IAIS International Association of Insurance Supervisors

Global Insurance Market Report (GIMAR)

SPECIAL TOPIC EDITION

Potential financial stability implications of natural catastrophe insurance protection gaps

NOVEMBER 2025

About the IAIS

The International Association of Insurance Supervisors (IAIS) is a voluntary membership organisation of insurance supervisors and regulators from more than 200 jurisdictions. The mission of the IAIS is to promote effective and globally consistent supervision of the insurance industry in order to develop and maintain fair, safe and stable insurance markets for the benefit and protection of policyholders and to contribute to global financial stability.

Established in 1994, the IAIS is the international standard-setting body responsible for developing principles, standards and other supporting material for the supervision of the insurance sector and assisting in their implementation. The IAIS also provides a forum for members to share their experiences and understanding of insurance supervision and insurance markets.

The IAIS coordinates its work with other international financial policymakers and associations of supervisors or regulators and assists in shaping financial systems globally. In particular, the IAIS is a member of the Financial Stability Board (FSB), member of the Standards Advisory Council of the International Accounting Standards Board (IASB), and partner in the Access to Insurance Initiative (A2ii). In recognition of its collective expertise, the IAIS also is routinely called upon by the G20 leaders and other international standard-setting bodies for input on insurance issues as well as on issues related to the regulation and supervision of the global financial sector.

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About this report

This is the special topic edition of the Global Insurance Market Report (GIMAR). The regular GIMAR presents the outcomes of the IAIS' Global Monitoring Exercise (GME), which is the IAIS' framework for monitoring risks and trends in the global insurance sector and assessing the possible build-up of systemic risk. Special topic editions of the GIMAR delve deeper into relevant topics stemming from each year's GME.

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Acronyms and abbreviations

ARC	African Risk Capacity (Group)
ACC	Accident Compensation Commission
ASF	Portuguese Insurance and Pension Fund Supervisory Authority
BIS	Bank for International Settlements
CCDRs	Country Climate and Development Reports
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CPI	Consumer price index
EMDE	Emerging market and developing economy
EQC	Earthquake Commission
FDI	Foreign direct investment
FDIC	First Domestic Insurance Company (in Dominica)
FSAP	Financial Sector Assessment Program
FSB	Financial Stability Board
FSI	Financial Stability Institute
G7	Group of Seven
G20	Group of Twenty
GDP	Gross domestic product
GIMAR	Global Insurance Market Report
GME	Global Monitoring Exercise
GWP	Gross written premiums
IAIS	International Association of Insurance Supervisors
IBC	Insurance Bureau of Canada
ICS	Insurance Capital Standard
IMF	International Monetary Fund
NatCat	Natural catastrophe
NHC	Natural Hazards Commission Toka Tū Ake
NPL	Non-performing loan
OECD	Organisation for Economic Co-operation and Development
PACICC	Property and Casualty Insurance Compensation Corporation
PDNA	Post-Disaster Needs Assessment
SFWG	Sustainable Finance Working Group (of the G20)
SWM	Sector-wide monitoring (part of the GME)
WBG	World Bank Group

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Executive summary

Natural catastrophe (NatCat) events can have profound economic and societal implications. Given the increasing frequency and severity of extreme weather events, as well as growing urbanisation in areas subject to NatCat events, the impacts will continue to endure. Despite the critical role of insurance in mitigating these impacts, significant protection gaps (ie, uninsured economic losses) persist globally, potentially posing risks to financial stability and economic resilience.

This special topic edition of the Global Insurance Market Report (GIMAR) explores the potential financial stability implications of NatCat protection gaps and examines their drivers, trends and impacts through a combination of theoretical analysis and case studies.

The findings of this report highlight the importance of coordinated global efforts to address NatCat protection gaps. While the historical case studies of NatCat events in this report did not lead to financial instability, widening protection gaps (eg through a reduction in the insurability of assets due to the increasing frequency and severity of weather-related events) could increase systemic risk, for instance by shifting more risks to the banking sector. Strengthening insurance markets, enhancing resilience and fostering collaboration can help mitigate the economic, financial and societal impacts of NatCat events. The IAIS remains committed to supporting its members in advancing this agenda for addressing protection gaps.

KEY FINDINGS

NatCat protection gaps arise from a combination of factors, including the uninsurability of certain risks, affordability issues and lack of risk awareness. Globally, insurance absorbs significant economic losses, supports recovery and can incentivise risk reduction. However, the uninsured portion of economic losses remains substantial, particularly in emerging market and developing economies (EMDEs). For instance, in 2024, at least 57% of global NatCat economic losses were uninsured (see Figure 2).

NatCat events can disrupt the real economy, financial sector and societal structures through direct and indirect impacts. Direct impacts include damage to infrastructure, homes and businesses, while indirect effects may follow from increased credit risks, reduced investment and heightened sovereign debt burdens. Insurance can mitigate these impacts; however, low coverage levels in high-risk regions expose

vulnerabilities. The case studies in this report provide insight into the potential for systemic risks, particularly in jurisdictions with concentrated exposures. For example, in the future, a reduction in the insurability of assets linked to bank lending could lead to systemic risk and financial instability.

The report presents six case studies – four that examine historical NatCat events and two that include forward-looking, modelled scenarios. The case studies provide valuable insights into the diverse impacts of NatCat events across different economic and insurance market contexts. Key findings include:

- Insurance payouts, reinsurance arrangements and government-backed schemes were mechanisms that mitigated the impact on the financial sector. However, the availability of these mechanisms varies significantly across jurisdictions, and their sustainability is uncertain given the expected increase in the frequency and severity of weather-related events, growing urbanisation and expanding/exposures in areas particularly prone to several NatCat risk perils.
- The economic impacts of NatCat events are often concentrated in specific sectors, such as agriculture, housing and infrastructure, with considerable knock-on effects for employment, income levels and public finances.
- Societal impacts, including displacement, poverty and health challenges, disproportionately affect vulnerable populations, exacerbating inequalities and delaying recovery efforts.

Despite the critical role of insurance in mitigating the impacts from NatCat events, significant protection gaps persist globally, potentially posing risks to financial stability and economic resilience.

- Insurance plays a critical role in mitigating financial and societal impacts, but significant protection gaps remain, particularly in EMDEs.

A case study approach offers valuable insights, but it also has limitations. Case studies based on historical events may not fully capture future risks, particularly those exacerbated by changes in the frequency and severity of weather-related events or by events with recurrence periods of several hundred years. Translating these risks into expected losses is challenging, as there is no track record available. Additionally, findings and lessons derived from one jurisdiction may not be applicable to others given the unique circumstances and contexts of each country.

NEXT STEPS

Insurance plays a critical role in reducing the economic and financial impacts of NatCat events. Thus, the report underscores the importance of strengthening insurance penetration, particularly in vulnerable regions. The IAIS, with its members, will continue efforts to assess and address NatCat protection gaps and collaborate with partners on this critical issue. Ongoing and planned commitments include:

- Data collection: The IAIS will consider further updates to its 2026 Global Monitoring Exercise (GME) data collection as well as opportunities to identify additional data sources on NatCat protection gaps, including external data sources, to strengthen the global understanding of NatCat protection gaps. IAIS members will play a key role in providing jurisdictional data and insights.
- Global collaboration: The IAIS will continue contributing to the Financial Stability Board (FSB) work on vulnerability analysis.
- Practical guidance: Building on the G20 Sustainable Finance Working Group (SFWG) input paper on NatCat protection gaps,[1] the IAIS, in collaboration with its members, the World Bank and other international organisations, will develop practical guidance and tools to assist policymakers and supervisors in addressing NatCat protection gaps.
- Knowledge sharing: The IAIS will continue to provide a platform for its members to share experiences, insights and challenges to foster a deeper understanding of NatCat protection gaps and promote effective solutions.

Through undertaking these next steps, the IAIS can help members strengthen their preparedness and better address potential challenges within their jurisdictions.

The IAIS will continue efforts to assess and address NatCat protection gaps through collaboration with members and partners.

[1] See IAIS/World Bank Group (2025), G20 SFWG input paper: Identify and address insurance protection gaps.

1. Introduction

One of the core objectives of the IAIS is to monitor and respond to key risks and trends in the global insurance sector. The IAIS assesses these trends and risks primarily through its annual Global Monitoring Exercise (GME), with results reported through the IAIS Global Insurance Market Report (GIMAR).

GIMAR special topic editions delve deeper into emerging trends or risks, or specific insurance sector issues. This special topic edition contributes to the IAIS' work on understanding and addressing natural catastrophe (NatCat) protection gaps, which is a key priority for the IAIS.

NatCat events[2] can have severe economic and financial stability implications, as well as devastating human and societal impacts. Insurance plays a vital role in enhancing resilience by providing risk assessment and risk management solutions, incentivising risk prevention, absorbing economic losses and supporting recovery efforts. Given the increasing frequency and severity of weather-related events and continued growth of exposures in high-risk areas, the NatCat protection gap could widen in future years if growth in insurance coverage does not match the growth in NatCat exposures.

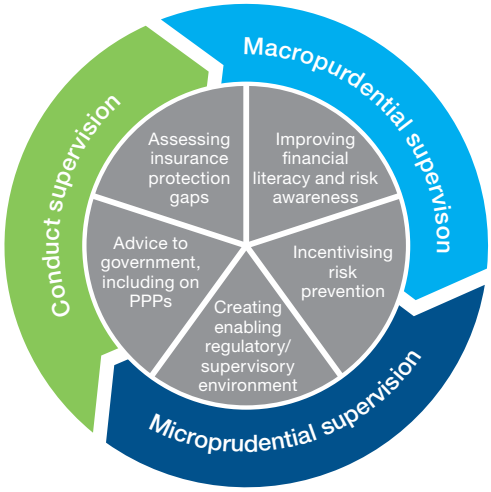
The primary objective of this GIMAR special topic is to explore the potential financial stability implications of NatCat protection gaps. Additionally, the report examines NatCat protection gap drivers, trends and impacts through a combination of theoretical analysis and case studies. As a global study of the issue can be a challenge, in part due to data limitations, the report uses case studies (covering six countries and various types of events) as well as a review of existing research on the topic to assess whether NatCat protection gaps have contributed to financial instability or could potentially lead to financial stability risks.

[2] In this report, the term "natural catastrophe" (NatCat) refers to damages caused or accentuated by events such as floods, earthquakes and storms and could be used interchangeably with the term "disaster risk", which is commonly used by other organisations such as the Organisation for Economic Co-operation and Development (OECD), the World Bank Group (WBG) and the United Nations.

1.1 RELATION TO OTHER IAIS WORK

This report builds on the IAIS' 2023 Call to Action report,[3] which outlined five major categories of action for insurance supervisors. As illustrated in Figure 1, a supervisory initiative can cover multiple categories of action and the recommended actions can also support multiple supervisory objectives. This report specifically supports the actions related to the assessment of protection gaps, including the analysis of the possible impact of protection gaps on the real economy and financial system.

FIGURE 1: Spectrum of supervisory activities to address protection gaps



Source: IAIS (2023), A call to Action

This report also complements other ongoing IAIS' work in this area. It builds on the regular GIMAR climate chapters,[4] where the IAIS has analysed how severe NatCat scenarios could significantly affect insurers' solvency. In addition, the IAIS is making significant efforts to promote solutions to address NatCat protection gaps. This includes fostering multi-stakeholder collaboration and clarifying the role that insurance supervisors can play. In this regard, the IAIS works with partners including the Financial Stability Institute (FSI) of the Bank for International Settlements (BIS), the Group of Seven (G7), the Group of Twenty (G20), the Organisation for Economic Co-operation and Development (OECD) and the World Bank Group (WBG). Most recently, the IAIS and the WBG developed an input paper to support the G20 Finance Track.[5]

NatCat events can have severe economic and financial stability implications, as well as devastating human and societal impacts.

[3] See IAIS (2023), A call to action: the role of insurance supervisors in addressing natural catastrophe protection gaps.

[4] See the dedicated GIMAR page on the IAIS website.

[5] IAIS-WBG (2025) input paper to G20 Sustainable Finance Working Group: Identify and assess insurance protection gaps.

1.2 SCOPE OF THE REPORT

While insurance protection gaps may exist in many areas, this report focuses solely on NatCat protection gaps (referred to in this report as "protection gaps").

Varying types of NatCat events are covered, including droughts, earthquakes, floods and hurricanes, which are sometimes referred to as "natural hazards". "Extreme weather events" is also a term used to describe some of these events (like floods, hurricanes and droughts). Long-term changes to weather patterns and their possible impact on the economy or financial sector are out of scope – as these are typically seen as uninsurable (see Section 2).

1.3 SOURCES

Most data referenced in this report are taken from public sources (including the work of partner organisations or industry). The IAIS also used its annual data collection through the GME for inputs from insurance supervisors. A total of 34 IAIS members[6] provided information as part of the sector-wide monitoring (SWM), including aggregate insurance market data and qualitative information.

1.4 STRUCTURE

The report is structured as follows. Section 2 provides a definition of NatCat protection gaps and describes underlying drivers, trends and measurement. Section 3 sets out the theory to analyse how NatCat events may impact the financial system and real economy. Section 4 discusses how the presence or absence of insurance protection against NatCat events can either mitigate or amplify these financial stability risks, building on the key insights from the case studies. Section 5 discusses supervisory responses and mitigating actions to address NatCat protection gaps. Section 6 concludes and shares next steps for the IAIS. Annex 1 provides a more detailed description of the case studies. Annex 2 provides a summary of related analysis performed by the WBG.

[6] SWM 2025 participating jurisdictions that provided information on protection gaps are Albania, Australia, Austria, Belgium, Bermuda, Canada, Chile, China, Chinese Taipei, Croatia, Czech Republic, Denmark, Estonia, France, Germany, Guatemala, Italy, Japan, Korea, Lithuania, Malaysia, Mexico, Moldova, Netherlands, Poland, Portugal, Romania, Singapore, Slovenia, South Africa, Switzerland, United Kingdom, United States and Uruguay.

2. NatCat insurance protection gaps

2.1 DEFINITION OF PROTECTION GAP AND ITS COMPONENTS

Insurance protection gaps can be interpreted in multiple ways.[7] A common definition of the insurance protection gap in relation to NatCat is the uninsured portion of economic losses caused by a natural disaster. NatCat economic losses include all the insured and uninsured financial losses directly attributable to a NatCat event, eg the property damage to buildings, infrastructure or vehicles. Economic losses also include losses due to business interruption as a direct consequence of the property damage. Economic losses do not include indirect financial losses such as loss of earnings by suppliers due to disabled businesses, estimated shortfalls in gross domestic product (GDP) and non-financial losses such as loss of reputation or impaired quality of life. In the context of the protection gap, NatCat insured losses do not include liability or life insurance (eg due to deaths from the event).

2.2 DRIVERS OF PROTECTION GAPS

Reasons for no or low levels of insurance coverage for NatCat events are wide-ranging and may include:

- Uninsurable nature of some risks;
- Barriers to offering insurance;
- Affordability of insurance;
- Lack of awareness of available insurance or of risks; and
- Decision not to insure (including self-insurance).

While this report does not examine these drivers in detail, each is described briefly below. The drivers of protection gaps are particularly relevant when designing actions to narrow the gap (see Section 5).

Reasons for no or low levels of insurance coverage for NatCat events are wide-ranging and may include uninsurable risks, affordability and lack of awareness.

[7] See also IAIS (2023).

2.2.1 Uninsurable nature of some risks and barriers to offering insurance

To be insurable, risks typically meet certain criteria, such as:

- There are a large number of similar exposures, as insurance operates through pooling, allowing insurers to benefit from the law of large numbers in which predicted losses are similar to actual losses.
- Loss is accidental and unintentional.
- Loss is determinable and measurable, and both the probability of loss and the costs are estimable.
- Premium is economically feasible, ie the likelihood of the event is not so high or the cost of the event so large that the resulting premium would lead to no or low take-up of the insurance protection.

Risks that do not meet the above criteria are also termed "inherently uninsurable". Examples of uninsurable risks include chronic risks, such as sea level rise and heatwaves, with regular or predictable occurrence.

Even when risks are technically insurable, there can be regulatory or market measures that create a barrier to offering insurance. For example, premium limits or product design constraints can limit insurers' ability to offer coverage if insurers are unable to adequately reflect the risk exposure within the imposed constraints on pricing or product design.

2.2.2 Affordability of insurance

Insurance may be available but too expensive for some individuals or businesses. Affordability of insurance can become a wider issue if insurance premiums increase significantly, for example, to reflect expected higher claims costs following a recent occurrence of a NatCat event or expected increases in the frequency and severity of weather-related events.

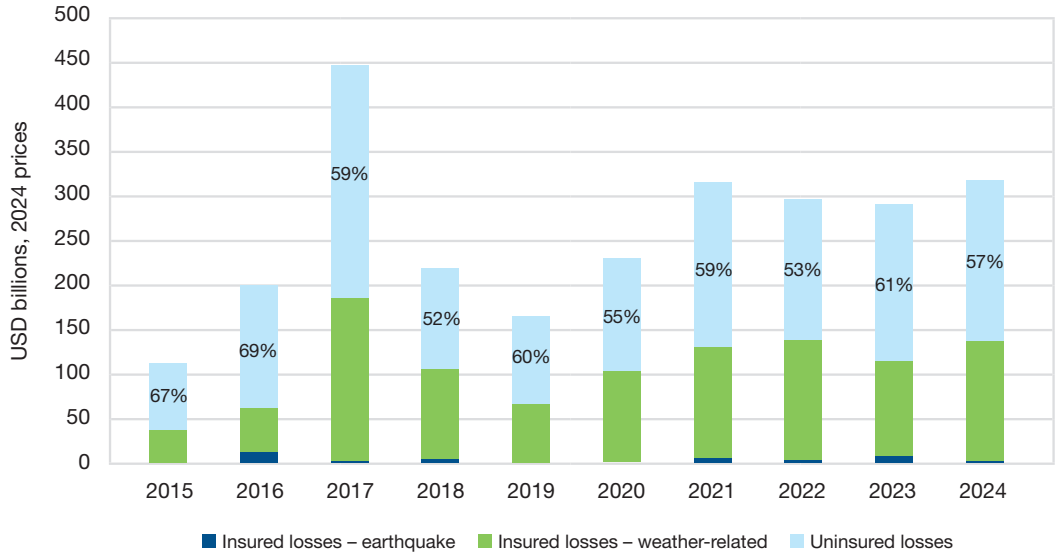
Primary insurers use reinsurance[8] to mitigate their NatCat exposure and to lower capital requirements. Increasing costs of reinsurance directly impact the cost of primary insurance if insurers pass the costs on to policyholders. As most relevant insurance policies renew yearly (or more frequently), insurers and reinsurers regularly update pricing for the risk of NatCat events to reflect the latest experience and changing risk profile as well as market conditions. Another issue that can drive up the cost of insurance, and thereby limit its affordability, is a lack of reliable data or models for insurers to accurately price the risk. This can lead to more prudent pricing and can be especially relevant in EMDEs, where data and model gaps may be more prominent.

2.2.3 Lack of awareness of available insurance or of risks and the decision not to insure

A lack of awareness or conscious decisions not to purchase insurance can also contribute to protection gaps. Some individuals and businesses may not fully understand the risks they face or the benefits of insurance. Other individuals or businesses may choose not to insure either because they underestimate the risk or because of a decision to self-insure. For instance, larger corporates frequently deem self-insurance to be more cost-effective in the long term.

[8] For a detailed discussion on the role of reinsurance and the NatCat protection gap, see IAIS/FSI (2025), Mind the climate-related protection gap – reinsurance pricing and underwriting considerations.

