.

Governments can also access debt financing to fund investments in risk reduction/ adaptation (where there is capacity to issue new debt). Government bonds that are issued with the aim of achieving environmental or social objectives can be issued as thematic bonds which may have some benefits in terms of cost of funding (see Box 4.1). Green bonds are a form of fixed income security where the borrowed funds are to be used to achieve positive environmental impacts, including for climate change adaptation (such as efforts to improve infrastructure resilience as well for information support systems, such as climate observation and early warning systems) (ICMA, 2021[27]). Social bonds are a form of fixed income security where the borrowed funds are to be used to achieve positive social impacts, including access to services, housing, food security and social advancement for target groups (including those that are vulnerable as a result of natural disasters) (ICMA, 2021[28]). As of March 2022, at least 30 sovereign issuers (from developed and developing economies) have issued ESG-labelled bonds - raising approximately USD 240 billion in financing. Green bonds accounted for approximately four-fifths of the volume of issuances (OECD, 2022[29]).

Box 4.1. Increasing investor appetite for green and other thematic bonds

There is some evidence of increasing demand for investments such as thematic bonds that meet Environmental, Social, and Governance (ESG) objectives, driven partly by voluntary initiatives related to climate risk disclosures (Klusak et al., 2021[30]) – although the definition of what constitutes an ESG asset varies across countries and over time. According to one estimate, ESG-based assets could reach USD 53 trillion by 2025, equivalent to approximately one third of all assets under management (Sidley Austin LLP, 2022[31]). Thematic bonds issued by a government have the same level of credit risk as other bonds issued by that government (Imrana Hussain, 2022[32]). While some green and/or social bonds have been priced fairly consistently with other government issuances of similar tenor (e.g. Thailand's issuance of a sustainability bond in August 2020), others appear to have benefited from lower pricing due to significant demand (e.g. Egypt's green bond and Mexico's Sustainable Development Goal bond, both issued in 2020 as well as Indonesia's green sukuks issued in 2018 and 2019) (Imrana Hussain, 2022[32]). However, better pricing for ESG-related bonds may be due to significant demand for such assets that exceeds current supply. As a result, the pricing advantage may decline over time if the sovereign issuers increase the issuance of ESG-related bonds (although sovereign issuers that demonstrate sustainability in their policies might still benefit from a lower cost of borrowing) (OECD, 2022[29]).

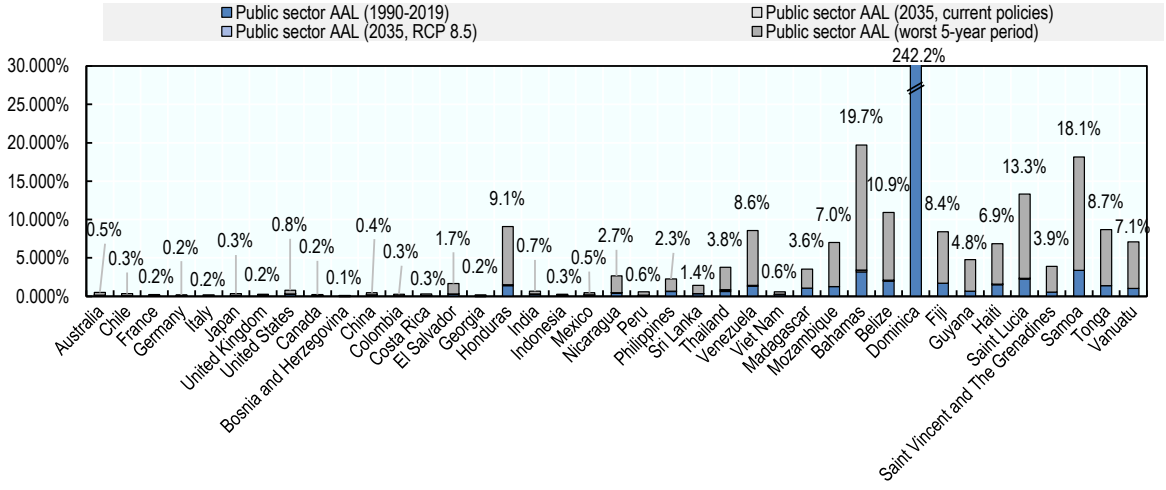
Proceeds from a number of green bonds have been used to finance climate change adaptation. In 2017, Fiji issued a green bond to fund the rehabilitation of schools and other structures that had been impacted by cyclones and to invest in improved drainage and coastal protection (Qadir and Creed, 2021[33]). In 2019, the Netherlands issued a green bond to fund sustainable water management, including investments in flood risk reduction (Qadir and Creed, 2021[33]). In Norway, a local government funding agency (*Kommunalbanken*) issued a green bond to fund climate mitigation as well as adaptation measures such as improving infrastructure resilience to flood risks (Qadir and Pillay, 2021[34]). According to one estimate,

approximately 16.4% of green bonds have been issued to finance some activities related to climate adaptation and resilience (Qadir and Pillay, 2021[34]).

4.4. Financial instrument options

For some climate-related catastrophes, and particularly major events, budgetary tools such as reserve funds may not provide sufficient funding to meet post-event government expenditure needs. Not all countries enjoy sufficient fiscal space. For many governments (particularly in lower-income countries), the potential public sector share of losses from climate-related catastrophes are equivalent to a significant share of general government revenues which would make it extremely challenging to fund recovery and reconstruction spending needs through current revenues (see Figure 4.3).

Figure 4.3. Potential climate losses and damages as a share of general government revenues



Note: General government revenues are for 2019. Public sector AAL (1990-2019) is calculated as 35% of the average losses per year between 1990 and 2019. Public sector AAL (2035, current policies) incorporates the estimated increase in flood and tropical cyclone losses in Climate Impact Explorer "NGFS current policies" scenario. Public sector AAL (2035, current RCP 8.5) incorporates the estimated increase in flood and tropical cyclone losses in Climate Impact Explorer "RCP 8.5" scenario. Public sector AAL (worst 5-year period) refers to 35% of average annual losses for 1990-1994 (Costa Rica, Haiti, Samoa, United Kingdom), 1995-1999 (France, Honduras, Venezuela), 2000-2004 (Belize, Germany, Italy, Madagascar), 2005-2009 (Dominica, Guyana, Nicaragua), 2010-2014 (Australia, Bosnia and Herzegovina, Canada, China, Colombia, El Salvador, Georgia, Indonesia, Mexico, Philippines, Saint Lucia, Saint Vincent and the Grenadines, Thailand), 2015-2019 (Bahamas, Chile, Fiji, India, Japan, Mozambique, Peru, Sri Lanka, Tonga, United States, Vanuatu, Viet Nam).
Source: OECD calculations based on catastrophe economic loss data from (Swiss Re sigma, 2020[35]), estimates of future economic losses from Climate Impact Explorer (Climate Analytics et al., n.d.[36]) and data on general government revenues from (IMF, 2021[37]).

Governments can borrow to meet budgetary needs, either through pre-arranged (*ex ante*) contingent credit arrangements (available to developing countries from official sources) or *ex post* borrowing from banks, capital markets or official lenders. They can also enter into various types of risk transfer arrangements in order to access the funding needed for post-event recovery and reconstruction, either through arrangements to meet general spending needs or to provide indemnification for damages and losses incurred to specific public assets. This section will provide an overview of risk financing and risk transfer tools, their use in different countries as well as the relative advantages and limitations of different risk financing and risk transfer options.

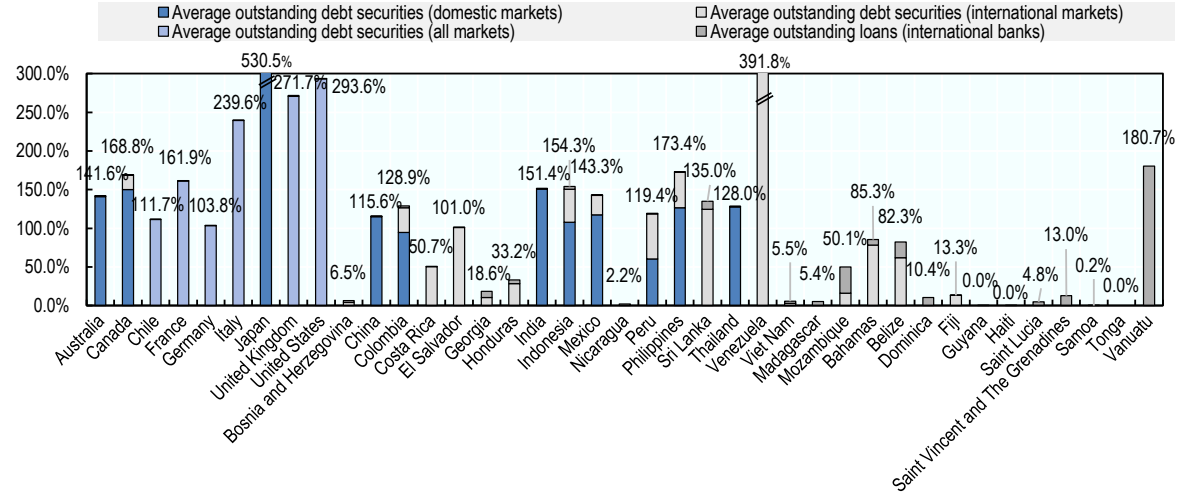
4.4.1. Funding public budgetary needs through risk (debt) financing

Governments (national and subnational) regularly access commercial lending and capital markets to meet a variety of funding needs, including funding needs related to recovery and reconstruction in the aftermath of a climate-related catastrophe.

Risk financing: commercial lending markets

In general, national and subnational governments have access to funds for general government funding needs through loans extended by domestic and international commercial banks and bills and bonds issued in capital markets – although access to credit varies significantly across countries. Some governments (particularly in low-income countries) depend more on commercial bank lending (as well as access to loans and grants from official sources) for government borrowing while others (particularly high-income countries) tend to fund government borrowing needs almost exclusively by issuing bills and bonds in either domestic or international capital markets (or both) (see Figure 4.4). Developing countries (particularly low-income countries) tend to rely more heavily on international capital markets and external creditors due to the limited development of local capital markets and the limited availability of domestic savings (An and Park, 2019[38]).

Figure 4.4. Outstanding loans and debt securities as a share of public revenues (selected countries)



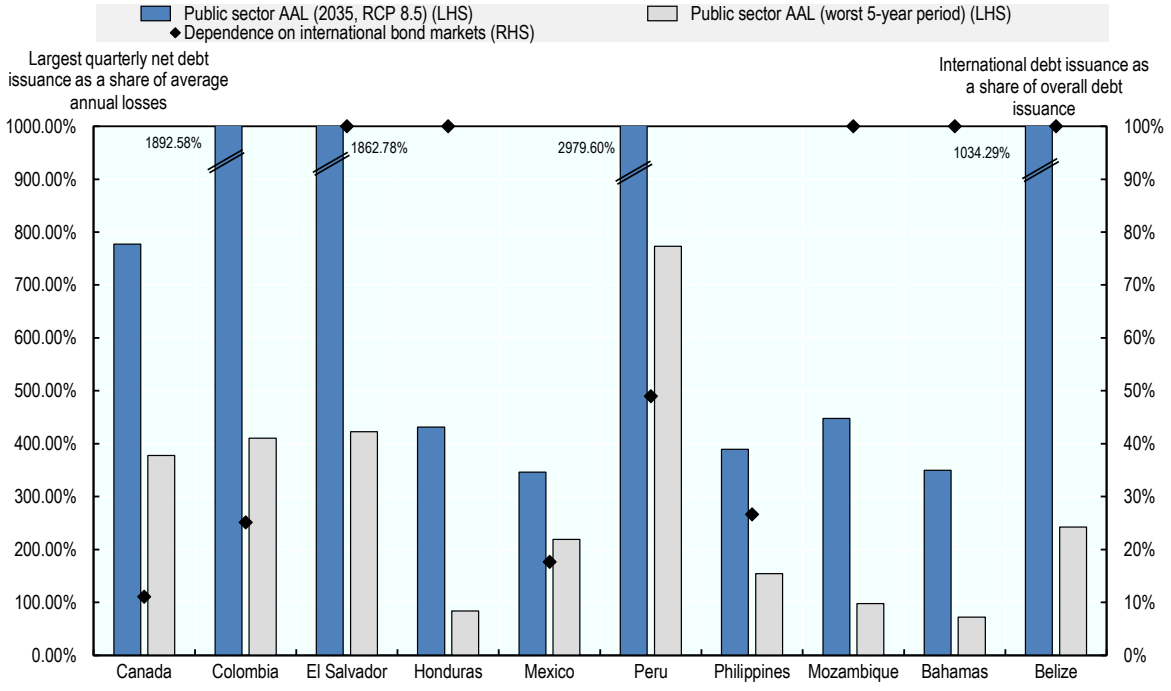
Note: Outstanding loan and debt securities is calculated as the average outstanding at year-end between 2016 and 2020. Public revenues are for 2019.
Source: OECD calculations based on general government revenue data from (IMF, 2021[37]) and data on loans and debt securities outstanding from (BIS, 2022[39]), (BIS, 2022[40]).

Governments can access commercial bank loans and issue debt (i.e. debt financing) to fund the spending needs that arise as a result of climate-related catastrophes although the availability and cost of debt financing varies across countries. In lower-income countries, domestic debt financing capacity is more limited while international debt financing may be difficult to access in the aftermath of a major catastrophe (Hochrainer-Stigler et al., 2014[16]). Only a few larger middle-income countries (as well as a number of developed countries) have access to significant financing from domestic debt markets (e.g. China, Colombia, India, Indonesia, Peru, Thailand) – most smaller middle-income countries, low-income countries and small island developing states only have access to international bond markets (or no access at all).

International bond markets often require issuance in international currencies such as USD or EUR which leads to foreign exchange risk for issuing countries and which ultimately must be paid using available foreign exchange reserves and earnings.

Figure 4.5 provides an illustration of the potential international borrowing capacity of governments in selected countries (measured as the largest quarterly net debt security issuance in international markets between 2016 and 2020) relative to potential climate-related catastrophe losses. For most developed countries and many upper middle-income countries, past international bond market issuance has demonstrated market capacity that is well above any potential financing needs for the public sector share of losses and damages. However, in some middle- and lower- income countries and small island developing states, past borrowing through international debt issuance is not significantly higher than potential future or significant past climate losses – which could be particularly challenging for countries whose debt issuance is dependent on international markets. The figure below should be considered illustrative as the level of recent net debt issuance in international markets is not necessarily a perfect indicator of potential market appetite as investors may be willing to provide significantly more debt financing than has been accessed in the recent past.

Figure 4.5. Illustrative international borrowing capacity relative to potential climate losses and damages



Note: Public sector AALs (average annual losses) are calculated as 35% of overall losses. Public sector AAL (2035, RCP 8.5) incorporates the estimated increase in flood and tropical cyclone losses in Climate Impact Explorer "RCP 8.5" scenario. Public sector AAL (worst 5-year period) refers to (35% of) average annual losses for 1990-1994 (Costa Rica, Haiti, Samoa, United Kingdom), 1995-1999 (France, Honduras, Venezuela), 2000-2004 (Belize, Germany, Italy, Madagascar), 2005-2009 (Dominica, Guyana, Nicaragua), 2010-2014 (Australia, Bosnia and Herzegovina, Canada, China, Colombia, El Salvador, Georgia, Indonesia, Mexico, Philippines, Saint Lucia, Saint Vincent and the Grenadines, Thailand), 2015-2019 (Bahamas, Chile, Fiji, India, Japan, Mozambique, Peru, Sri Lanka, Tonga, United States, Vanuatu, Viet Nam).

Source: OECD calculations based on quarterly data on net debt securities issuance in international markets from (BIS, 2022[39]), estimates of future economic losses due to floods and tropical cyclones from Climate Impact Explorer (Climate Analytics et al., n.d.[36])Source: OECD calculations based on quarterly data on net debt securities issuance in international markets from (BIS, 2022[39]), estimates of future economic losses due to floods and tropical cyclones from Climate Impact Explorer (Climate Analytics et al., n.d.[36]) and data on catastrophe losses from (Swiss Re sigma, 2020[35]). (Climate Analytics et al., n.d.[36]) and data on catastrophe losses from (Swiss Re sigma, 2020[35]).

The cost of debt financing also varies significantly across countries. Credit ratings are the main factor in determining the interest rate of debt securities issued by sovereign borrowers (i.e. the cost of debt financing through bond issuance) and are a major factor in determining interest rates on loans extended by commercial banks[4] (i.e. the cost of debt financing through commercial bank loans). The damages and losses that result from a climate-related catastrophe can lead to a deterioration in public finances, and the current account, which has a direct impact on the capacity of governments to repay creditors (or external creditors in the case of a deteriorating current account balance) (An and Park, 2019[38]). One analysis of the impact of natural disasters on credit ratings (based on past events) found that a large event with damages equivalent to 10% or more of GDP led to ratings downgrade of approximately 0.5 notches across the sample with more significant impacts in the case of meteorological and climatological catastrophes (such as floods, storms and droughts) and in developing countries relative to developed countries (An and Park, 2019[38]).[5]

In addition, the increasing integration of climate and other Environmental, Social and Governance (ESG) factors into credit ratings and credit pricing decisions[6] could potentially increase the future cost of debt financing for countries (particularly lower-income countries) that are vulnerable to climate risks. For example, an analysis by one major credit agency found that the "credit impact scores" of ESG factors, which provide a measure of the impact of ESG factors on credit ratings, were very highly or highly negative in just over 60% of the 107 emerging market sovereigns included in the analysis, driven in many cases[7] by climate-related physical risks (Moody's, 2021[41]). Similarly, an IMF analysis for the period 1995 to 2017 found that a measure of climate vulnerability in developing countries had a significant negative impact on credit ratings and that a measure of climate resilience had a significant positive impact (Cevik and Tovar Jalles, 2020[42]).[8]

There is some evidence that investors are already demanding higher yields from sovereign issuers in developing countries that are particularly vulnerable to climate change physical risks, even where that risk is not yet reflected in credit ratings (Semet, Roncalli and Stagnol, 2021[43]).[9] Similarly, the increasing use of climate stress testing in banking supervision could impact the risk-weighting of banks' loan assets and lead to higher debt financing costs for sovereigns in countries that face higher climate vulnerability[10] (with the possibility that banks are already rating climate vulnerable sovereigns higher even if capital requirements have not been calibrated to do so).

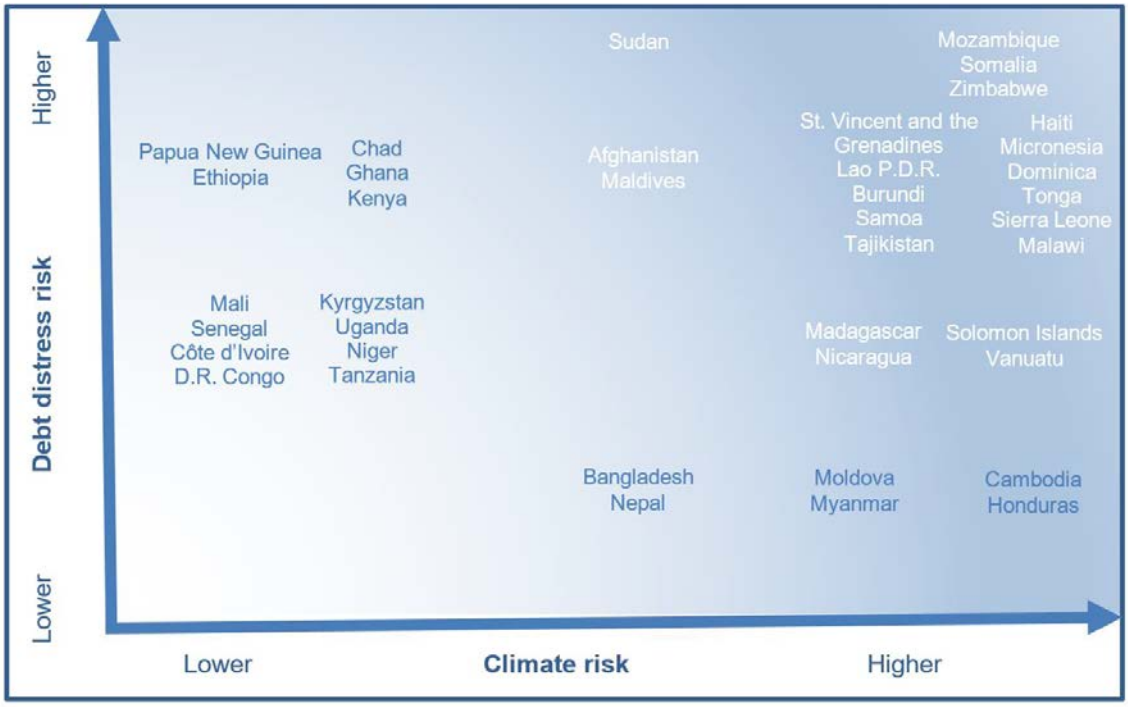
As the impacts of climate change materialise (particularly under high-emissions/low-mitigation scenarios), the impact on credit ratings and the cost of debt financing could become much more significant. One analysis that applied climate modelling to credit rating methodologies to estimate future rating impacts found that climate change could lead to ratings downgrades of approximately 1.02 notches for 63 sovereign issuers as soon as 2030 (under the RCP 8.5 climate scenario), increasing to downgrades of approximately 2.48 notches for 80 sovereign issuers by 2100 (Klusak et al., 2021[30]). An analysis of the potential impact of future hurricane risk on credit spreads and access to debt markets in seven Caribbean countries found that credit spreads could increase by 95 basis points on average and access to credit could decline, although with significant variation across the sample of countries (Mallucci, 2022[44]).

Borrowing by the government, particularly in domestic credit markets, could also crowd-out the availability of financing for other segments of society affected by climate-related catastrophes. For example, there is some evidence that, particularly in countries that implement capital controls, lending to those affected by natural disasters reduces credit availability in unaffected regions (Ivanov, Macchiavelli and Santos, 2022[45]). This suggests that domestic credit supply is limited and could result in unmet demands if external financing is limited by capital controls or reductions in the appetite of external lenders for credit risks in countries affected by major catastrophes.

For some developing countries, the ability to fund spending needs resulting from climate-related catastrophes through debt financing may be limited by debt sustainability constraints. The IMF and World Bank have developed a joint debt sustainability framework for low-income countries to assess the

sustainability of external and total debt (the IMF has also developed a debt sustainability framework for market access countries). The aim of these analyses is to ensure that countries are able to balance their debt financing needs with their ability to repay. A number of low-income countries that are highly exposed to climate-related catastrophe risk face moderate to high risk of external debt and/or total debt distress, which limits their ability to borrow new funds to meet spending needs related to climate-related catastrophes (see Figure 4.6).

Figure 4.6. Debt distress and climate risk: Low-income countries



Note: The indicators for climate risk are based on average annual climate-related losses for the worst 5-year period since 1990 as a share of GDP (countries with average annual losses above 0.5% of 2019 GDP for that period are considered to have high climate risk).
Source: OECD calculations based on data on GDP from (IMF, 2021[37]). Data on catastrophe losses is from (Swiss Re sigma, 2020[35]). Data on debt distress is from (World Bank, 2021[46]) Data on debt distress is from (World Bank, 2021[46])

To address some of these challenges, some countries have negotiated conditions that allow for reduced or delayed repayments of interest and/or principal due in the event of a large-scale catastrophe which would provide additional resources to fund post-event spending needs and reduce the need for additional debt financing. Often referred to as a "natural disaster clause" or "hurricane clause", this approach to payment deferral was first inserted into bonds issued by Grenada as part of a debt restructuring in 2015 and has since been included in sovereign bonds issued by Barbados in 2018 and 2019 (Ho and Fontana, 2021[47]). In Grenada, the bonds included a clause that would defer a semi-annual payment of principal and interest in the event that the country is affected by a tropical cyclone that causes USD 15 million to USD 30 million in losses and two semi-annual payments in the event of a tropical cyclone causing more than USD 30 million in losses (Ho and Fontana, 2021[47]). In Barbados, the bonds included a clause to allow deferral of principal and interest payments in the event of a tropical cyclone, earthquake or excess rainfall event resulting in losses of more than USD 5 million (Ho and Fontana, 2021[47]). For both countries, the payment deferrals were linked to the triggering of parametric insurance policies provided by CCRIF (a regional risk pool for countries in the Caribbean and Central America, see below) which provides an independent assessment of when the conditions for deferral are met (Ho and Fontana, 2021[47]). The clause would reportedly allow Barbados to defer USD 700 million in repayments in the case of a triggering

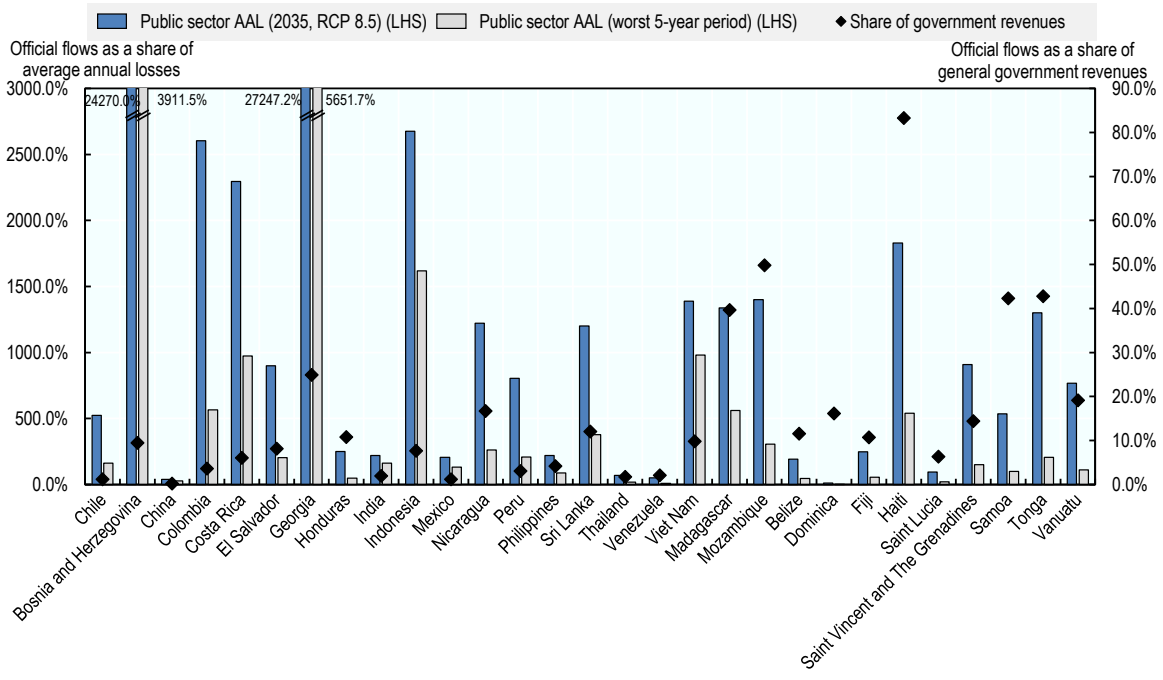
event (Ho and Fontana, 2021[47]), providing substantial resources to fund recovery and reconstruction. Based on this experience, the International Capital Markets Association has developed a model "hurricane-linked extendible feature" clause that sovereign debt issuers can incorporate into new loan agreements and bill and bonds securities (Ho and Fontana, 2021[47]). Some bilateral official creditors (e.g. Germany's KfW) have begun piloting shock-resilient loans that include clauses that allow for redemptions or payment deferrals should a climate-related catastrophe occur (OECD, 2021[48]).

More recently, Belize has incorporated a "catastrophe wrapper" into the issuance of a "blue bond" (a type of sovereign debt that incorporates use of proceeds conditions related to healthy oceans and blue economies). The catastrophe wrapper provides debt relief in the event that the country is affected by a hurricane of a given magnitude (Willis Towers Watson, 2021[49]). Similar to a natural disaster or hurricane clause, the catastrophe wrapper will provide Belize with resources to fund recovery and reconstruction in the event of a major hurricane – although by eliminating (rather than deferring) the repayment of principal and/or interest on the outstanding blue bonds. An analysis of the impact of hurricane risk and sovereign borrowing in seven Caribbean countries found that the inclusion of disaster clauses that provide a payment suspension (as in the case of Barbados and Grenada) or debt reduction (as would be provided by the catastrophe wrapper in Belize) can reduce sovereign default frequency and increase access to credit, particularly in the case of clauses that lead to debt reduction (Mallucci, 2022[44]).

Risk financing: official financing

Governments (national or subnational) in developing countries can also access official financing (or development financing) through multilateral development banks and bilateral donors, in the form of different financial instruments, such as grants or loans. Official financing plays a significant role in ensuring the availability of funding for recovery and reconstruction in countries with more limited access to commercial lending markets, whether as a result of climate risks or other factors. In low-income countries, the average annual level of official financing (funds dedicated to a variety of development objectives) from international providers of development cooperation (2015-2019) is equivalent to approximately 16% of general government revenues (2019) and to multiples of the potential level of climate-related losses and damages although with large variations across countries. In small island developing states, the official financing accounts for a similar (slightly higher) share of general government revenues although a lower share of potential climate-related losses and damages (see Figure 4.7).

Figure 4.7. Official financing as a share or general government revenues and potential climate losses and damages



Note: Public sector AALs (average annual losses) are calculated as 35% of overall losses. Public sector AAL (2035, RCP 8.5) incorporates the estimated increase in flood and tropical cyclone losses in Climate Impact Explorer "RCP 8.5" scenario. Public sector AAL (worst 5-year period) refers to (35% of) average annual losses for 1990-1994 (Costa Rica, Haiti, Samoa, United Kingdom), 1995-1999 (France, Honduras, Venezuela), 2000-2004 (Belize, Germany, Italy, Madagascar), 2005-2009 (Dominica, Guyana, Nicaragua), 2010-2014 (Australia, Bosnia and Herzegovina, Canada, China, Colombia, El Salvador, Georgia, Indonesia, Mexico, Philippines, Saint Lucia, Saint Vincent and the Grenadines, Thailand), 2015-2019 (Bahamas, Chile, Fiji, India, Japan, Mozambique, Peru, Sri Lanka, Tonga, United States, Vanuatu, Viet Nam).
Source: Data on general government revenues is from (IMF, 2021[37]). Data on catastrophe losses is from (Swiss Re sigma, 2020[35]) and estimates of future economic losses due to floods and tropical cyclones from Climate Impact Explorer (Climate Analytics et al., n.d.[36]) . Data on official financing is from the OECD database on Geographical Distribution of Financial Flows (OECD, 2022[50]).

However, access to official (or development) financing for climate-related needs can be volatile, slow and/or impacted by political, procedural and financial considerations in the donor country. One examination of international financial flows to nine countries in the 18 months following a crisis found that: (i) these flows provided only a small portion of the funding needs identified through post-disaster needs assessments (15%); (ii) funding commitments were slow to confirm (only 41% of response funding had been committed within the first 6 months) and disbursements were delayed (only 64% of committed funds had been disbursed within 18 months); and (iii) the amount of funding provided rapidly was significantly higher for rapid-onset events relative to slow-onset crises such as droughts and varied significantly across recipient countries (Crossley et al., 2021[51]).

To address some of the risks related the volatility and speed of official financing, a number of catastrophe-prone countries have arranged *ex ante* access to contingent credit through multilateral development banks and other official lenders that is triggered based on the occurrence of an eligible event, usually linked simply to the declaration of a disaster (see Table 4.3). Given that the credit is pre-arranged and that the trigger is usually based solely on a government declaration, this financing can be accessed relatively quickly (World Bank, 2022[52]) and is not subject to any re-assessment of credit risk as a result of the occurrence of an event. The cost of financing is also relatively low given the official nature of the creditors.

Table 4.3. Contingent credit arrangements (official creditors)

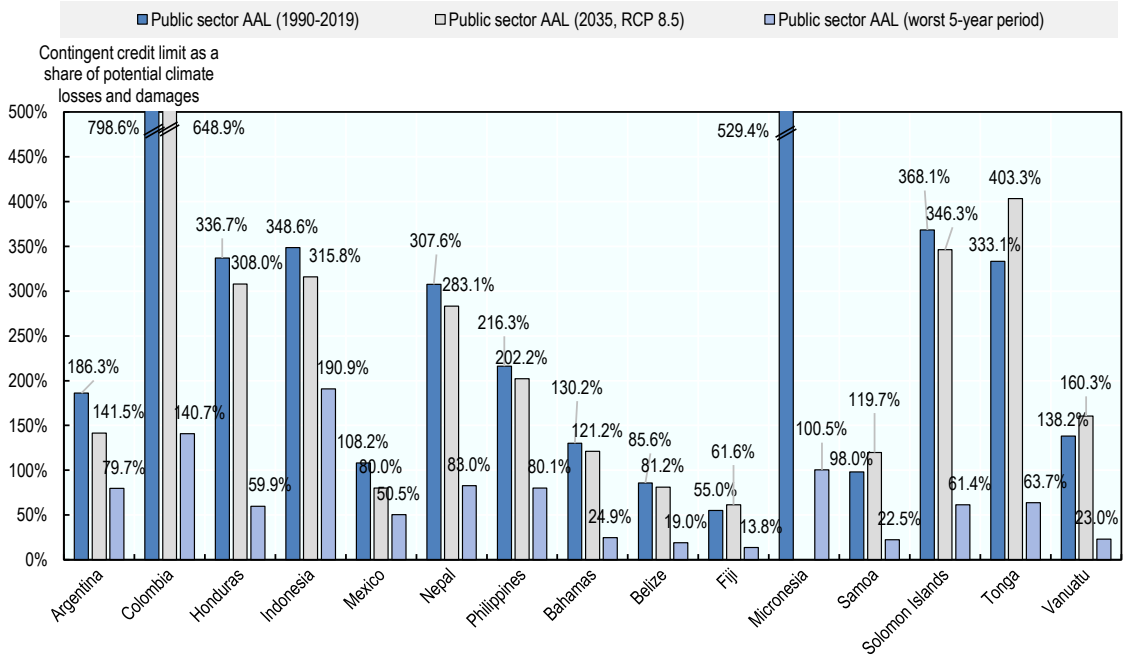
	Official creditor	Credit available	Climate perils covered (indicative)[1]
Argentina	Inter-American Development Bank	USD 300 million	Flood
Bahamas	Inter-American Development Bank	USD 100 million	Windstorm
Barbados	Inter-American Development Bank	USD 80 million	Windstorm
Belize	Inter-American Development Bank	USD 10 million	Windstorm
Colombia	World Bank	USD 300 million	Windstorm, Flood, Wildfire, Drought
Cook Islands	Asian Development Bank	USD 20.1 million	Windstorm, Flood, Drought
Dominican Republic	Inter-American Development Bank	USD 300 million	Windstorm
Ecuador	Inter-American Development Bank	USD 300 million	Flood
El Salvador	Inter-American Development Bank	USD 400 million	Windstorm
Fiji	World Bank	USD 13.9 million	Windstorm, Flood, Drought, Wildfire
Grenada	World Bank	USD 20 million	Windstorm, Flood, Wildfire
Guatemala	Inter-American Development Bank	USD 400 million	Windstorm, Drought
Honduras	Inter-American Development Bank	USD 300 million	Windstorm
Indonesia	Asian Development Bank	USD 500 million	Windstorm, Flood, Drought
Jamaica	Inter-American Development Bank	USD 285 million	Windstorm
Kiribati	Asian Development Bank	USD 8 million	Windstorm, Flood, Drought
Marshall Islands	Asian Development Bank	USD 6 million	Windstorm, Flood, Drought
Mexico	World Bank	USD 485 million	Windstorm
Micronesia	Asian Development Bank	USD 6 million	Windstorm, Flood, Drought
Nepal	World Bank	USD 36 million	Flood, Landslide
Nicaragua	Inter-American Development Bank	USD 186 million	Windstorm
Palau	Asian Development Bank	USD 20 million (3 years)	Windstorm, Flood, Drought
Panama	Inter-American Development Bank	USD 100 million	Flood
Paraguay	Inter-American Development Bank	USD 150 million	Flood, Wildfire
Philippines	Asian Development Bank	USD 500 million	Windstorm, Flood, Drought
Philippines	World Bank	USD 500 million (3 years)	Windstorm, Flood, Landslide
Saint Vincent and the Grenadines	World Bank	USD 70 million	Windstorm, Flood, Wildfire
Samoa	Asian Development Bank	USD 10 million	Windstorm, Flood, Drought
Solomon Islands	Asian Development Bank	USD 5 million	Windstorm, Flood, Drought
Suriname	Inter-American Development Bank	USD 30 million	Flood
Tonga	Asian Development Bank	USD 10 million	Windstorm, Flood, Drought
Tuvalu	Asian Development Bank	USD 4 million	Windstorm, Flood, Drought
Uruguay	Inter-American Development Bank	USD 100 million	
Vanuatu	Asian Development Bank	USD 5 million	Windstorm, Flood, Drought

Note: [1] The list of climate perils covered is based on reporting to InsuResilience although some (if not all) of the contingent credit arrangements could be available for other types of peril as well as disbursement often only requires a declaration of a state of emergency by the national government,
Source: (InsuResilience, n.d.[53]) (includes facilities identified as available in 2022).

Contingent credit arrangements offered through multilateral development banks often require borrowers to implement specific measures to improve disaster risk management or disaster risk financing before being provided access to the credit facility. Official lenders will often provide technical assistance and support to borrowers to implement those measures. For example, the World Bank's Cat Deferred Drawdown (Cat DDO) policy loans have provided access to capacity development to both national and subnational governments for strengthening disaster risk management policies, such as for the development of disaster risk financing strategies and the use of hazard and risk data to inform risk reduction (World Bank, 2022[52]).

The amount of funding available through contingent credit can be substantial. For example, the World Bank's programme can provide up to USD 500 million (or 0.25% of GDP, whichever is lower) to IBRD-eligible borrowers and up to USD 250 million (or 0.5% of GDP, whichever is lower) for IDA-eligible countries (World Bank Treasury, 2021[54]), (World Bank Treasury, 2018[55]). The Asian Development Bank has provided access to USD 500 million in contingent credit to Indonesia and the Philippines while the Inter-American Development Bank has provided access to USD 400 million in El Salvador and Guatemala. For many of the countries that have put in place such arrangements, available credit exceeds past average annual losses from climate-related catastrophes and a significant share of potential annual losses based on the highest annual losses for a five-year period since 1990 – although the amounts arranged relative to past losses appear to be slightly lower in small island developing states (see Figure 4.8). However, this does not mean that the amount of credit would be sufficient to cover the potential losses of an extreme event (i.e. larger than has occurred in recent years). There are also a number of countries that face high levels of exposure to climate risks and limited access to debt financing that are not covered by any official creditor contingent credit arrangement.

Figure 4.8. Available contingent credit relative to potential public share of climate losses and damages



Note: Public sector AALs (average annual losses) are calculated as 35% of overall losses. Public sector AAL (2035, RCP 8.5) incorporates the estimated increase in flood and tropical cyclone losses in Climate Impact Explorer "RCP 8.5" scenario. Public sector AAL (worst 5-year period) refers to (35% of) average annual losses for 1990-1994 (Samoa), 1995-1999 (Honduras), 2000-2004 (Belize), 2010-2014 (Colombia, Indonesia, Mexico, Philippines, Solomon Islands), 2015-2019 (Argentina, Bahamas, Fiji, Nepal, Tonga, Vanuatu). In the case of Dominican Republic, Ecuador, El Salvador, Guatemala, Jamaica, Nicaragua, Panama, Paraguay and Saint Vincent and the Grenadines, Uruguay (not shown), available credit is significantly larger than past climate losses and damages (both measures).
Source: Information on contingent credit arrangement is from (InsuResilience, n.d.[53]) for programmes identified as available in 2022. Data on catastrophe losses is from (Swiss Re sigma, 2020[35])and estimates of future economic losses due to floods and tropical cyclones are from Climate Impact Explorer (Climate Analytics et al., n.d.[36]).

Providers of development cooperation should take debt sustainability issues into account when establishing lending arrangements, including contingent credit facilities. Official development assistance

reforms in 2016 explicitly linked loan policy to IMF and World Bank requirements related to debt sustainability (OECD, 2021[48]).

4.4.2. Funding public budgetary needs through risk transfer

Governments (national or subnational) can transfer some of the risks related to climate-related catastrophe financing needs to insurance/reinsurance markets and capital markets (through insurance-linked securities and other financial products). The risk transfer could be structured to provide either an indemnity-based payment to cover losses incurred to a specific building/infrastructure asset or pool of public assets or as an event-based (parametric-based) payment to meet general government spending needs.

Risk transfer for general public budgetary needs

Governments (national or subnational) can acquire insurance coverage or other forms of financial protection (such as catastrophe bonds) with payments made based on the occurrence of an event that meets specific pre-determined parameters (i.e. a parametric trigger). This type of financial protection can provide a source of funds to meet a general increase in spending needs in the aftermath of a climate-related catastrophe. A number of countries have acquired this form of financial protection, either through regional risk pooling arrangements (in most cases) or the issuance of catastrophe bonds (see Table 4.4).

Table 4.4. Risk transfer for general spending needs: country examples

	Type of instrument	Type of trigger	Climate perils covered	Amount of coverage	Beneficiary (or issuer)
Anguilla	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 17.2 million	National government
Antigua and Barbuda	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 18.1 million	National government
Bahamas	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 38.6 million	National government
Barbados	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 55.0 million	National government
Belize	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 11.8 million	National government
Bermuda	Insurance (CCRIF)	Parametric	Windstorm	USD 26.4 million	National government
British Virgin Islands	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 18.8 million	National government
Cayman Islands	Insurance (CCRIF)	Parametric	Windstorm	USD 19.4 million	National government
Colombia	Insurance	Parametric	Flood, landslide	Not available (design phase)	Municipal government (Medellin)
Cook Islands	Insurance (PCRAFI)	Parametric	Windstorm	USD 2.9 million	National governments
Cote d'Ivoire	Insurance (ARC)	Parametric	Drought	USD 13.4 million	National governments (to be distributed to agricultural sector)
Dominica	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 36.0 million	National government
Gambia	Insurance (ARC)	Parametric	Drought	USD 2.5 million	National governments (to be distributed to agricultural sector)
Grenada	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 49.4 million	National government
Guatemala	Insurance (CCRIF-CA)	Parametric	Extreme rainfall	USD 7.0 million	National government
Haiti	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 75.4 million	National government
India	Insurance	Parametric		USD 0.31 million	State government (Nagaland)
Jamaica	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 113.2 million	National government

	Type of instrument	Type of trigger	Climate perils covered	Amount of coverage	Beneficiary (or issuer)
Jamaica	Catastrophe bond	Parametric	Windstorm	USD 185 million	National government
Lao People's Democratic Republic	Insurance (SEADRIF)	Parametric	Flood	USD 30 million	National government
Madagascar	Insurance (ARC)	Parametric	Drought, windstorm	USD 14.2 million	National governments (to be distributed to agricultural sector)
Malawi	Insurance (ARC)	Parametric	Drought	USD 16.0 million	National governments (to be distributed to agricultural sector)
Mali	Insurance (ARC)	Parametric	Drought	USD 15.0 million	National governments (to be distributed to agricultural sector)
Mauritania	Insurance (ARC)	Parametric	Drought	USD 7.1 million	National governments (to be distributed to agricultural sector)
Mexico	Catastrophe bond	Parametric	Windstorm	USD 485 million	National government (FONDEN)
Montserrat	Insurance (CCRIF)	Parametric	Windstorm	USD 2.5 million	National government
Nicaragua	Insurance (CCRIF-CA)	Parametric	Windstorm, Extreme rainfall	USD 19.8 million	National government
Niger	Insurance (ARC)	Parametric	Drought	USD 7.0 million	National governments (to be distributed to agricultural sector)
Panama	Insurance (CCRIF-CA)	Parametric	Extreme rainfall	USD 5.5 million	National government
Philippines (2019-2021)	Catastrophe bond	Parametric	Windstorm (67%)	USD 225 million	National government
Philippines	Insurance	Parametric	Windstorm	Not available (design phase)	Municipal governments
Saint Kitts and Nevis	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 11.3 million	National government
Saint Lucia	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 41.3 million	National government
Saint Vincent and the Grenadines	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 9.6 million	National government
Samoa	Insurance (PCRAFI)	Parametric	Windstorm	USD 10.7 million	National government
Senegal	Insurance (ARC)	Parametric	Drought	USD 25.0 million	National governments (to be distributed to agricultural sector)
Sint Maarten	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 19.6 million	National government
Sudan	Insurance (ARC)	Parametric	Drought	USD 7.2 million	National governments (to be distributed to agricultural sector)
Togo	Insurance (ARC)	Parametric	Drought	USD 5.5 million	National governments (to be distributed to agricultural sector)
Tonga	Insurance (PCRAFI)	Parametric	Windstorm	USD 7.1 million	National government
Trinidad and Tobago	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 47.0 million	National government
Turks and Caicos Islands	Insurance (CCRIF)	Parametric	Windstorm, Extreme rainfall	USD 29.2 million	National government
Zambia	Insurance (ARC)	Parametric	Drought	USD 5.4 million	National governments (to be distributed to agricultural sector)
Zimbabwe	Insurance (ARC)	Parametric	Drought	USD 13.2 million	National governments (to be distributed to agricultural sector)

Source: (de la Plaza, 2022[56]), (World Bank, 2021[57]) (InsuResilience, n.d.[53])

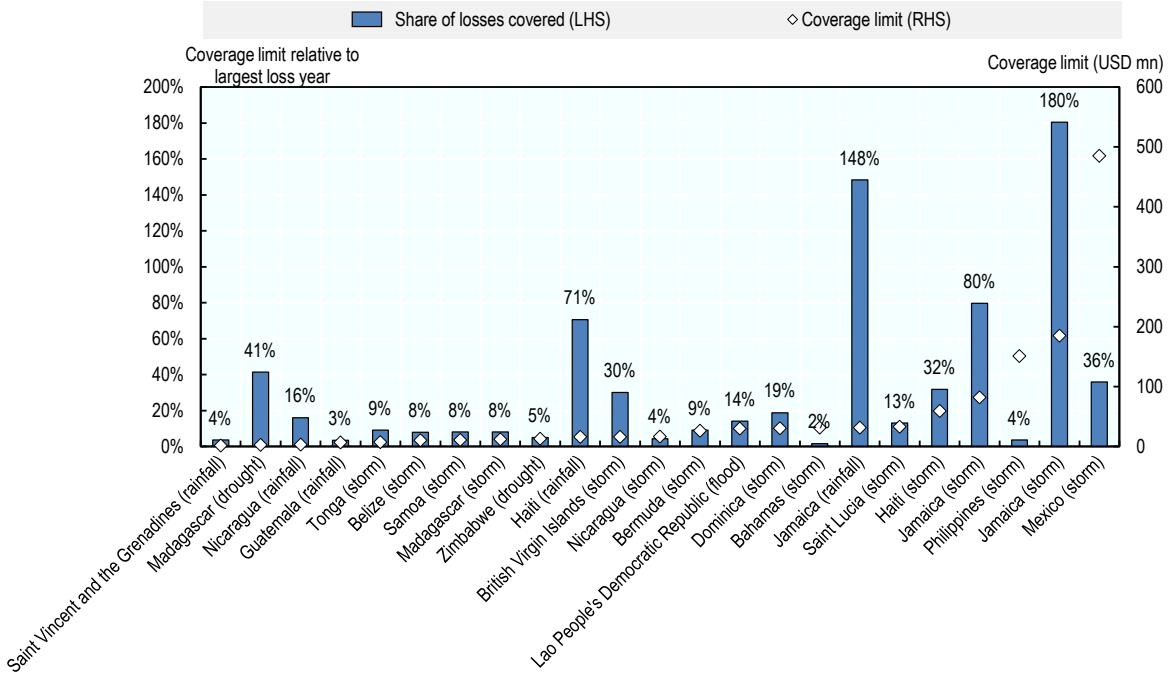
The financial protection arranged through regional risk pools generally provides relatively lower amounts of coverage for use as funding for recovery (rather than reconstruction). The financial protection acquired through the issuance of catastrophe bonds usually provides more significant amounts of funding that can be used to fund spending related to reconstruction (see Figure 4.9). In Mexico, payouts from the

catastrophe bond have been used to fund reconstruction of public assets and low-income housing through FONDEN (de la Plaza, 2022[56]).[11]

The use of parametric triggers can greatly increase the speed of payout and provide impacted countries with an almost immediate source of funds to support recovery (particularly in the case of regional risk pools). For example, CCRIF provides an initial estimate of the payout within 3-5 days and makes payment based on that estimate in approximately two weeks from the occurrence of the event. PCRAFI makes payments within 10 business days of the occurrence of a triggering event (World Bank, 2017[58]). Payouts from these programmes often reach the impacted country more quickly than other sources of funding. For example, a CCRIF payout to Haiti in the aftermath of the 2010 earthquake was reportedly the first to reach its beneficiary (de la Plaza, 2022[56]). Similarly, a payout of almost USD 2 million (approximately eight times the amount of the government's emergency funding provisions) was made by PCRAFI to the government of Vanuatu within seven days of the occurrence of Tropical Cyclone Pam in 2015 (World Bank, 2017[58]).

Catastrophe bond payments can take longer (given the more significant amounts involved). For example, payouts under the catastrophe bond issued by the Philippines are expected to be made within approximately one month in the case of an earthquake and five months in the case of a tropical cyclone (de la Plaza, 2022[56]) – although, as noted, the proceeds of catastrophe bonds are more often meant to fund reconstruction rather than recovery.

Figure 4.9. Coverage limits relative to potential public sector climate losses and damages



Note: Public sector AALs (average annual losses) are calculated as 35% of overall losses. Largest loss year refers to the year (since 1990) with the highest economic loss for the relevant climate peril.
Source: OECD calculations based on data on catastrophe losses from (Swiss Re sigma, 2020[35]) and information on coverage limits from (InsuResilience, n.d.[53]), (World Bank, 2021[57]) and (de la Plaza, 2022[56]).

The use of this form of financial protection has been increasing. Three countries (Mexico, Philippines and Jamaica) have issued catastrophe bonds (with the support of the World Bank as intermediary, see below) to provide financial protection against climate-related perils (and four others have issued catastrophe

bonds to provide financial protection against earthquake risks[12]). Prior to 2018, only Mexico had issued a catastrophe bond.[13] Many of the regional risk pools have expanded in terms of the number of participating countries (even if aggregate coverage limits have stayed relatively stable). CCRIF now has 19 participating countries and territories in the Caribbean (up from 16 in 2015/16) and has expanded to include three countries in Central America. Africa Risk Capacity is providing financial protection to 12 countries in 2021-22 (relative to 7 in 2015-16) and has also developed a coverage for humanitarian organisations to support their response to food security crises in Africa (referred to as ARC replica). In addition, a new regional risk pool has been established in Southeast Asia (SEADRIF) and is providing coverage to the government of Lao PDR against flood risks.

There is also likely significant appetite and capacity in international insurance and reinsurance markets for assuming risk in countries that otherwise account for only a small share of global insured exposure. As discussed below, the insurance business model depends on the ability to diversify risk by assuming (uncorrelated) risks across different sectors, perils and regions.

While there are likely few supply-side constraints to the availability of insurance coverage for fiscal risks, the costs of insurance reflects more than just the expected loss and includes profit margins and operational expenses as well as solvency capital requirements. Accordingly, the overall amount of premiums paid for insurance coverage generally exceeds the overall amount of claims paid by insurance companies to policyholders (otherwise, the insurance sector would be insolvent). Across OECD countries, on average, insurance companies collect approximately 1.5 times more in premiums (overall) than they pay in claims (for non-life insurance business) – although this will of course be higher or lower for individual policyholders based on individual policyholder loss experience over a given period and varies across countries and lines of business.[14] For catastrophe bonds (which are mostly issued by insurance companies, not governments), the average spread (the average coupon paid relative to the average expected loss) varies from year-to-year, ranging from 8.35% in 2006 to 2.92% in 2014 (Artemis, 2022[59]).

Insurance (and reinsurance) is more expensive for smaller, less-diversified pools of risks and when calibrated to make payments for more frequent events. As a result, small countries or territories can achieve lower insurance costs by: (i) establishing joint reserves to increase the collective risk retention capacity of all participants[15]; and (ii) accessing reinsurance markets collectively in order to capture the cost benefits of a more diversified portfolio (World Bank, 2017[58]), (Ghesquiere and Mahul, 2021[60]).[16] For example, according to the World Bank, the pooling of risks related to a 1-in-250 year tropical cyclone among countries participating in PCRAFI would achieve a 65% drop in required reserves and a reduction in premium costs of approximately 40% (World Bank, 2017[58]). Similarly, the pooling of risks globally (i.e. across regions) could reduce required reserves by close to 50% (for a 1-in-200 year event) relative to the cost of each region accessing insurance separately (World Bank, 2017[58]).[17] Diversification benefits can also be achieved by providing coverage for multiple (uncorrelated) perils.

Collaboration across countries or territories can also create operational efficiencies that should reduce the overall cost of insurance. Risk pools can share the operational costs of operating the pool among a larger group of participating countries as well as the initial costs related to product development, data collection and catastrophe modelling (World Bank, 2017[58]).[18] The World Bank estimates that regional risk pools incur operational costs equivalent to approximately 10% of the premiums they collect relative to the approximately 30% that insurers generally incur for operational expenses (World Bank, 2017[58]). This may be due to both donor support as well as the lower cost of distribution of regional risk pool policies. Operational efficiencies can also be achieved by sharing some of the fixed costs involved in issuing catastrophe bonds. In addition, governments issuing catastrophe bonds with the support of the World Bank have benefitted from a platform that avoids the need to establish a special-purpose entity (de la Plaza, 2022[56]) and that benefits from the World Bank's AAA credit rating.

Development cooperation providers have played a critical role in the establishment of all of the regional risk pooling arrangements, by providing funding for start-up costs (such as modelling) – which has also

had additional benefits as tools for risk reduction investment decisions and for underwriting insurance coverage outside of the programmes (Ghesquiere and Mahul, 2021[60]). In some cases, donors have also provided concessional financing as initial capital for the programmes and/or grants and loans for the payment of country premiums (World Bank, 2017[58]), (de la Plaza, 2022[56]). Donors have also supported capacity development to develop necessary expertise within the pooling arrangements and among the participating countries, for example, in terms of the effective use of payouts.

Similar to debt financing, premium pricing for insurance coverage could increase in the context of a changing climate. More frequent or intense climate-related catastrophes will mean higher losses for insurers which will need to be accounted for through higher premiums. For example, one estimate suggests that, in aggregate, property insurance premiums globally could increase by 33% to 41% to account for increasing losses due to climate change (Swiss Re Institute, 2021[61]).

Insurance for public assets

Governments (national or subnational) can acquire indemnity-based property insurance coverage to protect against damages to individual public buildings and infrastructure assets. Insurance coverage for individual buildings or infrastructure assets is usually available from domestic insurance companies or foreign insurers (if permitted under the insurance regulatory regime).

Governments take a variety of approaches to the use of indemnity insurance for public assets. Many governments (implicitly) self-insure these risks by not making any *ex ante* arrangements to manage the financial impacts of climate-related catastrophes on public assets (i.e. any damage or losses are funded using budgetary tools or *ex post* debt financing). Some countries have state-owned insurers (national, subnational or both) that are responsible for financing reconstruction of damaged public assets and which collect premiums for the coverage provided – for example:

- In Australia, the public assets of government entities such as state departments and agencies, are insured through Comcover. The government's general insurance fund provides cover for general insurable risks including natural hazards (excluding workers' compensation which is the responsibility of Comcare). Comcover is financed through premiums on property insurance; these premiums are based on the sum insured and past claims experience. Many states and territories also have self-managed funds or other public insurance arrangements for public assets under their responsibility (OECD and World Bank, 2019[15]).
- In the Philippines, a public insurer (Government Service Insurance System) is mandated to provide insurance coverage for all public properties owned by both national and local levels of government and all government agencies and government-controlled operations are required to acquire insurance for their assets from GSIS (Government Service Insurance System, n.d.[62]). GSIS transfers some of the risks for both individual assets and the overall portfolio of assets to reinsurance markets, providing a lower cost of insurance in aggregate for government-owned buildings and infrastructure.

In some countries (e.g. Iceland), a state-owned catastrophe risk insurance programme provides coverage for damages to public assets resulting from (covered) natural catastrophes. A few countries (e.g. Colombia, Viet Nam) either require or encourage public asset owners to seek adequate insurance coverage from private insurance markets.

In general, there is significant appetite in international insurance markets to provide coverage for public buildings and infrastructure assets, particularly in developing countries where insurers tend to have more limited exposure (as noted above). However, in some countries, domestic insurance companies may not have sufficient capacity to assume large risks, particularly those related to large infrastructure assets. In certain cases, such capacity constraints are exacerbated by regulations that restrict foreign insurance and

reinsurance companies from providing coverage or assuming significant amounts of risk from domestic insurers.[19]

Insurance coverage for public assets will be more costly where the transferred risk could involve frequent payouts or where the scope of risks being transferred involves limited risk diversification. Therefore, approaches that support pooled reserves (higher retentions) and the transfer of a pool of diversified risks to (re)insurance markets should benefit from reduced insurance costs. For example, in the Philippines, the government-owned public sector insurer (GSIS) has worked with the World Bank to acquire USD 389 million in parametric insurance coverage against typhoons for public assets owned by the federal government as well as 25 participating provinces (World Bank, 2018[63]). In Peru, an InsuResilience Solutions Fund is supporting the development of an insurance programme to protect the government against the costs of rebuilding public schools damaged by climate and other natural catastrophe perils (Insurance Development Forum, 2020[64]).