FIGURE 2: Global insured and uninsured losses from NatCat events



Source: Swiss Re Sigma, April 2025

Another potential factor contributing to protection gaps for NatCat risks is where governments are known or expected to be the insurer of last resort. In some jurisdictions, the government typically steps in to provide risk absorption and a financial backstop through social grants or payments. Because of expectations that the government will provide financial relief, consumers and businesses may be disincentivised to take out insurance cover (creating moral hazard).

Figure 2 also shows the portion of economic losses that was uninsured and the resulting protection gap in percentages, at a global level. Both the total economic losses and the protection gap vary significantly from year to year, which is not unexpected given that the type, magnitude and location of NatCat events impact the magnitude of the global protection gap in a specific year as does the level of insurance penetration and coverage, which varies significantly by peril and country.[9]

2.2.4 Trends in economic and insured losses

Total economic losses from NatCat events have grown in recent years (see Figure 2). This growth can be explained by a combination of various (socio)economic factors (eg economic growth, inflation and urbanisation) as well as climate-related factors (increasing frequency and severity of extreme weather events).

The future trend in economic losses will depend on several factors, such as changes in exposures (amount and location), vulnerability of exposed properties, the frequency and severity of NatCat events and the investment in prevention, risk reduction and adaptation measures. Understanding the impact of increasing frequency and severity of weather-related events is particularly important, as there is high variability of impact across different geographies and different perils.[10]

[9] For instance, for a description of trends within Europe between 1980 and 2020, including on the large variability between years and countries, see European Environment Agency (2022), Economic losses and fatalities from weather- and climate-related events in Europe.

[10] See IAIS (2024), Global Insurance Market Report, Section 5.3.3, which relies on estimates from the CLIMADA Technologies tool. For more details about the tool and how to access it (for IAIS members only), see the IAIS Climate Risk page. Swiss Re published information reports on expected losses based on its modelling of future events. On a prospective basis, it uses its proprietary models to estimate expected economic and insured losses for a range of NatCat events for 39 countries and reports an insurance resilience index that captures actual and expected changes over time. See SwissRe global resilience index.

2.3 INSIGHTS FROM IAIS MEMBERS

As part of the 2025 GME, the IAIS included various qualitative questions in the SWM about how NatCat protection is provided for and the underlying drivers for protection gaps. Thirty-four members responded, of which eight members are from an EMDE jurisdiction. Box 1 provides a snapshot of these responses.

BOX 1: IAIS member responses on NatCat coverage and protection gaps

The results of the SWM indicate:

- Insurance of NatCat perils is typically offered by private insurers. Nevertheless, in roughly one quarter of IAIS member jurisdictions, NatCat insurance is offered through insurance schemes with some level of public support. Often such insurance schemes do not provide NatCat cover for all perils. In such jurisdictions, it is likely that the level of protection gaps varies substantially by peril.
- Often, making NatCat insurance coverage mandatory and/or offering subsidies are seen as ways of addressing protection gaps. However, according to the SWM responses, only about 10% of jurisdictions have mandated NatCat insurance cover, and even fewer jurisdictions offer premium subsidies.
- In one quarter of responding jurisdictions, there are some regulatory or legal restrictions imposed on insurers when setting property insurance premium rates. This can constrain insurers' ability to maintain risk-based pricing and thus challenges their ability to sustainably provide insurance coverage.
- While only half of the responses provided a view on the availability of reinsurance capacity, most of the responses indicated a high availability of reinsurance capacity in their jurisdictions. In some jurisdictions, publicly backed reinsurers are set up, which helps provide reinsurance capacity in stressed conditions.
- In most jurisdictions, there are practices by banks to require NatCat insurance as a condition for bank financing (including mortgages). However, only a few jurisdictions require insurance coverage.
- In the majority of jurisdictions, there are practices of providing post-disaster relief funds, which can mitigate to some extent the immediate impact of NatCat events.

3. Framework for assessing financial stability risks of NatCat events

This section explores how NatCat events could pose risks to financial stability. It examines the impacts of NatCat events on the real economy, the financial sector and society at large. It also discusses possible secondary impacts, including feedback and amplification effects within and between different sectors of the economy and financial system.

This section – and the report as a whole – primarily focuses on the impacts of NatCat events at a local (jurisdictional) level. However, this section concludes with a brief reflection on potential cross-border and global implications. As highlighted in this section, the impact of NatCat events on financial stability is highly heterogeneous; it is largely dependent on the specific circumstances in a jurisdiction, as effects can interact with existing financial vulnerabilities[11] in the financial system and real economy.

While this section provides a theoretical framework for assessing the potential financial stability impact of NatCat events, the next section (Section 4) examines how the presence or absence of insurance protection against NatCat events can either mitigate or amplify this potential financial stability impact, based on insights from jurisdictional case studies.

3.1 CONTEXT AND KEY CONCEPTS

The analysis of financial stability risks in this report builds on the IAIS Holistic Framework for the assessment and mitigation of systemic risk in the insurance sector ("Holistic Framework")[12] as well as an analytical framework that the Financial Stability Board (FSB)[13] published in early 2025 on how physical and transition climate risks can be transmitted and amplified by the global financial system.

[11] Defined by the FSB as "a property of the financial system that: (i) reflects the accumulation of imbalances; (ii) may increase the likelihood of a shock; and (iii) when acted upon by a shock, may lead to systemic disruption." The FSB also defines "transmission" and "amplification or feedback loops" as follows: vulnerabilities when acted upon by a shock, can propagate strains through the financial system (transmission), amplify stress through which the financial system would increase the initial impact of the climate shock (amplification or feedback), and lead to systemic disruption.

[12] IAIS (2019), Holistic Framework for the assessment and mitigation of systemic risk in the insurance sector.

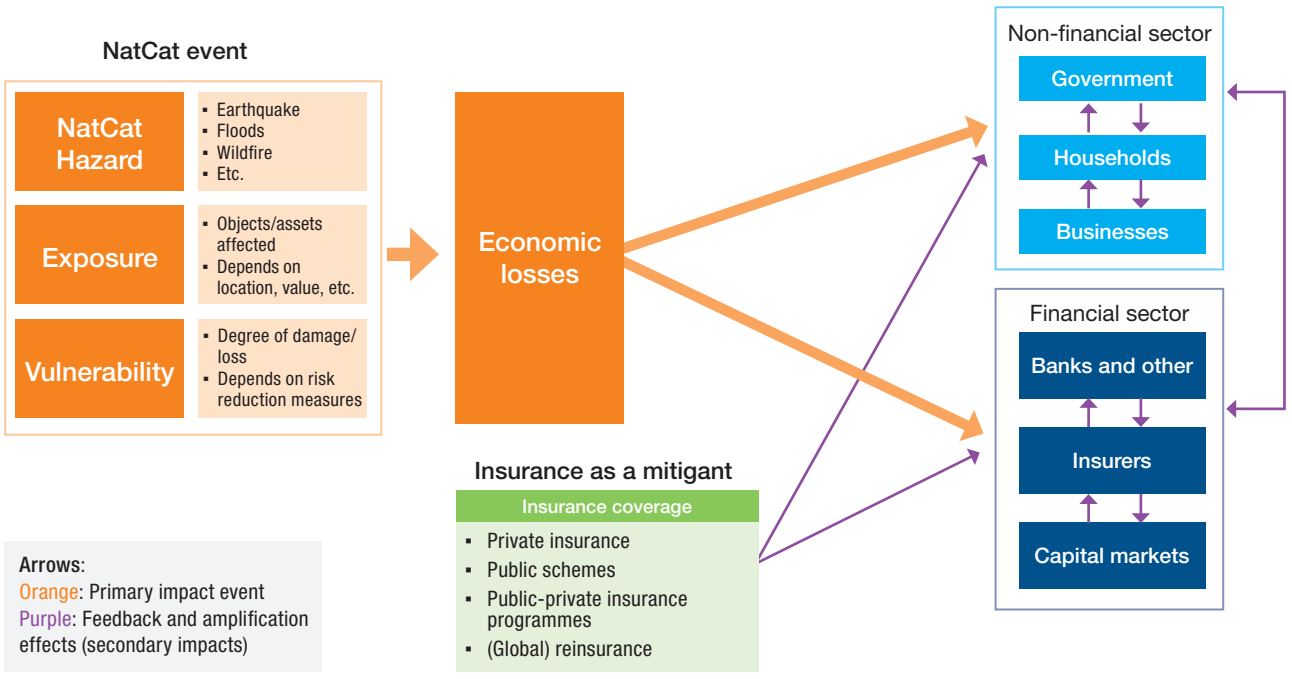
[13] FSB (2025), Assessment of Climate-related Vulnerabilities: analytical framework and toolkit.

While insurance inherently contributes to financial stability by absorbing shocks and promoting effective risk management, the Holistic Framework recognises that insurers could be vulnerable to systemic risks, and instability in the insurance sector itself could contribute to or exacerbate financial instability in the financial system. Such instability could arise from common activities or exposures across the insurance sector or from the distressed or disorderly default of a single insurer. The Holistic Framework acknowledges various types of exposures and vulnerabilities within the insurance sector, including interconnectedness and liquidity risk. Within the context of the case studies, it is important to consider the concept of "limited substitutability", ie where the supply of insurance coverage is reduced and no other substitutes within the financial system can offer a similar product or service.

Consistent with the Holistic Framework and the IAIS Insurance Core Principle (ICP) 24 (Macroprudential Supervision), the report recognises both inward[14] and outward[15] risks. In the context of protection gaps, there is the potential for spillover effects from a NatCat event to the financial system and real economy (see Section 3.2). The financial consequences of NatCat events are transmitted (and possibly amplified) through channels such as credit, market and underwriting risks.

Figure 3 illustrates how NatCat events can have both direct and indirect impact on the real economy and financial sector. The diagram emphasises the role of insurance in mitigating these impacts by providing financial protection and facilitating recovery efforts (see Section 3). The diagram also highlights how NatCat events can amplify financial instability through interconnectedness in the financial system, as well as trigger spillover effects in the broader economy (see Section 3.2).

FIGURE 3: Schematic diagram of impact of NatCat on financial system and real economy



[14] Inward risks refer to vulnerabilities of individual insurers and the insurance sector at large to shocks from the external environment.

[15] Outward risks refer to the build-up of systemic risk at the individual insurer level or within the sector as a whole that may be transmitted to the external environment.

3.2 IMPACT OF NATCAT EVENTS

3.2.1 Real economy

NatCat events can cause extensive destruction to homes, businesses, agriculture and infrastructure. Following a NatCat event, infrastructure (such as roads, bridges and telecommunications) often requires substantial and costly repairs or reconstruction before economic activity can resume. These represent the primary impacts of NatCat events on the real economy.

Based on NatCat loss estimates produced from CLIMADA, the direct impact in most jurisdictions is relatively low. However, for roughly 20–25% of countries, especially small and less resilient or diversified economies, the impact is more material.[16]

In addition, NatCat events can have far-reaching economic consequences that extend beyond the immediate physical damage, including business interruption and environmental degradation.

- Business interruption: Following NatCat events, businesses often face operational disruptions due to damaged infrastructure and facilities, power outages and workforce dislocation. Such disruptions can lead to loss of revenue and hinder economic activity in affected areas. The effect can be particularly pronounced for countries that do not have well diversified economies. For example, a devastating flood that destroys crops and agricultural infrastructure in a small, highly agriculture-dependent developing economy creates a different situation from a similar flood event in a well-diversified and advanced economy.
- Environmental degradation: Oil spills, chemical leaks and air pollution caused by the NatCat event can have both immediate and long-term consequences for public health. The financial costs associated with clean-up activities and environmental restoration add to the economic burden.

The combination of direct physical and indirect economic impacts are likely to materially affect local economies hit by NatCat events and can lead to financial difficulties for households, businesses and governments. Small and medium enterprises (SMEs) can be disproportionately impacted due to their size, location and limited financial resources. Economic failures can have a knock-on effect on households through lower local employment opportunities and reduced income levels, which also affect public finances. Prolonged decreases in economic activity can lead to lower real estate prices in regions impacted by NatCat events. Depending on the size and location of the event, and the structure of the economy, such indirect effects can impact economic activity and financial institutions far removed from the disaster zone.

NatCat events have the potential to slow economic growth, increase fiscal deficits due to emergency spending and create inflationary pressures[17] as demand increases and supply shortages drive prices up. Even if the overall impact on GDP may be limited, depending on the capacity and resources for reconstruction efforts, the effects across sectors can vary significantly. Some industries may see growth (for instance, those linked to reconstruction), whereas others, such as the tourism and agriculture sectors, could suffer substantial setbacks.

[16] See IAIS (2024), Global Insurance Market Report, section 5.3.3.

[17] For an empirical study, focusing on the impact of weather disasters on growth and inflation, across seven types of weather disaster, see BIS (2025), Macroeconomic impact of weather disasters: a global and sectoral analysis.

3.2.2 Financial sector

NatCat events can directly affect financial institutions (including banks and insurers) through operational disruption and in their capacity as investors.

- Operational disruption: Financial institutions can experience many of the same operational and financial challenges as other businesses. Financial institutions can face operational challenges such as damaged branches and offices, disrupted IT systems, delayed and disrupted supply chains and reduced workforce availability. The most significant consequences are felt by financial institutions with operations concentrated in the affected areas. As underwriters of NatCat risk, non-life insurers often face additional operational disruptions due to the need to respond to a surge in claims and higher call volumes, especially if their own operations are affected by outages.
- Investors: As large-scale investors, financial institutions may experience secondary impacts following a NatCat event through increased credit and market risks.

In addition, insurers, banks and other lending institutions will be exposed to NatCat risks in their respective roles as underwriters and credit providers, as outlined below.

NatCat events can amplify financial instability through interconnectedness in the financial system and spillover effects.

Insurance[18]

Insurers can face significant underwriting losses, especially in instances where consecutive major NatCat events occur, jeopardising earnings and eroding capital. If multiple insurers in a single jurisdiction face similar circumstances, there can be implications for financial stability. The extent to which NatCat-related insured losses become a prudential issue or even result in the failure of an insurer, or multiple insurers, depends on factors such as the:

- Magnitude of the NatCat event;
- Ability of insurers to reprice on a timely basis; and
- Enterprise risk management and solvency (including reinsurance).

Insurance premiums for the affected region(s) often increase after a NatCat event due to the large number of claims incurred and the increased likelihood of future claims. Increases in premiums often reflect the change in risk profile but also aim to improve insurers' future profit-earning capacity and restore their capital position over time. A risk-based pricing approach enables insurers to reflect the actual risk and charge adequate premiums. Regulations or legislation that restrict insurers' ability to reprice (such as setting specific upper limits to insurance prices or limiting price changes) without also increasing risk prevention, transfer or sharing mechanisms constrain insurers' ability to implement risk-based pricing. Without risk-based pricing, insurers may struggle to provide sustainable insurance coverage and could limit NatCat coverage to individuals and businesses.

[18] In this report, and in line with the IAIS ICPs, the term "insurance" or "insurers" generally applies to both primary insurers and reinsurers, but reinsurance is mentioned explicitly for statements specifically relevant for reinsurance.

BOX 2: The role of reinsurance

The results of the SWM indicate:

Benefiting from the ability to diversify across risks and geographies, reinsurance plays a vital role in providing NatCat risk coverage by enabling primary insurers to provide underwriting capacity and protect their solvency when NatCat events occur. Insurers who maintain adequate reinsurance and capital are generally well-equipped to manage significant NatCat events. Cross-border reinsurance, in particular, can contribute to strengthening risk diversification, especially in jurisdictions exposed to catastrophes.[19]

According to SWM data, as noted in Box 1, most members currently consider the availability of reinsurance capacity in their countries to be high. However, increased and/or consecutive NatCat events can use up reinsurance capacity, which can lead to more expensive reinsurance or the inability to access reinsurance (for certain perils, in certain regions); this can then leave citizens, governments and insurers, that decide to take on the risk, exposed. Increases in reinsurance premiums, which make insurance less affordable or less accessible, could disproportionately affect low-income households.[20]

Publicly-backed reinsurers could help provide reinsurance capacity in such stressed conditions. However, in some jurisdictions, public reinsurers may reduce capacity provided by private reinsurers if they benefit from more favourable conditions (eg public guarantees that lower premiums, more favourable terms or compulsory placement by insurers). To manage their risks effectively, public reinsurers rely not only on government support but also on retrocession capacity from the private market. If the availability of retrocession capacity is limited in the private market, publicly-backed reinsurers will also be limited in the coverage they can provide.

Insurers are expected to adhere to robust risk management practices and regulatory requirements (including holding sufficient capital for the risks underwritten) to ensure they can meet the needs of policyholders. In many jurisdictions, insurers' capital requirements include a specific requirement for the risk of NatCat events that are set at levels expected to meet the loss of an extreme event, typically at a "1-in-200 year" event level, which is also the level used in the Insurance Capital Standard (ICS).[21] Some jurisdictions require reinsurance or capital at return periods greater than 1-in-200 years. For example, in Canada, the requirement is set at a 1-in-500 year earthquake event (for insurers with earthquake exposure), and in New Zealand, the requirement is a 1-in-1,000 year earthquake.

The IAIS regular GIMAR[22] publications discuss the resilience of insurers' capital position to extreme NatCat events. The analysis shows that NatCat is a material risk for non-life insurers and reinsurers, but they have sufficient solvency buffers to withstand, for instance a 1-in-200 year event.

[19] IAIS ICP 13 outlines that geographical diversification of risk, often involving cross-border risk transfer, is a key component of insurers' and reinsurers' capital and risk management, benefiting both individual firms and the financial stability of jurisdictions (ICP 13.0.2). Supervisors should also consider the potential impacts of external limitations on cross-border risk transfer on insurers, reinsurers, and the overall insurance market ICP (13.0.3).

[20] See IAIS/FSI (2025), Mind the climate-related protection gap – reinsurance pricing and underwriting considerations.

[21] The ICS is a risk-based measure of capital adequacy for internationally active insurance groups, which was adopted by the IAIS in December 2024.

[22] See GIMAR 2023 and GIMAR 2025 (forthcoming).

Banks and other lending institutions

NatCat events can directly impact the loan books of banks and lending institutions. Secondary effects can include increased credit risk as borrowers struggle to meet loan obligations due to reduced income, resulting in higher non-performing loans (NPLs). Property values can also decrease, resulting in banks having lower collateral for their loans (mainly mortgages). If a bank's NPLs increase and loan-to-value (LTV) ratios increase, the combined effect generally points to a more restrictive lending environment going forward. The consequences could be more pronounced for microfinance institutions[23] where loan portfolios are directed to low-income populations who may be less resilient to the impact of NatCat events.

Banks could face liquidity strain if customers withdraw their money to deal with the consequences from the NatCat event. Banks, credit unions and similar financial institutions with operations concentrated in the area affected by the NatCat event could face the greatest impacts on liquidity and financial viability.

3.2.3 Societal impacts

NatCat events can affect the financial stability of a country or region through the combined effects on people and society, even when these effects take some time to emerge. NatCat events typically affect low-income populations disproportionately, as they often lack the resources (including insurance coverage) to recover quickly, thereby exacerbating existing poverty levels and inequality.

Displacement of populations due to destroyed homes or unsafe living conditions can create social and economic challenges. Refugees from disaster zones can face difficulties accessing basic services and employment.

Health impacts of NatCat events can be severe, ranging from injuries and fatalities to the spread of diseases due to poor sanitation and water contamination. Job losses are common in disaster-hit areas, particularly in those industries that relied on the damaged infrastructure or natural resources. School closures and damage to educational facilities may disrupt learning.

Most material societal consequences emerge over the medium to long term as higher rates of poverty and reduced quality of health and education impact the speed of recovery and long-term economic prospects of the area.

3.3 INSURANCE AS A MITIGANT

The absence or presence of insurance (ie the existence of an insurance protection gap) is an important factor in determining the materiality of the impacts described above.