References

AECA (2019), *La solidarité crée la sécurité: la recette du succès des établissements cantonaux d'assurance en Suisse*, Association des établissements cantonaux d'assurance, https://www.vkg.ch/media/1769/gemeinschaftsorganisationen_2019_v0-0_f.pdf (accessed on 4 May 2021). [23]

An, J. and B. Park (2019), "Natural Disasters and International Financial Accessibility in Developing Countries", *Asian Economic Papers*, Vol. 18/1, pp. 245-261, https://doi.org/10.1162/ASEP_A_00682. [38]

Arista, L. (2021), "AMLO: sin el Fonden, "estamos atendiendo mejor que nunca a los damnificados"", *Expansion politica*, https://politica.expansion.mx/presidencia/2021/09/08/amlo-sin-el-fonden-estamos-atendiendo-mejor-que-nunca-a-los-damnificados (accessed on 19 April 2022). [68]

Artemis (2022), *Average catastrophe bond & ILS issuance expected loss, coupon, spread by year*, Artemis (website), https://www.artemis.bm/dashboard/cat-bonds-ils-expected-loss-coupon/ (accessed on 19 April 2022). [59]

Basel Committee on Banking Supervision (2019), *Risk-based capital requirements: Calculation of minimum risk based capital requirements*, Bank for International Settlements. [70]

Baudino, P. and J. Svoronos (2021), *Stress-testing banks for climate change – a comparison of practices*, Financial Stability Institute. [69]

BIS (2022), *Debt securities statistics*, Bank for International Settlements, https://www.bis.org/statistics/secstats.htm?m=2615 (accessed on 20 May 2022). [39]

BIS (2022), *Locational banking statistics*, Bank for International Settlements, https://www.bis.org/statistics/bankstats.htm?m=2069 (accessed on 20 May 2022). [40]

Cazaux, E., C. Meur-Férec and C. Peinturier (2019), "Le régime d'assurance des catastrophes naturelles à l'épreuve des risques côtiers. Aléas versus aménités, le cas particulier des territoires littoraux", *http://journals.openedition.org/cybergeo*, https://doi.org/10.4000/CYBERGEO.32249. [24]

Cevik, S. and J. Tovar Jalles (2020), "Feeling the Heat: Climate Shocks and Credit Ratings", *IMF Working Papers*, No. 2020/286, International Monetary Fund, https://www.imf.org/en/Publications/WP/Issues/2020/12/18/Feeling-the-Heat-Climate-Shocks-and-Credit-Ratings-49945. (accessed on 24 August 2022). [42]

Climate Analytics et al. (n.d.), *Climate impact explorer*, Climate Analytics (website), http://climate-impact-explorer.climateanalytics.org/ (accessed on 15 May 2022). [36]

Crossley, E. et al. (2021), "Funding Disasters: Tracking Global Humanitarian Funding for Response to Natural Hazards", No. 8, Centre for Disaster Protection. [51]

de Janvry, A., A. del Valle and E. Sadoulet (2016), "Insuring Growth : The Impact of Disaster Funds on Economic Reconstruction in Mexico.", *Policy Research Working Paper, World Bank*, Vol. No. 7714, https://openknowledge.worldbank.org/handle/10986/24631. [14]

de la Plaza, L. (2022), "Fiscal insurance: a new tool of fiscal stability", in Ferrarini, B., M. Giugale and J. Pradelli (eds.), *The Sustainability of Asia's Debt: Problems, Policies, and Practices*, Edward Elgar. [56]

Delgado, R., H. Eguino and A. Pereira (2021), *Fiscal Policy and Climate Change: Recent Experiences of Finance Ministries in Latin America and the Caribbean*, Inter-American Development Bank, https://doi.org/10.18235/0003376. [21]

European Commission (2019), *Evaluation of the European Union Solidarity Fund 2002-2017*, https://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/eusf_2002_2016/eusf_2002_2016_swd_en.pdf. [13]

Ghesquiere, F. and O. Mahul (2021), *Sovereign catastrophe risk pools – 15 years on and still more to come*, World Bank Blogs, https://blogs.worldbank.org/psd/sovereign-catastrophe-risk-pools-15-years-and-still-more-come (accessed on 23 March 2022). [60]

Government Service Insurance System (n.d.), *General Insurance Mandate of GSIS*, https://www.gsis.gov.ph/general-insurance/general-insurance-mandate/. [62]

Guillemette, Y. and D. Turner (2021), *The long game: Fiscal outlooks to 2060 underline need for structural reform*, https://doi.org/10.1787/a112307e-en. [2]

Hochrainer-Stigler, S. et al. (2014), "Funding public adaptation to climate-related disasters. Estimates for a global fund", *Global Environmental Change*, Vol. 25/1, pp. 87-96, https://doi.org/10.1016/J.GLOENVCHA.2014.01.011. [16]

Ho, S. and S. Fontana (2021), "Sovereign Debt Evolution: The Natural Disaster Clause", *Emerging Markets Restructuring Journal* 11. [47]

ICMA (2021), *Green Bond Principles: Voluntary Process Guidelines for Issuing Green Bonds (June 2021)*, International Capital Market Association. [27]

ICMA (2021), *Social Bond Principles: Voluntary Process Guidelines for Issuing Social Bonds (June 2021)*, International Capital Market Association. [28]

IMF (2021), *World Economic Outlook Database, October 2021*, International Monetary Fund, https://www.imf.org/en/Publications/WEO/weo-database/2021/October (accessed on 20 May 2022). [37]

Imrana Hussain, F. (2022), "Thematic bonds to diversify fiscal sources", in Ferrarini, B., M. Giugale and J. Pradelli (eds.), *The Sustainability of Asia's Debt*, Edward Elgar Publishing, https://doi.org/10.4337/9781800883727.00027. [32]

Insurance Development Forum (2020), *IDF launches first Tripartite Project for Peru*, Insurance Development Forum, https://www.insdevforum.org/idf-launches-first-tripartite-project-for-peru/ (accessed on 19 April 2022). [64]

InsuResilience (n.d.), *Projects and Instruments*, InsuResilience, https://www.insuresilience.org/projects/ (accessed on 20 May 2022). [53]

Inter-agency Task Force on Financing for Development (2022), *Financing for Sustainable Development Report*, United Nations, https://desapublications.un.org/file/955/download. [4]

IPCC (2019), *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*, https://www.ipcc.ch/srocc/. [7]

IPCC (2018), *Special Report: Global Warming of 1.5°C, Intergovernmental Panel on Climate Change*, https://www.ipcc.ch/sr15/. [6]

Ivanov, I., M. Macchiavelli and J. Santos (2022), "Bank lending networks and the propagation of natural disasters", *Financial Management*, https://doi.org/10.1111/FIMA.12388. [45]

Klusak, P. et al. (2021), "Rising Temperatures, Falling Ratings: The Effect of Climate Change on Sovereign Creditworthiness"*, Bennett Institute Working Paper*, Bennett Institute for Public Policy, University of Cambridge. [30]

Kousky, C. (2018), "Financing Flood Losses: A Discussion of the National Flood Insurance Program", *Risk Management and Insurance Review*, Vol. 21/1, pp. 11-32, https://doi.org/10.1111/rmir.12090. [26]

Mallucci, E. (2022), "Natural disasters, climate change, and sovereign risk", *Journal of International Economics*, Vol. 139, p. 103672, https://doi.org/10.1016/J.JINTECO.2022.103672. [44]

Moody's (2021), *Explanatory Comment: New scores depict varied and largely credit-negative impact of ESG factors*, Moody's Investors Service. [41]

Munich Re (2012), *50th anniversary of storm surge in Hamburg: Subsequent flood controls prevent billions in losses*, https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2012/2012-02-13-50th-anniversary-of-storm-surge-in-hamburg-subsequent-flood-controls-prevent-billions-in-losses.html. [18]

Notre Dame Global Adaptation Initiative (2022), *Methodology*, University of Notre Dame, https://gain.nd.edu/our-work/country-index/methodology/ (accessed on 24 August 2022). [71]

OECD (2022), *Geographical flows to developing countries (database)*, https://stats.oecd.org/Index.aspx?DataSetCode=DACGEO (accessed on 8 September 2022). [50]

OECD (2022), *OECD Insurance Statistics (database)*. [73]

OECD (2022), *OECD Sovereign Borrowing Outlook 2022*, OECD Publishing, Paris, https://doi.org/10.1787/b2d85ea7-en. [29]

OECD (2021), *Enhancing Financial Protection Against Catastrophe Risks: The Role of Catastrophe Risk Insurance Programmes*, OECD. [25]

OECD (2021), *General government debt (indicator)*, https://doi.org/10.1787/a0528cc2-en (accessed on 10 December 2021). [3]

OECD (2021), *Government at a Glance 2021*, OECD Publishing, Paris, https://doi.org/10.1787/1c258f55-en. [19]

OECD (2021), *Managing Climate Risks, Facing up to Losses and Damages*, OECD Publishing, Paris, https://doi.org/10.1787/55ea1cc9-en. [48]

OECD (2021), *The role of catastrophe risk insurance programmes in supporting broader insurance coverage for catastrophe perils*, OECD Publishing, Paris. [11]

OECD (2018), *The Contribution of Reinsurance Markets to Managing Catastrophe Risk*, OECD, http://www.oecd.org/finance/the-contribution-of-reinsurance-markets-to-managing-catastrophe-risk.pdf (accessed on 23 January 2019). [65]

OECD (2017), *Boosting Disaster Prevention through Innovative Risk Governance*, OECD Publishing, https://doi.org/10.1787/9789264281370-en. [17]

OECD (2015), *Disaster Risk Financing: A global survey of practices and challenges*, OECD Publishing, https://doi.org/10.1787/9789264234246-en. [12]

OECD (2013), *OECD Reviews of Risk Management Policies: Mexico 2013*, https://doi.org/10.1787/9789264192294-en. [22]

OECD and World Bank (2019), *Fiscal Resilience to Natural Disasters*, OECD Publishing, https://doi.org/10.1787/27a4198a-en. [15]

Phaup, M. and C. Kirschner (2010), "Budgeting for Disasters: Focusing on the Good Times", *OECD Journal on Budgeting*, Vol. 2010/1, pp. 1-24, https://doi.org/10.1787/16812336. [10]

Qadir, U. and A. Creed (2021), *Green Bonds for Climate Resilience: A Guide for Issuers*, Global Center on Adaptation. [33]

Qadir, U. and K. Pillay (2021), *Green Bonds for Climate Resilience: State of Play and Roadmap to Scale*, Global Center on Adaptation. [34]

Radu, D. (2021), "Disaster Risk Financing: Main Concepts & Evidence from EU Member States", *European Economy Discussion Papers*, European Union, Luxembourg, https://doi.org/10.2765/504147. [8]

Rawdanowicz, Ł. et al. (2021), *Constraints and demands on public finances: Considerations of resilient fiscal policy*, https://doi.org/10.1787/602500be-en. [5]

Semet, R., T. Roncalli and L. Stagnol (2021), "ESG and Sovereign Risk: What is Priced in by the Bond Market and Credit Rating Agencies?", No. Working Paper 115-2021, Amundi Asset Management Institute. [43]

Sidley Austin LLP (2022), *Sidley Global Insurance Review 2022*, Sidley Austin LLP. [31]

Swiss Re Institute (2021), *More risk: the changing nature of P&C insurance opportunities to 2040 (sigma No 4/2021)*, Swiss Re, https://www.swissre.com/dam/jcr:19f316fe-0381-42a9-8cfd-9794f746e421/swiss-re-institute-sigma-4-2021-en.pdf (accessed on 19 April 2022). [61]

Swiss Re sigma (2020), *Natural catastrophes and man-made disasters: 1990-2019 (dataset)*, Swiss Re. [35]

United Nations (2019), *World Population Prospects 2019*, https://population.un.org/wpp/Download/Standard/Population/. [1]

White House (2021), *Executive Order on Climate-Related Financial Risk*, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/05/20/executive-order-on-climate-related-financial-risk/ (accessed on 30 May 2022). [20]

Willis Re (2021), *Reinsurance market report: Results for full-year 2020*. [72]

Willis Towers Watson (2021), *Willis Towers Watson designs 'world-first' parametric solution to help build resilience of sovereign borrowers to climate shocks*, Willis Towers Watson (website), https://www.wtwco.com/en-US/News/2021/12/wtw-designs-world-first-parametric-solution-to-help-build-resilience-of-sovereign-borrowers (accessed on 18 April 2022). [49]

World Bank (2022), *Strengthening the Philippines' Post-disaster Financial Resilience through Support at the National and Local Levels*, https://www.worldbank.org/en/news/feature/2022/04/05/strengthening-the-philippines-post-disaster-financial-resilience-drmhubtokyo (accessed on 12 April 2022). [52]

World Bank (2021), *Debt Sustainability Analysis*, World Bank Debt & Fiscal Risks Toolkit, https://www.worldbank.org/en/programs/debt-toolkit/dsa (accessed on 16 May 2022). [46]

World Bank (2021), *World Bank Catastrophe Bond provides Jamaica with Financial Protection against Tropical Cyclones*, World Bank. [57]

World Bank (2019), *Fiscal Policies for Development and Climate Action*, World Bank, https://doi.org/10.1596/978-1-4648-1358-0. [9]

World Bank (2019), *Super-sized Catastrophe Bond for Earthquake Risk in Latin America*, World Bank. [66]

World Bank (2018), *Insuring the Philippines Against Natural Disasters*, World Bank. [63]

World Bank (2017), *Sovereign Climate and Disaster Risk Pooling: World Bank Technical Contribution to the G20*, World Bank. [58]

World Bank (2015), *Facilitating Catastrophe Risk Transfer*, World Bank. [67]

World Bank Treasury (2021), *IBRD Catastrophe Deferred Drawdown Option (Cat DDO): Product Note*. [54]

World Bank Treasury (2018), *IDA Catastrophe Deferred Drawdown (Cat DDO): Product Note*. [55]

Notes

[1] There are a number of other catastrophe risk insurance programmes that provide insurance, co-insurance or reinsurance coverage for climate-related perils although without a government backstop (or explicit government backstop), including Norsk Naturskadepool (Norway), Philippine Catastrophe Insurance Facility (under development), the public insurers for real estate in various Swiss cantons, Flood Re (United Kingdom) and the Florida Hurricane Catastrophe Fund (United States) (amongst others).

[2] The guarantee is annually reinstated at AUD 10 billion and would be called upon in the event that funds from the pool are insufficient to meet claims costs. Each year, the guarantee resets to AUD 10 billion if it was called on in the previous year. However, in the event that a single year has an event or events exceeding the AUD 10 billion of the guarantee, the Government must fund any shortfall to ensure that the pool meets all its obligations. This means an event or event of greater than AUD 10 billion would still be covered by the guarantee.

[3] CCR (France) required EUR 263 million in funding from the French Treasury to address losses related to winter storms Martin and Lothar in 1999. NFIP (United States) has faced more frequent underwriting losses and has borrowed funds from the United States Treasury to meet its obligations (approximately USD 20.5 billion is owed to the Treasury as of Q2 2022). A more detailed overview of the financial soundness of catastrophe risk insurance programmes in OECD countries is provided in (OECD, 2021[11]).

[4] The cost of commercial bank lending is partly driven by the amount of capital that banks need to hold to account for the exposures they assume through their lending operations (i.e. credit risk). Under Basel III capital standards, banks may calculate capital requirements based on a standardised approach (which may rely on external credit ratings for the borrowing entity) or through an internal-ratings based approach that applies an internal rating model for credit risk that is subject to supervisory approval (Basel Committee on Banking Supervision, 2019[70]).

[5] There is limited research on the impact of natural catastrophes or climate-related risks on the creditworthiness or cost of borrowing of sovereign issuers so these results should be interpreted with some caution.

[6] According to one recent estimate, approximately USD 30 trillion (or one-third) of professionally-managed assets are subject to some form of ESG assessment criteria (Klusak et al., 2021[30]).

[7] The analysis assigns “issuer profile scores” that aim to provide an indicator of an issuer’s exposure to a range of different environmental, social and governance factors. Environmental issuer profile scores consider exposure to physical climate risks, carbon transition, water risks, natural capital and waste and pollution. According to the analysis, approximately 40% of emerging market issuers have very highly or highly negative environmental issuer profile scores that are driven mainly by physical climate and water risk exposures (Moody’s, 2021[41]).

[8] The analysis uses the Notre Dame Global Adaptation Initiative (ND-GAIN) country index scores as measures of climate change vulnerability and resilience. The score is based on an assessment of exposure, sensitivity and adaptive capacity for vulnerability and an assessment of economic, governance and social readiness for resilience (Notre Dame Global Adaptation Initiative, 2022[71])

[9] Based on analysis of bond yields, the authors found evidence that climate physical and transition risks were being priced into sovereign bonds, with higher emphasis placed on physical risks in the case of middle-income countries.

[10] The use of climate stress tests in banking (and other financial sector) supervision is relatively new although significant work is being undertaken in international organisations (e.g. Financial Stability Board, Network for Greening the Financial System) to support its implementation. One analysis of climate stress testing in France, Netherlands and the United Kingdom found that the impact of physical climate risks on credit were included within the scope of the exercises in France and the United Kingdom although have not been used for the purposes of setting capital requirements (Baudino and Svoronos, 2021[69]). That said, banks may choose to integrate such factors into internal rating models.

[11] In July 2021, a formal decision to eliminate FONDEN was announced although the catastrophe bond coverage remains in place (Arista, 2021[68]).

[12] Four Pacific Alliance countries (Chile, Colombia, Peru and Mexico) jointly issued USD 1.36 billion in catastrophe bonds in 2018 with support from the World Bank (World Bank, 2019[66]).

[13] In 2014, CCRIF was the beneficiary of a catastrophe bond issued by the World Bank to provide USD 30 million in financial protection to CCRIF against losses due to a tropical cyclone or earthquake in the Caribbean region (World Bank, 2015[67]). The catastrophe bond in this case would be considered an alternative to accessing reinsurance coverage.

[14] Between 2015 and 2020, the average non-life sector loss ratio across OECD member countries reporting under the OECD's Global Insurance Statistics exercise was 64.7% (OECD, 2022[73]). Between 2013 and 2020, major reinsurance companies reported an overall loss ratio of 64.6% (simple average for that period, calculated as the combined ratio minus the expense ratio for the "SUBSET" group of companies defined by Wills Re (2021[72]), for the property and casualty segment only, where available). A loss ratio of 66.6% would indicate that premiums collected were 1.5 times the amount of claims paid although it should be noted that a portion of the premium paid covers the operational expenses of the (re)insurance companies.

[15] Joint reserves allow the joint pool to provide coverage for higher frequency/lower severity events and therefore transfer only lower frequency risks to (re)insurance or capital markets.

[16] The higher cost for a less diversified pool of risks results from the need to apply a catastrophe load to risk-weighted capital requirements for covering risks with the potential for correlated losses. The pooling of a more diversified set of risks leads to a reduction in the catastrophe load and the corresponding level of capital that an insurer needs to hold as severe losses are less likely to occur simultaneously across a diversified pool of risks (World Bank, 2017[58]).

[17] The World Bank has also examined the marginal additional benefits of adding individual territories (a hypothetical large country in Asia) to a pool and found that the benefits are greatest as initial members join although decline as each additional member joins (while still having a positive impact in terms of increasing diversification and lowering insurance costs) (World Bank, 2017[58]).

[18] Commercial catastrophe models used in insurance and reinsurance pricing and exposure management tend to be more frequently available in countries with large private insurance markets – lower-income countries with less developed insurance markets are unlikely to be covered by commercial catastrophe models. As a result, the establishment of regional risk insurance programmes has involved significant initial costs for model development.

[19] For example, some countries might only permit insurers with a local legal presence to provide coverage in certain lines of business or to certain types of policyholders. There may also be regulatory restrictions related to the amount of risk that domestic insurers must retain or that limit the amount of risk that they can transfer to foreign reinsurers (OECD, 2018[65]).

5 Towards a framework for action

This final chapter provides a strategic framework for government action for the financial management of climate-related risks. At national level, it proceeds from the assessment and mitigation of climate-related fiscal risks, to developing multipronged government financial strategies, which take into account the extent of budgetary resources and financing capacities. At the international level, it emphasises the importance of integrated strategies to promote global climate financial resilience through coordinated donor action, particularly in support of economies facing high level of risks and possessing limited resources to manage them.

The aim of this chapter, which builds on the previous two substantive chapters, is to provide a framework for government action for the financial management of climate-related risks, serving to support enhanced decision-making at the national and international levels, with proposed actions and guidance, particularly with a view to supporting governments in emerging market and developing economies facing budgetary and financing constraints. The framework proceeds in a step-wise fashion:

- At the *national level*, from the assessment of climate-related fiscal risks due to adverse events, to the mitigation of losses from these climate hazard events and their implications for governments, followed by the development of appropriate governmental financial strategies, which take into consideration the extent of budgetary resources and financing capacities; and,
- At the *international level*, from encouraging integrated strategies that reinforce domestic actions through multiple channels, to promoting coordinated donor action, with the overarching goal of promoting climate financial resilience, particularly for economies facing a high level of risks yet possessing limited resources to manage them.

The framework provides a relevant action oriented toolbox to support decision making. It has been informed by the *OECD Recommendation on Disaster risk Financing Strategies*, the *OECD Recommendation on Budgetary Governance*, and the *OECD Recommendation on the Governance of Critical Risks*. It also benefitted from the OECD Development Assistance Committee Declaration on a new approach to align development co-operation with the goals of the Paris Agreement.

5.1. Strengthening the financial management of climate-related risks

5.1.1. Identify, assess and report on climate-related risks and their financial implications for government

Identifying and assessing climate-related risks, financial vulnerabilities, and financial implications for government

Central governments face a number of costs related to relief, recovery and reconstruction in the aftermath of climate-related hazards. These include costs related to responding to the immediate needs of those impacted by the event and costs related to supporting recovery and reconstruction, including losses and damages incurred by central government entities and potentially losses and damages incurred by subnational governments, and related public assets as well as businesses and households. This has multiple implications for governments, including for public finances. Fiscal risk assessment involves an assessment of the potential for these costs to materialise which can inform budgeting and public financial management strategies. This has to be based on the nature and potential scale of impact of the climate hazard(s), the exposure of communities and businesses and their assets to those hazard(s), and their vulnerability to impacts (e.g. structural resilience).

Assessing fiscal risks in a forward-looking perspective should take into account the potential for climate change to lead to increasing losses and damages in the future, including for central government. National climate risk assessments will need to be more explicitly linked to fiscal risk assessment frameworks, through greater whole of government coordination. This will be necessary to ensure that the fiscal impacts of climate hazards and extreme weather events are comprehensively identified and quantified. This assessment of fiscal risks can either be done by governments directly, or by independent fiscal institutions, or fiscal councils, working at arms' length from government.

In estimating climate-related fiscal risks, there is a need to distinguish between explicit and implicit contingent liabilities arising from such risks. Some contingent liabilities are clearly within the responsibility of central governments, such as losses and damages incurred to central government operations (and assets). Central governments may also have a clear responsibility to assume some (or all) of the losses

and damages incurred by subnational governments based on an established cost-sharing arrangement or a clear commitment to provide a set amount of compensation or financial support to impacted business or households.

Implicit liabilities may arise from the expectation – among subnational governments, businesses or households – of central government financial assistance (potentially based on the response to previous events) or as a result of financial vulnerabilities that emerge as a result of a climate event. The political pressures are often such that governments are placed in a position where they have to address unmet needs. The identification of financial vulnerabilities within different segments of society and the economy is therefore a critical component to understanding the fiscal implications as national governments are likely to face demands to respond to these vulnerabilities in the aftermath of a climate-related catastrophe. Identifying financial vulnerabilities requires an understanding of both the potential risk of losses and damages (determined, as mentioned earlier, by the nature and scale of the risk, exposure or who is expected to be affected by losses and damages in the event of a catastrophe (households, businesses or local, regional governments), and their vulnerability to damage and losses), and their financial capacity to absorb the potential losses and damages that they may face, for instance through savings, access to borrowing, or insurance coverage (where acquired).[1]

An assessment of the financial vulnerabilities should take into account the potential impact of climate change in the future. The financial vulnerabilities of households, businesses and subnational governments may increase in the context of climate change, for example through increased variability of major climate patterns. This may result in both potential increases in losses and damages as well as changes in their financial capacity to absorb those losses and damages (e.g. through debt financing or insurance). For instance, the cost of debt financing for sub-national governments and businesses could increase if lenders integrate concerns about climate risk into credit ratings and borrowing costs (or if such concerns are integrated into the credit ratings and borrowing costs of central government).[2] There may also be reductions in the availability (or increases in the cost) of insurance coverage in the future if increasing losses and damages lead to higher (and potentially unaffordable) premiums or insurance coverage withdrawals.[3] An increase in borrowing costs or a reduction in insurance coverage would reduce the capacity of subnational governments, businesses and/or households to absorb losses and increase financial vulnerabilities and potential (central) government fiscal risks.

Financial vulnerabilities can be mitigated through social protection and direct assistance to citizens, financial assistance to business, and transfers to (or cost-sharing with) sub-national levels of government which are critical to reducing the economic and social hardships that can result from climate-related catastrophes. A policy and legal framework that clearly sets out central government responsibility for the financing of post-disaster response, recovery and reconstruction will help to identify explicit contingent liabilities and to reduce the scope for implicit vulnerabilities (OECD and World Bank, 2019[1]). This includes, first, clear and explicit conditions (e.g. eligibility criteria) to reimburse disaster-related costs incurred by subnational level and second, commitment ceilings. According to the *OECD Recommendation on the Governance of Critical Risks*, governments can plan for contingent liabilities by "developing rules for compensating losses that are clearly spelled out at all levels in advance of emergencies to the extent that this is feasible to achieve cost effective compensation mechanisms" (OECD, 2014[2]). The establishment of operational procedures to ensure the timely distribution of financial support to those in need is critical for reducing the level of hardship and supporting a quicker recovery.

There are two main approaches to estimating potential fiscal risks due to climate-related hazards: direct estimation (based on historical losses) and estimation via probabilistic modelling (OECD and World Bank, 2019[1]). The first method consists in deriving estimates from historical data on the cost of past events for governments. Such information may be obtained from data repositories, payouts from relief funds, disclosed data on the spending to respond to hazards and disasters as well as from insurance programmes and companies. Information on the consequences of past hazards is important, especially for understanding how hazards interact with local vulnerability of exposed communities and assets; the past

is however not a perfect proxy of the future, in particular in a changing climate. The second method entails estimating the costs of climate losses and damages via a modelling of losses based on the probability of a catastrophe. Such methods can complement estimates based on past events but also serve to estimate the cost of extreme events that have not previously occurred. Further, the indirect or second-order effects of climate hazards should also be taken into account and need to be properly measured. (OECD, 2017[3]). Indirect impacts are more difficult to measure and yet may outweigh the direct costs of hazards. In assessing the magnitude of these risks, countries should evaluate average annual losses and probable maximum losses.

A variety of stakeholders and expert bodies can be involved in assessing climate-related fiscal risks. Economic and financial forecasters could work closely with climate change councils and independent fiscal institutions, which have begun preparing green analysis that could be readily adapted and incorporated into official planning frameworks (Cameron, Lelong and von Trapp, 2022[4]). For example, the UK Office for Budget Responsibility makes its climate-related fiscal scenarios by drawing from emissions mitigation scenarios projections by the Climate Change Committee (Office for Budget Responsibility, 2021[5]). The Ontario's FAO collaborated with the Canadian Centre for Climate Services that provided regional projections of climate indicators identified by an engineering firm, WSP, with expertise in public infrastructure and climate change. The (re)insurance sector, including intermediaries, (re)insurance companies, insurance associations and specialised catastrophe modelling firms, have developed sophisticated tools for analysing financial risks from climate-related events which could provide risk insights to support governments in the identification and assessment of climate risks.

Long-term fiscal sustainability analyses provide another tool for assessing potential climate risks to public finances. These analyses, though not forecasts per se, consist of long-term projections of baseline expenditures (under the assumption of no change to existing policies). They are usually aimed at capturing the trend impact of demographics. Scenario analyses are a useful type of long-term fiscal sustainability assessment to examine fiscal adjustment paths under various climate targets. These analyses can serve as a benchmark for policymakers regarding the economic and fiscal impacts of mitigation and adaptation measures.

Governments should reinforce their capacity to account for such losses and damages, given the possibility of increased losses in the future related to more severe and frequent extreme weather events. In estimating adaptation costs, governments should also agree on baseline estimates of temperature increases at the national level. Such estimates in turn rely both on assumptions of government policies towards emission reductions as well as countries' climate behaviour on the global scene. Long-term fiscal assessments can seek to capture the fiscal consequences of physical risks as well as adaptation costs from climate change.

For instance, the European Commission's 2021 Fiscal Sustainability Report presents the results of a fiscal stress test of the impact of extreme weather events on several European countries. By relying on data on past impacts of extreme weather events, the methodology (Box 5.1) highlights the usefulness of recording such data. As mentioned in Chapter 2, in developing countries, data availability is often challenging (PARIS21, 2022[6]). Making the impact of climate change on public finances transparent, as has for instance been done with the EU's Fiscal Sustainability Report, encourages public stakeholders to act. Uncertainty can indeed decrease investment in risk reduction.

Box 5.1. The European Commission's Fiscal Stress Test

In its latest Fiscal Sustainability Report, the European Commission performed a stress test of the fiscal impact of acute physical risks posed by extreme weather events on 13 European countries deemed particularly exposed to such risks.

The stress test consisted of estimating the deviation from the European Commission's baseline debt-to-GDP ratio forecasts for the next 10 years in the event that a past extreme event reoccurs. It is augmented by the effect of global warming under a 1°C and a 2°C scenario.

The stress test distinguishes a direct effect on the fiscal balance and an indirect effect. The direct impact is estimated by first computing country-specific exposure to extreme events (using data on past uninsured losses). To this is added the expected increase in economic losses from extreme events due to global warming levels (measured in quantitative climate risk assessments). The indirect impact captures the macroeconomic shock on GDP (growth and level).

The 13 countries for which the test is performed are Spain, Belgium, Romania, Austria, France, Italy, the Netherlands, Greece, Hungary, Germany, Poland, Czech Republic and Portugal. Spain and Czech Republic are found to be the most exposed: under a 2°C scenario their debt-to-GDP ratio would increase by 5.2 and 4.7 percentage points of GDP, respectively, compared to the baseline.

Source: (European Commission, 2022[7])

Understanding the full potential for central government losses and damages, clarifying explicit liabilities through established financial support programmes and social protection, and minimising potential implicit liabilities that could arise as a result of emerging unforeseen financial vulnerabilities will provide a clearer picture of the amount of the funding that governments will need to respond to climate-related risks. They will help build clearer and more resilient public financial management frameworks.

Reporting climate-related fiscal risks to promote transparency in public financial management

In turn, disclosing plans for managing public finance exposures to catastrophic climate-related events ensures accountability from civil society and lawmakers on the management of climate-related risks. Transparency can generate continued pressure on governments to identify, quantify and plan for these risks and ultimately ensure robust public financial management of climate risks. Likewise, disclosure can strengthen confidence from financial markets that countries can manage the impact of chronic and acute climate change (e.g. extreme weather events). High levels of public debt, high vulnerability to climate change and/or limited access to international capital markets for public borrowing make market confidence particularly important. As credit rating agencies increasingly examine countries' exposure to climate and catastrophe risks [4], the disclosure of funding and financial management plans could have a positive impact on countries' borrowing costs.