As experts in understanding and managing risk and as institutional investors, insurers play a critical role in society by mitigating the economic and societal impacts of NatCat events. Insurance provides financial protection and supports recovery in several ways, including by indemnifying losses from physical damage and compensating for losses due to business interruption. By making funds available to rebuild and recover, insurance not only helps mitigate some of the impacts described above but also helps accelerate economic recovery after a NatCat event.

Insurance compensates for losses incurred to damaged homes, businesses and infrastructure, which can enable quicker rebuilding efforts. Commercial insurance policies that include business interruption also help companies recover a portion of lost income.

[23] Organisations that provide financial services, like small loans and savings, to low-income individuals and small businesses who typically lack access to traditional banking.

Insurance can limit the impact on public finances, as governments often intervene when significant damages are uninsured.

Insurance products such as health, accident and unemployment coverage can offer critical financial support to individuals affected by NatCat events, helping to reduce poverty and health impacts.

Insurance helps individuals, businesses and governments respond more quickly with funds to address the consequences suffered from a NatCat event. This ultimately helps stabilise local economies and restore confidence among businesses and consumers. In this way, insurance can limit the impact on public finances as governments often intervene post-event when significant damages are not insured.

Finally, insurance may be used to incentivise risk reduction by recognising risk mitigation measures policyholders implement to lessen the potential damage from NatCat events (eg through premium discounts or other benefits).

3.4 AMPLIFICATION EFFECTS AND BROADER IMPLICATIONS

NatCat events can also trigger a series of cascading effects that could create financial instability or exacerbate it. These events often highlight, or even widen, existing insurance protection gaps, leaving individuals, businesses and communities more vulnerable to future risks. This in turn may also influence the behaviour of financial market participants, potentially leading to changes in risk perception, reduced lending or a reallocation of capital away from affected regions.

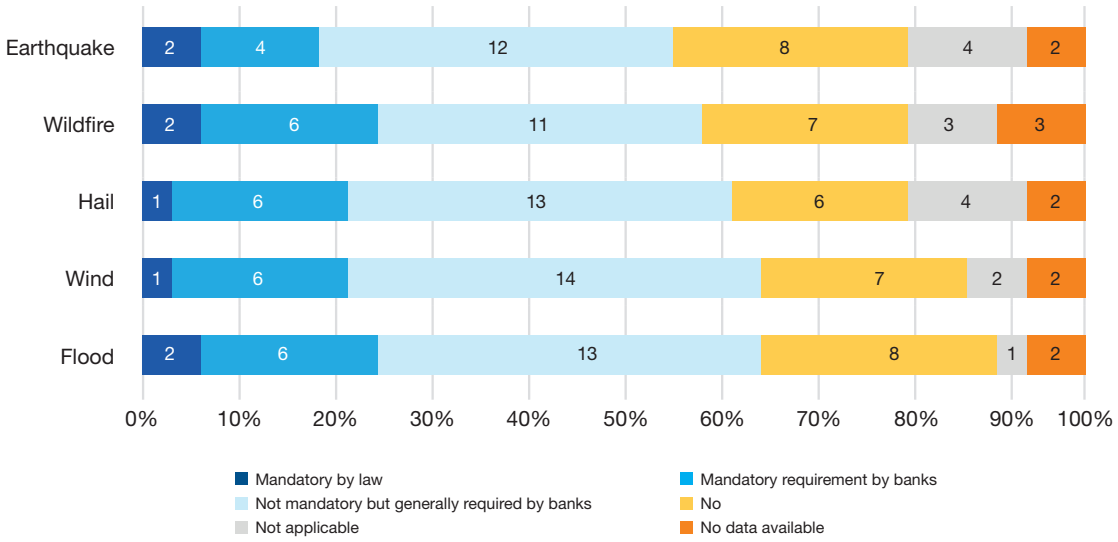
3.4.1 Feedback and amplification effects

The impact(s) of NatCat events on the financial sector could amplify the overall economic impact as material losses could reduce the financial sector's ability to finance economic recovery. The speed and extent of recovery largely depend on factors such as the size of the NatCat protection gap, the extent of government support available, community resilience and the availability and supply of investment. For local economies relying on agriculture and tourism in particular, the degradation of ecosystems due to NatCat events can significantly slow recovery efforts, often lasting for years since nature typically recovers slowly.

Both actual and perceived risks can increase after a major NatCat event. In particular, the inability to repair or rebuild damaged adaptation measures (such as flood walls) or improve their effectiveness may increase the perceived exposure of the area to NatCat risks. As a result, there could be reduced appetite for investment and lending and for providing insurance coverage. Furthermore, frequent and severe NatCat events can lead to higher insurance premiums and, in some cases, make risks uninsurable – thereby increasing protection gaps.

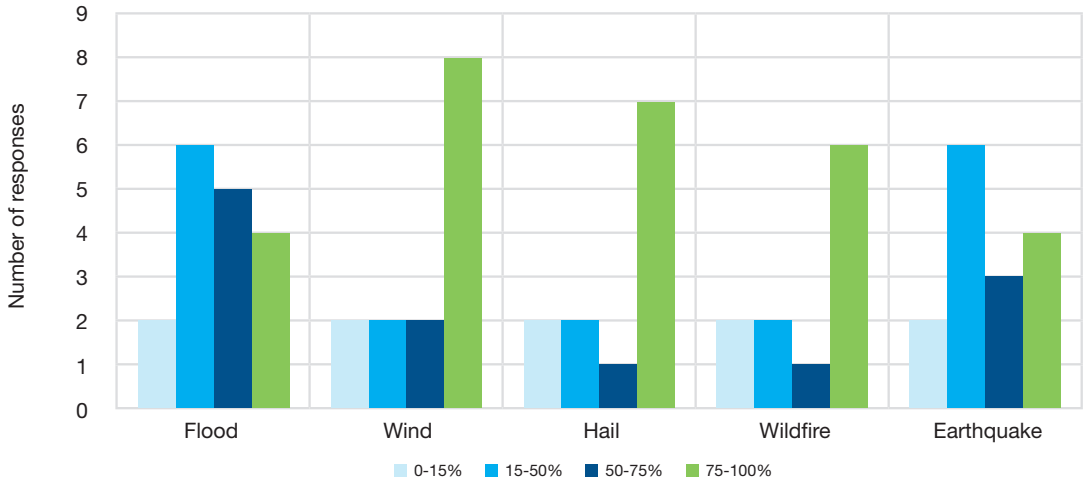
Banks rely on insurance in mortgage lending, but the extent and form of reliance varies by jurisdiction, product type and regulatory framework. Figure 4A and 4B show the responses received from IAIS members through the SWM on various approaches and coverage levels of property insurance. Where take-up of mortgage property insurance is high, it enables higher LTV lending, reduces banks' capital requirements and facilitates securitisation. However, there is uncertainty around whether mortgage holders or creditors continue to comply with such requirements after the mortgage or initial funding is secured, as insurance policies may be cancelled annually, whereas mortgages span decades, and insurance coverage is typically not monitored on an ongoing basis.

FIGURE 4A: Approaches to property insurance coverage requirements for real estate financing



Source: 2025 GME

FIGURE 4B: Property insurance penetration levels across jurisdictions and across perils



Source: 2025 GME

In addition, in the aftermath of a NatCat event, sovereign and corporate credit ratings may face downgrades, reflecting weakened financial profiles and reassessment of risk exposure. This may further impact the availability and cost of the financing needed for recovery efforts. Credit rating agencies may increasingly start to incorporate NatCat physical risk in their rating methodology. This may be done through stress testing and analysis of exposures, reinsurance adequacy and capital resilience. Where NatCat events pose a recurring or systemic threat, this can lead to downgrades or negative outlooks for financial institutions, although so far, rating actions primarily driven by NatCat events are uncommon outside the insurance sector.

Changes to perceived or actual risk exposure to NatCat events could negatively impact the valuation of assets in affected areas as well as the economic prospects of businesses operating in the area, thus further amplifying the impact on the financial sector and economy at large. Investors form expectations about physical risk as well as insurance coverage (and risk sharing more broadly, including through the government) at various time horizons in the future. In extreme cases, significant losses to government finances or significant changes to investor perceptions of possible fiscal contingent liabilities, based on an expectation on future expenses, could increase sovereign credit risk, impacting the value of government bonds. In turn, this can also impact financial markets.

NatCat events can also impact capital markets (as depicted in Figure 3), as insurers may need to sell assets to meet liquidity needs if claims exceed their buffers. Such asset sales could contribute to capital market disruptions, particularly if they occur during periods of broader financial stress. Additionally, distressed financial markets following major NatCat events may result in falling equity and bond prices, as well as currency fluctuations.[24]

3.4.2 Broader international impacts

While the description above focuses on impacts in a country or region directly affected by a NatCat event, there could also be indirect impacts on broader (global) financial markets.

The rising frequency and severity of extreme weather events not only impact risk perceptions in a particular country but could also lead to general shifts in investors' perceptions. In the case of a more sudden shift in investors' risk perception, including assumptions on the extent of insurance coverage, asset values could drop, generating a ripple effect on investor portfolios and financial institutions' balance sheets. This could influence real estate markets and equity prices.[25]

Some NatCat events can cause major damage to large-scale production facilities and transportation networks that can in turn impact global supply chains. The ripple effects of these disruptions have the potential to be felt far from the location of the NatCat event itself. For example, local impacts on agriculture for a large, dominant exporter of a specific crop in one country could, theoretically, impact global food and commodity markets. This could have financial consequences for businesses operating in related markets or to financial institutions exposed to those markets.

[24] It should be noted that these impacts, however, are not necessarily negative; in some cases, capital markets may benefit from increased investment in reconstruction efforts or risk mitigation measures. See for example Elsevier (2022), Climate change and financial stability: Natural disaster impacts on global stock markets.

[25] For a discussion on impacts on equity prices, see IMF (2020), Global Financial Stability Report (GFSR), chapter 5. For a discussion on possible impacts on real estate markets, see FSB (2025).

4. Potential financial stability implications of NatCat protection gaps – evidence from case studies

This section provides a summary of insights into the direct and indirect impacts of NatCat events and protection gaps on the real economy, financial institutions and society, building on the theoretical framework outlined in the previous section.

More specifically, it explores the unique transmission channels through which NatCat events and protection gaps may affect financial stability in different economic and insurance sector contexts.

This includes indirect impacts arising from feedback and amplification effects due to interconnections within the financial sector and between the financial sector and the real economy. It also discusses examples of how insurance can mitigate these impacts by providing financial protection and facilitating recovery efforts, but also how NatCat insurance protection gaps may amplify the financial stability implications of these shocks.

Ultimately, the relative impact of NatCat events on the financial system and real economy varies significantly across jurisdictions, as highlighted by the case studies. Key factors determining the significance of these events to systemic risk include their frequency, footprint and magnitude, the degree of financial resilience, including the adequacy of insurance coverage and the extent of any protection gaps, as well as the structure of the economy in the affected area.

4.1 DESCRIPTION OF THE APPROACH TO CASE STUDY ANALYSIS

4.1.1 Approach and scope

Given the complexity and diversity of NatCat events, and the lack of globally consistent data, the IAIS opted for a case study approach to explore the unique transmission channels through which NatCat events and protection gaps may affect financial stability in different economic and insurance sector contexts. The case

studies include advanced economies (AEs) and EMDEs as well as historic events and modelled future events. Four case studies are based on historical events, and two are theoretical and forward-looking and represent a prospective view of the potential implications of a severe NatCat event in each country.

To ensure the relevance and effectiveness of the analysis, the selected case studies focus on significant NatCat events only. The case studies reflect a range of NatCat perils, including flood, drought, tropical storm and earthquake. Table 1 provides a high-level overview of the case studies included in this report.

4.1.2 Limitations and caveats

While the case study approach offers valuable insights, there are limitations. The reliance on historical events means that the analysis may not fully capture future risks, particularly those exacerbated by changes in the frequency and severity of extreme weather events. Additionally, the findings and lessons derived for one country should not be generalised without due consideration, as the specific circumstances and contexts of one country may not necessarily apply to others.

TABLE 1: Overview of key information from case studies

	Malawi	Dominica	Pakistan	New Zealand	Canada	Portugal
Peril/event	Drought	Hurricane	Flood	Earthquake	Earthquake	Earthquake
Date	Oct-15	Sept-17	Jun-22	First Shock: September 2010	Prospective	Prospective
Economy classification	Low-income	Low-income	Low-income	High-income	High-income	High-income
IAIS Region	Sub-Saharan Africa	Caribbean	Asia	Oceania	North America	Western Europe
Population (year of event) [26]	18 million	66 thousand	227 million	4.4 million	41.5 million	10.7 million
Percentage of population affected	38%	90%	14%	13%	n/a	n/a
GDP year prior to event (current USD)	8.5 bn	580 m	348.5 bn	122 bn	2.24 trn (2024)	308.7 bn (2024)
Non-life insurance penetration [27]	0.8% (2015)	3% (latest available year: 2014)	0.22% (2020)	4.5% including ACC & NHC (2016 earliest available)	3.3% (2020)	2.2% (2023)

[26] Source: IMF Datamapper. For Portugal and Canada, this refers to the latest year available.

[27] Defined as ratio of non-life insurance premium volume to GDP. Sources: World Bank Global Financial Development database (2022), Reserve Bank of New Zealand and OECD Data explorer.

4.2 KEY INSIGHTS FROM THE CASE STUDIES

4.2.1 General findings

The case studies highlight that the most significant impacts arising from NatCat events were in the real economy. Impacts on the financial sector were more limited, partly due to the existence of insurance coverage. Impacts were also very country specific and included widespread human and societal impacts.

Table 2 provides an overview of selected financial metrics over a five-year period (including two years before and after the year of the NatCat event) for the historical case study jurisdictions of Malawi, Pakistan, Dominica and New Zealand. The table captures both real economy and financial sector metrics. Overall, the data underscores the varying economic challenges countries face in the aftermath of natural disasters.

It is important to note that this table does not account for external factors that may have influenced the trends. For instance, the Covid-19 pandemic coincided with this period for Pakistan, likely affecting several of the metrics. Similarly, other global or regional events may have shaped economic outcomes, making it challenging to isolate the specific impacts of the NatCat. Keeping these limitations in mind, some insights include:

- Aid inflows following NatCat events increased in most cases, with Dominica witnessing a sixfold rise (600% by X+2), suggesting strong international support.
- In most cases, post-event inflation – commonly observed after NatCat events due to demand surges and supply constraints – did not result in prolonged destabilising financial conditions. However, food price inflation created additional financial stress, affecting households in particular.
- Debt levels also rose post-NatCat, with Dominica and New Zealand seeing considerable increases in central government debt as a percentage of GDP.
- Banking sector resilience varied. NPL ratios rose in Malawi and Dominica during the NatCat year, while Pakistan and New Zealand exhibited stable or even improving ratios in subsequent years.

TABLE 2: Selected financial metrics for historical case studies

	X-2	X-1	Year of NatCat (X)	X+1	X+2
GDP (annual % change)					
Malawi (X = 2015)	5.4%	5.6%	2.8%	2.5%	4.0%
Pakistan (X = 2022)	-1.3%	6.5%	4.8%	0.0%	3.2%
Dominica (X = 2017)	-2.7%	2.8%	-6.6%	3.5%	5.5%
New Zealand (X = 2010)	2.9%	-0.1%	1.4%	2.2%	2.3%
Net official development assistance and official aid received (Ratios to X-1)					
Malawi	100%	100%	113%	133%	163%
Pakistan	89%	100%	63%	Data not available	
Dominica	137%	100%	224%	314%	600%

TABLE 2: Selected financial metrics for historical case studies (continued)

	X-2	X-1	Year of NatCat (X)	X+1	X+2
New Zealand			Not applicable		
CPI (all items), period average YoY percentage change					
Malawi	27%	24%	22%	22%	12%
Pakistan	9.7%	9.5%	19.9%	30.8%	12.6%
Dominica	-0.8%	0.1%	0.3%	1.0%	1.5%
New Zealand	4.0%	2.1%	2.3%	4.0%	1.1%
CPI (food and non-alcoholic beverages), period average YoY percentage change					
Malawi	Data not available		24%	27%	12%
Pakistan	16%	11%	25%	38%	5.70%
Dominica	0.7%	0.1%	-0.2%	2.2%	1.9%
New Zealand	8.4%	6.1%	1.0%	5.2%	-0.7%
Central government debt (% of GDP)					
Malawi	35%	34%	35%	37%	40%
Pakistan	80%	74%	76%	77%	Data not available
Dominica	71%	73%	87%	90%	89%
New Zealand	19%	24%	30%	35%	36%
Private debt, loans and debt securities (% of GDP)					
Malawi	8.8%	8.1%	8.7%	7.4%	7.3%
Pakistan	24%	23%	22%	Data not available	
Dominica	51%	47%	51%	47%	40%
New Zealand	199%	196%	187%	178%	179%
Banking sector's non-performing loan/total loan (NPL Ratio)					
Malawi	15%	15%	11%	17%	16%
Pakistan	9.2%	7.9%	7.3%	7.6%	6.3%
Dominica	Data not available		14%	19%	12%
New Zealand	0.9%	1.7%	2.1%	1.8%	1.5%

Source: World Bank

Overall, the historical case studies highlight the complex and heterogeneous impacts of NatCat events on economies and societies. Depending on the circumstances of the NatCat event and the country in which it occurred, there were very specific transmission channels with significant economic impact.

Given the low financial services penetration in Pakistan, Malawi and Dominica, there was limited impact on the financial sector. For all countries, the impact on the financial sector is lessened by the fact that large corporates and mortgaged properties are often insured, so the impact on the banking system in respect of mortgage lending and loans to large corporates is somewhat mitigated (see section 4.2.5).

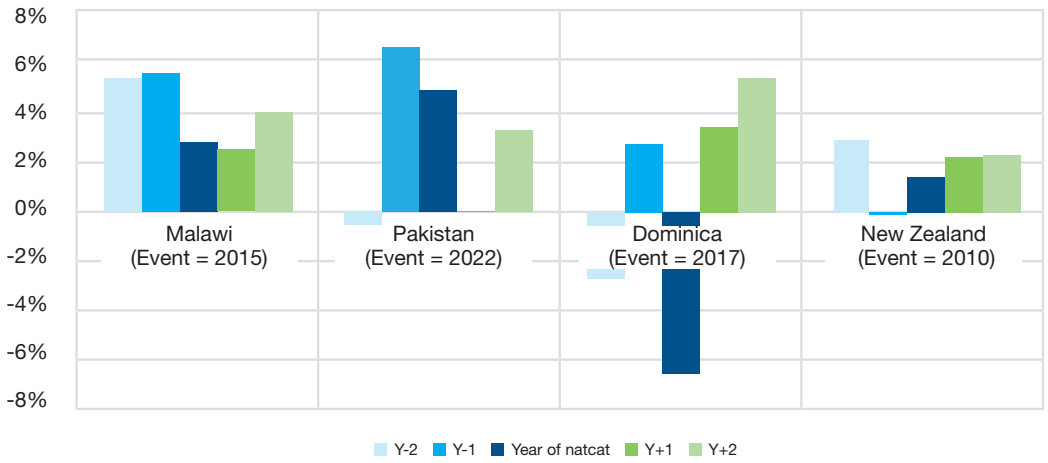
There was significant impact to agriculture and housing in most countries. In the EMDE case studies, the impact was exacerbated by existing high vulnerabilities to NatCat events and existing large insurance NatCat protection gaps. Agriculture played a significant role in the EMDE cases analysed, and the damages to agricultural output were a key driver of the direct and indirect economic impact of the events.

Government support and international recovery funding help reduce the economic impact and potential spillover effects that could lead to financial stability risks. A reduction in available government and international support in the future could increase the risk of such spillover effects.