Disclosure practices can come in varying forms. Ministries of Finance may publish strategies to manage contingent liabilities including climate-related ones outside the budget process. Countries have for example included information on funding plans into risk assessments (e.g. Hungary) or longer-term statements on national planning (e.g. Lithuania). Strategies can also be integrated in the budget process, often through so-called Fiscal Risks Reports, for example as an annex of the budget law. There may be regulations that require line ministries to report contingent liabilities to Ministries of Finance. The OECD Recommendation on the Governance of Critical Risks (OECD, 2014[2]) and the Recommendation on Budgetary Governance (OECD, 2015[8]) respectively state that, in the context of the budget process, countries should disclose

disaster-related contingent liabilities and report on the management of fiscal risks. In addition, the EU national fiscal frameworks Directive 2011/85 asks EU Member States to list key contingent liabilities in sufficiently broad terms to include climate-related ones.

For example, climate change has various entries in the New Zealand Treasury's reporting of fiscal risks. In New Zealand, budget reports for example disclose how the impact of natural and climate hazards on physical assets and public services is managed: "the Government generally relies on asset management, including built-in redundancies (e.g. in network capacities), and its ability to reallocate or repurpose assets rather than risk transfer instruments such as insurance." (New Zealand Treasury, 2021[9]). In addition, the Treasury categorised its National Adaptation Plan as a fiscal risk given that it is likely to generate new expenditures. The country is currently developing National Adaptation Plan in response to the risks identified the National Climate Change Risk Assessment. The Philippines publish their annual Fiscal Risks Statement, which recognises that the country is exposed and vulnerable to climate risks. The document gives details on the implications of climate risks, such as typhoons and tropical cyclones, but also slow-onset events, as well as on how they are managed (Department of Budget and Management, 2022[10]).

5.1.2. Mitigate financial losses from climate-related risks and their implications for governments

Promoting, investing and financing risk prevention, risk reduction and adaptation to reduce exposure and vulnerability

A strategy for risk prevention and reduction and adaptation, efficiently mixing preventive physical investments and non-structural measures, is an important step to reduce vulnerabilities. This should be part of a multipronged approach to help governments address climate related losses and damages. Increasing investment in risk reduction and climate adaptation can make an important contribution to reducing losses and damages from climate events and the potential fiscal risks related to climate change (see Box 5.3 for the role of mitigation and Box 5.2 for how risk reduction affects the cost of capital). According to the *OECD Recommendation on the Governance of Critical Risks*, an optimal disaster risk prevention and mitigation strategy efficiently combines structural with non-structural measures (OECD, 2014[2]). Structural measures include major physical investments, such as building dykes, whereas non-structural measures may involve land-use planning, dissemination of information materials on do's and don'ts at the time of disaster. Climate, disaster and fiscal risk assessments should be used to determine priorities for structural and non-structural preventive investments.

Since resources are scarce, alternatives for risk reduction investment should be evaluated in a transparent and comparable manner. Data collection helps identify climate risks, as discussed in Chapter 2, and thus can highlight a few possible priorities for such investments. Depending on the context, cost-benefit analysis (CBA) can usefully guide decisions. Such analyses estimate the advantages and disadvantages of different options, usually in monetary terms. This helps determine which path provides the most benefits net of costs. By their nature, CBAs are useful for illustrating trade-offs between different investments (OECD, 2018[11]), even if they face limitations regarding some climate change investments (e.g. the frequency and intensity of future extreme weather events is uncertain).

When not every impact can be monetised, a more appropriate approach may be to compare various plans to ensure the project is carried out at least cost. Typically, a cost-effectiveness analysis is easier to carry out than a CBA because it does not require that every aspect be monetised (e.g. impact of uncertain catastrophic events) (OECD, 2007[12]). Similar to a CBA, the costs are assessed in monetary terms. However, usually only direct costs are considered. If the impact can be measured without being monetised, the policies might be characterised by their cost-effectiveness ratio (OECD, 2007[12]; Tuominen et al., 2015[13]). Any decision-making process regarding climate change should be participatory to ensure consideration of diverse perspectives and consider possible costs and benefits across all affected

populations. Given the future impact of climate change-related risks, it is important to apply a long time horizon when assessing the benefits of resilience. This makes it important to have a public sector discount rate that values the true resilience benefits over a sufficiently long period. In addition, when evaluating public investments with long-term benefits, it is crucial to assess their whole-of-life costs, which includes assessing their capital, operational and decommissioning expenditures over the full, multi-decade life of the investment. This is key to understanding the true climate finance-related liability of building a particular investment in a certain location.

Box 5.2. Risk reduction and the cost of capital

Risk reduction and adaptation could be a good investment from a purely fiscal point of view. Some extreme weather events may lead to increase in government spending years after they hit (Deryugina, 2017[14]). Accordingly, countries (especially low-income ones) which are vulnerable to climate change are more susceptible to sovereign defaults (Cevik and Jalles, 2021[15]) and have a lower credit rating (Cevik and Jalles, 2020[16]). Financial markets also recognize and price climate vulnerability, as bond yields are lower for less vulnerable and more resilient countries (Cevik and Jalles, 2022[17]; Beirne, Renzhi and Volz, 2021[18]). Thus, more resilient countries can access capital at a cheaper price from the financial markets. This in turn, affects the cost at which the private sector within the country, can access capital (Arteta and Hale, 2008[19]; Corsetti et al., 2013[20]).

When investing in risk reduction, it is crucial to consider the incentives it may provide, to avoid increasing risks in the end (maladaptation). For example, the cost of building a sea wall depends on the length – rather than the value of assets – of the exposed coastline. This suggests the need to protect only high-value assets in a limited, well-defined area; low-value assets, or assets spread over a large, exposed area may justify alternative approaches. Such protection then creates the incentive to relocate or concentrate assets in the protected area, thereby increasing exposure should the sea wall break (Gibbs, 2015[21]). Where possible, new investment should be directed at infrastructure proposed to be built in low-risk areas, to minimise any future climate-related losses and financial liability.

Box 5.3. Role of climate mitigation in risk reduction

In risk reduction, the role of climate mitigation should also be underlined. In 2015, countries agreed to "hold global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels" (Paris Agreement, 2015[22]). In order to achieve this globally-agreed temperature goal, countries have submitted Nationally Determined Contributions (NDCs) in which they lay out their plans to reduce GHG emissions. Global collective action on GHG emissions however still falls far short from what is needed to meet the temperature goal in the Paris Agreement and to avoid the most dangerous impacts of climate change. Indeed, even if accounting for pledges made at COP26 in Glasgow in 2021, current levels of ambition in NDCs would lead to a temperature increase of 2.4°C by the end of the century (CAT, 2021[23]).

While not the focus of the report, mitigation is possibly the only way to reduce the risks of crossing some tipping points in the climate system and of some slow-onset events such as severe sea-level rise, while having the potential to decrease the frequency and severity of hazards (OECD, 2021[24]). It is without question that mitigation of GHG gases needs to be ramped up worldwide with countries putting forward clear mitigation plans, considering all sectors of the economy, including carbon-intensive and hard-to-abate sectors. While governments often see mitigation as a cost in the present, with benefits materialising in the future, this is a misguided view. Mitigation actions could contribute significantly to important improvements in human well-being in relation to the Sustainable Development Goals. By integrating climate action and action on sustainable development, governments can realise early benefits from health improvements and accessibility, as well as job creation (OECD, 2021[25]).

Governments should consider integrating climate risks into public investment management systems as it can make an important contribution to climate change adaptation. Preventive investments are aimed not only at directly mitigating climate losses and damages (e.g. higher barriers against larger floods or higher sea levels) but also at making "regular" infrastructure more resilient (e.g. making drainage systems and telecom systems more resistant to wildfires and floods). Climate-resilient public investments are also relevant in the context of post-disaster reconstruction efforts. It enables countries to "build back better" and provides resilience to shocks. Climate risk-sensitive public investments make financial sense as they enable governments to increase the efficiency of public spending, while reducing the future costs attributable to climate change.

This process of operating, maintaining, upgrading and expanding assets throughout their lifecycle (known as asset management) allows for the cost-effective provision of the desired level of service (World Bank, 2014[26]). Good infrastructure asset management can reduce life-cycle costs, enhance service levels, improve transparency, lower operational and legal risks and allow for performance tracking and monitoring, with positive implications in terms of resilience to climate change. Better financial management of physical assets is critical because public infrastructure often represents the largest physical asset in any country (World Bank, 2014[26]). As such, infrastructure is not only key in delivering services in modern societies, but it is also particularly exposed to climate risks. For example, in the Philippines —a country highly exposed to climate related risks— the Government released its national asset management plan (NAMP) in early 2022. The plan is designed to help the government realise value from its assets while achieving its strategic objectives by supporting evidence-based service delivery (GOV.PH, 2022[27]).

Risk analysis should be integrated in all phases of the infrastructure project cycle. In the project selection phase, exposure and vulnerability to climate hazards should also be embedded in the decision criteria. The project appraisal stage can for example include climate risk screening or the quantification of climate-related risks in the project economic analysis. Countries should also consider integrating climate-related risks in the reporting and management public infrastructure assets. (OECD, 2021[28]). Finally, climate

change exposure should be considered in estimating the maintenance needs of public assets (Italian G20 Presidency, 2021[29]). For the specifications required for risk analysis to be effectively managed, an entity should be responsible for standardising disaster risk analysis methodologies and climate-sensitive construction regulation (e.g. building codes) should be developed. Costa Rica has demonstrated best practices in the integration of climate-related risk in public investment management (Box 5.4).

The integration of physical climate risks is one aspect, among others, of the mainstreaming of climate change in the public investment management process. Other aspects include quantifying greenhouse gas-related externalities in project evaluation or aligning the project prioritisation process with national decarbonisation plans. These other aspects are however not covered in this report.

Box 5.4. Costa Rica's climate-sensitive National Public Investment System

As part of the country's 2015-2018 National Development Plan, the Costa Rican Ministry of Economic Policy and National Planning (MIDEPLAN) has strengthened its capacities in climate and disaster risk management, notably in public investment projects. In collaboration with other ministries, the MIDEPLAN has developed tools, presented below, to incorporate climate change considerations, including climate risks, throughout the framework of the National Public Investment System. The two main goals are to increase the resilience of public infrastructure and reduce the cost of post-disaster reconstruction.

The country developed a Methodological Guide for the Identification, Preparation, and Evaluation of Public Investment Projects. The guide incorporates climate risk into the project cycle by quantifying risks to projects, examining paths for risk reduction alternatives, performing cost-benefit analysis of climate change mitigation, among other things. A methodology was also developed to assess risk from natural hazards in the project planning stage. The country formulated a regulation that required institutions in charge of the implementation of public infrastructure projects to perform multi-hazard assessments that include existing scenarios and forecasts for climate change and climate variability.

Source: (Delgado, Eguino and Pereira, 2021[30])

An additional measure may involve leveraging targeted rates and levies, aimed at consumers as a charge on existing infrastructure that may be subject to future risk, such as transport routes, water infrastructure and electricity generation and distribution. Countries can then hypothecate and reinvest this revenue back in to future resilience activities to strengthen risk prevention.

The increasing interest of investors in ESG-related assets may offer governments an opportunity to access more affordable debt financing for investment in adaptation. Efforts to further build consistency in terms of minimum reporting requirements and the criteria for what constitutes "green spending" as well as the establishment of agreed mechanisms for addressing situations where issuers do not allocate funds in accordance with these criteria would facilitate the issuance process and build more liquid markets for ESG-labelled bonds (OECD, 2022[31]).

Protecting households and businesses through insurance and access to credit

Higher levels of insurance coverage of losses and damages incurred by households and businesses should reduce fiscal risks by limiting the need (and demand) for financial assistance and compensation from the government as households and businesses will have access to funding to absorb (at least a portion of) the losses and damages they incur. In addition to reducing fiscal risks, supporting the contribution of insurance to absorbing climate losses and damages can have important benefits for risk

assessment and risk reduction (see Box 5.5). Overall, these can help to dampen macro-shocks related to disasters, thus helping to stabilise government balance sheets and reducing the risk of a gap in finances.

Box 5.5. Risk management benefits of enhancing the contribution of insurance in covering climate risks

Broad insurance market involvement in providing coverage for climate-related perils should increase demand for the risk analytical tools necessary to underwrite and price climate risks, particularly catastrophe models. Catastrophe models apply catalogues of potential hazard events (past and hypothetical) to building and infrastructure inventories and take into account their construction characteristics and structural vulnerabilities to develop probabilistic estimates of the potential financial impacts of catastrophe events. The development of catastrophe models by specialised modelling firms, (re)insurance companies and intermediaries is primarily driven by financial considerations – models are developed for countries and perils where insurance or reinsurance companies have assumed significant exposure. Perils or countries where there is limited private insurance coverage – or where regulation limits the application of risk-based pricing – are often not well-covered by private sector catastrophe models.

Source: (OECD, 2021[32]), (OECD, 2021[33]).

However, a significant share of losses and damages from climate-related catastrophes are uninsured in developing countries as well as in many high-income countries. Limited insurance coverage of catastrophe losses and damages is often due to factors that lead to a gap between the cost of insurance coverage and the amount that households and/or businesses are willing to pay for that coverage (which is likely driven, at least in part, by low levels of awareness among households and businesses of climate risks, see Box 5.6) (OECD, 2021[32]). It may also be driven by low levels of property insurance penetration more generally (see Box 5.7).

Box 5.6. Building climate risk awareness among households and businesses

Communication about climate risks should encourage households and businesses to manage them, including through the use of insurance. Businesses and households often lack the capacity to identify the risks they might face in the future. Thus, raising awareness to potential climate-related hazards is crucial in reducing and managing the exposure and vulnerability of private actors to those hazards. Perceptions and expectations about risks are among the most important drivers of managing those risks. Households and business tend to change their behaviour when informed about the climate risks they face (Halady and Rao, 2010[34]; Andre et al., 2021[35]).

Governments and the insurance sector should develop initiatives to raise awareness of climate risks among households and businesses, including their responsibility for managing those risks and the scope of financial protection that is available from insurance markets. Communications initiatives should take into account the behavioural biases of individuals and groups, such as the tendency to underestimate risk as well as the level of financial literacy and inclusion. Mandated disclosure of climate risks by companies can play an important role in raising climate risk awareness among businesses and provide incentives to manage those risks.

Governments should evaluate the overall availability and affordability of insurance coverage for all of the potential climate-related risks that could result in losses and damages for households and businesses, with a focus on identifying potential market failures, such as moral hazard and adverse selection, and possible approaches to addressing those failures (OECD, 2012[36]). In particular, it is critical to identify any segments of society that are uninsured and financially vulnerable (e.g. low income, residents of certain regions, businesses of a certain size or active in specific sectors) and assess the reasons why they are uninsured.

Insurance regulators and supervisors can also support the availability of affordable insurance for catastrophe risks by allowing risk transfer by domestic insurers to global reinsurance and capital markets. These markets play a crucial role in providing financial capacity and diversifying catastrophe risks internationally which should reduce the cost of providing coverage to households and businesses and also provide a source of funding for recovery.[5] Despite these potential benefits, a number of countries impose various restrictions on the transfer of risk to reinsurance markets (and, particularly, for cross-border risk transfer) which may be concentrating risk domestically and limiting the ability of domestic insurance companies and their policyholders to fully capitalise on the benefits of risk transfer to reinsurance and capital markets.

Insurance regulators and supervisors can encourage the availability and take-up of insurance coverage by requiring insurance companies to make coverage available for climate perils (i.e. mandatory offer), automatically including coverage for climate perils in standard property insurance coverage (i.e. automatic inclusion) and/or ensuring that households and businesses are aware of the consequences of not acquiring insurance and required to explicitly opt-out of acquiring such coverage (mandatory opt-out). Alternatively, banking regulators can require banks to ensure that their borrowers have insurance coverage for relevant climate perils for properties with outstanding mortgages. All of these approaches tend to lead to higher take-up of insurance coverage for catastrophe perils and lower levels of uninsured losses – both in developed and developing economies.[6]

However, requiring insurance companies to offer insurance coverage for climate perils – or requiring households and businesses to purchase insurance coverage for climate perils – can have adverse consequences. Households and businesses facing high levels of exposure to climate hazards could face unaffordable premiums and, as a result, might choose not to purchase any insurance coverage at all if forced to acquire unaffordable coverage for climate perils. Similarly, insurance companies may choose not

to make any property insurance coverage available in areas that are highly exposed to one (or many) climate peril(s) if they are required to include or offer coverage for that (or those) peril(s). Targeted investments in risk reduction and adaptation can support the availability and affordability of insurance coverage in communities that are highly exposed to climate risks. An assessment of insurance availability and affordability can help identify where such investments are most needed.

Catastrophe risk insurance programmes may offer a potential solution for supporting the availability of coverage for high-risk households and businesses. These programmes can ensure that insurance coverage for climate perils is available to highly-exposed (or all) households and/businesses and support affordability by leveraging diversification benefits as well as (potentially) through subsidisation - either between policyholders (cross-subsidisation) or at the programme-level (although significant subsidisation can blunt risk signals and potentially lead to fiscal risks if governments have financial obligations within the programme structure).[7] There is some evidence that these types of programmes have led to higher levels of insurance coverage for covered climate perils. In countries with catastrophe risk insurance programmes in place for flood losses, the share of economic losses insured is significantly higher than in countries without such programmes – and the same appears true in the case of storm losses.[8]

The design of catastrophe risk insurance programmes can have different implications in terms of the programme's ability to support broad availability and affordability of coverage, contribute to risk reduction and limit fiscal exposure. Careful consideration needs to be given to the potential trade-offs inherent in different approaches to programme design (OECD, 2021[32]).

Catastrophe risk insurance programmes, particularly those that benefit from government co-insurance, reinsurance or a guarantee, should be regularly reviewed with the aim of ensuring that the programme is achieving its policy objectives and to take account of developments in private insurance and reinsurance markets. The reviews should consider whether broad levels of coverage have been achieved and financial vulnerabilities have been reduced as well as whether there is any need to revise the scope of programme coverage due to increases or reductions in private market capacity (e.g. in terms of types of policyholders and/or perils included). Such reviews should also aim to ensure that the fiscal risks resulting from government financial involvement in the programme are minimised, including by leveraging any additional opportunities to transfer programme exposure to private insurance, reinsurance or retrocession markets.[9] It is also important that the design of these programmes encourages risk reduction and adaptation in order to avoid providing incentives for continued construction or increased exposure in high risk areas that are prone to floods or coastal devastation for example. Programmes that make insurance coverage broadly available without accounting for the level of risk could reduce incentives for private and public investments in risk reduction and adaptation as the costs of not reducing risk will ultimately be borne by the programmes through claims payments, and not by those in a position to reduce the risk (a form of moral hazard). Risk-based pricing or deductibles, risk management requirements or the promotion of targeted investments in risk reduction in high-risk locations can address this problem of alignment of incentives for risk management.

Box 5.7. Responding to needs of low-income countries and vulnerable groups

The policy and regulatory approaches described in this section can support the availability, affordability and take-up of insurance coverage for climate losses and damages although their effectiveness will be limited in countries where insurance penetration (or insurance culture) is very low. In those countries, enhancing the contribution of insurance to absorbing losses and damages will require initial investments in creating an enabling environment for insurance market development. There are a number of factors that have been empirically linked to insurance market development, including the strength of the legal framework, levels of financial development, private participation in the insurance market as well as cultural factors and broader economic criteria (such as income and inequality) (Feyen, Lester and Rocha, 2011[37]). Financial (insurance) literacy and the strength of insurance regulatory and supervisory frameworks (licensing, solvency, etc.) are also important for the development of insurance markets.

Particular attention should be focussed on addressing the financial protection needs of vulnerable segments of society in developing countries, such as low-income households, small businesses and smallholders in the agricultural sector. Inclusive insurance instruments, such as micro-insurance for households and businesses and weather index insurance for the agricultural sector, can play an important role in helping to meet the most urgent needs of vulnerable groups. Microinsurance premiums have reached over USD 1 billion, providing coverage for an estimated 372 million people (Murray, 2022[38]), although coverage for losses and damages related to climate-related extreme events remains a small portion of the overall microinsurance market.

Governments should assess the potential impact of climate change on the future availability of affordable insurance coverage. An increase in losses and damages due to climate perils will necessitate an upward adjustment of the premiums that insurers (and reinsurers) collect for the coverage that they provide – exacerbating existing challenges in providing coverage at a cost that households and businesses are willing (or able) to pay.[10] This assessment should include an evaluation of potential future losses and damages relative to estimates of future financial capacity (such as income) in order to determine whether increased insurance costs could lead to affordability challenges. This would allow an evaluation of potential policy or regulatory interventions that may be required to address these challenges[11] and should also be used as an important criteria for identifying priority risk reduction and adaptation measures.

Access to credit can also play an important role in ensuring that households and businesses have access to the funding necessary to manage disruption to livelihoods or business operations and to support reconstruction of damages assets. A financial sector regulatory framework that supports the availability of credit for households and SMEs is therefore also critical, particularly where insurance coverage is limited or unaffordable. Governments can support credit availability by providing guarantees for loans extended to impacted households or businesses which can increase access to loans and reduce the cost of financing. However, unlike insurance coverage, loans must be repaid and could therefore increase leverage and potentially lead to future financial difficulties for households and businesses if repayments account for an unsustainable share of income or revenue. Significant credit defaults could also have implications for financial stability and for governments if loans were backed by a government guarantee.

Aligning incentives across levels of government

An important share of contingent liabilities for central governments is the financing of the costs for reconstructing and rehabilitating public assets owned or operated by subnational governments. Countries should have clear and explicit cost-sharing mechanisms regarding post-disaster assistance.

In countries where post-disaster assistance by central governments is important, it may create the expectation from subnational levels that they can avoid repaying the costs of disasters and thus invest little

in risk prevention efforts. A well-designed financial assistance framework can help mitigate this moral hazard. By defining the reimbursement conditions of reconstruction and relief efforts (e.g. eligibility criteria, commitment ceilings, etc.), central governments can ensure that subnational governments consider how the residual costs can be addressed. In this context, central governments also have a role to play in supporting subnational ones in identifying the measures that can be taken to reduce the costs for reconstruction they will have to bear. This can include cost-sharing of structural preventive investments and guidance on the use of non-structural measures. Central governments can also require or encourage the use of cost-benefit analyses (see above). In other words, a strong and clear financial assistance framework, complemented by active government support, should encourage subnational levels to invest in structural and non-structural risk reduction measures.

Financial assistance frameworks governing post-disaster payments made to subnational government should also consider the use of insurance by subnational governments. The clarity of financial assistance rules to subnational governments is essential for ensuring proper fiscal risk assessment by central governments and can reduce fiscal risks related to implicit liabilities by encouraging subnational governments to manage the climate-related risk that they assume.

These incentives should extend to property owners and infrastructure providers at the community level who stand to directly benefit from a country's financial investment in reducing climate risk. By placing some of the cost on property owners and infrastructure providers, in terms of subnational and local government authorities, it also incentivises them to build new assets in low-risk places. This could take the form of targeted levies placed upon property owners or asset owners, which are gathered then reinvested into resilience activities in the future.

Ensuring clarity in public financial assistance arrangements for households and businesses to mitigate future financial losses

A significant share of losses and damages from climate-related catastrophes are uninsured in developing countries as well as in many high-income countries. Efforts to support the availability of affordable insurance coverage may not achieve full coverage of climate-related losses and damages to households and businesses and there may still be segments of the population and economy that may remain uninsured.

Governments should ensure that basic compensation and post-disaster financial support is made available to reduce economic and social hardship, for instance through the development of government financial assistance arrangements. For households, financial arrangements for disasters could involve the provision of compensation payments to cover certain types of losses such as property damage and basic living expenses; for businesses, they could provide for compensation and/or special lending.

These arrangements, established in advance of any disaster, should have clear provisions on the nature, scope, and level of financial assistance, for instance with well-defined eligibility criteria and caps on the level of assistance, with payments covering only essential or reasonable needs. Such arrangements will typically exclude compensation of already insured property, in order to avoid double payments. Furthermore, to prevent moral hazard, no compensation should be provided if insurance could ordinarily have been purchased to provide coverage (if insurance markets are present and coverage is affordable). By providing clarity on the scope and extent of government financial assistance, these arrangements can serve to reduce expectations of full compensation for losses, while strengthening incentives for financial self-protection and risk reduction, and help to clarify and limit the government's contingent liabilities (OECD, 2012[36]). Financial support that is provided by governments to households and businesses in the aftermath of climate events can create expectations of future support and discourage individual responsibility for reducing risk or seeking financial protection. The establishment of clear eligibility criteria and distribution procedures is critical for ensuring that funds are provided to those in need in a timely fashion – which should support quicker recovery and reduce hardship.

5.1.3. Prepare integrated multipronged government financial strategies

The different budgetary, risk financing and risk transfer tools for funding climate-related fiscal risks have different advantages and limitations – as well as different costs that will vary across countries depending on factors such as fiscal position, revenue-generating capacity, access to capital markets and official financing and quality of risk data. The trade-offs between these various approaches might also evolve in the context of climate change. The framework for action that follows recommends that governments aim to maximise the use of funding capacities available through fiscal frameworks and access to debt markets, which will usually provide the most cost-effective approach to funding climate losses and damages for governments while recognising that developed and developing countries face different levels of fiscal capacity and access to (low-cost) debt financing (see Box 5.8), which may call for different approaches.

Box 5.8. Developing government financial strategies to strengthen resilience to climate-related events

A government financial strategy is there to ensure sufficient access to funding to meet the spending needs that will materialise in the future. The goal is to address the fiscal risks that may arise as a result of climate-related losses and damages. This framework for government action recommends that governments maximise the use of the funding capacity available through existing fiscal resources and access to public debt financing, to the extent possible, while recognising the existence of budgetary and financing constraints and possible access to (lower cost) official financing, particularly for developing countries, which may require different financial approaches:

- Using funds available through fiscal frameworks and public debt financing is generally the lowest-cost approach for responding to climate-related losses and damages to governments. For instance, general contingency reserves that can be accessed in the event of a disaster can provide an efficient first line of defence. Countries may, in some circumstances, need to rely on budgetary reallocations to secure funding; however, such an approach, arranged in an *ex post* manner, may create risks. Budget reallocations may not provide sufficient funding in the case of extreme events, could require additional legislative approvals (affecting their timeliness) and can undermine other spending priorities. In developing countries, the reallocation of budgeted funds might be impossible given tight government financial constraints and can derail long-term economic and social investments and threaten development strategies. While public debt financing can provide an efficient source of financing, its arrangement *ex post* can also involve challenges. For instance, issuing new debt can be costly in countries facing high borrowing costs (especially where the event itself results in the deterioration of credit ratings (IMF, 2019[39])) or may be limited by debt sustainability or market access constraints; furthermore, it may take time, suggesting that this financing tool may be more suited to funding recovery and reconstruction, not relief. For countries facing fiscal or debt financing constraints, and/or with access to sources of (lower cost) official finance (e.g. concessional loans, premium subsidies), *ex ante* financial tools may be more cost-effective for ensuring funding adequacy to meet climate-related losses and damages.
- *Ex ante* financial tools include allocating funds in advance for an uncertain future need, for example by establishing a disaster reserve fund or acquiring insurance. However, such tools have an opportunity cost in terms of the efficiency of capital, as the funds could otherwise be allocated to other spending needs, including investments in risk prevention and medium- to long-term growth and development. When other spending priorities are not met, such pre-funding can also become politically costly. For countries where establishing sufficient *ex ante*

reserve funds is limited by fiscal capacity or high political costs, a contingent credit arrangement could provide a cost-effective alternative, particularly the lower-cost contingent credit provided by official lenders..

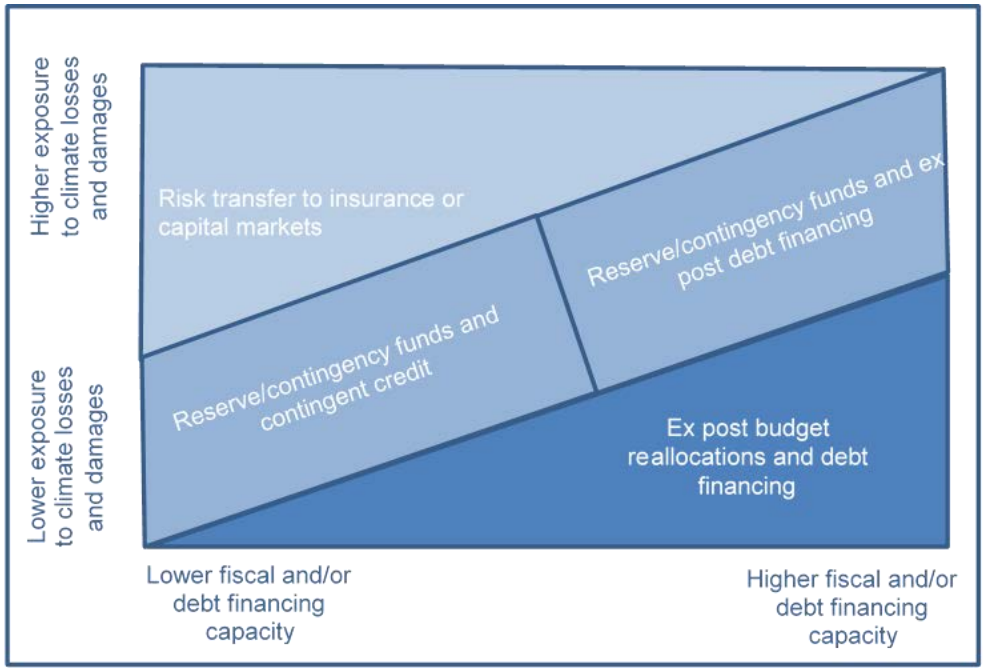
As a result of these considerations, different countries will choose different budgetary and financing solutions based on their fiscal and debt financing capacity and constraints that they face and the opportunity costs in terms of alternative spending demands, which could involve a mix of *ex ante* and *ex post* tools.[1] What is critical is that governments explicitly assess their potential funding needs, given fiscal risks and overall risk assessment, and develop a financial strategy that can feasibly provide the funds required to meet those needs – at lowest possible cost while ensuring that the funds will be available when needed, across relief, recovery and reconstruction.