Depending on the circumstances of the NatCat event and the country in which it occurs, there may be different, impactful transmission channels with significant economic impact, including both expected and somewhat surprising ones, for example:

- Tourism and natural resources: The damages caused to nature in Dominica had longstanding implications for its tourism industry, while in New Zealand, guest nights in Canterbury accommodation fell 22% below pre-earthquake levels in 2012, reflecting both physical damage and safety concerns.
- Energy and utility disruptions: In Malawi, the drought disrupted hydropower generation, causing widespread power outages and higher irrigation costs. Similarly, in Pakistan, damage to hydroelectric power stations and electricity networks led to blackouts, compounding economic losses.
- Transport and infrastructure damage: Pakistan saw damage to 3.2% of roads and 40% of railways, disrupting logistics networks. In New Zealand, damage to 52% of Christchurch's sealed roads and underground water systems cost NZD 2.7bn, delaying recovery.
- Agro-processing and manufacturing losses: In Malawi, 80% of agro-processing losses were concentrated in tea and sugar production, two key industries, reflecting how disruptions in agriculture can ripple through related industries. In Pakistan, flood-related cotton losses disrupted the textile industry, which accounts for more than half of the country's goods exports. Damages to agricultural machinery, while small compared to overall agricultural losses, impacted the long-term recovery of agricultural activity in Dominica.
- Education system disruption: In Malawi, drought forced 140,000 children to drop out of school, while in Pakistan, over 6,200 education institutions were destroyed, affecting 2.6 million students. New Zealand also saw a 28% drop in first-year university enrolments in Christchurch.

FIGURE 5: Annual changes in GDP



Source: World Bank

4.2.2 Impact on real economy

For the historical case studies, most countries experienced a (significant) slowdown of economic growth or even a contraction (see Figure 5). The speed and extent of recovery largely depended on factors such as the level of NatCat insurance coverage, the scale of government support, community resilience and the availability of investment. Key recovery stakeholders, such as governments and large corporates, were generally able to mobilise financial resources for reconstruction and recovery through insurance payouts, foreign or donor assistance, investments and access to banking credit.

Looking prospectively, the study conducted in Canada indicates that following a 1-in-500-year earthquake, the rate of GDP growth would decrease by 50%, with cumulative real GDP losses exceeding 4% of Canada's GDP in 2024.

Impact on agriculture

The impact on agriculture was significant in the EMDE case studies. Damage to agricultural output was a major contributor to direct economic impacts given its substantial share of GDP, and also to indirect impacts, as rising food and commodity prices further constrained broader economic activity, while agribusiness interruptions reduced citizens' purchasing power.

The case studies highlight that the most significant impacts arising from NatCat events were in the real economy.

4.2.3 Impact on financial sector

In the historical case studies, the financial sector benefited from insurance coverage of large corporates and mortgaged real estate, which helped mitigate the impact on the banking system's mortgage lending and corporate loan portfolios.

In Pakistan, Malawi and Dominica, the financial sector experienced limited impact, primarily due to its significant exposure to low-risk portfolios, such as government loans and large corporates, rather than SMEs and households.

In New Zealand, the widespread insurance coverage of earthquake risks for housing, supported by essential government backing for the insurance scheme, further reduced the financial impact on the banking sector, particularly on household loans such as mortgages and personal consumer loans.

Government debt typically increased while private debt decreased following such events (see Table 2). In some cases, private sector loan portfolios became more concentrated among large corporates, indicating a post-event shift in the financial sector's exposure towards lower-risk portfolios. This shift, however, may have operational implications for household and individual access to financial resources during the post-event recovery period.

In the historical case studies, the financial sector benefited from insurance coverage of large corporates and mortgaged real estate, which helped mitigate the impact on the banking system.

Impact on insurers

In some cases, insurers experienced stress or even failure due to a significant increase in claims – this was the case in Dominica. In New Zealand, regulators or governments had to intervene. This included providing a financial support package to maintain confidence in the insurance market, while one smaller insurer entered into liquidation. In Dominica, its sole domestic non-life insurer declared insolvency due to claims arising from Hurricane Maria. Its capital shortfall amounted to 2% of GDP. Also, the forward-looking earthquake analysis in Canada, shows that a 1-in-700-year event could trigger systemic failure in the Canadian non-life insurance industry.

Impact on banks

Across all historical case studies, no banks were found to be distressed following the NatCat events, although NPL ratios and provisions tended to rise in the post-event period. This then further restricted private sector financing, thereby slowing economic recovery.

The forward-looking case studies do point to possible vulnerabilities in the banking sector. For instance, as highlighted in the case study of Portugal, the low insurance penetration for earthquake risks may pose a threat to the banking sector, since a major event could lead to a sharp increase in NPLs, as uninsured properties lose value. In Canada, a large earthquake could severely affect the banking sector, particularly through its impact on mortgage-backed lending. The absence of a government backstop for insurance amplifies risks to banks. If insurers fail and Property and Casualty Insurance Compensation Corporation (PACICC) (Canada's insurance guarantee fund) reaches its capacity limits, banks may face significant losses due to uninsured or underinsured properties.

4.2.4 Human and societal impacts

The human impact of NatCat events was often more apparent than the financial impact, especially for the developing economies. This was because the most affected are often vulnerable socio-economic groups, who typically possess fewer (high-value) assets, thereby limiting the overall losses in financial terms. The repercussions of such events disproportionately undermines their livelihoods and well-being, exacerbating their precarious circumstances. The human impact is multifaceted and includes housing, poverty, food security, sanitation, (physical and mental) health, education and security. These varied impacts can in turn lead to financial losses, especially if violence or looting follows. Furthermore, damage to the fabric of society (such as increased conflict or the inability to access safe food and water sources) can delay recovery and long-term economic prospects.

4.2.5 Financial stability implications of NatCat insurance protection gaps

The case studies provide some specific insights into the role of insurance in mitigating the economic and financial sector impacts of NatCat events – and demonstrate how NatCat insurance protection gaps may amplify the financial stability implications of these shocks.

Real economy impact

- There was significant impact to agriculture and housing from NatCat events, particularly in the EMDE case studies, which was exacerbated by large insurance NatCat protection gaps. The impact on agricultural output was a key driver of the direct and indirect economic impact of the NatCat events in these EMDE jurisdictions; higher insurance protection for agriculture in particular would likely have reduced the financial impact and sped up recovery.
- Impacts to SMEs are exacerbated when there is limited or no insurance in place, which can lead to business closures and bankruptcy. This was the case in the EMDE case study jurisdictions, where insurance coverage for SMEs and households is low.
- Household property insurance played a critical role in supporting household savings and consumer confidence in New Zealand, where housing makes up the vast majority of household assets.

Financial sector impact

- The case studies demonstrate how the impact on the financial sector is reduced through large corporates and mortgaged properties being insured against NatCat risks, by mitigating the impact on the banking system in respect of mortgage lending and loans to large corporates.
- The case study of New Zealand, where insurance is typically required at origination of a mortgage, supported by essential government backing for the insurance scheme, demonstrates how insurance can mitigate the financial impact on the banking sector, particularly on household loans such as mortgages and personal consumer loans.
- In the future, however, widening protection gaps (eg through a reduction in the insurability of assets) linked to bank lending could shift more risks to the banking sector, thereby increasing systemic risk, as shown in the forward-looking cases.

BOX 3: Summary findings from World Bank studies

Overall, the findings from the case studies align with those of the World Bank, which conducted over 40 climate-related financial risk assessments. Currently, the World Bank's stress tests primarily focus on the banking sector. Results from the stress tests indicate that the impacts on financial stability are generally manageable, particularly for larger economies. However, the resilience of individual banks can vary significantly, potentially affecting their financial health. The World Bank analyses show that severe climate events can endanger entire financial systems in small economies. Furthermore, compounded shocks – often missed by current assessments – can sharply amplify impacts (see Annex 2 for a more comprehensive summary of their studies).

Yet, despite advances in recent years, there are still significant gaps in current climate-related financial risk assessments. Those include data limitations, insufficient treatment of risk mitigants such as insurance, narrow coverage of transmission channels, and uncertainty about how climate impacts will unfold.

The case studies in EMDE jurisdictions show how government support and international recovery funding help reduce the economic impact and potential spillover effects that could lead to financial stability risks. A reduction in available government and international support in the future could increase the risk of such spillover effects, if not compensated for by greater insurance protection. Greater access to appropriate and affordable insurance cover is critical in an environment in which government budgets may become increasingly constrained or levels of international aid are being cut.

Greater access to appropriate and affordable insurance cover is critical in an environment in which government budgets may become increasingly constrained or levels of international aid are being cut.

5. Actions to address protection gaps

In 2023, the IAIS published its "Call to Action" report, which highlights five types of actions that insurance supervisors can take to assess and address NatCat protection gaps. Building on that report, the IAIS – together with the WBG – developed an input paper for the G20 Finance Track on identifying and addressing NatCat protection gaps. The input paper also outlines practical and implementable actions that not only supervisors, but the broader stakeholder community, including governments, the insurance industry, civil society and development partners, can take to address protection gaps. Taken together, certain foundational actions coupled with insurance-based solutions can address protection gaps and thereby also mitigate the resulting potential financial stability risks.

Foundational actions include:

1. Investing in data collection and assessment of exposure to NatCat events and protection gaps;
2. Implementing risk-based and proportionate supervisory frameworks;
3. Improving financial literacy and risk awareness; and
4. Incentivising risk reduction.

In addition, insurance-based solutions include:

a. Promoting availability and affordability of insurance products and services, for example, through parametric insurance and microinsurance;

b. Use of risk transfer mechanisms including catastrophe bonds, reinsurance, and regional risk pools; and

c. Development of public-private insurance programs (PPIPs).

This GIMAR Special Topic edition contributes to a number of these actions. Specifically, it supports action (1) as it provides a framework for assessing the exposure to NatCat events and protection gaps that individual supervisors can use to conduct a similar analysis in their own jurisdiction. This report contributes to action (3) (risk awareness) by sharing the outcomes of case study-based analysis. The case studies also provide evidence of how particular insurance-based solutions, such as the PPIP in New Zealand, can successfully contribute to mitigating the economic and financial impacts of NatCat events. Finally, the case study results emphasise the importance of risk reduction measures to build more resilient infrastructure and economies.[28]

[28] For more details on the range of actions that can be taken in this regard, see IAIS-WBG (2025).

5.1 DATA COLLECTION AND ASSESSMENT

This report confirms the importance of investing in monitoring and assessment of NatCat protection gaps and the potential impact on the financial sector and the real economy. As part of the 2025 GME, IAIS members provided insight into the actions they are already taking to monitor and address NatCat protection gaps. For instance, the IAIS asked supervisors for any analysis or monitoring activities related to the property market (ie real estate) and the agriculture sector, two key economic sectors vulnerable to NatCat events. Figures 6A and B below show that analysis of protection gaps, underlying drivers and possible future trends is still very nascent.

FIGURE 6A: Monitoring and analysis of property insurance market

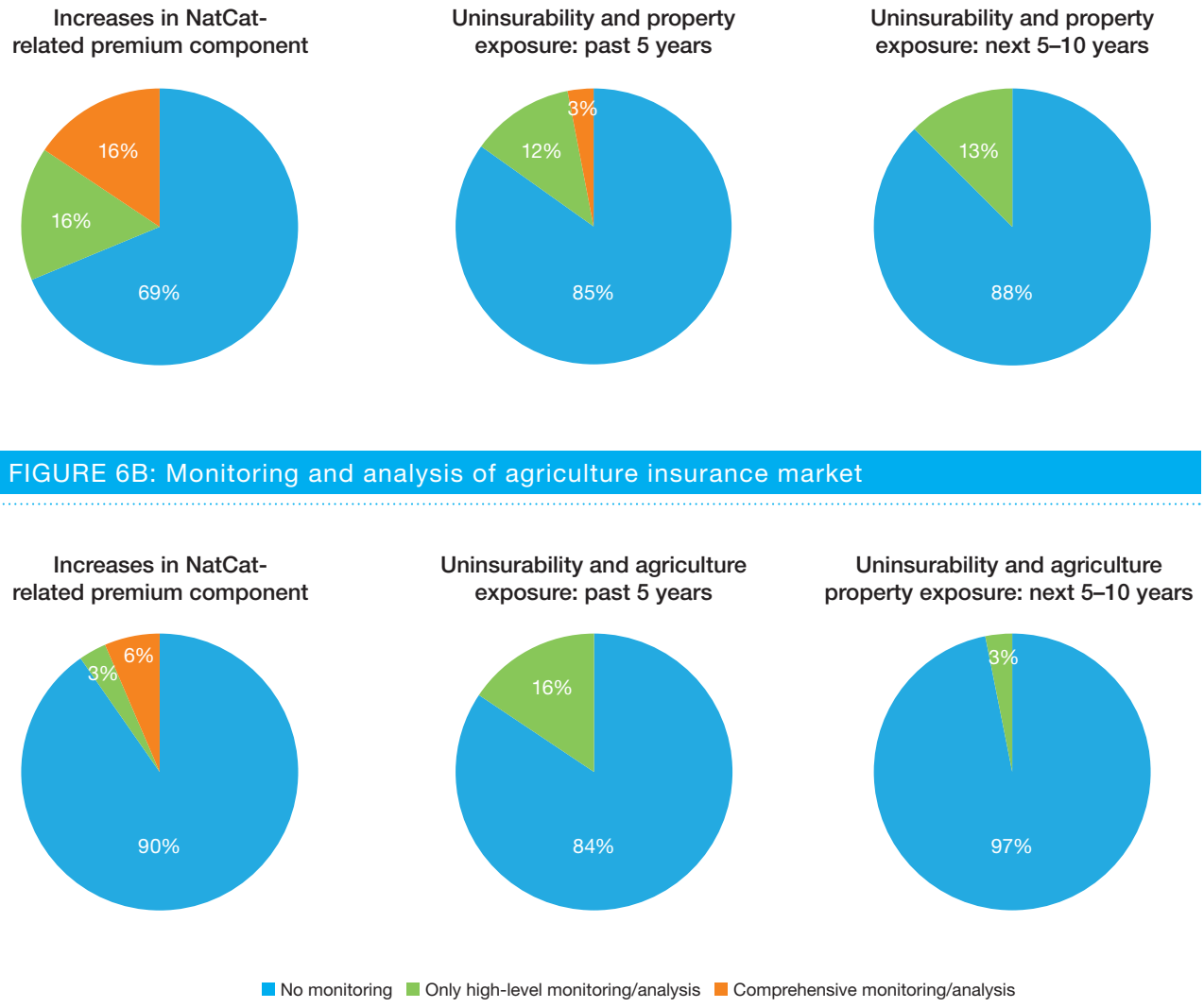


FIGURE 6B: Monitoring and analysis of agriculture insurance market

Source: IAIS GME 2025

To increase understanding of the NatCat protection gap and the possible associated financial stability risks, there are various initiatives insurance supervisors or other relevant bodies can take, including:[29]

- Data collection: Supervisors can collect data from insurers as part of supervisory reporting requirements. Such data could include insured losses, premiums and coverage offerings. Supervisors can complement information collected from insurers with data from other sources, such as results of third-party models for assessing NatCat risks and academic or other scientific physical risk projections.

- Risk dashboards: Risk dashboards can be useful tools to provide insights into climate-related vulnerabilities. Supervisors can aggregate, analyse and present in dashboard format available climate data to facilitate the monitoring of climate-related vulnerabilities and macroeconomic instability. Dashboards could include indicators such as the projected impact of climate change on NatCat capital requirements or exposure-based proxies, such as NatCat exposures by peril.

- Scenario analysis: Scenario analysis can be used to assess how increasing frequency and severity of weather-related events under different climate scenarios impact on NatCat protection gaps. Scenario analysis can also assess how demand for cover changes as insurance prices increase, which is relevant from both prudential and policyholder protection perspectives. Supervisors can also conduct scenario analysis in a cross-sectoral manner, allowing an analysis of broader financial system implications (eg impact on banks' balance sheets and/or on government finances).

[29] These actions are derived from: IAIS (2025), Application Paper on the supervision of climate-related risks in the insurance sector and IAIS-WBG (2025).

6. Conclusion and next steps

This report used case studies to explore the impact of NatCat protection gaps on financial stability. While none of the historical case studies resulted in financial instability, they still provided valuable insights into relevant direct impacts, potential transmission channels, and the importance of mitigants (including insurance), external funding and resilience measures. Also, the case studies point to potential disruptions to the financial system and real economy that could – especially if losses from NatCat events grow – ultimately lead to financial instability.

The case studies also illustrated the significance of economic and societal impacts. Economic and financial indicators are useful when considering the impact of uninsured NatCat events; however, the human and societal impacts of NatCat events are not fully apparent or observable using only these kinds of metrics.

Each case study shows that insurance helps mitigate the impact of NatCat events on the financial sector and thereby mitigates wider financial system and real economy disruption. For example, the impact on the banking system is mitigated because mortgaged properties are required to have insurance, which also facilitates funding for reconstruction. However, if such assets become uninsurable over time due to the increasing frequency and severity of extreme weather events, and protection gaps continue to widen, then there could be serious implications for the banking system as well as for local housing markets.

The analysis also highlights the importance of other mitigating factors such as access to insurance, other financial resources (eg banking credit, public funding, foreign investment and aid assistance) and NatCat schemes (including sovereign insurance programs, PPIPs and regional disaster recovery schemes). Without ready sources of funding following NatCat events, the financial impacts could be severe and, in some cases, may lead to systemic risk.

The implementation and continuing success of NatCat insurance schemes depend on multiple factors including fiscal capacity, insurance penetration, pricing and ongoing market development – all of which can be adversely affected by NatCat events, and in particular, by the increasing frequency and severity of such events. To effectively implement and ensure the sustainability of solutions to address NatCat protection gaps, continued collaboration between key stakeholders is needed in design, delivery and sustainable continuity (eg after an event or a series of events).

Next steps

The IAIS will continue work to assess and address NatCat protection gaps and collaborate with partners on the issue. Specifically, the IAIS will:

- Consider future data collection, such as further updates to its 2026 GME data collection, to continue to refine insights into NatCat protection gaps and potential financial stability risks;
- Continue to contribute to the FSB work on vulnerability analysis, including work to identify relevant metrics to monitor climate related risks including on how physical risk may have (global) financial stability implications; and
- With the WBG, and building on the G20 SFWG input paper, continue efforts to provide practical guidance and tools to assist policymakers and supervisors in addressing NatCat protection gaps. The IAIS and the WBG will also work with other international organisations and partners to ensure the support provided is inclusive, well-informed, and aligned with the diverse needs and priorities of jurisdictions.

The analysis highlights the importance of mitigating factors such as access to insurance, public funding, foreign investment and NatCat schemes.

Annex 1: Detailed descriptions of case studies

The case studies are presented in a largely uniform way, with some differences as not all transmission channels were considered in all cases due to either their immaterial impact or unavailability of data. Unless specifically noted otherwise, all values in Annex 1 are in US dollars.

Each case study starts with a description of the country at the time of the event, including its exposure to the relevant NatCat peril, and follows with descriptions of its economy, insurance market and financial sector. The case study continues with a description of the event, followed by a summary of the impact on the real economy and the financial sector (including insurance). While there were significant societal impacts in each country due to the NatCat event(s), this report does not include detail of those impacts as its primary focus is on the protection gap and thus the economic and financial impacts.

The EMDE case study descriptions are largely informed by data from the Word Bank Post-Disaster Needs Assessments (PDNAs).[30] This is an internationally accepted methodology for determining the physical damages, economic losses and costs of meeting recovery needs after a natural disaster through a government-led process.[31] PDNAs also provide guidance to the government and international donor community on the country's short-, medium- and long-term recovery priorities. Information from the PDNA reports is supplemented with various other sources of information, notably from the IMF. The descriptions of the modelled events (Canada and Portugal) rely on estimations and analysis performed in recent studies.