Note: [1] Budgetary, risk financing and risk transfer tools can be classified as *ex ante* or *ex post* based on: (i) whether the financial tool or financing is arranged or established before or after the event; or (ii) whether the financing provided through the financial tool is paid for before or after an event. For example, a contingent credit may be established before an event (and would therefore be considered and *ex ante* tool) although the financing provided would be repaid after the event (and therefore could be considered *ex post*). A risk transfer arrangement is always established before the event (*ex ante*) and paid for before the event through premium payments (*ex ante*).

In the past, countries have generally not explicitly planned for climate-related contingent liabilities, relying instead on ad hoc, *ex post* funding strategies (Bevan and Cook, 2015[40]). In countries where the scale of potential climate-related losses and damages is low relative to debt financing capacity, there may be little need to create dedicated reserve/contingency funds, pre-arrange access to contingent credit or transfer risk to insurance or capital markets, as public debt financing may be efficient and the most cost-effective, thus fully adequate as a financing tool – allowing funds to be allocated to other productive uses (OECD, 2012[36]).

In countries with more significant potential for climate-related losses relative to debt financing capacity, the use of financial tools arranged *ex ante* such as disaster reserve funds, pre-arranged contingent credit and risk transfer help ensure that sufficient funding will be available to respond effectively to climate catastrophes when they occur (see Figure 5.1), as public debt financing may be costly or unavailable, particularly following a major disaster event.

Figure 5.1. The impact of exposure and capacity on fund strategies



Source: OECD

Investments in risk reduction and climate adaptation or measures to reduce the financial vulnerabilities of households, businesses and subnational governments (such as broader insurance coverage) can reduce national government exposure and the need for reserve funds, pre-arranged contingent credit or risk transfer instruments. However, while risk reduction and adaptation actions can help mitigate climate-related liabilities, residual fiscal risks will always remain. Financial strategies should be developed to ensure adequate funding to help governments manage these remaining residual fiscal risks and the related contingent liabilities in a way that meets cost and liquidity objectives and supports economic recovery, as will be discussed below.

Assessing budgetary capacities to fund relief, recovery, and reconstruction, including through budget reallocation

Once fiscal risks are assessed, a strategy for ensuring adequate funding for the expenditures required for responding to climate-related catastrophes needs to be developed. The strategy should consider the amount of funding needed and when and should weight the costs and benefits of different approaches (including opportunity costs of alternative uses of the funds as well as the potential benefits of investing further in risk reduction and adaptation).

As a starting point, governments should consider their own financial capacity for managing climate-related risks through their budgetary and fiscal framework, as borrowing from financial markets or transferring risks to (re)insurance will introduce costs (interest expense, premium payments, respectively). Since public budgets are approved in advance, the scope for securing funding for a climate-related event within the fiscal framework can be limited in the short term. Immediate funding can be secured through budgetary reallocations, although there may be rules on the use (or not) of reallocations and their extent and, as discussed below, reallocations have opportunity and political costs. In many countries, general contingency reserves for meeting unanticipated and non-recurring expenditures may exist and may be used to fund climate-related event costs, providing a first potential source of funding and reducing the need for budgetary reallocations or minimising their extent. In the medium term, governments may have the

capacity to generate revenue-enhancing measures, such as taxes, to strengthen their fiscal position and ensure funding capacity to compensate losses and fund recovery and reconstruction. Low- and lower middle-income countries are likely to face greater fiscal constraints and higher opportunity costs given more limited revenue-generating capacity, greater challenges in ensuring domestic resource mobilisation, and more substantial demands on limited fiscal resources.

In the eventuality of more frequent and/or larger climate-related risks, *ex ante* financial tools may be needed. For instance, extra-budgetary reserve accounts or funds, possibly built up over time (or as needed restored) through budgetary allocations and accessible in the event of a climate disaster, may be established. There will also likely be a need to have a recourse to external financing, most notably through public debt markets (and official financing, where available), but also possibly through borrowing from commercial banks or transferring risk *ex ante* through insurance (see subsection "Optimising financial under budgetary and financing constraints, within an overall framework of disaster risk management and risk reduction" below).

Contingency and reserve funds

Climate risks should be integrated into the budget and public financial management framework to the extent possible, from fiscal risk assessment to the potential creation of fiscal buffers to absorb the costs of climate-related catastrophes (Cebotari et al., 2009[41]). Governments commonly use two budgetary instruments to build these fiscal buffers: contingency reserves and dedicated reserve funds (Cevik and Huang, 2018[42]). Both contingency reserves and reserve funds allow central and subnational governments to retain a certain amount of risk *ex ante* (effectively, to self-insure that risk). The main difference between the two instruments is whether the unspent funds are returned at the end of every fiscal year (contingency reserves) or if they accumulate over time (reserve funds). The amount of risk that can be retained depends on the amount of the funds set aside. Because they are larger, reserve funds should be used to cover the costs of lower-frequency but higher-severity climate disasters. Conversely, contingency reserves should be mobilised for higher-frequency but lower-severity events such as localised climatic events. After a disaster, contingency reserves should be disbursed first to cover the immediate cost of aid and relief to affected populations. Reserve funds should supplement contingency funds once they are depleted or to fund longer-term costs related to recovery, rehabilitation and reconstruction.

When a disaster strikes, *ex ante* budgetary tools (contingency reserves and reserve funds) act as fiscal buffers that provide quick liquidity to cover immediate post-disaster financing needs without compromising other spending priorities or long-term fiscal sustainability. These buffers can also help avoid expensive debt financing for countries with lower credit ratings. Most countries have annual contingency reserves in place to quickly address disaster-related costs. However, specificities regarding when and how these provisions can be used vary across countries.

To minimise opportunity costs, the amount of resources set aside for climate-related contingent liabilities should be determined based on risk assessments (including climate risk assessments). Contingency reserves should be large enough to provide immediate liquidity in case of disaster but not so large that line ministries try to capture the funds. Reserve funds, on the other hand, are most appropriate for more rare but costly contingent liabilities. As a result, drawdowns from these reserves should only be possible when fiscal costs exceed a certain threshold. Contingency reserves should be used to finance fiscal costs below that threshold (i.e., costs from lower-severity disasters).

Accumulating enough reserves to absorb a large catastrophe requires an extended period free of disasters. Allocations to a reserve fund are made on an annual basis so that capital can accumulate over time (i.e., the reserve grows with each year without a disaster). In countries exposed to high-frequency disasters (of medium or high-severity), reserve funds are not appropriate solutions. For example, in small-island developing states that are particularly exposed to climate hazards, total disaster-related costs might exceed annual GDP. Even in larger economies, reserve funds will not be replenished in time if two

disasters occur within a relatively short interval. However, countries less exposed to frequent climate hazards enjoy more flexibility in financing contingent liabilities over time. Allocations made each year can be smaller because they are spread out over longer periods. At the same time, a prolonged period without a disaster creates a false sense of security, which, in turn, can create political pressures to repurpose the reserve funds for other needs. This pressure could be mitigated, to some extent, by allowing part of the reserve funds to be used to provide greater incentives for investments in risk reduction – while ensuring that reserve funds remain at adequate levels to meet post-disaster needs.

Though time is of the essence in a post-disaster context, the swift disbursement of funds should not come at the expense of oversight and transparency. Contingency and reserve funds should be carefully designed to avoid creating opportunities for the mismanagement of public funds. Governments should therefore stipulate clear and stringent conditions for the use of contingency and reserve funds (Tommasi, 2016[43]). For instance, various modalities can be set to authorise the disbursement of funds. In some countries, standing authorisations allow for the disbursement of funds at the discretion of the executive branch following a trigger (e.g., an official declaration of disaster). Standing authorisations with automatic triggers are best suited to the immediate needs of climate disasters. However, they should be designed carefully to reduce conflicts of interest. For example, if independent agencies are in charge of making the official declaration of disaster, they can act as a check on the executive branch.

In terms of transparency, requiring an official declaration of disaster (or at least a public announcement) ensures that drawdowns cannot be made without the public's knowledge. After triggering reserve funds, financial management authorities should disclose any disbursements and classify them according to their purpose and economic nature (Cevik and Huang, 2018[42]). To promote fiscal discipline and increase transparency, reserve funds should be kept within the usual budget process and follow best public financial management (PFM) practices (Allen and Radev, 2010[44]). The fund balance should appear in financial statements, while any disbursement should be disclosed promptly through budget execution reports (IMF, 2016[45]). Best practices also include conducting public audits into the use of contingency and reserve funds.

Governments generally invest the funds set aside in a reserve until they are needed. However, doing so should not come at the expense of liquidity. Given the urgent nature of disaster relief, investment strategies should aim to maintain a high degree of asset liquidity (Cevik and Huang, 2018[42]). Investing in domestic markets can be costly if a large climate hazard causes a significant disruption to the economy and domestic financial markets. To mitigate this risk, funds can be invested in liquid foreign assets. In addition, the repatriation of these assets following a disaster would also improve the balance of payments at a time of economic distress while holding reserves in domestic banks would also cause dangerously large withdrawals precisely when the banking system is vulnerable (Ibid.). However, ensuring the liquidity of funds does not guarantee they can be used quickly to cover financing needs. The establishment of operational procedures for the disbursement of funds from contingency reserves and reserve funds is critical for ensuring timely disbursement while maintaining proper oversight. Governments should also ensure that public procurement rules allow for the immediate provision of aid and relief to affected populations (Ibid.).

As outlined below, contingent credit arrangements from official lenders can provide an alternative to contingency and reserves funds in countries with more limited fiscal capacity and significant demands for fiscal resources to support economic and social development. Such arrangements should be designed to provide similar levels of speed of access in order to ensure the availability of funding for immediate needs and be complemented by established procedures for disbursement of funds.

Budget reallocations

Governments commonly use flexibilities embedded in the budget, including emergency reallocations, to finance relief and recovery efforts. Emergency budget reallocations redirect budgeted resources from lower

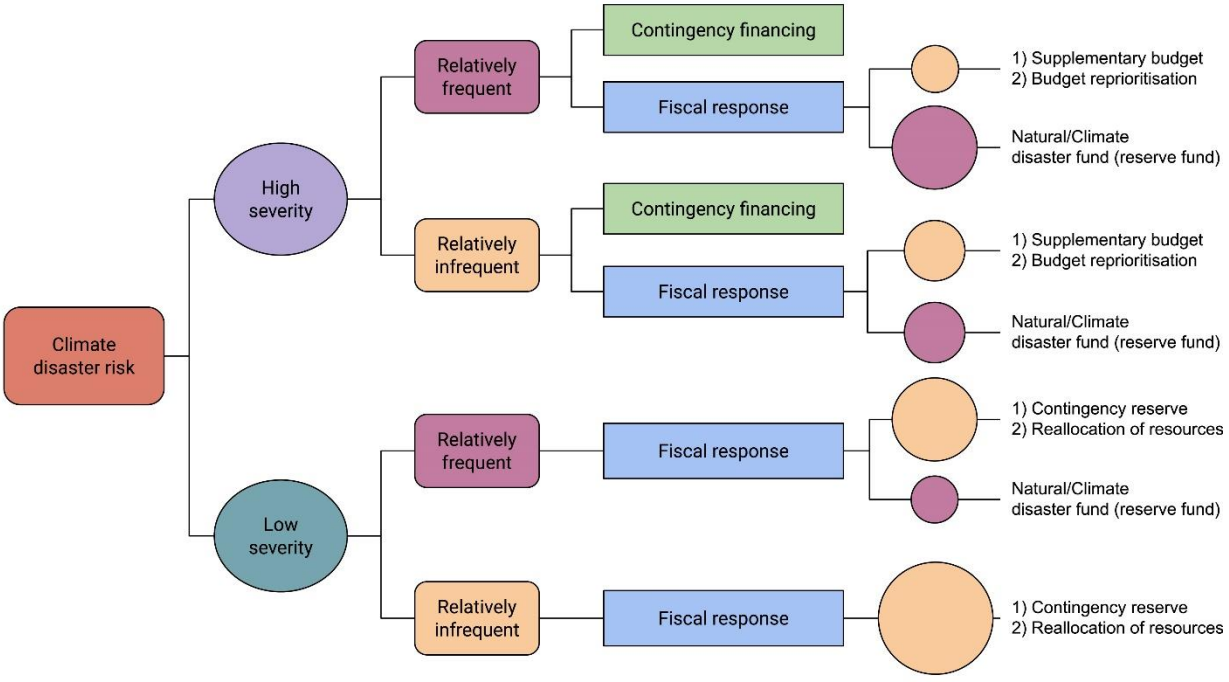
priorities to finance more urgent needs. The most critical features of budget reallocations are speed and flexibility (Cevik and Huang, 2018[42]). Financing the immediate costs of climate disasters requires fast mobilisation of resources to provide the affected population with emergency aid and relief (World Bank, 2019[46]). However, as with other budgetary mechanisms to secure funding, speed should not compromise fiscal governance and transparency. Legislative authorities should therefore be informed of reallocations between budget items even if their approval is not required to operate them. In addition, the executive branch should regularly report the overall impact of reallocations to the legislature. If a supplementary budget is put forward, it should be subject to the same scrutiny that characterises the regular budget process. Once approved, supplementary budgets should be published in the same way as annual budgets.

When disaster costs exceed available contingency reserves, budget reallocations can help meet new expenditure priorities, including post-disaster relief and recovery efforts. Budget reallocations may be directed at the contingency fund or directly to line ministries in need of additional funding. However, as discussed in chapter 3, such realignments to the budget can have high opportunity costs – particularly in low- and lower middle-income countries facing tighter fiscal constraints. At the same time, some budgeted investments may have been derailed by the disaster. Through budget reallocations, governments can shift budgeted resources away from existing investment projects and recurring expenditures to meet more urgent requirements (Bevan and Cook, 2015[40]; Laframboise and Loko, n.d.[47]). After a disaster, governments can realign resources in the next budget to prioritise rehabilitation and reconstruction efforts. Budgets may also be cut in the years following a disaster, especially when government revenues are expected to fall due to economic disruptions (OECD, 2015[48]).

In practice, budget reallocations can take the shape of a virement, a supplementary budget, or a reprioritisation of budgets in the years following a disaster (see Figure 5.2).

- A **reallocation of resources,** which may or may not require legislative approval, as it does not impact the fundamental composition of expenditures, nor does it change the total budgeted level of such expenditures expenditure (Saxena and Yläoutinen, n.d.[49])) Reallocations can be used to supplement contingency reserves in funding post-disaster relief.
- A **supplementary budget** changes the annual level of total budgeted expenditure or restructures the distribution of appropriated allocations. As such, it requires legislative authority. Supplementary budgets should be used for high-severity climate disasters when virements and contingency reserves alone cannot meet recovery and reconstruction needs (Cevik and Huang, 2018[42]).
- The **reprioritisation of budgets** is part of the next regular budget process (y+1). Following a major climate disaster, expenditure priorities may change significantly. Governments can realign the next budget according to their revised long-term investment plans. These revisions should be based on a detailed post-disaster needs assessment. The need for budget reprioritisation may be particularly substantial in developing countries that receive additional financing from bilateral and multilateral donors to cover disaster-related costs (Cevik and Huang, 2018[42]).

Figure 5.2. Financing the fiscals cost of climate disasters through budgetary instruments



Note: The size of the bubble in the rightmost column represents the relative importance of the instruments listed.
Source: Adapted from (Cevik and Huang, 2018[42])

Assessing debt market borrowing capacities, including cost and speed of access

Gross debt financing requirements for governments reflect the need both to refinance outstanding debt due in the year and to fund new spending requirements included in the government's budget (i.e. net borrowing). Public debt market financing, the payments for which are backed by the government's balance sheet and capacity to raise new fiscal resources (e.g. through taxes), is often the cheapest source of external financing (with the exception of official financing, as discussed below), and provides the necessary funds for the current year's public budget, beyond that provided by government revenues, and for any new and unexpected expenditures needs during the course of the year, authorised through supplementary budget appropriations. Accordingly, debt market financing provides an efficient source of funding to manage climate-related disaster costs for most countries, should the current year's budget allocation prove to be inadequate to fund climate-related disaster expenditures. Furthermore, and particularly for governments with a strong credit standing and that regularly access public debt markets, access to public debt finance can be fast, enabling governments to secure funds rapidly to meet some of the costs of a large event, although not necessarily for immediate disaster relief.

However, governments lacking a strong credit standing, which is the case in many developing countries, can be expected to face higher costs of debt financing, which may be aggravated by bouts of global financial and macroeconomic instability. These factors may reduce the capacity of such governments to borrow from financial markets, and may also affect the speed at which they can borrow, should a large climate event occur, with costs exceeding budgetary capacities, as a deteriorated fiscal position may increase financing costs further As discussed earlier, the increasing frequency and/or scale of climate-related events and the broader integration of these risks into credit ratings and credit models may adversely affect the cost of accessing public debt finance for countries facing significant climate vulnerability. Governments that face constraints in accessing low-cost financing from public debt markets may need to

consider – or could benefit from considering – alternative sources of funding for meeting climate-related expenditure needs, as discussed in the next section.

Optimising financial tools under budgetary and financing constraints, within an overall framework of disaster risk management and risk reduction

Governments with reduced budgetary capacities to manage large-scale climate hazards, for instance owing to limited budgetary flexibility within an overall constrained fiscal framework, or facing external financing constraints due to their credit standing, may experience difficulties in securing funds efficiently and cheaply to meet disaster-related expenditures. For many governments, particularly in lower-income countries and small island developing states, the potential public sector share of losses from extreme climate-related catastrophes is equivalent to a significant share of general government revenues, which would make it extremely challenging to fund recovery and reconstruction spending needs through current revenues (particularly if these events occur with increasing frequency). These same countries are also likely to face external debt financing constraints or higher public debt financing costs.

While public debt financing may remain an option for such governments to access funds, although at possibly higher costs in comparison with countries with a higher credit standing, governments facing a more constrained budgetary and financing environment may also consider a number of other financial tools to access funds to meet disaster needs. Options may include:

- *Official development financing (if available):* Low- and middle-income countries may have access to official development financing, with access to grants and pre-arranged finance at concessional (or below-market) rates. Official financing may be provided as humanitarian assistance to support relief and recovery efforts (usually as grants) or as grants or (concessional) loans to finance reconstruction. As noted in Chapter 3, a number of countries have arranged access to contingent credit through multilateral development banks and other donors that is triggered based on the occurrence of an eligible event. Pre-arranged access to official financing can mitigate some of the risk that official financing may not be available in time for response to some events.
- *Extra-budgetary disaster reserve funds:* Countries may establish extra-budgetary reserves, enabling them to build up funds for expected future disasters. These funds are built up through yearly budgetary allocations.
- *Commercial bank credit arrangements:* Governments can access credit arrangements provided by commercial banks, provided at market interest rates. The credit status of the government can, as with public debt markets, be expected to affect the cost of financing. Commercial bank financing is more significant for countries that do not have the capacity to access international bond markets.
- *Risk transfer:* Governments may have the option of transferring risks to insurance markets or to capital markets via insurance-linked securities, such as catastrophe bonds. As discussed below, the credit status of the government is not relevant for pricing; by contrast, the credit standing of the insurer, or the structuring of the funds backing the issued securities, is relevant. As noted above, the use of risk transfer arrangements by developing countries (particularly regional risk pooling arrangements) may be supported by donor-provided premium subsidies that would reduce the cost of this form of funding.

The different financial tools – budgetary, risk financing, and risk transfer – that may be employed to secure funding for climate-related losses and damages involve different advantages and limitations, particularly in terms of speed of access and cost (including opportunity costs as well as “political” costs):

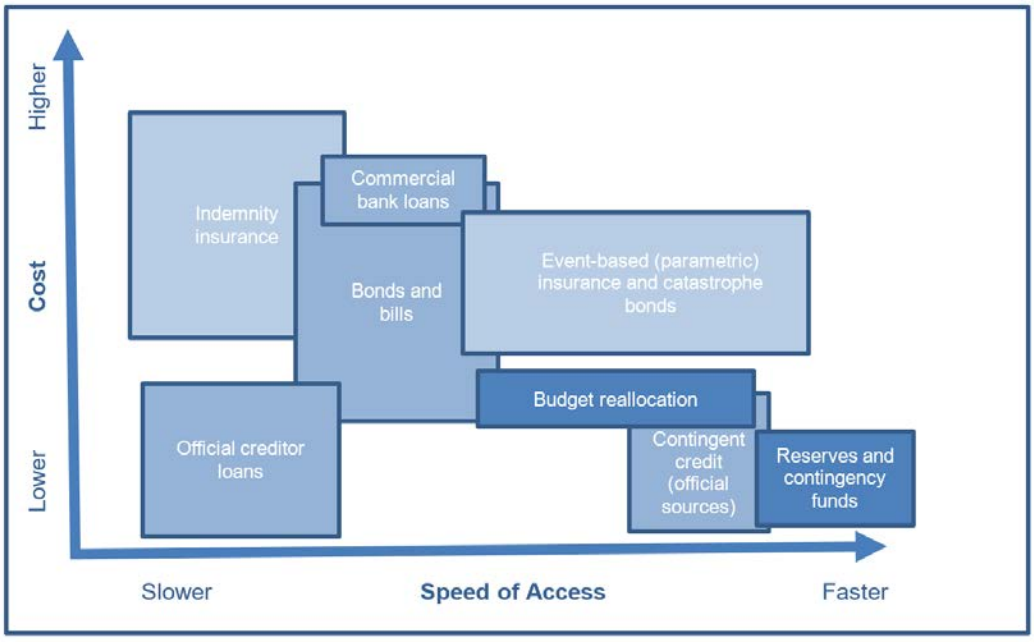
- *Ex ante* budgetary tools, which have been discussed above, such as dedicated reserve funds, generally involve low transactional costs relative to market-based instruments but potentially high opportunity costs, depending on potential alternative use of the funds as well as on the ability of governments to earn a return on any invested funds. Funding through reserve funds can generally

be accessed quickly, depending on legislative requirements related to their use, although there may be political risks (such as appropriation) if funds are not accessed.

- Credit-based financing, including public debt finance described earlier, involves transaction costs, including: issuance, underwriting and interest costs for debt securities; and interest costs for commercial bank loans. Such risk financing also involves opportunity costs in terms of the potential future alternative use of funds for interest payments – although for public debt finance, such costs may not be large, particularly for countries with a high credit standing. Bond issuance and commercial bank loans may take longer to access, depending on a country's existing relationships with investors and lenders. Access to financing through commercial lending and debt markets may also involve some risks related to market conditions when the funding is needed (which may increase cost or reduce availability).
- Official financing, while (usually) accessible only to developing countries, is generally provided at low or no-cost. Humanitarian assistance and concessional loans (arranged *ex post*) can be volatile and uncertain and subject to political considerations in the donor country. Contingent credit arrangements provided by official lenders will provide the quickest and most secure access to funding and can mitigate some of the risks related to the volatility of official financing.
- Risk transfer tools, including insurance and insurance-linked securities such as catastrophe bonds, involve transaction costs in the form of premium payments in the case of insurance and reinsurance (which incorporate commissions, insurer operating expenses and profits) and issuance, underwriting and interest costs in the case of catastrophe bonds. As noted above, these costs can be significant depending on the level of diversification in the risks transferred, the expected frequency of payouts and the quality of risk information – and will ultimately depend on loss experience. Indemnity-based insurance would likely be more costly than event-based (parametric) coverage given higher underwriting and claims adjustments costs but would also provide coverage consistent with losses and damages incurred (event-based coverage can involve basis risk which could lead to uncovered losses or damages). Event-based coverage will payout much more quickly than indemnity insurance, including in the case of catastrophe bonds that apply event-based triggers (including modelled loss triggers). Similar to disaster reserve funds, risk transfer tools involve opportunity costs relative to alternative uses of the funds used to pay premiums or interest on catastrophe bonds and political risks if premiums are paid over many years without the occurrence of a covered event. Official financing can (and has) supported the affordability of premiums for vulnerable countries through premium subsidies. Unlike credit-based financing and official loans, insurance and catastrophe bond payments do not need to be repaid after the event which may provide benefits, particularly for countries with limited fiscal space or facing debt sustainability challenges or for whom additional borrowing could lead to a lower credit rating or increasing borrowing costs. The process of transferring risk to (re)insurance or capital markets can also create other risk management benefits.[12]

Figure 5.3 provides a simplified illustration of the relative speed of access, amounts available and (approximate) cost of different types of ex ante budgetary, risk financing and risk transfer instruments, although factors including expected loss, fiscal rules, sovereign credit risk, market conditions and opportunity costs for alternative use of funds have an impact on the trade-offs between different instruments. As a result, the relative cost, speed of access and available amounts could vary significantly for different countries.

Figure 5.3. Speed and cost of budgetary, risk financing and risk transfer tools (simplified illustration)



Note: This chart provides an illustration of relative (approximate) cost, amounts available (relative size of shape) and speed of access for different types of budgetary, risk financing and risk transfer tools (the different categories are linked by lines in the graph and shaded in different colours. The actual cost and speed will depend on specific country circumstances.
Source: OECD. Relative cost estimates are consistent with World Bank estimates in (World Bank, 2017[50])

Accessing risk financing and risk transfer to respond to public spending needs can involve significant costs, particularly if accessed through commercial credit and insurance markets. In the case of risk (debt) financing, costs are driven by assessments of the repayment capacity of the borrower and could increase as a result of the event directly or due to concerns about the capacity of the borrower to manage the risks that could materialise in the context of a changing climate. In the case of risk transfer, costs are driven by the quality and availability of data for risk assessment (more limited or lower quality data can lead to a surcharge to account for uncertainty), the level of diversification within the portfolio of risks transferred and the pure risk cost of the ceded risk (i.e. expected loss). Increasing frequency and/or severity of climate losses and damages in the future and uncertainty about future climate impacts would likely lead to higher costs in terms of premium requirements (for insurance) or higher interest costs (for catastrophe bonds).

There are a number of approaches to reducing the cost or increasing the value of risk financing and risk transfer tools that governments should consider when establishing financial strategies:

- Governments with access to credit financing through official creditors should aim to maximise the use of these sources of financing to meet funding needs that cannot be efficiently met through reserves and contingency funds. Contingent credit offers both speed of access and cost efficiency.
- Governments that are highly-exposed to climate risks should aim to integrate natural disaster clauses or insurance-based funding relief into debt financing arrangements in order to provide a source of funding for public sector costs while limiting the need for additional borrowing in the aftermath of climate event, which might only be available at a higher cost given the implications of the event on repayment risk.
- Risk transfer instruments to fund relief and recovery needs can offer an alternative to risk financing for those facing debt financing constraints (limited access or existing high debt levels) . This form

of funding will be more cost-efficient for diversified risk portfolios and if calibrated to less frequent payouts (i.e. more severe events).

- Risk transfer instruments to fund reconstruction can similarly offer an alternative to risk financing for countries with debt financing constraints. Significant efforts should be made to access insurance or capital markets with a diversified pool of risks in order to benefit from lower premium costs. This is particularly important in the case of indemnity insurance for public assets.
- Finally, some of the most climate vulnerable countries, including SIDS, may only be able to access commercial debt at a high cost, which may impact debt sustainability. Risk transfer instruments may be available only at unaffordable premium rates. Therefore, for such countries, the seeking of international grants and other forms of assistance should be integrated into the financial strategy. This could include premium subsidies financed by providers of development assistance, which would enable risk transfer, although it is worth noting that such subsidies have generally been made in support of the establishment of regional risk pools, suggesting the desirability of pooling (where and if relevant) to ensure efficiencies in small country access to global insurance markets.

5.2. Promoting global climate financial resilience

Climate change is a global phenomenon, and as such requires collective global action, especially because some countries will not be able to cope with its consequences based on only their own resources. As described in Chapter 1, developing countries, especially LICs, LDCs and SIDS, are likely to experience the most severe impacts, not only due to their higher vulnerability levels but also due of their exposure to the often more frequent and severe hazards. These countries do not have the capacity to cope with the hazards they face and will likely need the direct support from the international community.

In 2021, the OECD Development Assistance Committee issued the OECD DAC Declaration on a new approach to align development co-operation with the goals of the Paris Agreement on Climate Change, which includes a recognition of the "urgent need to support investments in adaptation and resilience" and the "importance of averting, minimising, and addressing loss and damage associated with the adverse effects of climate change" (OECD, 2021[51]). Recent work by the OECD shows that donors invest large shares of their Official Development Assistance (ODA) to capacity development activities, such as technical co-operation, study exchanges, visits, policy support and training (Casado-Asensio, Blaquier and Sedemund, 2022[52]). While this matches well partner countries' priorities, the effectiveness, impact and sustainability of these investments are questioned. To ensure results from these investments, donors ought to take a more integrated view and focus on a range of issues, including on supporting partner country access to finance, improving the access and availability of climate services and data, and fostering partnerships with academia or the private sector. While capacity development matters more for climate change adaptation than for mitigation, information is lacking on how donors are supporting partner countries on climate-related losses and damages (Casado-Asensio, Blaquier and Sedemund, 2022[52]). As this area of work develops in the future, donors could draw the lessons to ensure capacity is developed sustainably to heighten action and ambition (OECD, 2021[25]).

5.2.1. Promote integrated strategies to strengthen financial resilience at the country or regional level

Supporting the integration of climate related risks in fiscal risk assessments

Capacity to develop fiscal risk assessments that integrate the potential impacts of climate change and assess potential financial vulnerabilities across society is critical and should be the basis for coordinated interventions by development partners. Fiscal risk assessments that are forward looking, account for the implications of a changing climate and integrate all potential sources of fiscal risk (i.e. including the implicit

liabilities that might arise due to financial vulnerabilities) provide a sound basis for targeting investments in risk reduction and adaptation and developing a strategy to ensure adequate funding for recovering and rebuilding in the aftermath of climate-related catastrophes. These assessments should be country-owned and act as a shared basis for supporting country efforts to protect public finances against climate losses and damages. Among the close to 600 donor-supported initiatives in 115 countries and territories identified in InsuResilience's database for 2020 and 2021, less than 3% were focused on the development of a risk financing strategy (or elements of such a strategy) (covering 15 countries) (InsuResilience, n.d.[53]). This suggests that there may be opportunities to increase support for the development of risk financing strategies as a basis for identifying appropriate and donor-supported financial tools.