[30] PDNA (2018), Lessons from a decade of experience.

[31] In the PDNA reports, "damage" is defined as total or partial destruction of physical assets existing in the affected area. Their monetary values are expressed as the replacement costs according to prices prevailing just before the event. "Losses" are defined as changes in economic flows arising from the disaster. They occur until full economic recovery and reconstruction is achieved, in some cases lasting for several years. Typical losses include the decline in output in production. In this IAIS report, we use the term "losses" differently, as it refers only to the direct impacts of the event, which in this case can be seen as simultaneous with damages, whereas in the World Bank definition it also includes what in this report is referred to as "secondary losses". The World Bank PDNA reports also identify "recovery needs", which are the costs of recommended interventions after an event. These include not only actual reconstruction needs (related to physical damages), but also recovery related to restoring or rehabilitating certain activities or services, "building-back-better" investments, and capacity building. This is not discussed in detail in the GIMAR.

Malawi

Case study: 2015/2016 Malawi drought

Country description

Located in the south-eastern region of Sub-Saharan Africa, Malawi is landlocked. Its economy is heavily dependent on agriculture, which employs over 80% of the population and contributes 31% to GDP. Other major sectors include the services sector (55% of GDP) and manufacturing (10%). According to the World Bank, Malawi remains one of the poorest countries in the world, where 70%[32] of the population live in extreme poverty.

Insurance market and NatCat coverage

In 2016, there were eight general insurers and one reinsurer. Motor insurance was the largest line of business (61% of GWP), followed by fire insurance (18% of GWP). Only 25% of the GWP was reinsured.

Private property catastrophe insurance is almost non-existent in Malawi due to a combination of supply and demand factors. The government of Malawi also does not systematically insure its public infrastructure and buildings.

Economic activities that operate outside the formal, regulated economy (ie the informal economy) are often uninsured and characterised by limited assets and limited resilience to disasters.

The primary instrument used for NatCat protection in Malawi is the sovereign-level drought insurance product from the African Risk Capacity (ARC) Group.[33] This is a type of parametric insurance where the government, as a member of the ARC risk pool, receives a payout when rainfall deviations are so severe that the estimated response costs exceed a pre-defined threshold. The payouts are, however, relatively small compared to the total losses.

Agriculture insurance

For indemnity-based agriculture insurance (such as multi-peril crop indemnity (MPCI) insurance), most Malawian insurers tend to apply very strict exclusions to mitigate weather-related risks. MPCI products are generally provided to medium–large scale farmers for crops, such as tobacco. MPCI products focus on perils with a localised impact, such as hail, fire and wind. To mitigate against weather perils, insurers often exclude flooding, cyclone and drought impacts for agriculture insurance policies.

There were also pilot crop insurance schemes run by some stakeholders in targeted districts.

[32] World Bank Group (April 2025) Malawi Poverty and Equity Brief.

[33] ARC is a Class 2 Bermuda Registered Insurer, refer to https://www.arc.int/arc-limited.

Banking sector

Malawi is one of the least banked countries in the world: total banking assets were 30% of GDP; and only 16% of the population have an account at a financial institution. In 2014, there were 11 banks in Malawi, with the largest commercial banks holding nearly 90% of deposits, and 25% of the banks were foreign owned.[34] Bank loans are generally provided to the government and large enterprises.[35] The largest shares of total bank lending to different sectors are as follows:

- Wholesale and retail trade – 24%
- Agriculture – 20%
- Manufacturing 18%

Event description

The highly variable climate of Malawi significantly influences the amount, timing and frequency of precipitation resulting in frequent droughts and floods. In the 2015/2016 rainfall season Malawi was hit by prolonged dry spells – rainfall was 30% less than the average.

In response to the dry spells, the government of Malawi declared a state of disaster in April 2016. The drought conditions were exacerbated by the El Niño phenomenon. The drought significantly impacted agriculture, resulting in substantial crop failures and livestock losses.

The drought followed severe floods in January 2015, which impacted more than 1.1 million people. While the human cost of the floods was relatively large, its net effect on national GDP was small, 0.6% lower growth, due to the low levels of economic development in the affected areas. The majority of the population is engaged in subsistence agriculture. The aggregate damage and losses due to the floods were estimated at USD 335m (5.2% of GDP), with the biggest impact on housing and agriculture.

Macroeconomic impact

The 2015/2016 drought hit Malawi at a time when the country's economy was particularly vulnerable due to the effects of floods in January 2015. The impact of drought is estimated at USD 295.2m, which is equal to 5.6% of Malawi's GDP (see Table A1 for the impact by sector). The drought drove up food prices, most notably for maize.

The agriculture sector was hit hardest and experienced the largest economic losses (more than USD 200m) due to a significant loss in crop production. Electricity and water were the next most affected sectors.

The government and other stakeholders implemented several projects with preparatory measures against drought. Such projects included planting diverse crops, which helped offset some of the losses in crop production.

[34] Malawi: Selected Issues in: IMF Staff Country Reports Volume 2018 Issue 116 (2018).
[35] IMF Country report 15/365: Malawi (2015).

Dry spells led to distress sales of livestock as farmers sought to raise funds for food. Other main effects of the drought were felt in the agro-processing industry, with 80% of the losses incurred by tea and sugar producers. Losses were mostly due to the unavailability and increased cost of raw materials, frequent power outages and low purchasing power that decreased the overall demand, and increased production costs.

Financial sector impact

Insurance

The sovereign-level drought insurance product from the ARC did not initially trigger a payout because the model estimated that a low number of people were affected. However, the Government's estimate of the impacted population in Malawi was much higher, suggesting a discrepancy in the results of the model. Through extensive technical work, ARC investigated the discrepancy and changed some model assumptions, which in turn triggered a payout of USD 8.1m under the revised policy in November 2016.

Banking and microfinance

Before the drought, the NPL ratio showed a downward trend, decreasing from 15% in 2013 and 2014 to 11% in 2015. However, in the post-event period, the trend reversed, with the NPL ratio rising to 17% by the end of 2016. It subsequently improved, falling to below 10% by August 2018.

Since 2015, banks increasingly concentrated their lending portfolio towards the government (from less than 40% in 2015 to above 50% in 2017) instead of to the private sector.[36]

TABLE A1: Summary of damage and loss by sector

	DAMAGES (USD m)	LOSSES (USD m)
PRODUCTIVE SECTORS	**15.8**	**281.4**
Crops	–	198.8
Livestock	15.8	31.2
Fisheries	–	10.8
Irrigation	–	31.9
Trade and industries	–	8.8
INFRASTRUCTURE SECTORS	**17.4**	**14.8**
Energy	–	5.9
Environment and forestry	4.2	1.5
Water resources	1.4	–
Water supply sanitation	11.8	7.4
SOCIAL SECTORS	**3.4**	**33.2**
Education	3.4	6.9
Health	–	14.3
Nutrition	–	12.0
TOTAL	**36.6**	**329.4**

[36] Malawi: Selected Issues in: IMF Staff Country Reports Volume 2018 Issue 116 (2018)

Drought also had an adverse impact on small businesses and village banks, which are locally managed community banks that provide loans to households and SMEs. The drought also indirectly affected the village savings programme. Because of lost revenues, SMEs had limited extra money to save or duly repay their loans, further reducing the services of some of the village banks.

Societal and human impact

Infrastructure

The 2015/2016 drought affected electricity generation, as Malawi's electricity is largely generated by hydropower. The irrigation sector was also impacted due to the loss of production and increased crop irrigation costs. Finally, the reduction in water availability and accessibility adversely impacted sanitation.

Human impact

The drought added an extra 14% of Malawians to the "food insecure" population. This was primarily due to food unavailability, price increases and diminishing purchasing power. Serious food shortages increased the risk of malnutrition among the most vulnerable population. Large stagnant and dry water bodies, dry and dusty air and unhealthy hygiene practices during the drought led to an increase in diseases.

The drought also impacted the education system, with almost 42% of primary schools affected and almost 140,000 children forced to drop out of school.

The drought added an extra 14% of Malawians to the 'food insecure' population.

Dominica

Case study: 2017 Dominica hurricane

Country description

The Commonwealth of Dominica is part of the Windward Islands in the Caribbean Sea. In 2016, Dominica's population was under 70,000 people and the poverty rate was 29%. Dominica is a small developing island state and one of the smallest economies in the Caribbean. Its economy relies predominantly on tourism (23.9% of GDP) and agriculture (17% of GDP and 21% of the workforce). The steep topographic conditions and rugged interior mean human settlements and development are highly concentrated along narrow coastal areas. Dominica is vulnerable to numerous natural disasters, including meteorological events (high wind, excess rainfall and hurricanes) and geophysical events (earthquakes, volcanoes and tsunamis).

Insurance market and NatCat coverage

There were 17 licensed insurers operating in Dominica in 2017, but the take-up of NatCat insurance coverage was low. Only houses with a mortgage (about 30% of the total housing stock) have NatCat coverage, because insurance is a mandatory condition for obtaining a mortgage. The take-up of motor insurance coverage was also low, with only 20% to 25% having comprehensive insurance and less than 10% having cover for NatCat events.

The electricity company is insured for damages to its generation assets but not to transmission and distribution assets.

Banking sector

In 2016, the size of the banking sector in Dominica as measured by deposits to GDP was more than 90% of GDP, with a total of three banks, both foreign-owned and domestically incorporated. In 2016, banks provided close to 60% of credit, while credit unions provided around 35%. The market share of credit unions was growing, particularly in providing loans for middle- and lower-income groups and other key segments of the population that might otherwise find it difficult to access credit through the commercial banking system. In its 2016 Article IV report, the IMF noted the growth of the credit union sector, stating that financial intermediation was becoming increasingly subject to weaker regulatory and supervisory standards, a characteristic of the credit union sector.[37] The IMF also noted a strong interconnectedness within the financial system, as credit unions account for about one-third of the stock of banks' deposits.

[37] Dominica: 2016 Article IV Consultation--Press Release; Staff Report; and Statement by the Executive Director for Dominica; IMF Country Report No. 16/244; June 22, 2016

Event description

Hurricane Maria affected the northeastern Caribbean in September 2017, particularly in the US territory of Puerto Rico, the country of Dominica and the territory of the US Virgin Islands. With over 3,000 deaths, Maria was the deadliest Atlantic hurricane since 2004 and the eleventh most intense Atlantic hurricane on record.

Hurricane Maria hit Dominica on 18 September 2017. It was one of the fastest intensifying storms on record (intensifying from tropical storm to category 5 in 24 hours), giving little warning to the citizens of Dominica. The hurricane passed over the centre of the island, and the storm brought with it intense winds for three hours, intense rainfall and strong waves – provoking flash floods and landslides.

Macroeconomic impact

The economic impact was about USD 1.3bn, which is 226% of Dominica's 2016 GDP. In 2017, the economy contracted by 6.6% but grew by 3.5% in 2018. Economic growth was back to pre-hurricane level in 2019. The economic impact of Hurricane Maria was notably less than the impact in 2020 of the Covid-19 pandemic at which time Dominica's GDP decreased by more than 15%.

Dominica received USD 28.8m (5% of GDP) including a payout of USD 19.3m from the Caribbean Catastrophe Risk Insurance Facility (CCRIF) and pledges for grants of USD 9.5m.

Most direct physical damages were sustained in the housing sector (38%), followed by the transport (20%) and education sector (7%). The greatest losses were sustained in the agriculture sector (30%), followed by the tourism (19%) and transport sector (14%) (see Table A2 for the detailed breakdown by sector).

Agriculture

Losses in the agriculture sector were extensive and affected all aspects of agricultural production including crops, infrastructure, equipment and croplands. Much of the agricultural infrastructure and equipment were damaged or destroyed including buildings, animal husbandry facilities, agricultural roads and croplands. Sector recovery was affected by the damaged transportation network.

Commerce and industries

It was estimated that, prior to Hurricane Maria, micro and SMEs generated over 60% of private sector employment and income and contributed significantly to GDP. Losses arose from damaged infrastructure, disrupted supplies and lost trade opportunities as changes in customer demands refocused their purchasing priorities.

Transport service providers faced uninsured losses far exceeding their income as well as financing costs associated with re-establishing operations.

Over 10,000 microbusinesses required government support.

TABLE A2: Summary of damage and loss by sector

	DAMAGES		LOSSES	
	USD m	XCD m	USD m	XCD m
PRODUCTIVE SECTORS	**178**	**480**	**202**	**547**
Agriculture	55	149	124	336
Fisheries	2	7	1	1
Forestry	30	80	–	–
Commerce and micro business	70	190	7	19
Tourism	20	54	71	191
SOCIAL SECTORS	**444**	**1,199**	**42**	**112**
Housing	354	956	29	77
Education	74	200	3	9
Health	11	30	7	19
Culture	5	14	3	8
INFRASTRUCTURE SECTORS	**306**	**826**	**135**	**365**
Transport	182	492	53	142
Electricity	33	90	33	89
Water and sanitation	24	65	40	107
Telecommunication	48	129	8	22
Airports and port	19	51	3	9
Cross-cutting	3	8	1	2
Disaster risk management	3	8	1	2
TOTAL	**931**	**2,513**	**380**	**1,026**

Tourism

Thirty-nine percent of hotel rooms were severely damaged, and 34% had less significant damage that allowed them to return to operation faster. Hotel staff and support personnel were directly impacted by both unemployment and the concurrent need to rehabilitate their own properties. Cruise-based tourism was severely disrupted, which impacted tour operators, vendors and other support services.

Damages to the natural environment (including the forest system) also impacted the recovery of the ecotourism sector, which is a major contributor to the island's economy.

Transport

Although all seaports were back in operation just days after the storm, the shipping sector still suffered losses due to reduced traffic. The reduction in traffic was due to infrastructure damage and the government's moratorium on fees for non-commercial activity, such as those related to the relief and rebuild efforts after Maria, which caused 75% revenue loss. Dominica's airport suffered losses due to the reduced tourist traffic.

Motor vehicles were damaged by flooding, flying trees and building debris, with an estimated 1–4% destroyed and 7–10% damaged. It is estimated that less than 10% of motor vehicles had insurance coverage for NatCat events.

Financial sector impact

Insurance

One year after the event (2018), there was considerable progress in insurance payouts from the hurricane. Total payouts amounted to 20% of GDP, mostly from foreign insurers, but outstanding claims were still around 15% of GDP – equal to about one-third of total claims – mostly related to property insurance.

First Domestic Insurance Company (FDIC) was Dominica's only domestic general insurer at the time of Maria, and in 2018, a large proportion of those outstanding claims were from FDIC. Ultimately, FDIC declared insolvency due to claims arising from Maria – its capital shortfall amounted to 2% of GDP. In 2019, FDIC announced it facilitated an arrangement with the Insurance Company of the West Indies to continue to provide insurance coverage to its Dominican clients. As of March 2024, USD 23m was still owed to policyholders by FDIC, but the liquidator was still in the process of liquidating assets to determine how much could be paid.

Dominica also had some coverage through the CCRIF, but this was insufficient due to the scale of the losses. This facility paid out USD 19.3m for claims associated with Maria (less than 4% of GDP).

In total, payouts from the private insurance sector and the CCRIF were significant, but far below total post-disaster needs.

Banking and microfinance

Banks' mortgage portfolios were somewhat protected given that mortgaged properties were largely insured.

By the end of 2017, banks' NPL ratios increased to 17.4%, and banks' provisions doubled to reach 80% of NPLs. NPL ratios for credit unions are not available but they likely also increased. Given their already low capital buffers, it is possible that these institutions were undercapitalised.[38]

In contrast, credit to government as a percentage of GDP increased in the post-hurricane years, averaging an annual increase of 37% over the three years following the event. Domestic financing played a key role as the post-hurricane public creditor when reconstruction costs were high and international grant financing was low, providing 24% of central government debt in 2016, which increased to 42% by 2019.[39] Real credit to the private sector decreased by an average of 4% annually in the three years following the event and only began to increase in 2020.

Societal and human impact

Infrastructure

Roads, major bridges and water supply areas were damaged or closed due to substantial debris from trees and flooding. Widespread damage to the transmission and distribution networks caused electricity service failure. At least 75% of the network was down, and 80%–90% of the transformers were so severely damaged that they could not be repaired. Entirely overhead, the network was highly vulnerable to severe weather events. The hurricane also caused extensive and widespread damages to the telecommunications network and public communication infrastructure.

Poverty

The impact on critical employment sectors, such as agriculture and tourism, led to a reduction in overall consumption and an increase in poverty levels, from 29% to 43%. Maria significantly increased social vulnerability in Dominica, including drug and alcohol addiction, particularly among men; limited access to health services for women, the elderly and persons living with disabilities; and food insecurity, especially for households dependent on subsistence farming by women.

Education

Major damage affected 41% of educational facilities, which required reconstruction. Overall, Maria affected the entire student population. Nevertheless, schools opened about one month after the storm, relying on temporary structures.

Health

Many medical facilities suffered significant damage from Maria, which greatly increased health-related risks due to poor sanitation and outbreaks of vector-borne diseases.[40] Poor nutrition exacerbated chronic diseases. There was also an increases in substance abuse and mental health problems.

[38] Dominica: 2018 Article IV Consultation-Press Release and Staff Report.
[39] Domestic sources provide 37% and 35% of central government debt in 2020 and 2021 respectively.
[40] Illnesses transmitted to humans and animals through the bite of infected arthropods, such as mosquitoes, ticks and fleas.

Pakistan

Case study: 2022 Pakistan floods

Country description

Pakistan is characterised by diverse topography, ecosystems and climate zones. Rich in natural resources, including fertile agricultural lands, natural gas reserves and mineral deposits, Pakistan faces challenges in balancing competing objectives between economic development and environmental protection. In 2022, the service industry accounted for 58% of GDP, agriculture for 23% and industrial activities for 19% (with textile being the main exporting item).[41]

As of 2018, 22% of the population lived below the national poverty line and more than 12% of the population remained undernourished. Most of Pakistan's population live along the Indus River, an area prone to severe flooding in July and August. Major earthquakes are also frequent in the mountainous northern and western regions.

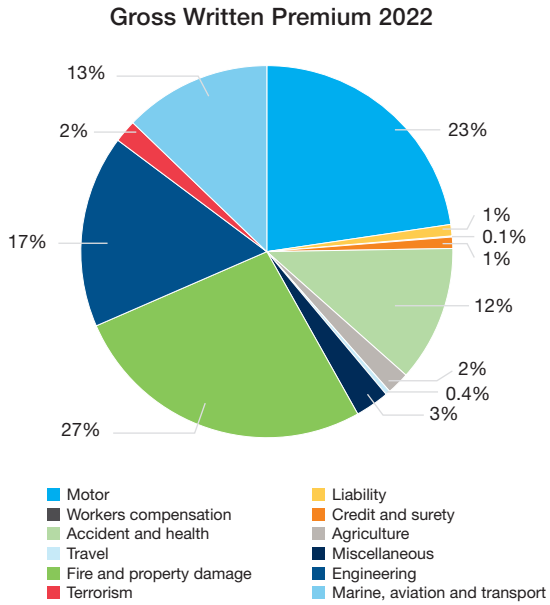
Insurance market and NatCat coverage

There were 39 non-life insurers and one reinsurer operating in 2022. Gross premium income in 2022 was PKR 553bn (USD 2.5bn) with total insurance assets of PKR 2,421bn (USD 11.3bn) (68% life insurance and 32% non-life insurance). The distribution of 2022 non-life insurance premium by line of business is summarised in Figure A1.

Residential and commercial property insurance

Residential and commercial properties with mortgages are typically insured as banks require fire and allied perils insurance as part of loan agreements. However, self-owned or informally constructed homes and buildings are often uninsured, creating a significant coverage gap. Only around 1% of the 32 million residential properties are insured.

FIGURE A1: Distribution of non-life insurance premium by line of business (2022)



Source: Securities and exchange commission of Pakistan, Insurance industry statistics 2022

[41] Pakistan Bureau of Statistics, Gross Domestic Product of Pakistan.

Large corporations and SMEs

Large corporations (particularly multinational and listed companies) typically insure plants, factories and other assets. Construction projects and power plants backed by foreign loans and funding projects have property insurance that covers catastrophic events.

There are an estimated five million SMEs in Pakistan, most of which have either no insurance or only minimal coverage (usually limited to fire or theft when linked with microfinance institution loans), which results in a significant protection gap. Main drivers of the low insurance take-up for SMEs include lack of awareness, affordability and limited availability of products that are tailored to SME needs.

Agriculture insurance

In 2022, agriculture insurance premiums accounted for 2% of the overall premiums in Pakistan's non-life insurance sector. Crop insurance is primarily covered by government-led schemes. Additionally, a few companies offer pilot projects and direct insurance. Only 14% of farmers are insured. Insurers cannot charge a premium of more than 2% of the sum insured. Insurance prices are not determined on an actuarial basis and do not consider the prevailing market conditions.

Lending institutions are the direct beneficiaries of the government-led agriculture insurance schemes as they receive compensation for loans provided to farmers. There is a notable absence of a national crop and livestock insurance scheme catering specifically to farmers without loans in Pakistan.

Banking sector

In March 2022, there were 37 banks (including five Islamic banks), nine development finance institutions and 11 microfinance banks. Bank loans were primarily to corporates (71%), followed by commodity financing (9%), consumer loans (8%, including 2% for mortgages), SMEs (4%) and agriculture (4%).

TABLE A3: Selected metrics for the banking sector in Pakistan

PKR bn	TOTAL ASSETS (PKR bn/USD bn)	ADVANCES (NET) (PKR bn/USD bn)	NPL (%)	CAPITAL ADEQUACY RATIO
Banks	30,717/143	10,342/48.1	7.8%	16.4%
Development financial institutions	547/2.5	144/0.7	9.6%	39.1%
Microfinance banks	5902.7	292/1.4	6.0%	16.5%

Source: State Bank of Pakistan

Description of event

Between June and August 2022, Pakistan experienced its wettest August since 1961. Torrential rains and a combination of riverine, urban and flash flooding led to an unprecedented disaster in the country. Sindh and Balochistan provinces were subject to rainfall that surpassed the average monthly amounts by six and seven times, respectively. These floods came on the heels of a severe heatwave – previously a 1-in-1,000-year event. The drought saw temperatures continuously above 45°C and caused crop losses, power outages and forest fires.

According to the National Disaster Management Authority, around 33 million people (1-in-7) were affected by the floods, including nearly 8 million people who were displaced. The floods took the lives of more than 1,700 people, one-third of whom were children. Rain-induced floods, accelerated glacial melt and the resulting landslides devastated millions of homes and key infrastructure, submerging entire villages and destroying livelihoods.

According to the National Disaster Management Authority, around 33 million people (1-in-7) were affected by the floods, including nearly 8 million people who were displaced.

Macroeconomic impact

The floods had a substantial negative impact on Pakistan's economy. It is estimated that the physical damage and the secondary economic losses were more than 4% of Pakistan's GDP each. The direct impact was most significant on the agricultural sector, which accounted for almost 25% of the total physical damage brought by the flood (see Table A4 for the detailed breakdown on impact by sector). The decline in agricultural output, combined with existing international supply shocks, triggered tremendous food and commodity price increases, and the headline consumer price index (CPI) rose by nearly 25% within one year after the flood.

Compression in domestic demand followed with spillover impact into large-scale manufacturing as well as the services sector, the latter being the largest contributor to the GDP of Pakistan. As a result, GDP growth rate dropped from 4.8% in 2022 to zero in 2023.

To stabilise the economy amid multiple challenges, including devastating floods and a difficult external environment, the government of Pakistan adopted resilient policy measures and entered a new Stand-By Arrangement (SBA) programme with the International Monetary Fund (IMF), resulting in the receipt of USD 3bn. As a result, Pakistan's economy showed signs of recovery in 2024, achieving an annual GDP growth rate of 2.5%.

The sectors that suffered the most damage were housing, agriculture, transport and communications. But most of the losses were in the agricultural sector.

TABLE A4: Summary of damage and loss by sector

	DAMAGES		LOSSES	
	PKR bn	USD m	PKR bn	USD m
PRODUCTIVE SECTORS	**996**	**4,635**	**2,853**	**13,281**
Agriculture	800	3,725	1,986	9,244
Water resources and irrigation	153	711	-	-
Commerce and industries	40	186	758	3,527
Finance and markets	1	3	90	417
Tourism	2	10	20	93
INFRASTRUCTURE SECTORS	**843**	**3,927**	**85**	**396**
Transport and communications	701	3264	60	281
Energy	19	88	1	3
WASH, municipal services and community infrastructure	123	575	24	112
SOCIAL SECTORS	**1,345**	**6,261**	**193**	**896**
Housing	1,200	5,586	137	636
Health	23	109	7	34
Education	120	559	47	219
Culture and heritage	1	6	1	7
CROSS-CUTTING SECTORS	**18**	**83**	**142**	**660**
TOTAL	**3,202**	**14,906**	**3,272**	**15,233**

Source: PDNA

Housing

The floods destroyed approximately 780,000 houses and partially damaged more than 1.27 million houses. Rural houses, in particular, were affected. Housing losses caused large-scale displacement of people and the associated risks, including to health.

Agriculture

The floods damaged around 4,410 million acres of agricultural land, and it was estimated that 0.8 million livestock perished. The destruction of crops, livestock and aquaculture infrastructure and assets resulted in the temporary deterioration of livelihoods, employment and agriculture-related income as well as the decline of exports of important crops such as cotton and sugarcane.

The greatest damage occurred to flood protection infrastructure (36%) and irrigation channels (32%), followed by drainage systems (14%) and dams, headworks and weirs (9%). Overall, the irrigation water supply systems suffered 41% of the total damage.

Commerce and industries

Generally, the impact to commerce and industry was considerably less relative to their large contribution to Pakistan's economy. This was because the floods largely spared the country's industrial heartland and key urban centres.

Flood-related cotton losses impacted the domestic textile industry as local cotton constitutes about half of the industry's required cotton input. Textiles account for around one-quarter of total industry output and more than half of goods exports. Similarly, the expected reduction in food harvests and reduced supply of livestock negatively impacted the local food processing and slaughtering industries.

Transport

Lower agricultural and industrial activity adversely impacted wholesale and transportation services, which account for about half of Pakistan's service sector output. In addition, transportation challenges arising from the damaged roads and bridges disrupted supply and further dampened overall economic activity.

Tourism

The 2022 floods caused widespread devastation to the travel and tourism industry by damaging infrastructure and partially or completely destroying the private sector enterprises and markets in tourism value chains across Pakistan. This led to an immediate decline in tourist footfall during the peak tourist season. Hotels, restaurants and tour operators incurred physical damages and revenue losses. Supply chains were disrupted, and a complete closure of tourist sites occurred in the affected districts. Some geographic areas reported no infrastructural damage but suffered losses due to the reduced occupancy in hotels and substantial drop in private sector activity.

Financial sector impact

Insurance

Estimates of insured losses include PKR 5.44bn (USD 25.3m) that were not reinsured abroad. Of these, infrastructure-related insured losses were small, at PKR 190m (USD 0.9m), while refineries and oil and gas exploration companies reported no uninsured damages from the floods, as losses were covered under their insurance policies subject to applicable deductibles.

Given the low penetration of property coverage, there were no insurance insolvencies due to the 2022 floods.

Banking and microfinance

The reported impact on the physical infrastructure of the financial sector included damages to 268 branches and 81 microfinance branches. The physical infrastructure damages are estimated at PKR 600m (USD 2.8m), of which PKR 510m (USD 2.4m) was in the commercial banking sector and PKR 90m (USD 0.4m) in the microfinance sector.

The flood-induced incremental NPL ratio for commercial banks, microfinance banks (MFBs) and microfinance institutions in flood-impacted areas are estimated to be 2%, 54% and 24%, respectively. At the national level, commercial banks' NPL ratios decreased from post-flooding level of 7.8% to 6.3% in 2024, while MFBs increased from 6% to 9.7%.

Although MFBs hold total advances portfolio that are only about 3% of that of commercial banks, potential failure of MFBs due to NatCat events could have significant operational implications, particularly in terms of access to loans for flood-exposed areas and flood-vulnerable assets.[42]

Societal and human impact

Infrastructure

Initial estimates suggest that approximately 3.2% of total in-service roads and around 40% of total in-service railways were damaged by the 2022 floods. Telecommunications infrastructure was also damaged.

Damage in the petroleum sector was primarily to the transmission and distribution pipeline network. In the power sector, most of the direct damage was to the distribution network and the hydroelectric power generation stations. Due to distribution network outages, most of the affected population suffered from electricity blackouts.

There were damages to more than 4,300 water supply schemes and 2,700 sanitation facilities. The damage to public sector schemes was estimated at USD 186m.

[42] In districts that are affected by the 2022 flood, MFBs provide more than 40% of the agricultural loan and more than 25% of total loans rather than commercial banks as of December 2023 (Source: SBP's Financial Stability Review 2023).

Environment

The floods also impacted forestry as well as protected areas, wildlife and infrastructure in national parks. Landslides and soil erosion led to material effects in residential areas. The floods also caused chemical spills and contamination of sites.

Damage to weather monitoring stations and devices impaired the forecasting and flood warning capacity of the relevant government offices, potentially leading to further damage and losses due to inaccurate forecasts.

Poverty, food security and loss of life

The national poverty rate increased by roughly 4%, pushing between 8.4 and 9.1 million people into poverty as a direct consequence of the floods. Estimates suggest the floods more than doubled the number of people facing food insecurity – from 7 million to 14.6 million – due to lost production and rising prices.

Communities in riverine areas suffered severe losses of life and property as limited resources hindered their ability to act on flood warnings and relocate assets. Lost food stocks, poor harvests and rising food prices exacerbated food insecurity and compromised the quality of nutrition. The prevalence of standing water and limited access to safe drinking water, sanitation and hygiene services contributed to an increase in waterborne diseases and additional loss of life.

Education

More than 6,200 education institutions were assessed as fully damaged and nearly 11,000 as partially damaged. This affected more than 94,000 teachers and 2.6 million enrolled students.

Health

The 2022 floods affected almost half of the country, damaging 13% of the health facilities. Pakistan experienced substantive increases of communicable diseases such as acute diarrhoea, cholera, malaria and dengue. Disruption in health service delivery exacerbated health inequities for the poor and disadvantaged.

New Zealand

Case Study: 2010/11 New Zealand earthquakes

New Zealand is the first of three cases focused on earthquakes. The description of New Zealand is based on the actual experiences of the significant earthquakes that occurred in Canterbury in 2010 and 2011. Given the very low frequency and high-severity pattern of such events, there is a risk of underestimating their potential magnitude, severity and consequences to society in general.

Country description

New Zealand is an island country located in the southwestern Pacific Ocean, comprising two main landmasses—the North Island and South Island—along with numerous smaller islands. New Zealand lies about 2,000 kilometres (1,200 miles) southeast of Australia across the Tasman Sea. With a population of approximately 5.2 million (2025 estimates), New Zealand is considered a high-income economy, with a high standard of living and strong social services. Key sectors include agriculture (notably dairy, meat and wine), tourism, services and technology. The economy is export-driven, with major partners including China, Australia, the US and Japan.

General description of the insurance market

New Zealand has a small insurance sector compared to world standard. In 2012, private insurers' premium was around 4% of GDP, below the OECD average of 8.7% GDP.

Prudential regulation of private insurers in New Zealand only began in 2010; and by 2013, all private insurers were required to be licensed under the Insurance (*Prudential Supervision*) Act 2010.[43] As of June 2014, there were 98 licensed insurers (26 life and 72 non-life), ranging in size from NZD 600,000 in total assets to more than NZD 5bn (USD 2.9bn). Around 44% of licensed insurers are branches or subsidiaries of overseas insurers. Between 2010 and 2013, non-life insurance held around 60% of the private insurance market premium.[44] Major lines of business for non-life insurance in New Zealand include private and commercial motor, private and commercial property and liability and public coverage for earthquake.

The government is also a key player in the provision of general insurance. Personal injury is compensated by the Accident Compensation Commission (ACC), while natural disaster damage for residential land, buildings and contents that are privately insured against fire is partly compensated by the Natural Hazards Commission Toka Tu Ake (NHC) (formerly the Earthquake Commission, EQC). As a result, only about half of non-life premiums are written by the private sector, while the remaining are paid as charge levies to the NHC and ACC.

[43] The *Insurance Prudential Supervision Act 2010*, enacted in 2010, established New Zealand's first comprehensive system for regulating and supervising insurance businesses. Since 2013, insurers must be licensed by the Reserve Bank, comply with the legislation, its license terms and standards like "Fit and Proper" and "Solvency". The Reserve Bank of New Zealand also holds powers to manage insurer distress under the legislation.

[44] The insurance sector and economic stability.

The EQC provided first loss cover for residential dwellings, with a building cap of NZD 100,000 at the time of the Canterbury earthquakes. This limit was later increased to NZD 150,000 and subsequently to NZD 300,000. Contents were covered up to NZD 20,000 at the time and later reduced to nil. The EQC also offered limited land cover, for which there is no private additional insurance.

The multiple aftershocks in Canterbury since September 2010 created complexity in claims settlements that had not occurred since the establishment of the NHC in 1945. In September 2011, the High Court made the declaratory judgement that the NHC, as the first loss insurer, is responsible for up to NZD 100,000 cover for dwelling damage in respect of each earthquake individually, with any balance above the building cap to be settled by private insurance policies.

Residential and commercial property insurance

In 2010, housing played a significant role in household savings in New Zealand. Housing made up a substantial portion of total household assets, accounting for around three-quarters of households' overall wealth.[45]

In New Zealand, around 96% of households take out residential insurance.[46] Banks usually require an insurance policy when originating a mortgage. However, ongoing renewal of these policies is usually not monitored throughout the term of the mortgage.

Banking sector

In June 2010, registered banks held total assets of approximately NZD 374bn (USD 220bn), representing more than two times New Zealand's GDP, and total loans of NZD 296bn (USD 174bn).[47] The asset composition consisted of 60% household, of which 55.6% was housing, 24% business and 16% agriculture.[48]

Description of event

The Canterbury earthquake sequence began early in the morning on 4 September 2010, with a Mw 7.1 magnitude, 40 km west of Christchurch. Although it caused significant damage to older brick and masonry buildings and injured around 100 people, there were no fatalities due to its timing and distance from major urban areas.

The aftershock sequence was intense, with a Mw 4.9 aftershock on 26 December 2010. The most devastating aftershock occurred on 22 February 2011 (Mw 6.3), centred 6 km southeast of Christchurch at a depth of 5 km. This event caused extreme ground shaking, killed 185 people and injured 6,000 to 7,000 people. Both the original earthquake and the February aftershock occurred in an area previously not regarded as highly prone to seismic risk. Further major aftershocks followed, in June and December 2011.

About 8,000 people left Christchurch (at least temporarily) following the earthquakes.

[45] New Zealand Housing Report 2009/2010: Structure, Pressure and Issues.
[46] Reserve Bank of New Zealand – Te Pūtea Matua (2024), Insurance availability and risk-based pricing.
[47] Reserve Bank of New Zealand – Te Pūtea Matua (2025), Banks: Balance sheet (S10).
[48] New Zealand: Financial Sector Assessment Program in: IMF Staff Country Reports Volume 2017 Issue 110 (2017).

Macroeconomic impact

The total cost of the Canterbury earthquakes is estimated at approximately NZD 50bn (USD 31bn), equivalent to 20% of GDP. The amount includes the fiscal costs for the government, approximately NZD 17bn (USD 10bn),[50] of which about NZD 7.3bn is NHC cost net reinsurance proceeds. Insured losses are estimated at NZD 38bn (USD 22.35bn).

In terms of GDP, the Canterbury economy increased 32% (NZD 8bn, USD 5bn) between March 2011 and March 2016. In comparison, the national economy increased 24%. The gap between Canterbury's and New Zealand's growth rates peaked in 2014. Since then, growth declined, and by 2016, for the first time since 2008, national economic growth exceeded that of Canterbury.[51] While GDP growth in Canterbury's economy may appear to be a positive side effect from the natural disasters, GDP does not represent the significant loss of assets or the broader societal impacts experienced in the Canterbury region.

Sectoral impacts

The Canterbury earthquakes resulted in significant physical damage to buildings and disruptions to lives. The earthquakes had short and long-term impacts on tourism. However, manufacturing, which is the most important industry for Canterbury (around 11% of the Canterbury economy), remained robust in the post-earthquake period. The reconstruction work that followed the earthquakes was a strong support for the Canterbury economy. Construction grew from roughly 6% of Canterbury's GDP in 2010, which was the same as the national average, to more than 10% in March 2015, becoming the second largest GDP contributing sector of Canterbury.

Housing

In the Canterbury region, the earthquakes damaged approximately 75% of the houses, with approximately 9,100 homes deemed uninhabitable and requiring demolition.[52] NHC, as the first loss insurer for residential housing loss, received 460,000 claims from the 2010 earthquakes and aftershocks, including claims on building, contents and land exposure.[53] About 20% of building claims exceeded the NHC cover limit, thus the remaining losses (and building losses outside of NHC coverage) were settled by private insurance policy.

The total cost of the Canterbury earthquakes is estimated at approximately NZD 50bn (USD 31bn), equivalent to 20% of GDP.

[50] See Lessons from The Treasury's role in the Canterbury earthquakes.
[51] Source: Stats NZ – Canterbury: the rebuild by the numbers.
[52] ScienceDirect (2015), An overview of the impacts of the 2010-2011 Canterbury earthquakes.
[53] Earthquake Commission (EQC)(2019), Briefing to the public enquiry into the Earthquake Commission.
[54] See An overview of the impacts of the 2010-2011 Canterbury earthquakes.

Extensive damage occurred to homes affected by land settlement from liquefaction, rockfalls and mass movements. The supply of low-cost rental housing declined, partly due to landlords opting not to rebuild or upgrade properties, resulting in higher rents. The implications of damaged housing were particularly difficult for vulnerable populations. House purchase prices rose and land sales in some areas increased by between 88% and 115% in the year following the February 2011 earthquake, compared to the previous two years.[54]

After the earthquakes, there was a sharp rise in new home consents and building activity in Canterbury, marking the start of a long rebuilding process. Between 2010 and 2017, the cost of building a new home in Canterbury rose by 52%, outpacing the national increase of 40%. From 2010 to 2014, Canterbury saw the fastest growth, with an average annual increase of 7.8% – twice the rate of the national average.[55]

Agriculture

The agriculture sector was largely unaffected by the earthquake. This sector, which contributed 6.6% to Canterbury's GDP in 2010, achieved 17.7% annual growth in 2011.

Commerce and industries

Economic activity was more resilient than initially expected.

The government was able to stabilise economic disruption and build confidence in the market in a timely manner through immediate measures, including employment subsidies and land zoning. Insurance payouts were the primary source of funds for the rebuild of residential and commercial property in Christchurch.

Key industries in Canterbury, including the manufacturing and service sectors, kept pace with the rest of New Zealand. Many manufacturers were outside the most affected areas and thus remained in operation. In a survey conducted by the Department of Labour of Canterbury's employers, only 11% of manufacturers reported permanent relocation of workplace following the earthquakes, while 84% indicated that they did not relocate.[56]

New Zealand received higher net inflows of foreign direct investment (FDI) in 2010 and 2011, including from insurers and reinsurers. Investment patterns suggested confidence in the market for long-term development of Canterbury, as well as New Zealand, despite the shot-term disruptions resulting from the earthquakes.