Efforts by the International Monetary Fund to better integrate the potential risks of climate change catastrophes for public finances in surveillance and Article IV consultations with its member countries (IMF, 2021[54]) can provide a basis for encouraging countries to develop fiscal risk assessments and to integrate a climate change and climate resilience perspective into public financial management (as well as plans for ensuring adequate funding for response to these events). The proposed establishment of an IMF Resilience and Sustainability Trust to provide long-term concessional financing in support of policy measures that build long-term economic resilience to climate change (and other risks) can encourage country implementation of fiscal risk assessments and disaster risk financing strategies that incorporate climate risks (IMF, 2022[55]).

Supporting fiscal risk reduction through funding risk reduction and adaptation and supporting insurance market development

Addressing the risks of climate losses and damages to public finances at the national level should be based on an integrated approach that includes the potential contributions of risk reduction (mitigation and adaptation) investments and the role of insurance markets in protecting households, businesses and subnational governments. There may be opportunities for international development partners to enhance the support that they provide to these other critical elements of fiscal risk management, including:

- Investment in risk analytical tools to support the development fiscal risk assessments and insurance underwriting;
- Investment in risk reduction and adaptation, including technical assistance for identifying risk reduction and adaptation options, grant funds and loans for investing in risk reduction and adaptation measures and efforts to leverage private sector financing for risk reduction and adaptation by facilitating the issuance of thematic bonds (including by supporting greater consistency and standardisation in ESG-asset reporting, definitions and recourse mechanisms);
- Investing in insurance market development and the availability and affordability of insurance coverage for climate loss and damage faced by households and businesses, including technical assistance related to insurance market development, insurance regulation and supervision and considering the need for the establishment of catastrophe risk insurance programmes for climate risks, as a way to promote insurance penetration and address potential insurability gaps;
- Supporting the effective management of public asset risks, including through the development of asset inventories, public asset insurance needs assessments and the establishment of public asset insurance pools; and,
- Ensuring the efficient use of funds in the aftermath of climate-related extreme events, including through the development of operational procedures that ensure the responsiveness and inclusiveness of social protection programmes.

Development partners are clearly supporting the elements above, although not always as part of an integrated approach for managing the climate risks. Approaching these elements in an integrated way has the potential to enhance their effectiveness and improve their scale.

Facilitating public financial management strategies at the country or regional level to strengthen financial resilience, including through innovative approaches

Once fiscal risks are properly assessed, technical assistance should be focused on developing adequate funding strategies for identified climate-related risks. This could include the establishment of reserve and contingency funds, budget reallocation procedures, debt management strategies and risk transfer arrangements. However, the relevance and importance of these financial management strategies depend on the extent and nature of climate-related risks and their impact on public finances.

Financial management strategies should benefit from strong coordination across the different crisis financing facilities available from development banks and other official donors and creditors to respond to identified funding needs. Support from international organisations and other official creditors for risk financing and risk transfer facilities should be clearly linked to the beneficiary country's fiscal risk assessment and identified funding needs. However, less than 40% of the initiatives included in the database developed under InsuResillience (2021 initiatives) were reported by implementing organisations as linked to the beneficiary country's disaster risk financing strategy (36% were reported as not linked) (InsuResilience, n.d.[53]). This suggests that there may be opportunities for improving coordination across donor initiatives and linkages to country-owned risk financing strategies.

The G7 can show leadership in ensuring coordination. Recognising and acting on the challenges posed by the greater need for coordination has been a priority for both the previous and current G7 presidency (UK Government, 2021[56]). Indeed, the current president, Germany, has made strengthening the climate and disaster risk finance and insurance architecture in a systematic, coherent and sustained way a priority in its presidency (MCII, 2022[57]). Building on InsuResilience Global Partnership, their aim is to work towards a global shield against climate risks.

There may be opportunities for innovation in development partner contributions to climate-related financial instruments – some options for consideration include:

- Support for the inclusion of hurricane (or more general) catastrophe clauses in debt issuances (particularly clauses that involve a reduction in debt) by climate-exposed developing countries (e.g. through pension fund or sovereign wealth fund investment allocations) or financial sector capital requirements (assuming these clauses might reduce default risk);
- Support for developing other forms of catastrophe protection for borrowing by climate-exposed developing countries (e.g. catastrophe wrappers that provide debt relief upon occurrence of a climate event);
- Supporting further diversification of risk across regional risk pools and catastrophe risk insurance programmes (i.e. inter-regional transfers) in order to reduce reinsurance costs; and,
- Re-orienting *ex ante* premium subsidies for regional risk pool participation to *ex post* loss sharing, which could provide similar benefits in terms of reducing the cost of participation without subsidising the profits of (re)insurance companies. Development partners could potentially transfer some of their own exposure to loss sharing to reinsurance and retrocession markets (basically, providing a development partner backstop for regional risk pools and catastrophe risk insurance programmes).

5.2.2. Mobilise additional development finance to strengthen global financial resilience

While there has been an increasing amount of funds dedicated to addressing losses and damages, the availability of funds does not guarantee access to them (OECD, 2021[24]). Several factors limit access. First, accreditation procedures are often complex and differ across funds. Second, application processes and fiduciary requirements often place a disproportionate burden on the limited administrative and technical capacities in developing countries. Climate-related funds and programmes are working to address access issues, as recently done by the Green Climate Fund and the on-going work to ensure

mutual recognition to entities of the Global Environment Facility, Green Climate Fund and Adaptation Fund. However, there is growing recognition that efforts to address these issues fall short and that structural issues go beyond the design of individual funds. Environmental and credit ratings of individual countries, for example, have also been identified as potential barriers of accessing funds if a financing is offered as credit (OECD, 2021[24]). In response to these perceived shortcomings of the international development financing architecture (UK Government, 2021[58]; LIFE-AR, 2019[59]), different stakeholders are highlighting the urgent need for enhanced and simplified access to development finance to complement the provision and mobilisation of climate-related development finance.

Relatedly there is an increasing recognition that there are many benefits of enhanced collaboration and coherence between climate and disaster risk reduction communities (OECD, 2020[60]; Haque et al., 2018[61]). Policy coherence for sustainable development viewed as a process of co-ordination can occur on a continuum – from the strategic to operational and technical levels (OECD, 2020[60]; OECD, 2021[24]). While investing in increased coherence can improve efficiency and effectiveness, it may also render processes to enhance individual policies more difficult (Dazé, Terton and Maass, 2018[62]). Actual or perceived mismatches often hinders achieving the aim of coherence. Mismatches can be due to several factors. For example, the different institutional histories of the two approaches have contributed to separate institutional structures and funding mechanisms with different operational timescales. The immediate disaster response, for example, may be short term, whereas climate action requires long-term thinking (OECD, 2020[60]). Indeed, despite recent increases in funds for *ex ante* measures, the current global system remains focused on response rather than anticipation (Weber and Musshoff, 2021[63]). This is despite anticipation of risks making relief and recovery less costly (OECD, 2021[24]).

There is also a need for increased coherence between approaches to manage climate risk and the strategies promoted through the humanitarian community. Humanitarian assistance plays an important role in response to extreme events. It takes the form of relief, as well as in-kind support such as food, water, medicines and tents. While post-disaster humanitarian assistance from donors is crucial, the timing and volume can be unpredictable and slow to mobilise, thus difficult to plan with (Bowen et al., 2020[64]). Development co-operation providers can help partner countries manage the risks of climate-related losses and damages in several ways. First, they could use more predictable and flexible financing to meet immediate humanitarian needs. Second, their interventions could adapt to changing circumstances and future climate risks (Bowen et al., 2020[64]; OECD, 2021[65]). Providers are also increasingly integrating anticipatory action into development (German Federal Foreign Office, 2020[66]; Levine et al., 2020[67]; Kuriyama et al., 2020[68]) and humanitarian programmes (UK Government, 2021[69]).

Development co-operation providers face a trade-off between rapid humanitarian assistance and support for recovery versus medium- to longer-term investments to achieve sustainable development (Fanning and Fullwood-Thomas, 2019[70]). Yet development co-operation providers often plan and implement their development interventions, including on climate change, separately from their humanitarian assistance. Different teams or agencies frequently manage the two types of support according to distinct rules, decision-making processes, programming cycles and budget envelopes (OECD, 2019[71]). With mounting losses and damages, the need for greater collaboration across humanitarian and development actors is increasingly recognised (United Nations, 2016[72]). In fact, collaboration between the humanitarian and development co-operation communities will require more synergies. Providers must respond to people's immediate needs, while contributing to their resilience in the wake of both already experienced and projected hazards, which will also help ease the future burden of public finances. They can do this by planning and investing early in preparedness, through their choices of programming, and through early and sustained engagement with local capacities (OECD, 2021[24]).

In May 2022, the G7 Foreign Ministers issued a statement committing to embedding anticipatory action into the humanitarian system and increasing the availability of corresponding financial resources (G7 Foreign Ministers, 2022[73]). The commitment includes designing and developing innovative risk analytics, modelling for

anticipation as well as investment in coordination and infrastructure to allow for data and model sharing. The commitment also emphasises the importance of locality-specific knowledge and the agency of local actors for successful implementation.

In co-ordination with various policy communities, multilateral organisations such as the IMF, World Bank and the OECD have a crucial role to play. These organisations can provide a platform for discussions, become a focal point for coordination, and anchor the agreements. For example, for donors the OECD Development Assistance Committee helps set international principles and standards for development co-operation, and track how donors deliver on their commitments. They also have experience in experimenting with supporting the implementation of innovative approaches to risk management, piloting them and scaling them up (catastrophe bonds, for example). They can offer a holistic framework to resolve these challenges posed by climate risks in a way that reinforces global financial resilience.

References

Allen, R., R. Hemming and B. Potter (eds.) (2016), *The Budget Execution Process*, Palgrave Macmillan. [43]

Allen, R. and D. Radev (2010), *Extrabudgetary Funds*, International Monetary Fund. [44]

Andre, P. et al. (2021), "Fighting climate change: The role of norms, preferences, and moral values"*, Discussion Paper*, No. 14518, Institute of Labor Economics, Bonn, http://ftp.iza.org/dp14518.pdf. [35]

Arteta, C. and G. Hale (2008), "Sovereign debt crises and credit to the private sector", *Journal of International Economics*, Vol. 74/1, pp. 53-69, https://doi.org/10.1016/j.jinteco.2007.05.008. [19]

Beirne, J., N. Renzhi and U. Volz (2021), "Feeling the heat: Climate risks and the cost of sovereign borrowing", *International Review of Economics & Finance*, Vol. 76, pp. 920-936, https://doi.org/10.1016/j.iref.2021.06.019. [18]

Bevan, D. and S. Cook (2015), "Public expenditure following disasters", *Policy Research Working Paper*, Vol. No. 7355, https://openknowledge.worldbank.org/handle/10986/22240. [40]

Bowen, T. et al. (2020), *Adaptive Social Protection Systems, Building Resilience to Shocks*, World Bank, Washington, DC, https://doi.org/10.1596/978-1-4648-1575-1. [64]

Cameron, S., M. Lelong and L. von Trapp (2022), *More than words: Potential Roles for Independent Fiscal Institutions in Green Budgeting*, https://ec.europa.eu/info/sites/default/files/ifisgreenbudgeting-20220309.pdf. [4]

Casado-Asensio, J., D. Blaquier and J. Sedemund (2022), "Strengthening capacity for climate action in developing countries: Overview and recommendations"*, OECD Development Co-operation Working Papers*, No. 106, OECD Publishing, Paris, https://doi.org/10.1787/0481c16a-en. [52]

CAT (2021), *Glasgow's 2030 credibility gap: net zero's lip service to climate action Wave of net zero emission goals not matched by action on the ground*, https://climateactiontracker.org/documents/997/CAT_2021-11-09_Briefing_Global-Update_Glasgow2030CredibilityGap.pdf (accessed on 28 May 2022). [23]

Cebotari, A. et al. (2009), *Fiscal Risks: Sources, Disclosure, and Management*, International Monetary Fund, https://doi.org/10.5089/9781589067905.087.A001. [41]

Cevik, S. and J. Jalles (2022), "This changes everything: Climate shocks and sovereign bonds", *Energy Economics*, Vol. 107, p. 105856, https://doi.org/10.1016/j.eneco.2022.105856. [17]

Cevik, S. and J. Jalles (2021), "An Apocalypse Foretold: Climate Shocks and Sovereign Defaults", *Open Economies Review*, Vol. 33/1, pp. 89-108, https://doi.org/10.1007/s11079-021-09624-8. [15]

Cevik, S. and J. Jalles (2020), *Feeling the Heat: Climate Shocks and Credit Ratings*, https://www.imf.org/en/Publications/WP/Issues/2020/12/18/Feeling-the-Heat-Climate-Shocks-and-Credit-Ratings-49945. [16]

Corsetti, G. et al. (2013), "Sovereign Risk, Fiscal Policy, and Macroeconomic Stability", *The Economic Journal*, Vol. 123/566, pp. F99-F132, https://doi.org/10.1111/ecoj.12013. [20]

Dazé, A., A. Terton and M. Maass (2018), *Coordinating Climate-Resilient Development Alignment to Advance Climate-Resilient Development. Overview Brief 1: Introduction to Alignment*, NAP Global Network, http://napglobalnetwork.org/wp-content/uploads/2018/08/napgn-en-2018-alignment-to-advance-climate-resilient-development-overview-brief.pdf. [62]

Delgado, R., H. Eguino and A. Pereira (2021), *Fiscal Policy and Climate Change: Recent Experiences of Finance Ministries in Latin America and the Caribbean*, Inter-American Development Bank, https://doi.org/10.18235/0003376. [30]

Department of Budget and Management (2022), *Fiscal Risks Statement*, https://www.dbm.gov.ph/wp-content/uploads/DBCC_MATTERS/FiscalRiskStatement/Fiscal-Risks-Statement-2022-for-Circulation.pdf (accessed on 30 May 2022). [10]

Deryugina, T. (2017), "The Fiscal Cost of Hurricanes: Disaster Aid versus Social Insurance", *American Economic Journal: Economic Policy*, Vol. 9/3, pp. 168-198, https://doi.org/10.1257/pol.20140296. [14]

European Commission (2022), *Fiscal Sustainability Report 2021*, https://doi.org/10.2765/682828. [7]

Fanning, E. and J. Fullwood-Thomas (2019), "The humanitarian-development-peace nexus: What does it mean for multi-mandated organizations?", *Discussion Paper*, Oxfam, United Kingdom, https://doi.org/10.21201/2019.4436. [70]

Feyen, E., R. Lester and R. Rocha (2011), "What Drives the Development of the Insurance Sector? An Empirical Analysis Based on a Panel of Developed and Developing Countries", *Policy Research Working Papers*, World Bank, https://doi.org/10.1596/1813-9450-5572. [37]

G7 Foreign Ministers (2022), *Statement on Strengthening Anticipatory Action in Humanitarian Assistance*, https://www.g7germany.de/resource/blob/997532/2039874/5321a78338cf79d9b421c2b6e0baaa69/2022-05-14-anticipatory-data.pdf?download=1 (accessed on 20 May 2022). [73]

German Federal Foreign Office (2020), "Helping Before disaster strikes – anticipatory humanitarian assistance in Bangladesh", 13 October, German Federal Foreign Office, https://www.auswaertiges-amt.de/en/aussenpolitik/themen/humanitaerehilfe/disaster-risk-reduction/2404730. [66]

Gibbs, M. (2015), "Pitfalls in developing coastal climate adaptation responses", *Climate Risk Management*, Vol. 8, pp. 1-8, https://doi.org/10.1016/j.crm.2015.05.001. [21]

GOV.PH (2022), *National Asset Management Plan*, https://dbm.gov.ph/index.php/systems-and-productivity-improvement-related-matters/implementation-of-the-pgamp/national-asset-management-plan-namp/namp-2022-2023. [27]

Halady, I. and P. Rao (2010), "Does awareness to climate change lead to behavioral change?", *International Journal of Climate Change Strategies and Management*, Vol. 2/1, pp. 6-22, https://doi.org/10.1108/17568691011020229. [34]

Haque, M. et al. (2018), "Towards establishing a national mechanism to address losses and damages: A case study from Bangladesh", in *Loss and Damage from Climate Change, Climate Risk Management, Policy and Governance*, Springer International Publishing, Cham, https://doi.org/10.1007/978-3-319-72026-5_19. [61]

IMF (2022), "Proposal To Establish A Resilience and Sustainability Trust", No. Policy Paper No. 2022/013, International Monetary Fund, https://www.imf.org/en/Publications/Policy-Papers/Issues/2022/04/15/Proposal-To-Establish-A-Resilience-and-Sustainability-Trust-516692 (accessed on 2 September 2022). [55]

IMF (2021), "2021 Comprehensive Surveillance Review— Background Paper on Integrating Climate Change into Article IV Consultations", *Policy Paper*, No. 2021/032, International Monetary Fund, https://www.imf.org/en/Publications/Policy-Papers/Issues/2021/05/18/2021-Comprehensive-Surveillance-Review-Background-Paper-on-Integrating-Climate-Change-into-460303 (accessed on 9 May 2022). [54]

IMF (2019), "Building resilience in developing countries vulnerable to large natural disasters", *Policy Paper*, No. 19/020, International Monetary Fund, Washington, DC, https://www.imf.org/-/media/Files/Publications/PP/2019/PPEA2019020.ashx. [39]

IMF (2016), *Analyzing and Managing Fiscal Risks*, International Monetary Fund. [45]

InsuResilience (n.d.), *Projects and Instruments*, InsuResilience, https://www.insuresilience.org/projects/ (accessed on 20 May 2022). [53]

Italian G20 Presidency (2021), *G20 Policy Agenda on Infrastructure Maintenance*, http://www.g20.utoronto.ca/2021/G20-Policy-Agenda-on-Infrastructure-Maintenance.pdf. [29]

Kuriyama, N. et al. (2020), "Towards a comparative framework of adaptive planning and anticipatory action regimes in Chile, Japan, and the US: An exploration of multiple contexts Informing tsunami risk-based planning and relocation", *Journal of Disaster Research*, Vol. 15/7, pp. 887-889, https://www.researchgate.net/publication/347773615_Towards_a_Comparative_Framework_of_Adaptive_Planning_and_Anticipatory_Action_Regimes_in_Chile_Japan_and_the_US_An_Exploration_of_Multiple_Contexts_Informing_Tsunami_Risk-Based_Planning_and_Relocation. [68]

Laframboise, N. and B. Loko (n.d.), "Natural Disasters: Mitigating Impact, Managing Risks", *IMF Working Paper 12/245*. [47]

Levine, S. et al. (2020), *Anticipatory action for livelihood protection*, Overseas Development Institute, London, https://cdn.odi.org/media/documents/202006_odi_anticipatory_action_for_livelihood_protection_wp_final.pdf. [67]

LIFE-AR (2019), "LDC 2050 Vision: Towards a climate-resilient future", (brochure), LDC Initiative for Effective Adaptation and Resilience, http://www.ldc-climate.org/wp-content/uploads/2019/09/2050-Vision.pdf. [59]

MCII (2022), *Towards an Effective Global Shield Against Climate Risks for Climate Vulnerable Countries and Communities*, https://climate-insurance.org/news/towards-an-effective-global-shield-against-climate-risks-for-climate-vulnerable-countries-and-communities/. [57]

Moody's (2021), *Research: Moody's - Physical climate risk is credit negative for most sovereigns, particularly in emerging markets*, Moody's, https://www.moodys.com/research/Moodys-Physical-climate-risk-is-credit-negative-for-most-sovereigns--PBC_1282314?cid=7QFRKQSZE021 (accessed on 18 November 2021). [76]

Murray, E. (2022), *Intelligence Microinsurance: Opportunity on the horizon*. [38]

New Zealand Treasury (2021), *Half-Year Economic and Fiscal Update*, https://www.treasury.govt.nz/system/files/2021-12/hyefu21.pdf. [9]

OECD (2022), *OECD Sovereign Borrowing Outlook 2022*, OECD Publishing, Paris, https://doi.org/10.1787/b2d85ea7-en. [31]

OECD (2021), *Building resilience: New strategies for strengthening infrastructure resilience and maintenance*, https://doi.org/10.1787/354aa2aa-en. [28]

OECD (2021), *Enhancing Financial Protection Against Catastrophe Risks: The Role of Catastrophe Risk Insurance Programmes*, OECD. [33]

OECD (2021), *Financial Management of Catastrophe Risks: Approaches to Building Financial Resilience*, OECD. [32]

OECD (2021), *Managing Climate Risks, Facing up to Losses and Damages*, OECD Publishing, Paris, https://doi.org/10.1787/55ea1cc9-en. [24]

OECD (2021), *Managing Climate Risks, Facing up to Losses and Damages*, OECD Publishing, Paris, https://doi.org/10.1787/55ea1cc9-en. [25]

OECD (2021), *OECD DAC Declaration on a new approach to align development co-operation with the goals of the Paris Agreement on Climate Change*, https://www.oecd.org/dac/development-assistance-committee/dac-declaration-climate-cop26.htm (accessed on 20 May 2022). [51]

OECD (2021), *Strengthening Climate Resilience: Guidance for Governments and Development Co-operation*, OECD Publishing, Paris, https://doi.org/10.1787/4b08b7be-en. [65]

OECD (2020), *Common Ground Between the Paris Agreement and the Sendai Framework: Climate Change Adaptation and Disaster Risk Reduction*, OECD Publishing, Paris, https://doi.org/10.1787/3edc8d09-en. [60]

OECD (2019), *DAC Recommendation on the Humanitarian-Development-Peace Nexus*, OECD Development Assistance Committee, Paris, https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-5019. [71]

OECD (2018), *Cost-Benefit Analysis and the Environment: Further Developments and Policy Use*, OECD Publishing, Paris, https://doi.org/10.1787/9789264085169-en. [11]

OECD (2018), *The Contribution of Reinsurance Markets to Managing Catastrophe Risk*, OECD, http://www.oecd.org/finance/the-contribution-of-reinsurance-markets-to-managing-catastrophe-risk.pdf (accessed on 23 January 2019). [74]

OECD (2017), *Recommendation on Disaster Risk Financing Strategies*, https://www.oecd.org/daf/fin/insurance/OECD-Recommendation-Disaster-Risk-Financing-Strategies.pdf. [3]

OECD (2015), *Disaster Risk Financing: A global survey of practices and challenges*, OECD Publishing, https://doi.org/10.1787/9789264234246-en. [48]

OECD (2015), *Recommendation of the Council on Budgetary Governance*. [8]

OECD (2014), *Recommendation of the Council on the Governance of Critical Risks*, https://www.oecd.org/gov/risk/Critical-Risks-Recommendation.pdf. [2]

OECD (2012), *Disaster Risk Assessment and Risk Financing: A G20/OECD Methodological Framework*, OECD. [36]

OECD (2007), *Handbook for Appraisal of Environmental Projects Financed from Public Funds*, OECD Publishing Paris, https://www.oecd.org/environment/outreach/38786197.pdf. [12]

OECD and World Bank (2019), *Fiscal Resilience to Natural Disasters*, OECD Publishing, https://doi.org/10.1787/27a4198a-en. [1]

Office for Budget Responsibility (2021), *Fiscal Risks Report*, https://obr.uk/docs/dlm_uploads/Fiscal_risks_report_July_2021.pdf. [5]

Paris Agreement (2015), *15 December 2015*, United Nations Treaty Collection Certified True Copies (CTCs) of Multilateral Treaties Deposited with the Secretary-General Chapter XXVII.7.d, https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27 (accessed on 28 April 2020). [22]

PARIS21 (2022), *Envisioning a climate change data ecosystem - A path to co-ordinated climate action*, https://paris21.org/ccde. [6]

Saxena, S. and S. Yläoutinen (n.d.), *Managing Budgetary Virements*, International Monetary Fund. [49]

Standard & Poor's Ratings Service (2015), *The Heat Is On: How Climate Change Can Impact Sovereign Ratings*, Standard & Poor's Ratings Service, https://www.agefi.com/uploads/media/S_P_The_Heat_Is_On_How_Climate_Change_Can_Impact_Sovereign_Ratings_25-11-2015.pdf (accessed on 22 March 2018). [75]

Tieman, A. (ed.) (2018), *How to manage the fiscal costs of natural disasters*, International Monetary Fund. [42]

Tuominen, P. et al. (2015), "Economic appraisal of energy efficiency in buildings using cost-effectiveness assessment", *Procedia Economics and Finance*, Vol. 21, pp. 422-430, https://doi.org/10.1016/s2212-5671(15)00195-1. [13]

UK Government (2021), "G7 famine prevention and humanitarian crises compact", *Policy Paper*, 5 May, Government of the United Kingdom, London, https://www.gov.uk/government/publications/g7-foreign-and-development-ministers-meeting-may-2021-communique/g7-famine-prevention-and-humanitarian-crises-compact#iv-scale-up-anticipatory-action. [69]

UK Government (2021), *New G7 action to keep people safer from climate disasters*. [56]

UK Government (2021), *Taskforce on Access to Climate Finance: Draft Concept Note*, Government of the United Kingdom, London, https://2nsbq1gn1rl23zol93eyrccj-wpengine.netdna-ssl.com/wp-content/uploads/2021/05/Taskforce-on-Access-to-Climate-Finance-Draft-Concept-Note-May-2021.pdf. [58]

United Nations (2016), "Too important to fail – addressing the humanitarian financing gap", *Report to the UN Secretary-General*, UN High-Level Panel on Humanitarian Financing, New York, https://digitallibrary.un.org/record/830113?ln=en. [72]

Weber, R. and O. Musshoff (2021), "Risk-contingent credit for sovereign disaster risk finance", *International Journal of Disaster Risk Reduction*, Vol. 56, p. 102105, https://doi.org/10.1016/j.ijdrr.2021.102105. [63]

World Bank (2019), *Fiscal Policies for Development and Climate Action*, World Bank, https://doi.org/10.1596/978-1-4648-1358-0. [46]

World Bank (2017), *Sovereign Climate and Disaster Risk Pooling: World Bank Technical Contribution to the G20*, World Bank. [50]

World Bank (2014), *A Guide to Delivering Good Asset Management in the Road Sector through Performance Based Contracting*, https://openknowledge.worldbank.org/bitstream/handle/10986/18646/878270NWP0TP4200Box377314B00PUBLIC0.pdf?sequence=1&isAllowed=y. [26]

Notes

[1] The capacity of households, businesses and subnational governments to absorb losses and damages depends on their income/revenue, access to savings, existing debt levels, access to debt financing on reasonable terms and, in the case of subnational governments, the ability to reallocate funds or raise additional revenues (OECD, 2012[36]). The existence of insurance coverage that will respond to the losses and damage incurred also increases the absorptive capacity of households, businesses and governments, subject to deductibles or insured limits applied.

[2] Subnational government and corporate borrowers have traditionally faced a "sovereign ceiling" in the determination of their own credit risk (and therefore cost of borrowing) – where a subnational government or corporate borrower cannot have a credit rating above the sovereign rating. While many credit ratings agencies have moved away from a mechanistic application of a sovereign ceiling, it is still rare for subnational governments and corporate borrowers to be rated above the sovereign issuer. As a result, a downgrade in the sovereign credit rating continues to impact the ratings and cost of debt financing for subnational governments and businesses.

[3] There is some (limited) evidence that the contribution of insurance to absorbing losses and damages for climate-related perils is declining in some regions. In a number of OECD countries, including Australia, Italy, Greece, Mexico, Poland, Mexico and Slovenia, the share of flood losses that was insured was lower in 2010-2019 than the overall average for those countries between 1990 and 2019 (OECD, 2021[33]). A number of OECD countries have made – or are considering making – interventions to support the availability of affordable insurance coverage for climate perils (including Australia (cyclone and related flooding), Canada (flood), Ireland (flood), United Kingdom (flood) and the US states of California and Oregon (wildfire)) (OECD, 2021[33]).

[4] At least two of the major credit ratings agencies have undertaken analyses of the potential impacts of physical climate risks on sovereign credit ratings (Standard & Poor's Ratings Service, 2015[75]) (Moody's, 2021[76]).

[5] Risk transfer to international markets also ensures that some portion of the losses from a catastrophic event to be absorbed by international markets (and investors), diversifying the burden away from the domestic financial system. One OECD analysis found that, in countries where higher levels of risk were transferred to international reinsurers, post-event recovery occurred more quickly while those countries with lower levels of reinsurance coverage struggled to recover (OECD, 2018[74]).

[6] In OECD countries, the share of flood losses and damages insured between 2000 and 2019 was approximately 55% to 63% in countries where flood coverage was automatically included in standard property insurance, 27% to 48% in countries with mortgage-related flood insurance requirements and 23% to 32% in countries with no such requirements. In India and Myanmar, despite similar levels of insurance penetration, a significantly higher share of climate losses and damages have been insured in India (10%-18%, relative to 1% to 6% in Myanmar, 2000-2019) where coverage for Storm, Typhoon, Cyclone, Tempest, Tornado, Hurricane, Flood or Inundation is automatically included.

[7] A number of catastrophe risk insurance programmes intentionally apply flat (or relatively flat) premium structures which ensures affordability and also supports solidarity across the country. Many of these programmes make other contributions to risk reduction, including direct investment in prevention as well as other approaches to incentivising risk reduction (e.g. through the application of deductibles that account for risk). A recent OECD analysis found limited evidence of significant subsidisation at the programme-level as most (but not all) programmes have sufficient financial capacity to respond to annual and extreme losses without calling on government financial support (OECD, 2021[33]).

[8] In countries with catastrophe risk insurance programmes (Algeria, Denmark, France, Norway, Romania, Spain, Switzerland and the United States for flood losses and France, Norway, Spain, Switzerland and the United States for storm losses), the share of flood losses insured was approximately 35% (relative to 16%) and the share of storm losses insured was approximately 54% (relative to 36%).

[9] A number of catastrophe risk insurance programmes regularly assess the cost-sharing arrangements between the public and private sectors and make adjustments to the arrangements to changes in private market capacity (e.g. the terrorism risk insurance programmes in Australia, United Kingdom and United States as well as the earthquake risk insurance programme in Japan).

[10] Climate change also creates new uncertainties as a result of changes to the climate parameters that drive the occurrence of floods, storms, droughts, wildfires and other climate-related perils which insurers and reinsurers will need to account for in the premiums they collect.

[11] A number of OECD countries have made – or are considering making – interventions to support the availability of affordable insurance coverage for climate perils (including Australia (cyclone and related flooding), Canada (flood), Ireland (flood), United Kingdom (flood) and the US states of California and Oregon (wildfire)) (OECD, 2021[33]).

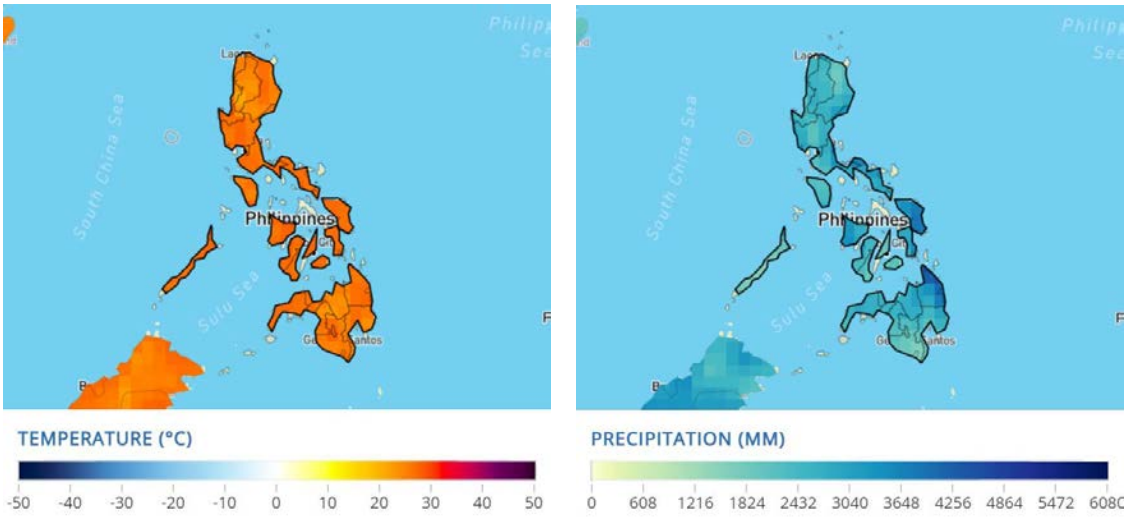
[12] For example, risk transfer necessitates an investment in risk quantification that can also be applied to the development of insurance markets for households and businesses and in decision-making on risk reduction and adaptation investments.

Annex A. Philippines

Philippines' exposure and vulnerability to climate hazards and climate change

This section aims to provide a short overview of the past and future hazards based on the IPCC Sixth Assessment report (Shaw et al., 2022[1]). It discusses the observed hazards, the projections for the future, and concludes with a discussion of exposures and vulnerabilities. The Philippines comprises approximately 7,000 islands, most of which can be characterised as mountainous terrain bordered by narrow coastal plains. Figure A A.1 shows the historical averages of temperature and precipitation (1990-2020). Average temperatures are generally high at 25°C with little variation across the country or throughout the year. Average annual rainfall is approximately 2400 mm, but with significant variation both across the country and the year. Climatological variations in the Philippines are significantly influenced by El Niño Southern Oscillation (ENSO), with El Niño causing droughts and La Niña causing rainfall leading to floods (OECD, 2020[1]).

Figure A A.1. Observed climatology of mean temperature and precipitation of the Philippines



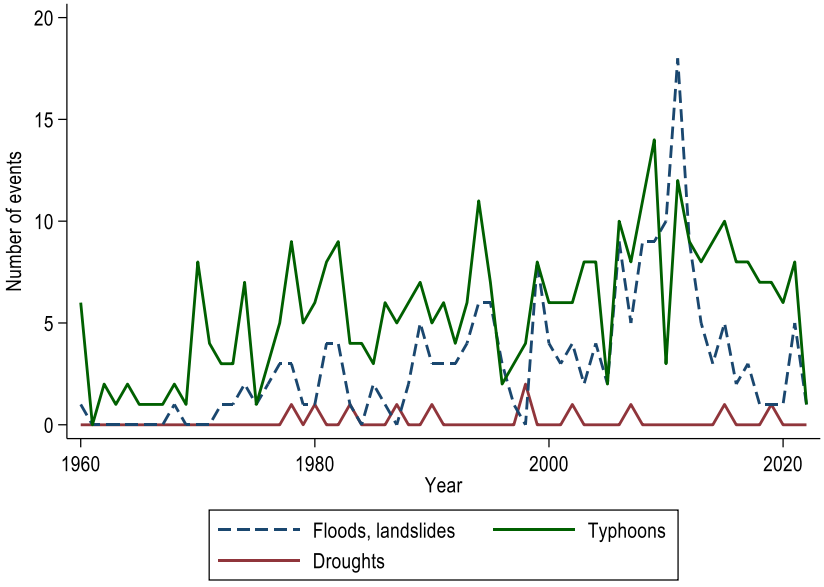
Source: (World Bank, 2022[2])

Past and current hazards

Due to its geographical location and topography, the Philippines is exposed to different types of extreme weather events, such as typhoons, floods, landslides and droughts (as well as to other types of hazards such as earthquakes and volcanic eruptions). Its narrow coastal plains are particularly vulnerable to rising sea levels, erosion, droughts, monsoon rains and changes in sea surface temperatures. Climate change and heightened climate disaster risks also affect the lives and livelihoods of populations whose economic activity is dependent on nature (e.g. agriculture, fishing, tourism, etc.). From 2000 to 2019, the Philippines reported 304 weather-related disasters which affected a total of 149 million people over several years[1], making the Philippines the fourth most disaster-affected country in the world (UNDRR, 2020[3]).

On average, 20 tropical cyclones per year enter the Philippine Area of Responsibility (PAR), with about 8 or 9 of them crossing the Philippines (PAGASA, 2022[4]). Since 2009, the Philippines has experienced a number of highly destructive extreme weather events with Typhoons Ondoy, Pepeng, Sendong, and Pablo leading to over 3,000 deaths, affecting more than 10 million people and causing economic losses and damages amounting to approximately USD 5.7 billion (OECD, 2020[1]). In addition, the 2013 Super Typhoon Yolanda (Haiyan) is recorded as one of the most intense and deadly tropical typhoons. It caused more than 6 300 deaths, and economic costs of about PHP 95 billion or about USD 2.3 billion (using 2013 exchange rates) (NDRRMC, 2013[5]). Figure A A.2 shows the frequency of floods and landslides, droughts and typhoons from 1960 to 2022 July, based on EM-DAT data (CRED/UC Louvain, 2022[6]). The frequency of typhoons has increased over the period, but the trend is not as apparent as the upward trend for floods and landslides. This coincides with the most recent scientific evidence. The frequency of typhoons has not changed since 1950, but the frequency of extreme typhoons[2] (with wind speeds over 150 km per hour) has increased (Shaw et al., 2022[7]). In addition, there has been a northward shift in typhoon tracks (PAGASA, 2021[8]).

Figure A A.2. Frequency of floods and landslides has increased in the Philippines



Note: The graph illustrates the frequency of extreme events in the Philippines between 1960 and 2022. Note that the 2022 data is incomplete, it is only covered until July. A drawback of EM-DAT is only disasters which cause 10 or more deaths, or affect 100 or more people, or lead to declaration of a state of emergency, or there is a call for international assistance, are recorded, which biases the data against certain events.
Source: (CRED/UC Louvain, 2022[6]).

Projected hazards

The already observed increase in the strength of typhoons and their northward shift are projected to exacerbate as climate change progresses, according to regional projections.[3] The expected damages for a 1-in-100 year tropical cyclone are projected to increase by 10%, as storms with this frequency become more severe, under the most likely scenarios by 2060 (Climate Analytics, 2022[9]). Rising temperatures will also likely lead to more floods, landslides and stronger typhoons in the region, even though the effect on rainfall is not clear (Shaw et al., 2022[7]). In some parts of the country, the intensity and frequency of rainfall events are increasing, whereas in others, decreasing (OECD, 2020[1]). The annual damages from river flooding are expected to rise by about 40% by 2060, according to central projections, though with considerable uncertainty (Climate Analytics, 2022[9]). Projections also show that the frequency of droughts

will increase (Shaw et al., 2022[7]). This will have consequences for the agricultural sector and will impact the poor through increased food prices. In other parts of Asia, droughts have already led to changing agricultural practices.

Exposure and vulnerability

The Philippines is considered to be a climate hotspot where strong hazards, large exposure and high concentration of vulnerable people coincide. In such hotspots, the impacts of global climate also have profound social implications, threatening human health and well-being, destabilising assets, stressing coping capacities and response infrastructures, and substantially increasing the number of socially, economically and psychologically vulnerable individuals and communities (Shaw et al., 2022[7]).

Around half of the economic activity of the Philippines is nature-dependent (WEF, 2020[10]; GOV.PH, 2022[11]). Thus, biodiversity and ecosystem services play a crucial role in socioeconomic development, but also cultural and spiritual fulfilment of the population (IPBES, 2018[12]). The coastal ecosystems provide services related to food production by fisheries, carbon sequestration, coastal protection and tourism (Shaw et al., 2022[7]). In addition, around a third of employment is accounted for by agriculture, a sector which is vulnerable to climate change (ABI and CIAT & WFP, 2022[13]). Thus, climate change has significant and widespread effects on water supply, food production, human health, well-being and availability of land and ecosystems (Shaw et al., 2022[7]).

Rapid urbanisation and the proliferation of informal settlements have increased vulnerabilities, especially among poor households migrating from rural areas (OECD, 2020[1]). Unregulated urban expansion has intensified flood risk and is expected to continue to do so in the future (Shaw et al., 2022[7]). For example, in its second national communication to the UNFCCC, the Philippines notes that while the rise in flood risk can, in part, be explained by increased rainfall variability, it is also caused by sewers and waterways clogged by waste trapping the water (GOV.PH, 2014[14]; OECD, 2020[1]). Other anthropogenic factors, including deforestation and land use change, also exacerbate flood risk (Shaw et al., 2022[7]; OECD, 2020[1]).

Climate change also threatens long-run growth as poor households are constrained in their ability to receive nutrition, schooling and healthcare for their children (Shaw et al., 2022[7]). At higher warming, key infrastructure such as power lines, transport by roads, railways, and infrastructure such as airports and harbours are more exposed to climate-induced extreme events, especially in coastal cities (Shaw et al., 2022[7]).

Low-income households are disproportionately affected by extreme events (Shaw et al., 2022[7]). Climate change, when combined with factors such as unmanaged development, has adverse impacts on ecosystems and the role of these systems for many rural populations as sources of income and livelihood, as noted above (Hallegatte et al., 2015[15]; OECD, 2020[1]). In addition, lower income households often reside in areas more exposed to the risks of climate change, in some cases because these areas are more readily available. Complemented by heightened vulnerabilities to climate impacts, poorer households also have relatively fewer resources at their disposal for responding to these impacts. As a result, many residents that live just above the poverty line cycle in and out of poverty (OECD, 2020[1]). The concentration of population growth in less developed regions means that an increasing number of people with the least ability to adapt to climate change will be at increased risk (Shaw et al., 2022[7]).

Identify, assess and report on climate-related risks and their financial implications for government

Identifying and assessing climate-related risks, financial vulnerabilities, and financial implications for government

The Philippines Catastrophe Risk Model was developed in 2014 to provide probabilistic estimates of total losses from typhoons and earthquakes, on an annual long-term average basis (World Bank, 2021[16]). Assessments are based on a database of asset exposure and historical loss as well as a geo-referenced catalogue of national government assets (World Bank, 2021[16]). The model is used to assess the government's potential losses and inform the design of risk transfer instruments to adequately finance disaster and climate risks (see below). Estimates are reported in a Fiscal Risks Statement published annually by the Department of Budget and Management (DBM). The model shows that, on average, the Philippines is expected to incur PHP 177 billion (USD 3.5 billion) per year in losses to public and private sector assets due to typhoons and earthquakes. The country has a 10% annual probability of experiencing losses exceeding PHP 377.8 billion and a 1% annual probability of experiencing losses exceeding PHP 1.73 trillion (World Bank, 2021[16]) Of the PHP 177 billion average annual loss, 96% relates to private assets and 4% to public assets. Within the 4% of average annual losses to public assets (PHP 8 billion or USD 158.4 million), 75% can be attributed to typhoons and 25% to earthquakes (World Bank, 2021[16]).

Risk and vulnerability assessments are also key tools for informing planning processes to identify and prioritise investments (OECD, 2020[1]). The Climate and Disaster Risk Assessment (CDRA), which is conducted by local governments, as per the Supplemental Guidelines on Mainstreaming Climate and Disaster Risks in Comprehensive Land Use Plan (CLUP), aims at:

- identifying different hazards and hazard-prone areas;
- evaluating the likelihood of occurrence and severity of consequence of different hazards;
- understanding exposure for different critical areas (e.g. population, infrastructure, natural resources); and
- recommending appropriate measures for climate change adaptation and disaster risk reduction (GOV.PH, 2017[17]).

While the CDRA is implemented at the local level, the assessments aid the National Government in designing risk transfer instruments, such as through the PH Catastrophe Risk Model. An ongoing challenge which has lead to confusion in implementation and generated possible inefficiencies is that different national institutions (e.g., National Economic and Development Authority (NEDA), Climate Change Commission (CCC), National Disaster Risk Reduction and Management Council (NDRRMC), Department of the Interior and Local Government (DILG)) promote slightly different versions of the CDRA, with different definitions and methodologies. This inconsistency is partly due to the desire of national agencies to make the process less resource intensive and ensure that lower income (and thus lower capacity) Local Government Units (LGUs) are not excluded from the risk assessment process due to requirements they cannot meet. However, there remain some challenges in conducting CDRA at the local government level. These capacity gaps hinder subsequent policy planning and implementation processes, including efforts to access disaster risk management (DRM) funds. More importantly, the variations in the different methodologies reflect the specificities of the policy planning processes they serve (OECD, 2020[1]).

LGUs also play a central role in disaster risk prevention and management in the Philippines. The implementation of the Mandanas-Garcia[4] ruling in 2020 is seen as strengthening the capacity of LGUs which will help limit disaster-related damages, enhance emergency response time and facilitate reconstruction and recovery.

Reporting climate-related fiscal risks to promote transparency in public financial management

The Philippines's Development Budget Coordination Committee provides an overview of the country's exposure to fiscal risks from contingent liabilities (including natural disasters) in its annual Fiscal Risk Statement published by the Department for Budget Management. For example, according to the 2022 statement, the Philippines is expected to incur USD 3.6 billion per year in total losses to public and private assets due to typhoons and earthquakes on a long-term average basis (Department of Budget and Management, 2022[18])Losses and damages could be even higher without adequate policies for adaptation and risk mitigation in place. However, while fiscal risks statements provide information on past events and probabilistic estimates of total losses and damages, information on public financial exposure is more limited and is only available based on historical losses rather than probabilistic modelling.[5]

Mitigate financial losses from climate-related risks and their implications for governments

Promoting, investing and financing risk prevention, risk reduction and adaptation to reduce exposure and vulnerability

Reliable data and information on hazards, exposure and vulnerabilities are necessary to inform disaster risk reduction (DRR) activities and policies. This information should be made available and communicated effectively to policy makers and stakeholders. Recent efforts by the government demonstrate its willingness to address the need to centralise and facilitate access to climate and disaster-related information. For example, GeoRisk Philippines is a multi-agency initiative that aims at building the country's resilience to climate hazards by providing a central source of information for hazard and risk assessment (see Box A A.1).

Box A A.1. GeoRisk Philippines – An initiative to centralise climate and disaster-related information

GeoRiskPH is a multi-agency initiative that aims to become the central source of information for hazard and risk assessment in the Philippines. By bringing multiple agencies together, the initiative plans to address mapping inaccuracies, gaps, overlaps and duplication of efforts due to the absence of mapping standards, protocols and codes.

The initiative was led by the Philippine Institute of Volcanology and Seismology (PHIVOLCS), funded by the Department of Science and Technology (DOST) and monitored by the Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD) from 2018 to 2020. In 2021, the initiative was institutionalised in DOST-PHIVOLCS. Today, 10 government agencies have agreed to contribute their data to the GeoRiskPH platform.

As of 2022, GeoRiskPH provides a set of tools to share and collect information on hazards, exposure, and risk. For example, HazardHunterPH is a web and mobile application that allows users to quickly generate hazard assessment reports for a selected location.

Note: Given that the initiative is still recent, it is too early to evaluate its impact.
Source: (GeoRisk Philippines, 2022[19])

With the same goal of providing stakeholders with timely climate information, early warnings systems (EWS) with clear, colour-coded instructions to take action are now in place for all major hazards. For example, PAGASA issued yellow 'take action' weather warnings to alert people to the risk of flooding in advance of three typhoon-related events in 2014 in Manila (Met Office, 2017[19]). Before EWS, general weather forecasts would provide a warning of heavy rains but would not assess the risk of flooding, leaving forecasts up for individual interpretations.

Funding for risk prevention and reduction is well-integrated in the budget structure of local governments (UNDRR, 2019[20]). The DRRM Act of 2010 mandates LGUs to set-up a Local Disaster Risk Reduction and Management Fund (LDRRMF). Under the legislation, this fund should be financed by a minimum of 5% of LGUs' estimated revenue from regular sources. 70% of the Fund's resources are to be dedicated to risk prevention, reduction and preparedness. This includes both structural (e.g. construction of flood barriers) and non-structural measures (e.g. building codes and land-use planning). The remaining 30% are allocated to the Quick Response Fund (QRF) for funding emergency response.

Despite the existence of such good practice budgeting mechanisms for risk reduction, several constraints make it difficult for these funds to make an impact (OECD, 2020[21]):

- The country's fiscal decentralisation system does not recognise the differentiated exposure of LGUs to climate change. Given that the LGUs more exposed to climate change are the ones with the least resources, vulnerability reduction efforts are effectively limited.
- Even when the funds' resources are spent, LGUs have little technical capacity to assess effective risk reduction measures which diverts existing financing towards short-term measures (e.g. relief equipment). Greater efforts can also be made in terms of non-structural measures. There is low enforcement of building codes and standards as communities continue to construct buildings in high-risk areas and informal settlements to reduce construction costs (COA.GOV.PH, 2014[22]).

Protecting households and businesses through insurance

The Philippines has a well-developed regulatory framework for insurance companies. Capital requirements have been increased in recent years to ensure that insurance companies have sufficient funds to meet their obligations to policyholders (OECD, 2020[23]). The Insurance Commission (IC) has established minimum pricing for flood and typhoon (as well as earthquake) coverage to ensure that insurers are collecting sufficient premium although a highly competitive market has led some insurers to set premiums at (or even below) the minimum requirements (OECD, 2020[23]). Commercial catastrophe models are available for many of the main climate-related perils although use of these models has been limited (OECD, 2020[23]). A national reinsurance company has been established and ensures the availability of reinsurance coverage for domestic insurance companies although a system of preferences creates some limitations on the ability of insurers to leverage international property catastrophe reinsurance markets (OECD, 2020[23]).

The Philippines has a relatively low-level of non-life insurance penetration (although similar to other middle income economies in the region). Non-life insurance premiums were equivalent to 0.23% of GDP in 2020 (Insurance Commission, 2021[24]), relative to 4.9% of GDP in OECD countries and 0.4% in Indonesia (OECD, 2022[25]). Insurance coverage for floods and typhoons is available as an optional add-on to commercial and residential fire insurance policies and is often only acquired by commercial policyholders and higher-income households (OECD, 2020[23]). Some mortgage lenders have requirements for adequate insurance coverage that includes flood and typhoon risks although this requirement is not consistently (and continuously) enforced (OECD, 2020[23]). A stand-alone (low insured limit) coverage for typhoon risks is also available to commercial and residential policyholders (OECD, 2020[23]). For events with available data (2000-2019), approximately 4.5% of flood losses were insured and 9.4% of typhoon losses.[6]

Increasing the level of household and commercial insurance coverage for disaster and climate risks has been identified as a key element of the Philippines' Disaster Risk Financing and Insurance (DRFI) Strategy (Alvarez, 2019[26]). In the Philippines, a working group has been established involving the Insurance Commission, Philippine Insurance and Reinsurance Association and NatRe (national reinsurer) to develop a Philippines Catastrophe Insurance Facility (PCIF) for typhoon, flood and earthquake risks. The facility would pool these risks among insurers with the aim of broadening insurance coverage and supporting financial resilience (Philippine Insurers and Reinsurers Association (PIRA) and German Development Cooperation - Regulatory Framework Promotion of Pro-poor Insurance Markets in Asia (GIZ RFPI Asia), 2020[27]). The Insurance Commission (IC), issued a regulation to establish the PCIF in April 2021 (Insurance Commission, 2021[28]). In July 2022, the IC issued a regulation revising minimum rates for catastrophe risk insurance which will support the operation of the PCIF (Insurance Commission, 2022[29]).

The Philippines has a highly-developed microinsurance sector facilitated by a tailored regulatory framework (ADB, 2017[30]). The Philippines has the highest level of microinsurance outreach (share of population covered) in the world although the vast majority of coverage is provided for life and health (including credit life) with only a few providers offering coverage for climate risks to property (Kong and Gopalakrishna, 2020[31]).

Ensuring clarity in public financial assistance arrangements for households and businesses to mitigate future financial losses

A key element of the Philippines' DRFI Strategy is a strong link between social protection and disaster risk financing (Alvarez, 2019[26]) which involves integrating a disaster-related income support into the national conditional cash transfer programme. The Department of Budget and Management (DBM) also provides financial assistance to individuals residing in cities and municipalities affected by destructive natural disasters such as typhoons. For example, in the aftermath of Typhoon Odette in 2021, the DBM released PHP 4.85 billion to LGUs in impacted communities to provide financial assistance of up to PHP 1 000 per individual and PHP 5 000 per household. The DMB also issued complementary guidance for LGUs on the delivery of financial assistance to those affected (DMB, 2021[32]). However, there is still a need to strengthen the link between disaster risk financing and social protection by establishing a post-disaster emergency income support programme which integrates a post-disaster component in the national conditional cash transfer programme (OECD, 2020[21]).

Aligning incentives across levels of government

With the support of international donors, the country is currently transferring the primary responsibility for disaster risk reduction and climate change management from the central government to Local Government Units (LGUs).

The national government's People's Survival Fund (PSF) was created by virtue of the Republic Act (R.A.) No.10174 (Amending R.A. No. 9729 or the Climate Change Act of 2009). It is an annual fund intended for LGUs and accredited local/community organisations to implement climate change adaptation projects that will better equip vulnerable communities to deal with the impacts of climate change. It supplements the annual appropriations allocated by relevant government agencies and LGUs for climate change-related programmes and projects.

The fund has an annual allocation of PHP 1 billion in the national budget with the aim of financing adaptation programmes and projects that are directly supportive of the objectives enumerated in the Local Climate Change Action Plans (LCCAP) of LGUs and communities.

The fund is managed and administered by the PSF Board headed by the Secretary of the Department of Finance (DOF). The PSF Board shortlists and approves proposals submitted by LGUs, NGOs and CSOs.

However, proponents have reportedly faced difficulties in obtaining funding approval, resulting in a low utilisation of the fund.

To address these challenges, the PSF has a sub-financing window called the Project Development Grant (PDG) with an allocation of PHP 60 million or 6% of the annual PHP 1 billion PSF budget. It aims to help project proponents, mainly LGUs, in preparing PSF funding proposals based on concept notes that have been approved by the PSF Board and have the potential for community-level climate change adaptation.

In parallel, funds from the National Disaster Risk Reduction and Management Fund (NDRRMF) may be used for disaster risk mitigation, prevention, and preparedness activities, including the training of personnel as well as the procurement of equipment and capital expenditures. The funds can also be used for relief and reconstruction efforts, including pre-disaster activities or to replenish the Quick Response Fund when its balance has reached 50 percent.

Capacity constraints are also visible in the access to the NDRRMF (CFE-DM, 2021[33]; OECD, 2020[21]). LGUs that have exhausted their internal resources can access the NDRRMF for additional funding. However, the process of accessing such funds is intricate and lengthy which limits the approval of requests.

For many years now, the country has also considered the use of additional incentives for DRR investments at the subnational level (UNDRR, 2019[20]). Such incentives would take the form of concessional loans from the central government. This has, however, not yet been operationalised.

Budget Tracking

Collaboration between DBM, the Climate Change Commission (CCC) and Department of the Interior and Local Government (DILG) has resulted in an initiative on Climate Change Expenditure Tagging (CCET). The initiative came into effect at the national and local government levels in 2015. The purpose of CCET is to track, monitor and report climate change programmes, activities, and projects. The typology used for tracking expenditure follows that of the National Climate Change Action Plan (NCAPP), which includes long-term investments in adaptation and mitigation activities. By analysing the results of programs, activities, and projects related to climate-change, CCET supports the government in its effective implementation of the NCCAP strategy across seven priorities: food security, water sufficiency, ecosystem and environmental stability, human security, climate-smart industries and services, sustainable energy, and knowledge and capacity development. From 2019 to 2021, the country's adaptation expenditures increased to PHP 80.27 million while mitigation expenditures accrued to PHP 2.23 million. This contributed to a PHP 82.5 million increase (41% increase) to total climate change expenditures from 2018 to 2022.

The process of identifying, reporting, and tagging expenditure related to climate-change also enhances transparency. The data generated from CCET is reported in the National Integrated Climate Change Database and Information Exchange System (NICCDIES), the Philippine's integrated climate information portal launched in 2018.

The local implementation of CCET requires continuous capacity building and knowledge sharing across government levels. This collaboration has contributed to the institutionalisation of climate adaptation and mitigation into the planning and budgeting processes of both national and local government by mandating considerations related to building resilience to climate change.

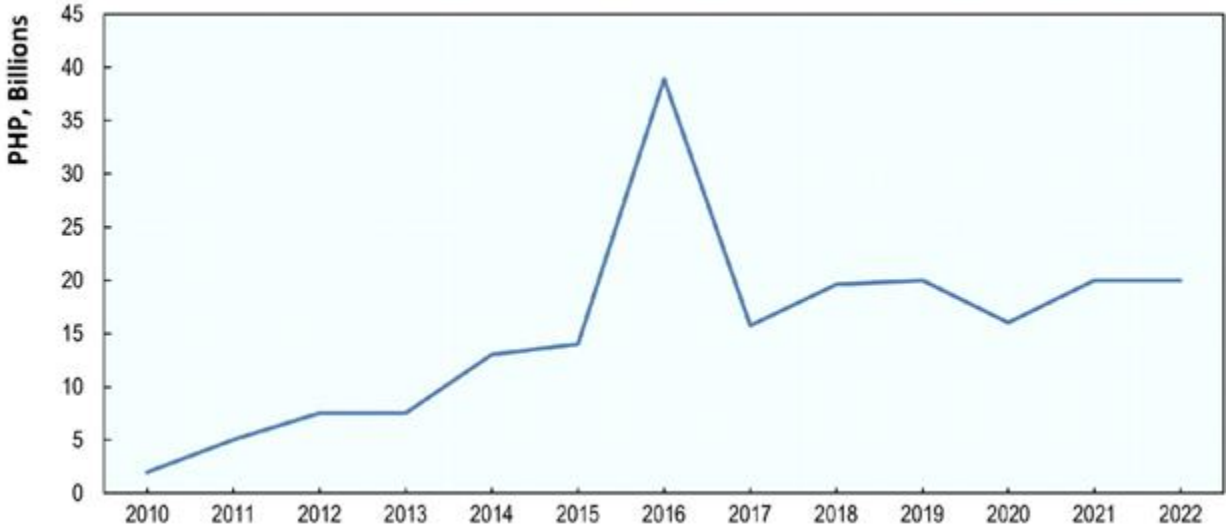
Prepare integrated multipronged government financial strategies

Assessing budgetary capacities to fund relief, recovery, and reconstruction, including through budget reallocation

National Disaster Fund

Financial reserves and contingency mechanisms are in place to support effective response and recovery when required. The Philippine Disaster Risk Reduction and Management Act established the above-noted National Disaster Risk Reduction and Management Fund (NDRRMF) in 2010 to finance both early investments in risk prevention as well as more immediate post-disaster needs. An annual allocation to the fund is set in the national budget; its size is based on recommendations from the National Disaster Risk Reduction and Management Council (NDRRMC) and subject to the approval of the President. Of the total allocation, 70% is mandated for DRR and prevention while the remaining 30% are set aside in a QRF available for relief, response, and recovery programmes. The overall allocation to the fund has increased steadily since its inception in 2010 (see Figure A A.3). This increase is due to both an increase in political focus on disaster risk management as well as increasing expenses from damages caused by more frequent and intense weather and climate events. Prior to the DRRM Act of 2010, the Calamity Fund served as the main source of funds for disaster risk management. Allocations to the NDRRM fund are made in addition to regular budget allocations to government line agencies with mandates, projects and activities that contribute to building resilience to climate impacts. These agencies include the Department of Public Works and Highways, the Department of Agriculture, the National Irrigation Agency, the Department of Transportation, the Department of Energy, and the Department of Labour and Employment.