Transport

Export volumes from Canterbury seaports and airports recovered to pre-earthquake levels by 2022. Import volumes into Canterbury increased at a greater rate than nationwide imports as rebuild-related materials and replacement goods were brought in.[57]

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55 See Canterbury: the rebuild by the numbers.

56 A Changing Landscape: The Impact of the Earthquakes on Christchurch Workplaces.

57 Reserve Bank of New Zealand – Te Pūtea Matua (2016), The Canterbury rebuild five years on from the Christchurch earthquake.

58 Canterbury: the rebuild by the numbers.

Tourism

Tourism contributed to 4.8% of New Zealand's GDP in March 2010. Before the earthquakes, Canterbury accounted for approximately 20% of total tourist arrival in New Zealand. The number of international and domestic guest nights fell by 14% in 2011 and dropped further in 2012 to 22% below the 2010 pre-earthquake levels, reflecting a reduction in international visitors. Guest nights spent in Canterbury accommodation started to show signs of recovery in the year ending September 2013, as international guests returned to Canterbury.[58]

Financial sector impact

Insurance

Following the Canterbury earthquakes, the government played a key role in stabilising the insurance market. The New Zealand Reserve Bank estimated total insurance claims at about NZD 38bn (76% of the estimate of total recovery cost). NHC had reinsurance recoveries of roughly NZD 5bn (USD 2.9bn), and the claims costs exhausted reinsurance and largely depleted the Natural Disaster Fund. As of March 2022, private insurers (ie excluding NHC) paid out around NZD 26bn (USD 15.3bn) for the earthquakes of 2010 and 2011.

The multiple aftershocks, especially the February 2011 shock, created unprecedented complexity in claims settlement that took years to fully resolve. For private insurers, the best estimate made in 2011 on the ultimate claim costs was around 50% of the value estimated in June 2020. The uncertainty in claims estimation created difficulty in both claims reserving and settlement.

Although pre-existing capital and reinsurance covered most insured losses, 10 out of 20 insurers required additional capital. Overall, 81% was funded from existing resources, while 14% required new capital, with some insurers heavily reliant on capital injections.

Two insurers, Western Pacific Insurance and AMI, faced significant financial challenges due to the earthquakes. Western Pacific Insurance entered liquidation, which led to 42% of its claims being unfunded. In contrast, AMI met all its insured loss obligations through substantial capital support from the government.[59]

As of 2010, AMI Insurance was New Zealand's fourth largest general insurer and had an approximate 35% share of the Christchurch market. AMI's catastrophe reinsurance cover of NZD 600m (USD 367m) per earthquake was initially expected to be sufficient to meet the claims from the September 2010 earthquake but ultimately proved to be insufficient. The reinsurance was also insufficient for the claims arising from the more damaging February 2011 aftershock. The New Zealand government determined that the potential failure of AMI was systemic given the potential impact on the speed and scale of the rebuilding process, the potential policyholder effects related to partial or delayed payouts and the implications for insurance availability and pricing more broadly.[60] In April 2011, the Crown provided a support package of NZD 500m (USD 296m) to AMI with the objective of giving the public confidence. One year later, AMI was restructured: the Crown retained the earthquake claims and associated reinsurance under the Southern Response agency, and the remaining business – including in-force policies apart from earthquake claims and recoveries – was sold to IAG group.

[59] See Funding and Reserving Canterbury earthquake insurance claims.
[60] See Lessons from the Canterbury earthquake sequence – Whole of Government Report.

At the time of the Canterbury earthquakes, insurers were not subject to formal solvency requirements. Following the enactment of the *Insurance* (*Prudential Supervision*) Act 2010, the New Zealand insurance supervisor gained powers to supervise compliance in the insurance market with rules and requirements issued by the New Zealand Reserve Bank. Given concerns that future NatCat events could push some insurers toward insolvency, and in light of New Zealand's relatively concentrated property exposures in a small number of cities and the highly concentrated property insurance market, the Reserve Bank of New Zealand mandated insurers to hold sufficient capital or reinsurance to cover the costs of a 1-in-1,000-year earthquake. The intent of this measure was to provide confidence in the funding of future NatCat events.

Immediately after the Canterbury earthquakes, residential property insurers shifted from full replacement cost to sum-insured coverage. NHC also later changed its coverage with an increase in building damage limits and the removal of contents coverage, which had a ripple effect on private insurers' policies.

Reinsurance played a significant role in the 2010 and 2011 earthquakes, with 72% of the total claims paid (based on the most current estimates).[61] Following the Canterbury earthquakes, insurers doubled their reinsurance coverage, while reinsurers expressed concerns over the scale of their exposure and delays in assessing final liabilities. There was fear that reinsurers might exit the New Zealand market, which posed risks to both the insurance sector and wider economy. The Treasury considered securing reinsurance an immediate priority to maintain coverage and insurer stability.

In response to these concerns, the government intervened to restore confidence and secure ongoing reinsurance. Actions included a significant increase in NHC's reinsurance cover from NZD 2.5bn (USD 1.5bn) before the earthquakes to NZD 10.3bn by 2025. Recognising the systemic role of insurance, the Treasury reviewed the *EQC Act 1993* and considered broader risk financing options beyond reinsurance to strengthen disaster recovery funding in New Zealand.[62]

Banking and microfinance

The banking sector demonstrated resilience following the September 2010 earthquake. The NPL ratio for total loans saw a modest increase of 0.1% immediately after the earthquake but soon dropped to levels below those recorded prior to the event. Both business and agricultural loans showed increases, with the latter reflecting a longer-term trend since 2009, influenced by a sharp decline in agricultural commodity prices.[63] Meanwhile, NPL ratios for housing loans and personal consumer loans declined. New Zealand's household resilience may partly be attributed to the protection offered by the housing insurance.

[61] 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.

[62] See Lessons from the Canterbury earthquake sequence – Whole of Government Report.

[63] New Zealand: 2011 Article IV Consultation--Staff Report; Public Information Notice on the Executive Board Discussion; and Statement by the Executive Director for New Zealand; IMF Country Report 11/102; April 22, 2011.

Societal and human impact

Infrastructure

The earthquake damaged greater Christchurch's horizontal infrastructure network, including damage to hundreds of kilometres of underground pipes (fresh water, wastewater and stormwater), and to an estimated 52% of Christchurch's sealed roads. The total cost of damage to infrastructure was estimated to be NZD 2.7bn (USD 1.6bn) as at November 2015, only a small portion of which was insured.[64] The Crown and Canterbury local government shared much of the spending in the recovery of infrastructure and local public assets.

Education

While schools reopened relatively quickly after the September 2010 event, the February 2011 earthquake resulted in greater disruption as many schools had extensive damage. Within three weeks, 84% of students in greater Christchurch returned to school.

Universities also experienced impacts, with first-year enrolments in 2011 falling by 28%. Despite this, academic performance at the University of Canterbury remained stable, and withdrawal rates did not significantly rise following the September 2010 event, indicating resilience in academic outcomes.

Health

In the September 2010 earthquake, 377 people suffered injuries, while over 1,000 people were injured in its aftermath. The February 2011 earthquake resulted in 185 fatalities and injuries to more than 4,400 people. Apart from physical injuries, the earthquakes also caused psychosocial impacts, with longer-term impacts ultimately influencing the demand for health and disability insurance for several years after the initial event.[65]

[64] Whole of Government Report: Lessons from the Canterbury earthquake sequence – Department of the Prime Minister and Cabinet – 31 July 2017.
[65] Social effects of the Canterbury earthquakes – New Zealand Parliament.

Canada

Case study[66]: Canada earthquake

Country description

Canada is the second largest country in the world based on total area and is bordered by three oceans, the Atlantic, Pacific and Arctic. According to Statistics Canada, as of 1 July, 2024, roughly 75% of Canadians lived in metropolitan areas.[67]

Canada's ten provinces and three territories make up five distinct regions based on geographic and economic factors. These regions are: Atlantic Provinces, Central Canada, Prairie Provinces, West Coast, and Northern Territories. In 2024, Canada's GDP was driven by Central Canada (58%), Prairie Provinces (22%) and West Coast (14%).[68] In 2024, almost 75% of Canada's GDP was from service-producing industries (eg real estate, finance and public administration) with 25% from goods-producing industries (eg manufacturing, mining, oil and gas extraction and construction).[69]

Canada is exposed to a wide range of NatCat events including wildfires, floods, ice storms, convective storms and earthquakes. Many of these exposures exist across the country. The two most significant exposures with substantial protection gaps are floods and earthquakes.

Flooding is Canada's most costly and frequent hazard, and Public Safety Canada estimates the risk in Canada to be CAD 2.9bn (USD 2.15bn) per year, with residential property owners bearing approximately 75% of uninsured losses.[70] The Bank of Canada and the Office of Superintendent of Financial Institutions (OSFI) conducted recent stress tests that included comprehensive analysis of flood risk. The economic impacts of flooding can be severe for affected communities, but they do not pose a systemic shock to the broader financial system.

However, the losses from a very large earthquake, particularly in British Columbia or Quebec, could create a financial stability risk. According to AIR Worldwide:

"The expected socioeconomic consequences of a future earthquake event in densely populated metropolitan regions of Canada are comparable to those of all other natural hazard events combined, and would likely strain existing capacities to manage financial losses and disaster recovery efforts at all jurisdictional levels of government."

The issue of Canadian earthquake risk has long been the focus of work by the PACICC, which is the national policyholder protection scheme for non-life insurance in Canada, the Insurance Bureau of Canada (IBC), numerous insurers and universities, as well as the Department of Finance Canada (Finance Canada) and Natural Resources Canada. This case study relies on their analyses.

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66 This section benefited from contributions from Alister Campbell, Grant Kelly (PACICC) and Tiegan Hobbs (Research Scientist, Geological Survey of Canada; Adjunct Professor, University of British Columbia; Adjunct Professor, University of Victoria)

67 Statistics Canada, Population Estimate.

68 Ibid, GDP.

69 Ibid.

70 Public Safety Canada, Adapting to rising flood risk (2022).

Short description of insurance market[71]

As of year-end 2024, there were 116 private non-life insurers on a consolidated basis operating in Canada with total insurance service revenue of CAD 108.5bn (USD 80.3bn), total assets of CAD 226.6bn (USD 168bn) and total capital of CAD 80.8bn (USD 60bn). Major lines of business include: automobile (35%), personal property (19%), commercial property (17%) and liability (12%); the remaining 17% is a mix of numerous other lines of business including boiler and machinery, marine and aircraft, surety and fidelity. In 2024, insurers incurred CAD 92.6bn (USD 68.5bn) insurance service expense, representing 87% of the insurance revenues earned.

Earthquake risk

About one in three Canadians are exposed to potentially dangerous shaking levels (at the 1/475 annual exceedance probability), going up to one in two in high hazard regions in British Columbia and Quebec.[72] A major earthquake affecting a highly populated area is one of the most destructive natural disasters Canada could experience. The financial implications of a large earthquake are significant for Canada. Based on projections, the costs on a per capita basis could be more than double those the government incurred for Covid-19.

A large earthquake will result in extensive loss of life, destruction of property and leave remaining infrastructure vulnerable to aftershock(s). While the City of Vancouver has taken steps to manage the risk, the City of Montreal and most other communities have not.

The City of Vancouver has advanced seismic provisions in their building bylaw,[73] but across Canada there are building codes that ensure modern structures are built to preserve life safety during expected levels of shaking.[74] Still, older buildings, such as those constructed with unreinforced masonry, remain an issue in many historical cities, such as Victoria and Montreal.

Many damaged homes will not have earthquake insurance. The earthquake penetration rate is 50% to 70% in British Columbia and less than 5% in Quebec.[75] Likely causes for low earthquake insurance take-up rates include: high price, risk perception, unattractive policy structure (eg high deductible), low risk awareness, misunderstanding of the policy terms and optimistic expectation of government assistance or compensation after major natural disasters.[76]

For those who have purchased earthquake insurance, the large deductibles imposed in current policies in British Columbia will result in no payment at all for many damaged homes. And the exclusions for tsunami and liquefaction of soil mean that many customers who thought they were protected will not be. The problems for strata/condominium corporations will be a magnified version of this. If aftershocks cause further damage and loss, and a second deductible is applied, very few homeowners or condo owners will be able to afford to rebuild.

The following discussion addresses implications arising from (1) a 1-in-500-year event that the Canadian non-life industry is assumed to be able to withstand and (2) a 1-in-700-year event that would lead to notable failures in Canadian non-life insurers.

71 Source: MSA Research. Dollar amounts refer to IFRS 17 values. Percentages and dollars exclude the Canadian provincial automobile insurers.
72 Hobbs et al., 2023, Earthquake Spectra.
73 Vancouver city building by-laws.
74 National building code of Canada (2020).
75 Goda (2022): Earthquake insurane gaps for Canadian homeowners.
76 Goda et al, 2020 (IJDRR).

1-in-500-year event

With a 1-in-500-year event, estimates of the uninsured losses[77] (ie the protection gap) are roughly:

- CAD 30bn (USD 22.2bn) for personal physical losses in both the west and east
- CAD 50bn (USD 37bn) for commercial physical losses in the west and CAD 14bn in the east.

With the inclusion of indirect, public and infrastructure losses, the estimates of uninsured total economic losses are CAD 110bn (USD 81.4bn) for the west or CAD 22,000 per capita. In comparison, costs per capita related to Covid-19 were CAD 11,000. These estimates are from presentations to Finance Canada in February 2022 and are not adjusted for inflation or the effects of tariffs or other trade actions occurring in 2025. These estimates likely understate current uninsured values as insurance penetration has decreased in recent years due to increases in premiums and deductibles. The estimates are also probably underestimated as the cost of land is not covered in any insurance policies nor in the modelling.

In the presentation to Finance Canada, it was noted that following a 1-in-500-year earthquake, the rate of GDP growth in Canada would decrease by 50%, and cumulative real GDP losses would amount to CAD 100bn (USD 74bn), more than 4% of Canada's GDP in 2024. Major government support would be necessary and critical.

Recent modelling by Natural Resources Canada[78] which is limited to total building losses only from shaking damage, considered the impact from a British Columbia earthquake (magnitude 9.0 Cascadia Subduction Zone). Preliminary estimates of protection gaps are roughly 20% for combined personal and commercial properties, in addition to significant losses of borne by policyholders through deductibles. Commercial and personal insurance deductibles accounted for 50% and 10% of the total losses, respectively.

1-in-700-year event

Assuming a 1-in-700-year event with no government backstop, an earthquake causing total losses exceeding CAD 35bn (USD 49.2bn) could bring systemic failure to the Canadian P&C insurance industry.[79] This in turn could lead to losses in the rest of the financial system and housing market.

Following such an event, the availability of non-life insurance coverage would be severely limited, due to failure of some providers as well as reticence to continue providing insurance.

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[77] Key modelling assumptions include: no change to the current commercial earthquake product as well as uptake of the product; current commercial lines 1-in-500 probable maximum loss (PML) is equivalent to the personal lines PML; the non-life industry is able to withstand an event up to USD 10bn above the current OSFI requirement (which is based on 1-in-500 year return period and combination of west and east exposures), or USD 35bn per PACICC's latest evaluation. The model estimates, which are based on the RMS EQ model, include shake, fire following, and loss adjustment expenses.

[78] Hobbs, T.E., 'Modelling Insured and Uninsured Losses for Earthquakes in Canada'. In preparation.

[79] PACICC, 'How Big is Too Big?'

Impact on financial system

Insurance guarantee system (incl. PACICC)

All non-life insurers licensed in Canada are required to be members of a guarantee fund. Most Canadian non-life insurers offering coverage for homes, cars, businesses and other property are Members of PACICC. PACICC's coverage extends to policies representing more than 95% of all non-life GWP in Canada.

Some insurers may fail after a major Canadian earthquake. While PACICC has a process to ensure that claims are paid if an insurer fails, this is only up to defined limits. If the event (or series of events) is sufficiently large, PACICC's capacity to fund obligations may be exhausted.

The absence of a government backstop means that tail risk may partly be priced into the premium consumers and businesses pay. The absence of a backstop also leads some insurers to ration capacity or withdraw from the market entirely. Higher risk and fewer competitors contribute to higher prices, which then contribute to lower take-up rates. The limited financial resources of insurance buyers drive demand for higher deductibles and onerous exclusions for those who still purchase coverage, compounding existing problems.

As members of PACICC, Canadian non-life insurers fund the administrative costs of PACICC via an annual assessment. PACICC maintains a liquidity fund sufficient to meet the initial cash-flow requirements of an insolvent insurer. If additional resources are required, PACICC has the legal authority to assess the industry up to an annual limit, with no cap on the total funds assessed.

Without government guarantee or backstop mechanism, PACICC faces an upper limit above which its assessment mechanism could transmit risk.

Above a certain (albeit high) threshold, Canada reaches a "tipping point" where further PACICC assessments trigger systemic contagion and failures. In this situation, the PACICC board would pull its "circuit breaker" that leaves policyholders of insolvent insurers without any protection at all. In other words, in the absence of a government backstop liquidity mechanism, consumers could assume 100% of their losses.

The consequences of the 1-in-500-year requirement combined with the absence of a backstop, constrain available capacity and increase pricing. The increased pricing has an upper limit above which consumers are unlikely to take up the insurance product.

Assuming a 1-in-700-year event with no government backstop, an earthquake causing total losses exceeding CAD 35bn (USD 49.2bn) could bring systemic failure to the Canadian P&C insurance industry.

Banks

When insurers fail, PACICC only pays up to defined limits (currently CAD 520,000 (USD 384,000) for personal property), which would not be adequate to rebuild many earthquake-damaged properties. Lending institutions that rely on insurance to respond to NatCat events have not sufficiently stress tested for the additional loan losses that could arise in the banking sector if PACICC was limited in the compensation it could provide.

Beyond the "tipping point", multiple insurers would fail, which either leads to the collapse of PACICC itself or to the PACICC pulling a "circuit breaker" that would force policyholders at failed insurers to wait years for partial compensation as the estates are settled in the legal system. Such a breakdown could transmit risk to credit-granting institutions where a portion of mortgage and loan collateral – properties that are still standing but no longer insured for damage – is completely unprotected. Credit-granting institutions would then face stress levels far exceeding those in current stress test scenarios, as higher proportions of their total loan portfolios would be secured by uninsured and potentially devalued property assets.

Canada's West Coast is tectonically active, compared to the more stable eastern regions, and therefore has a higher likelihood of earthquake events. Earthquakes anywhere could be followed by significant aftershocks occurring months or even years after the initial event. Credit-granting institutions are not currently stress-testing for the impact of a second shake. Given the high earthquake deductibles in current British Columbia property policies, there is a high likelihood that policyholders would not have the financial capacity to fund rebuilding net of two earthquake deductibles. Thus, it is reasonable to expect that a high percentage would walk away from their properties and thus their mortgages.

Portugal

Case Study: Portugal earthquake

Country description

Portugal is a southern European country, part of the European Union (EU), located on the Iberian Peninsula, bordered by Spain to the east and north, and the Atlantic Ocean to the west and south. As of 2025, the population of Portugal is 10.4 million, with roughly 3 million people residing in the Lisbon metropolitan area and 500,000 in the Algarve region, both of which face the greatest seismic hazard. The Azores islands (with a population of approximately 235,000) are also exposed to NatCat events (volcanic activity and seismic hazard).

The service sector represents 60% of Portugal's total output. Tourism has also become a major industry. Portugal's largest trading partners are within the EU, with more than 70% of both imports and exports from and to other EU countries. The regions responsible for the highest contribution to GDP are the greater Lisbon and Tejo Valley regions (43%), North Region (29%) and Centro Region (14%). According to 2023 figures, the percentages for the Algarve region and Azores are 5% and 2%, respectively.