Figure A A.3. Budget allocation to the Philippines' National Disaster Risk Reduction and Management Fund, 2010-2022



Note: the major budget increase observed in 2016 (178%) follows the devastating impact of typhoon Yolanda in late 2013. Of the PHP 38.9 billion allocated to the fund in 2016, PHP 18.9 billion (nearly 50% of the total) was allocated to the Comprehensive Rehabilitation and Recovery Plan (CRRP) for areas devastated by typhoon Yolanda.
Source: (GOVPH, 2022[34]), (GOVPH, 2017[35])

In theory, part of the 70% allocation of the NDRRM Fund towards prevention can be used for climate adaptation projects (OECD, 2020[1]). In practice, however, there can be limited funding for prevention and adaptation. A 2017 review of how the fund was disbursed over the past decade found that it is mainly used for relief, recovery and reconstruction, due to the high and immediate financing needs in these areas (OECD, 2020[1]). In some years, the amount in the NDRRM Fund has been inadequate to meet post-disaster financing needs, much less risk reduction efforts (Villacin, 2017[36]). In addition, disaster prevention activities should be included in the regular budgets of agencies rather than charged to the NDRRMF, as they can be determined in planning exercises and programmed by agencies.

Local disaster funds

The Local Disaster Risk Reduction and Management Fund (LDRRMF) is the primary instrument for LGUs. The DRRM Act of 2010 requires that LGUs set aside no less than 5% of estimated annual revenues from regular sources to their LDRRMF (OECD, 2020[1]). Those contributions are allocated as follows:

- Quick Response Fund (QRF) - 30% of the annual LDRRMF allocated for post-disaster financial liquidity. Resources from the QRF are available upon the declaration of a state of calamity at a local (city or higher) or national level by a relevant body.
- Disaster Mitigation Fund - 70% of the annual LDRRMF allocated for use in disaster prevention, mitigation, preparedness, response, rehabilitation and recovery projects identified in a city's local disaster risk reduction and management plan and integrated into its annual investment programme.[7]
- Special Trust Fund (STF) - unexpended balances of the LDRRMF at the end of a budget year accrue to a special trust fund for use within 5 years for the sole purpose of disaster risk reduction and management activities (NDCC, 2010[37]).

Budget reallocations

In the Philippines, one third of post-disaster expenditure is financed through ex ante arrangements (e.g. national disaster funds and contingency reserves). The remaining two thirds of post-disaster expenditure is mainly financed through regular budget allocations and reallocations (World Bank, 2020[38]). This heavy reliance on budget reallocations can be explained by their relative speed compared to the delays and bottlenecks experienced in the disbursements of pre-arranged funding sources for disasters (Ibid.). When a disaster strikes, the government can reallocate spending from other sectors relatively quickly to finance its disaster response.

The redistribution of budgeted resources across priorities can compromise allocative efficiency and place a disproportionate burden on national governments even though local governments also have a dedicated budget for disasters (Ibid.). In the aftermath of Typhoon Yolanda, the Department of Social Welfare and Development reallocated PHP 489.5 million in budgeted funds to purchase supplies for relief operations. These funds were replaced upon receipt of the DBM Special Allotment Release Order (SARO) from the NDRRM fund. Similarly, the Department of Health reallocated PHP 254.8 million in budgeted FY2013 appropriations to emergency purchases.

The effectiveness of the NDRRM fund is reportedly a concern as it routinely experiences bottlenecks in the approval, release and transfer of funds to implementing agencies (World Bank, 2020[38]). While the indicative timeline for the Office of Civil Defence is 15 to 30 working days and 60 working days for Local Government Units, the reported delay for the provision of NDRRM funds can exceed one year (Ibid.). These delays hinder the fund's capacity to cover the immediate spending needs that follow a disaster – the very purpose for which it was established. According to the World Bank, these delays are likely to be related to the capacity to manage a large number of requests requiring the processing and approval of different agencies (World Bank, 2020[38]).

Assessing debt market borrowing capacities

Risk financing – and particularly contingent credit facilities – also make an important contribution to funding government spending needs. The Philippines issues debt in both domestic and international markets (international debt issuance represents 27% of total debt issuance). Funding the entire estimated average annual loss (as estimated by the Government of the Philippines) with debt funding would require approximately 2.7% of the average international and domestic debt outstanding between 2016 and 2020 (for all perils, including earthquakes). As of 2020, the Philippines' national government outstanding debt was equivalent to 62.1% of GDP (of which 42.6% is domestic debt and 19.5% is external debt) (Bureau of the Treasury, 2022[39]).

Optimising financial tools under budgetary and financing constraints, within an overall framework of disaster risk management and risk reduction

Contingent credit

Contingent credit arrangements play a prominent role in the Philippines' DRFI Strategy. These arrangements provide the government with immediate liquidity when a disaster strikes. Automatic triggers can further facilitate the disbursement of these funds when a pre-set condition is met (e.g., a Presidential Declaration of a State of Calamity or public health emergency).

The Philippines has entered into four contingent credit arrangements under the World Bank's Development Policy Loan with a Catastrophe Deferred Drawdown Option (Cat DDO) programme since 2011. The most recent arrangement was approved in 2021 and provides up to USD 500 million in loans (renewable for 15 years) to address shocks related to natural disasters and health emergencies (World Bank, 2022[40]).

The ADB's Disaster Resilience Improvement Program (DRIP) is a USD 500 million loan executed by the Department of Finance. This program is part of the national government's contingent financing strategy and can be disbursed quickly following a health-related emergency or other nature-induced disaster. The DRIP came into effect in October 2020, with a three-year implementation period. It was fully disbursed as of April 23, 2021.

JICA's Post Disaster Stand-By Loan Phase 2 (PDSL2) provides JPY 50 billion in quick budget support to build resilience to climate and health related disasters. The loan agreement for PDSL2 was signed in September 2020. It was fully disbursed as of August 20, 2021.

The three facilities, if drawn down in full, would provide approximately USD 1.4 billion in funding, equivalent to approximately 39% of the Government of the Philippines' estimate of annual loss from all perils.

Official financing

Official development financing and cooperation for climate change adaptation and DRR play an important role in the Philippines. Bilateral and multilateral development partners provide technical assistance, policy support, financial aid, and in-kind disaster relief.

When a major climate disaster overwhelms both local and national governments, targeted assistance can help fill the gaps in capacities and resources. The Philippines may accept specific offers of assistance through the Philippines International Humanitarian Assistance Cluster (PIHAC), its main institutional framework for the mobilisation and coordination of international assistance. The framework also institutionalises a one-stop-shop facility to facilitate the entry of international humanitarian personnel, equipment, and in-kind support (PIHARC).

Disaster management partners can also provide policy support to pilot new initiatives and instruments. For example, the World Bank suggested revisions to the National Building code to include measures for DRR such as the incorporation of wind load related to typhoons. Other examples of policy support include a pilot for the Philippine City Disaster Insurance Pool (PCDIP)[8].

A review of adaptation-related commitments by bilateral providers and other multilateral providers reported into the OECD Creditor Reporting System show considerable variation over the period, ranging from a high of USD 586 million in 2014 to a low of USD 82 million in 2016 (OECD, 2020[1]). In general, the majority of commitments include a significant focus on adaptation. This can in part be explained by the fact that, over the period 2013-2017, nearly half of commitments targeted three broader sectors: (1) general environmental protection, (2) water supply and sanitation and (3) government and civil society. An examination of the adaptation-related commitments shows that only a small share, ranging between 1% and 11%, target the three DRM-linked sub-sectors. Again, this can be linked to the predominant focus on broader sectors that do not necessarily facilitate a focus on DRM. An exception is 2014, when Japan, ADB

and the World Bank committed post-disaster stand-by loans following Typhoon Yolanda in November 2013 (OECD, 2020[1]).

Insurance

Insurance and other financial protection mechanisms, both indemnity and event-based, are also an important element of the Philippines' DRFI Strategy. This includes indemnity-based insurance of public assets to fund reconstruction as well as various risk transfer mechanisms to provide early funding for government spending needs.

The Government Service Insurance System (GSIS) is a government entity mandated to: (i) provide various types of insurance coverage to government employees; and (ii) since 1951, administer a General Insurance Fund that provides property insurance coverage to all government-owned assets, including for disaster and climate risks. All government organisations, at national and subnational level, are legally required to acquire insurance coverage from GSIS although there is some evidence that many assets remain uninsured (or underinsured) (World Bank, 2021[16]), (OECD, 2020[1]). Since 2017, the Bureau of the Treasury (BTr) has been developing a National Asset Registry System (NARS) with the aim of improving (public) asset management. By 2020, the NARS included data on schools and hospitals, roads and bridges, irrigation facilities, social welfare centres, communications towers and power plants (Department of Finance, 2021[41]). The government plans to transfer some of the disaster-related risk to strategically important public assets to international reinsurance markets through a National Indemnity Insurance Program (NIIP) (Department of Budget and Management, 2021[42]), although the programme's planned launch has been delayed due to challenges in the insurance procurement process (de Vera, 2022[43]).

The Philippines has implemented financial protection mechanisms to provide funding based on the occurrence of an event, including a pilot parametric insurance programme (2017-2019), a catastrophe bond (issued in 2019) and is currently finalising the implementation of a Philippines City level Parametric Liquidity Program (CPLP).

In 2017-2018 and 2018-2019, through the Government (BTr), a parametric insurance coverage against typhoons and earthquakes was acquired to provide quick funding for the national government and affected local governments. The policy provided USD 206.4 million in coverage in 2018 and USD 406.7 million in coverage in 2019 (based on additional interest from the international insurance sector) and was designed to trigger based on a modelled loss (either partially or in full).[9] The funds were to be allocated equally between the national government and affected local governments although most of the funds for qualifying events were distributed to the national government (World Bank, 2021[16]). The policy was issued to the BTr by GSIS and 100% reinsured by the World Bank which transferred (retroceded) 100% of the risk to international reinsurance markets. The parametric (modelled loss) approach allowed for payment to be made to GSIS (cedant) within 3 weeks and to the policyholders and beneficiaries (national and local governments) within 30 days from the occurrence of the event (World Bank, 2021[16]). In 2019, the insurance coverage was triggered on two occasions and made payouts of PHP 1.34 billion (approximately USD 26.8 million) (Department of Budget and Management, 2021[42]).

While the parametric insurance coverage was not extended beyond the pilot phase, elements of its design were applied in the issuance of a 3-year catastrophe bond in 2019 covering typhoon (USD 150 million in coverage) and earthquake (USD 75 million in coverage) risk. Similar to the parametric insurance policy, the catastrophe bond pays out based on a modelled loss trigger. The catastrophe bond was issued by the World Bank with premiums (coupon rate[10] on bonds) paid by - and benefits accruing to - the national government (World Bank, 2019[44]). Some of the proceeds of any catastrophe bond payouts will be provided to subnational governments (local government units) impacted by such events.

The Department of Finance is also working with the Asian Development Bank on the design of a Philippine City Disaster Insurance Pool (PCDIP), currently called the CPLP, that would provide quick funding to support response and recovery at municipal level (ADB, 2018[45]). The initial proposal would provide

coverage for earthquakes and typhoons with a potential future expansion to also include flood risk. The coverage would be provided by GSIS through a special purpose vehicle that who would then seek reinsurance coverage for the pool of city risks from domestic and international reinsurance markets. Participating cities would be able to acquire coverage for different return periods, from 1-in-10 years to 1-in-100 years (ADB, 2018[45]). The national government is currently finalising the technical and operational elements of the proposal.

References

ABI and CIAT & WFP (2022), *Philippine Climate Change and Food Security Analysis*. [13]

ADB (2018), *PCDIP: Philippine City Disaster Insurance Pool*, Asian Development Bank, https://www.adb.org/sites/default/files/publication/479966/philippine-city-disaster-insurance-pool-summary.pdf. [45]

ADB (2017), *Assessment of Microinsurance as Emerging Microfinance Service for the Poor: The Case of the Philippines*, Asian Development Bank, Manila, Philippines, https://doi.org/10.22617/RPT178653-2. [30]

Alvarez, P. (2019), *The Philippines Disaster Risk Financing Strategy*, https://mefin.org/files/DOF%20Disaster%20Risk%20Financing%20Initiative.%20TWG%20P&R%2020%20May%202019.pdf. [26]

Arias, C. (2021), *Estrategia Nacional de Protección Financiera del Riesgo de Desastres, Epidemias y Pandemias*, Ministerio de Hacienda y Crédito Público. [73]

BBC (2014), *Colombia drought triggers clashes in La Guajira province*, https://www.bbc.com/news/world-latin-america-28754687 (accessed on 2 July 2022). [64]

Bureau of the Treasury (2022), *National Government Debt Indicators (1986-2022)*, Bureau of the Treasury. [39]

Cardona, O. et al. (2020), *Entregable 3: Informe con los resultados de la propuesta de medidas de adaptación y su efecto en reducción del riesgo – Fase 1*, INGENIAR Risk Intelligence Ltda. [50]

Castellanos, E. et al. (2022), *Central and South America*, Cambridge University Press. [67]

CFE-DM (2021), *2021 Philippines Disaster Management Reference Handbook*, https://reliefweb.int/report/philippines/2021-philippines-disaster-management-reference-handbook. [33]

Climate Analytics (2022), *Climate Impact Explorer*, https://climate-impact-explorer.climateanalytics.org/ (accessed on 1 August 2022). [9]

COA.GOV.PH (2014), *Assessment of Disaster Risk Reduction and Management (DRRM) at the Local Level*, https://www.coa.gov.ph/phocadownloadpap/userupload/DRRM/Assessment_of_DRRM_at_the_Local_Level.pdf. [22]

CRED/UC Louvain (2022), *EM-DAT*, https://www.emdat.be/ (accessed on 15 July 2022). [6]

Cruz, R. (2017), *2017 Philippine Climate Change Assessment: Working Group 2 Impacts, Vulnerabilities and Adaptation*. [75]

de Vera, B. (2022), "Gov't eyes insurance for P1.9T public assets", *Philippine Daily Inquirer*, https://business.inquirer.net/341501/govt-eyes-insurance-for-p1-9t-public-assets (accessed on 2 August 2022). [43]

Department of Budget and Management (2022), *Fiscal Risks Statement*, https://www.dbm.gov.ph/wp-content/uploads/DBCC_MATTERS/FiscalRiskStatement/Fiscal[1]Risks-Statement-2022-for-Circulation.pdf. [18]

Department of Budget and Management (2021), *Fiscal Risks Statement*, https://www.treasury.gov.ph/wp-content/uploads/2020/12/Fiscal-Risks-Statement-2021-for-Circulation.pdf. [42]

Department of Energy (2018), *Developing a Disaster Risk Finance and Insurance Strategy for the Philippines*, https://www.doe.gov.ph/sites/default/files/pdf/announcements/a_plenary_04_developing_disaster_risk_finance.pdf?withshield=1. [70]

Department of Finance (2021), *BTr inventories P1.3-T non-financial Gov't assets in 2020*, Department of Finance, https://www.dof.gov.ph/btr-inventories-p1-3-t-non-financial-govt-assets-in-2020/ (accessed on 2 August 2022). [41]

Department of Finance (2019), *The Philippines Disaster Risk Financing Strategy*, https://mefin.org/files/DOF%20Disaster%20Risk%20Financing%20Initiative.%20TWG%20P&R%2020%20May%202019.pdf. [69]

DMB (2021), *LGUs Receive Additional P4.85 Billion for Typhoon Odette*, Department of Budget and Management, https://www.dbm.gov.ph/index.php/secretary-s-corner/press-releases/list-of-press-releases/2043-lgus-receive-additional-p4-85-billion-for-typhoon-odette (accessed on 27 October 2022). [32]

DOST-PAGASA (2022), *DOST-PAGASA MODIFIES TROPICAL CYCLONE WIND SIGNAL (TCWS) SYSTEM*, https://www.pagasa.dost.gov.ph/press-release/108. [76]

FINAGRO (2017), *Seguro Agrícola Catastrófico en Colombia: Estudio de Factibilidad*, FINAGRO. [56]

French Development Agency (2022), *Disaster Risk Reduction: New Support for Localities in the Philippines*, https://www.afd.fr/en/actualites/disaster-risk-reduction-new-support-localities-philippines. [68]

GeoRisk Philippines (2022), *GeoRisk Philippines*. [19]

GOV.PH (2022), *Gross Domestic Product, by Industry*, https://psa.gov.ph/grdp/tables/2022 (accessed on 17 July 2022). [11]

GOV.PH (2018), *DBM Secretary discusses climate and infrastructure financing on second day of World Bank Annual Meetings*, https://www.dbm.gov.ph/index.php/secretary-s-corner/press-releases/list-of-press-releases/853-dbm-secretary-discusses-climate-and-infrastructure-financing-on-second-day-of-world-bank-annual-meetings. [74]

GOV.PH (2017), *Enhanced LGU Guidebook on the Formulation of Local Climate Change Action Plan*, https://lga.gov.ph/. [17]

GOV.PH (2014), *Second National Communication to the United Nations Framework Convention*, https://unfccc.int/sites/default/files/resource/phlnc2.pdf. [14]

Government of Colombia (2022), *Colombia's response to the Questionnaire for the review of the OECD Recommendation on Disaster Risk Financing Strategies*. [55]

Government of Colombia (2022), *Report from Colombia on implementation of the OECD Recommendation on Disaster Risk Financing Strategies (submission to the OECD Insurance and Private Pensions Committee)*. [48]

Governor's Office of Huila, Ministry of Finance and Public Credit and World Bank (2021), *Disaster Risk Management Financial Protection Strategy for the department of Huila*, Government of Huila. [59]

GOVPH (2022), *Status of National Disaster Risk Reduction and Management Fund*, https://www.dbm.gov.ph/index.php/programs-projects/status-of-national-disaster-risk-reduction-and-management-fund (accessed on 18 July 2022). [34]

GOVPH (2017), *Policy Brief: Examining the Philippines' Disaster Risk Reduction and Management System*, https://senate.gov.ph/publications/SEPO/PB_Examining%20PH%20DRRM%20System_05June2017.pdf. [35]

Hallegatte, S. et al. (2015), *Shock Waves: Managing the Impacts of Climate Change on Poverty*, Washington, DC: World Bank, https://doi.org/10.1596/978-1-4648-0673-5. [15]

Insurance Commission (2022), *Guidelines on the Adoption of the Revised Schedule of Minimum Catastrophe Rates*. [29]

Insurance Commission (2021), *Key Statistical Data: 2016-2020*, Insurance Commission, https://www.insurance.gov.ph/summary-from-2016-2020/. [24]

Insurance Commission (2021), *Strict Implementation Of Sustainable Catastrophe Insurance Premium Rates And Establishment Of The Philippine Catastrophe Insurance Facility (PCIF)*. [28]

IPBES (2018), *Summary for policymakers of the regional assessment report on biodiversity and ecosystem services fro Asia and the Pacific of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. [12]

IPCC (2021), *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press. [61]

Kong, D. and I. Gopalakrishna (2020), *Philippines: Highly developed microinsurance market; 90% respondents rate microinsurance as very important*, https://www.asiainsurancereview.com/Milliman/MillimanArticle/aid/25/-a-href-articleLink-class-subcat-sapn-class-red-Philippines-sapn-Highly-developed-microinsurance-market-90-respondents-rate-microinsurance-as-very-important-a- (accessed on 1 August 2022). [31]

L'Hereux, M. (2014), *What is the El Niño–Southern Oscillation (ENSO) in a nutshell?*, https://www.climate.gov/news-features/blogs/enso/what-el-ni%C3%B1o%E2%80%93southern-oscillation-enso-nutshell (accessed on 22 June 2022). [62]

Met Office (2017), *Improving resilience to severe weather and climate change in the Philippines*. [77]

Met Office (2017), *Improving resilience to severe weather and climate change in the Philippines*, https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/business/international/17_0015-pagasa_case_study_final.pdf. [78]

Ministerio de Hacienda y Crédito Público (2021), *Estrategia Nacional de Protección Financiera de Riesgo de Desastres, Epidemias y Pandemias*. [57]

Ministry of Finance and Public Credit (2011), *Contingent Liabilities: The Colombia Experience*, Ministry of Finance and Public Credit. [51]

Nagy, G. et al. (2019), "Climate vulnerability, impacts and adaptation in Central and South America coastal areas", *Regional Studies in Marine Science*, Vol. 29, p. 100683, https://doi.org/10.1016/j.rsma.2019.100683. [60]

NDCC (2010), *Implementing Rules and Regulations of Republic Act No. 10121*, https://ndrrmc.gov.ph/attachments/article/95/Implementing_Rules_and_Regulartion_RA_10121.pdf. [37]

NDRRMC (2013), *Final Report re Effects of Typhoon "YOLANDA" (HAIYAN)*, https://ndrrmc.gov.ph/attachments/article/1329/FINAL_REPORT_re_Effects_of_Typhoon_YOLANDA_(HAIYAN)_06-09NOV2013.pdf. [5]

OECD (2022), *OECD Insurance Statistics (database)*. [25]

OECD (2021), *Managing Climate Risks, Facing up to Losses and Damages*, OECD Publishing, Paris, https://doi.org/10.1787/55ea1cc9-en. [79]

OECD (2020), "Approaches in the Philippines to increased coherence in climate change adaptation and disaster risk reduction", in *Common Ground Between the Paris Agreement and the Sendai Framework : Climate Change Adaptation and Disaster Risk Reduction*, OECD Publishing, Paris, https://doi.org/10.1787/4ec0f8bc-en. [1]

OECD (2020), *Approaches in the Philippines to increased coherence in climate change adaptation and disaster risk reduction*, OECD Publishing, https://doi.org/10.1787/4ec0f8bc-en. [21]

OECD (2020), *Leveraging the Role of Property Catastrophe Reinsurance Markets: The Case of India, Indonesia, Myanmar, and the Philippines*, OECD, https://www.oecd.org/finance/insurance/leveraging-the-role-of-property-catastrophe-reinsurance-markets.htm (accessed on 15 July 2021). [23]

OECD (2017), *OECD Insurance Statistics (database)*, http://stats.oecd.org/Index.aspx?DatasetCode=INSIND (accessed on 26 March 2018). [52]

OECD/The World Bank (2019), *Fiscal Resilience to Natural Disasters: Lessons from Country Experiences*, OECD Publishing, Paris, https://doi.org/10.1787/27a4198a-en. [54]

Office of the Governor of Putumayo, Ministry of Finance and Public Credit and World Bank (2021), *Financial Protection Strategy for the Management of Disaster Risks in the Putumayo Department*. [58]

PAGASA (2022), *Tropical Cyclone Information*. [4]

PAGASA (2021), *Annual Tropical Cyclone Tracks*, https://www.pagasa.dost.gov.ph/information/annual-cyclone-track. [8]

Philippine Insurers and Reinsurers Association (PIRA) and German Development Cooperation - Regulatory Framework Promotion of Pro-poor Insurance Markets in Asia (GIZ RFPI Asia) (2020), *Climate and Disaster Risk Insurance-related Country Experience: Philippine Catastrophe Insurance Facility (PCIF)*, The Mutual Exchange Forum on Inclusive Insurance (MEFIN) Network, https://www.mefin.org/docs/CDRI-Philippine-Catastrophe-Insurance-Facility-Factsheet-2020.pdf. [27]

Ranasinghe, R. et al. (2021), *Climate Change Information for Regional Impact and for Risk Assessment*, Cambridge University Press. [66]

Senviratne, S. et al. (2021), *Weather and Climate Extreme Events in a Changing Climate*, Cambridge Unversity Press. [65]

Shaw, R. et al. (2022), *Asia*, Cambridge University Press. [7]

Swiss Re sigma (2020), *Natural catastrophes and man-made disasters: 1990-2019 (dataset)*, Swiss Re. [53]

UNDRR (2020), *The human cost of disasters: an overview of the last 20 years (2000-2019)*. [3]

UNDRR (2019), *Disaster Risk Reduction in the Philippines, Status Report*, https://www.unisdr.org/files/68265_682308philippinesdrmstatusreport.pdf. [20]

Unidad Nacional para la Gestión del Riesgo de Desastres (2018), *Atlas de Riesgo de Colombia: revelando los desastres latentes*, Government of Colombia. [49]

Villacin, T. (2017), "A review of Philippine government disaster financing for recovery and reconstruction", *PIDS Discussion Paper Series*, Vol. 2017/21, http://hdl.handle.net/10419/173598. [36]

WEF (2020), *Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy*. [10]

World Bank (2022), *Current Climate: Colombia*, https://climateknowledgeportal.worldbank.org/country/colombia/climate-data-historical (accessed on 15 July 2022). [71]

World Bank (2022), *Current Climate: Philippines*, https://climateknowledgeportal.worldbank.org/country/philippines/climate-data-historical (accessed on 20 July 2022). [2]

World Bank (2022), *Strengthening the Philippines' Post-disaster Financial Resilience through Support at the National and Local Levels*, World Bank, https://www.worldbank.org/en/news/feature/2022/04/05/strengthening-the-philippines-post-disaster-financial-resilience-drmhubtokyo (accessed on 1 August 2022). [40]

World Bank (2021), *Climate Risk Profile: Colombia*. [63]

World Bank (2021), *Lessons Learned: The Philippines Parametric Catastrophe Risk Insurance Program Pilot (Evaluation Report)*, World Bank, https://openknowledge.worldbank.org/handle/10986/36013. [16]

World Bank (2020), *Public Expenditure Review : Disaster Response and Rehabilitation in the Philippines*. [38]

World Bank (2019), *Super-sized Catastrophe Bond for Earthquake Risk in Latin America*, World Bank. [46]

World Bank (2019), *World Bank Catastrophe Bond Transaction Insures the Republic of Philippines against Natural Disaster-related Losses Up to US$225 million*, World Bank, https://www.worldbank.org/en/news/press-release/2019/11/25/world-bank-catastrophe-bond-transaction-insures-the-republic-of-philippines-against-natural-disaster-related-losses-up-to-usd225-million (accessed on 2 August 2022). [44]

World Bank (2012), *Thai Flood 2011 : Rapid Assessment for Resilient Recovery and Reconstruction Planning*, World Bank. [47]

World Bank & ADB (2021), *Climate Risk Profile: Philippines*. [72]

Notes

[1] The total number of affected people (149 million) is higher than the population of the Philippines (approximately 112 million) because the number of affected people is counted per year (i.e. people can be counted multiple times if they are affected by multiple disasters across different years).

[2] Based on the modified Tropical Cyclone Wind Signal (TCWS) system of the PAGASA-DOST, typhoon (TY) is a tropical cyclone with maximum wind speed of 118 to 184 kph and super typhoon (STY) is a tropical cyclone with maximum wind speed exceeding 185 kph (DOST-PAGASA, 2022[76]).

Floods and landslides have become more frequent, as is shown by Figure A A.2 (note that the 2022 data ends in July, which likely explains the drop of the last data point). These are driven, at least partially, by stronger typhoons and extreme precipitation events which have become more frequent (Shaw et al., 2022[1]). Stronger typhoons also lead to more severe landslides (World Bank & ADB, 2021[9]). For example, the average annual loss associated with flooding in the Philippines is around USD 625 million (World Bank & ADB, 2021[9]). There is no discernible trend for droughts in Figure A A.2. Frequency of floods and landslides has increased in the Philippines.

[3] While the current and past observations of hazards are made for the Philippines specifically, the uncertainties associated with climate projections are not country-specific (see Chapter 2 of (OECD, 2021[79])), but are made for wider regions, in the case of Philippines to South-East Asia.

[4] The Supreme Court (SC) ruled that the just share of LGUs from the national taxes is not limited to "national internal revenue taxes" collected by the Bureau of Internal Revenue (BIR) but includes collections (customs duties) by the Bureau of Customs (BOC).

[5] For example, the National Disaster Risk Reduction and Management Council Operations Center (NDRRMC OC) has been collecting data on damages to properties by type (i.e., agriculture, infrastructure, private) caused by tropical cyclones since 2011.

[6] OECD calculations based on data provided by (Swiss Re sigma, 2020[53]).

[7] Source: https://dilg.gov.ph/PDF_File/issuances/joint_circulars/DILG-Joint_Circulars-2013417-26053e1cc9.pdf.

[8] Formerly known as the PCDIP, the USD2.5 million Technical Assistance grant will be funded from the ADB Regional Technical Assistance (RETA) 9766: Southeast Asia Public Management, Financial Sector, and Trade Policy Facility

[9] A modelled loss trigger is designed to make payments based on the whether the actual parameters of the event exceed specific thresholds as defined in a designated catastrophe model. The most common threshold is a modelled loss level (i.e. where a model is used to estimate losses based on the parameters of the event and payouts are made if the loss exceeds a specific threshold). In this policy, payouts were made based on the estimated annual probability of occurrence of an event with the parameters of the actual event – providing a partial payout for events with a probability of occurrence of between 3.3% and 10% and a full payout for events with a probability of occurrence below 3.3% (World Bank, 2021[16]).

[10] The coupon rate was set as the 3-month LIBOR rate plus a funding margin (-0.12%) and risk margin (+5.65% in the case of tropical cyclones) (World Bank, 2019[44]).

Building Financial Resilience to Climate Impacts

A FRAMEWORK FOR GOVERNMENTS TO MANAGE THE RISKS OF LOSSES AND DAMAGES

Governments are facing significant climate-related risks from the expected increase in frequency and intensity of cyclones, floods, fires, and other climate-related extreme events. The report *Building Financial Resilience to Climate Impacts: A Framework for Governments to Manage the Risks of Losses and Damages* provides a strategic framework to help governments, particularly those in emerging market and developing economies, strengthen their capacity to manage the financial implications of climate-related risks. The goal of the framework is to support sound public financial management strategies that take into account budgetary and financing constraints, and to foster broader actions at the national and international levels.

The report examines the role of governments in identifying and assessing climate-related physical risks and their impacts on public finances, and reporting climate-related fiscal risks to promote transparency in public financial management. It discusses how to mitigate those risks through protecting households and businesses, and developing integrated multipronged financial strategies to fund government expenditure needs. Finally, it calls for promoting integrated strategies to strengthen financial resilience at the country and regional levels, and for mobilising development co-operation to strengthen global climate financial resilience.

Federal Ministry
for Economic Cooperation
and Development

PRINT ISBN 978-92-64-92067-5
PDF ISBN 978-92-64-80119-6

9 789264 920675