Portugal is exposed to a wide range of NatCat events including earthquakes and tsunamis. Portugal is also increasingly exposed to fire, particularly wildfire, storm and flood events.[80] The risk of seismic activity is significant, particularly along the southwest coast and the Tejo River Valley. Like Canada, given the exposure to earthquakes and the extent of the protection gap in Portugal, a very large earthquake could create financial stability risk.

Short description of insurance market

According to the Portuguese Insurance and Pension Fund Supervisory Authority's (ASF)[81] May 2024 report, there were 65 insurers established in Portugal in 2024. These included 27 EU foreign branches. The total 2024 premiums were EUR 14.7bn (USD 17bn), with 49% being life and 51% being non-life business. The largest classes of non-life business are accident and health (41.6%), motor (32.1%), and fire and other damages (17.4%).

Insurance coverage for NatCat risks

Financial protection against earthquake events can be obtained by adding this cover under "fire and other damage" or "multi-risk" insurance policies. As such, coverage for the earthquake peril is generally available in the Portuguese insurance market, but its penetration levels (and coverage rate) are deemed insufficient, based on studies conducted by the ASF. In Q1 2023, the ASF launched an extensive data collection process

[80] The increase in temperature, together with the change in rainfall patterns and higher coastal erosion, are the main manifestations of climate change in Portugal.

[81] ASF, Information on the insurance market in Portugal.

encompassing 98% of the insurance market. The ASF targeted segments and types of insurance in which the seismic coverage is or might be included. A key objective of this process was to conduct a comprehensive analysis of seismic risk coverage within the Portuguese insurance market. In October 2023, the Secretaries of State for Civil Protection and Finance requested ASF's support for the creation of an earthquake risk coverage system.

Including both fire and allied perils policies, the ASF found that as of December 2022 only 1.5 million of the total 4.4 million policies (34%) had earthquake coverage. The industrial segment, while representing only roughly 1% of insurance contracts, shows the highest earthquake cover penetration level (41%),[82] followed by housing (36%) and commercial and services (24%) segments. From the perspective of total sum insured (for both buildings and contents), only 41% had earthquake coverage – EUR 373bn (USD 435bn) of EUR 903bn (USD 1,052bn).

Some of the most hazardous regions for the earthquake peril (Lisbon and Algarve) show a higher earthquake coverage penetration rate for the housing segment, reflecting higher demand for insurance protection. Such high demand could be driven by demographic and building concentration levels and/or by higher risk sensitivity in these areas.

Although earthquake coverage has nearly doubled over the past 15 years, its still relatively low penetration level remains a concern. Given that housing accounts for around 47%[83] of households' total savings (or around 57% of their net savings, considering household debt), potential losses resulting from a major earthquake event could significantly impact households and, in turn, pose risks to financial stability.

Considering the national housing stock and the corresponding distribution (according to data from Statistics Portugal),[84] less than 20% of dwellings nationwide are covered for earthquake risk, while approximately 55% are covered for fire and allied perils. The higher coverage rate for fire and allied perils is likely due to the compulsory nature of fire insurance cover for homeowners in buildings containing multiple apartments and owners. This requirement also applies to common areas of buildings (eg, condominiums).

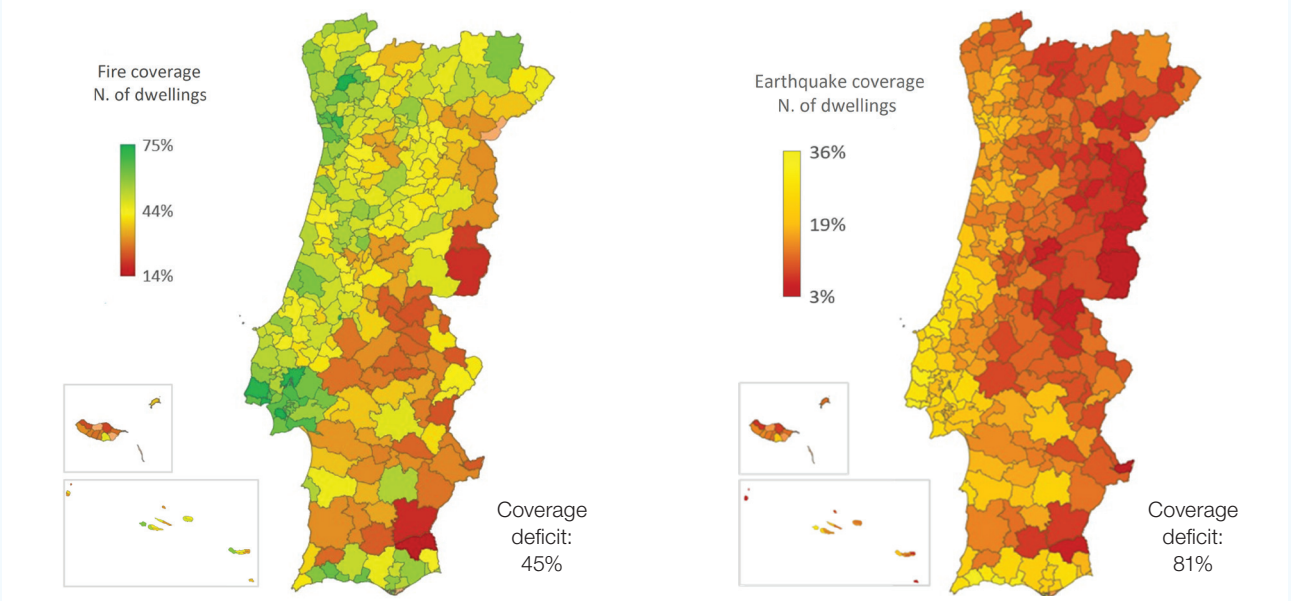
As illustrated in the figure, the insurance coverage rate for the housing segment varies significantly by municipality, ranging from 14% to 75% for fire and allied perils, and only 3% to 36% for earthquake, based on the number of dwellings. Coverage for other NatCat perils, namely storm and flood, closely mirrors that of fire risk as coverage is generally included by default in fire and multi-risk insurance policies.

[82] In this section, the terms "penetration level" and "penetration rate" refer to the measurement of the insured portfolio with earthquake coverage against the total fire and multi-risk insured portfolio, in number of policies and sum insured, respectively. On the other hand, the terms "coverage rate/deficit" and "protection level/gap", refer to the level of (or: lack of) insurance protection against the national stock, in number of dwellings and estimated capital amount (reconstruction cost), respectively.

[83] See series for the Portuguese economy- Património dos particulares – from the Bank of Portugal (2024).

[84] Instituto Nacional de Estatística – INE.

FIGURE A3: National level of coverage rate (in number of dwellings), for fire and allied perils and for earthquake coverage, in December 2022



Source: ASF Portugal

The ASF also estimated the protection gap for the national housing building component (in terms of capital exposure):

- More than 81% of the reconstruction cost for the national housing stock does not have any type of protection against earthquake peril; and
- For fire and allied perils, the protection gap is around 45%, pointing to a less concerning protection deficit.

The ASF's estimates should be interpreted with caution as they rely on the average sum insured per dwelling for each municipality as a proxy for the cost of reconstruction. Such an estimate could therefore understate the actual protection gap, particularly due to the possibility of underinsurance by policyholders.[85] Additionally, sharp increases in reconstruction costs, in post-disaster severe scenarios, are also an exogenous factor to consider, driving up the loss and reducing the insurance economic protection.

[85] Underinsurance occurs when the insured value (for the cost of reconstruction) guaranteed in the policy is less than the actual value (of the cost of reconstruction) of the building.

Banking sector

This protection gap exposes banks to the risk of loss of value of the collateral in the event of an earthquake, which is likely to happen together with a sharp increase of NPLs. The banking sector therefore has an incentive to play a key role in improving the earthquake protection gap, particularly in the housing sector, by requiring coverage before extending credit for the purchase or construction of residential properties.

Based on ASF's analysis, around 42% dwellings with fire and allied perils coverage have a mortgage lender as the beneficiary of the insurance policy as of December 2022. However, more than half of dwellings under these policies (23% of total dwellings sampled) do not have earthquake risk cover. If earthquake risk was guaranteed in all mortgage-related insurance policies, the national coverage rate for this risk is estimated to increase from 19% to 32% of the housing stock.

Earthquake catastrophe models

To support its proposal for a national scheme, ASF has obtained "PML studies",[86] based on several earthquake catastrophe models, which are currently being used in the Portuguese market.

Those studies considered several options for the base portfolio and deductibles. The outputs covered ten models, including several model adjustments to consider certain effects, not covered by the models, such as demand surge, claims inflation, fire following earthquake and tsunami.

The results vary considerably for the same return period, revealing the high level of uncertainty inherent in the estimates. Considering the residential and commercial portfolio and a 5% deductible, the results for the return periods of 200, 250, 500 and 750 years, reveal that the higher PML for those return periods exceeded the lowest by 401% for the first two periods, and by 174% and 83%, for the remaining two, respectively.

These results underscore that even though catastrophe models are important tools, there is a need to improve their transparency, comparability and understandability for the market.

More than 81% of the reconstruction cost for the national housing stock does not have any type of protection against earthquake.

[86] In Catastrophe Modelling it is common to talk about return periods and the corresponding PMLs. In this context, the return period – generally given by the Occurrence Exceedance Probability –, corresponds to the expected number of years between events that exceed certain loss amounts, simply referred as PMLs – Occurrence Probable Maximum Loss. See also: Notes on using catastrophe model results.

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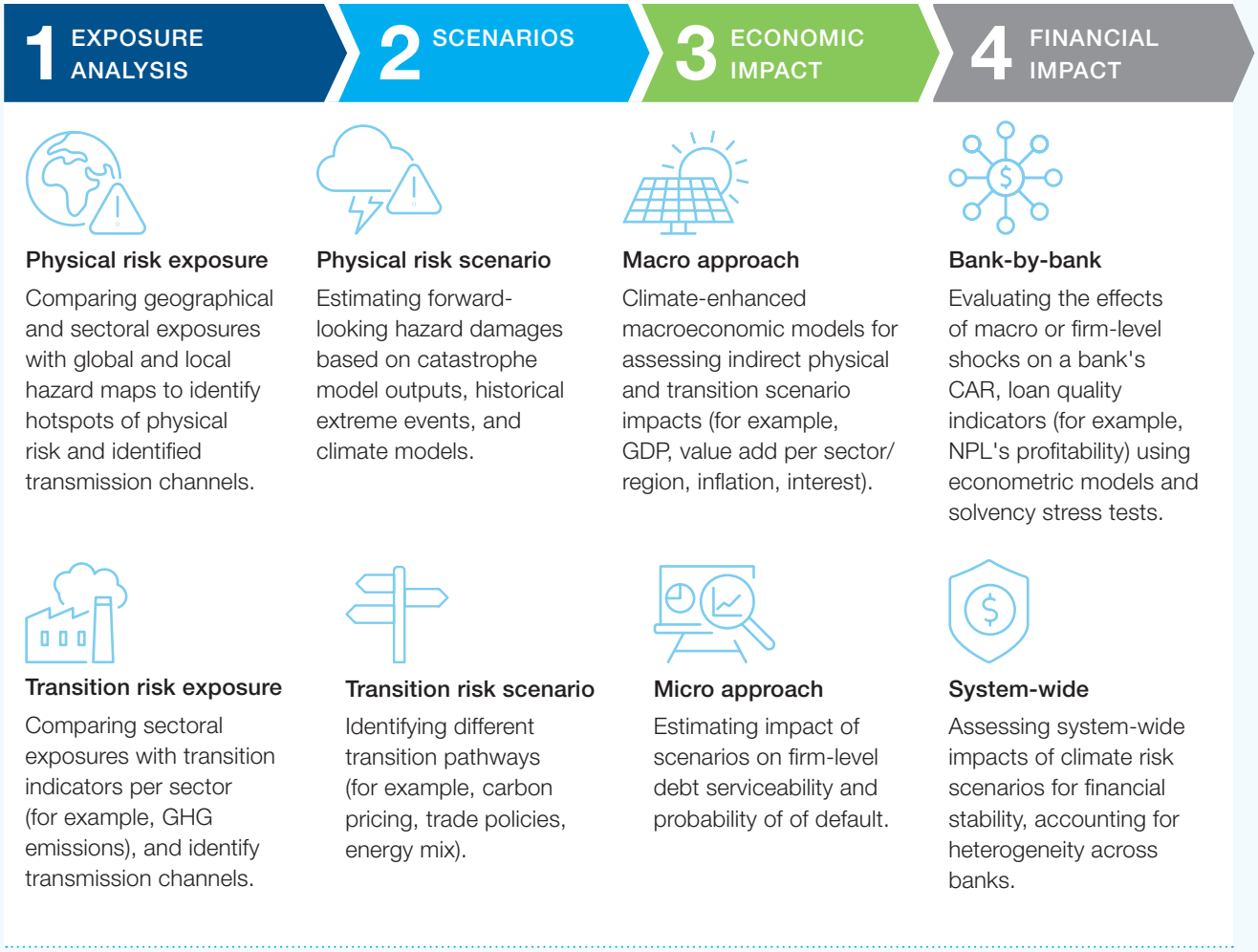
Annex 2: Climate-related financial risk analysis conducted by the World Bank

Assessing and managing climate-related financial risks in EMDEs necessitates tailored approaches due to diverse contexts, including varying risk types, data availability and capacities. Methodological approaches can range from simple exposure assessments to complex climate stress tests, each providing a complementary perspective on risk materiality (see Figure A4). These approaches involve integrating various models and data sources to identify potential climate-related risks and vulnerabilities within the economy and financial sector.

Exposure assessments connect climate-related data, like flood risk maps, with financial sector information, such as geolocated bank lending, to identify high-risk areas. These assessments also reveal data and capacity gaps, guiding more detailed risk evaluations for financial authorities and institutions. For example, a recent joint report by the World Bank and the Reserve Bank of Malawi highlights significant losses for major insurers in Malawi due to recent climate events, although overall sector exposure remains low due to underinsurance (RBM and WB 2024). Climate stress tests, on the other hand, focus on the implications of severe but plausible scenarios, which need to be defined based on expected biophysical dynamics due to climate change, such as a 1-in-200-year tropical cyclone event. The economic impacts are then assessed either by directly evaluating firm-level impacts (micro approach), by incorporating macroeconomic feedback effects (macro approach), or a hybrid approach. Subsequently, the financial impacts, such as credit or market risks arising from the economic impacts, are evaluated.

FIGURE A4: Overview of the World Bank approach for climate-related financial risk analysis



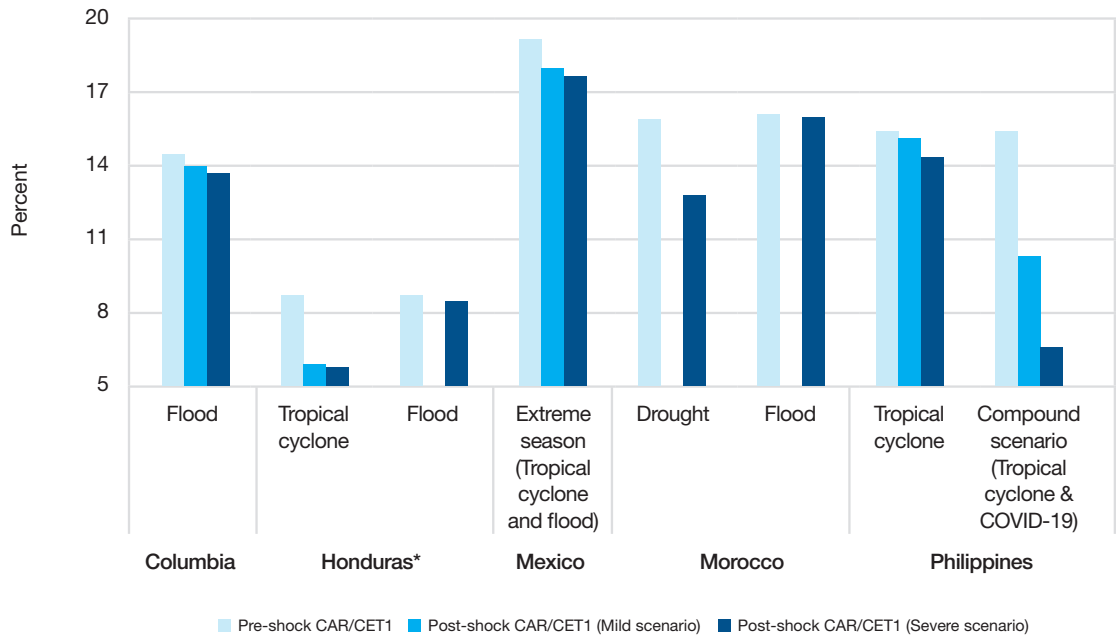
Source: World Bank (2024). Finance and Prosperity 2024, Washington, DC: World Bank)
Note: CAR = capital adequacy ratio; GHG = greenhouse gas.

The World Bank has conducted over 40 climate-related financial risk assessments across its client countries, either as standalone technical assistance or within the frameworks of the Financial Sector Assessment Program (FSAP) and Country Climate and Development Reports (CCDRs). Currently, these stress tests primarily focus on the banking sector. Results from these stress tests indicate that the impacts on financial stability are generally manageable, particularly for larger countries. For example, stress tests in Colombia, Morocco, and Mexico suggest that overall physical risks, such as droughts and floods, pose relatively low threats to the financial system as a whole (Reinders et al. 2021; World Bank 2024; IMF 2022). However, the resilience

of individual banks can vary significantly, potentially affecting their financial health. In Mexico, for instance, the projected impact of extreme weather events on banks' capital adequacy ratios ranges from a modest 0.5% to a significant 4%.

For smaller economies like Honduras, severe scenarios can pose substantial risks to the financial system. Unlike larger economies, where a tropical cyclone might affect only certain regions, in smaller countries, such events can impact the entire country and its economy. Additionally, the compounding effects of multiple shocks and feedback loops can significantly amplify climate impacts, yet these are rarely captured in current climate-risk assessments. In the Philippines, a stress test conducted jointly by the World Bank and the IMF revealed that the occurrence of a large typhoon during a COVID-19-like pandemic increased the impact on bank capital by nearly 9 percentage points compared to a scenario without a pandemic (Hallegatte et al. 2022).

FIGURE A5: Climate stress test results as impact on system-wide capital adequacy ratio for different scenarios, selected countries (pre- and post-shock banking system capital ratio in percentages)



World Bank staff calculation based on publicly available climate risk assessments conducted with World Bank support across five EMDEs (Reinders et al. 2021; World Bank 2023; IMF 2022; World Bank 2024, Hallegatte et al. 2022).
Note: The graph shows the outcomes of a mild and severe physical scenario per country. The year of assessment for these studies varies from 2022 to 2050. The analysis shows the impact on banking system–wide capital adequacy ratio (CAR), except for Honduras, where it indicates CET1 ratio impacts. CET1 = common equity tier 1.*

Despite significant progress in developing climate-related financial risk assessments, challenges and shortcomings remain, particularly for EMDEs. These challenges include: (i) the availability, granularity, and quality of data for risk assessment, and the capacity to utilise these data; (ii) limited incorporation of potential mitigants for climate risk into the assessments, such as insurance or adaptation measures; (iii) the limited set of direct transmission channels currently being considered; and (iv) uncertainty about how climate change impacts will unfold.

For example, sectoral and geographic breakdowns of banking sector data are crucial for physical climate-related financial risk assessments. However, the lack of availability of these breakdowns, including combined location and industry data, has constrained several risk assessments in EMDEs. Even when location data are available, they may misrepresent the locations of assets and operations, as exposures are reported at the location of the bank branch originating the loan or the firm's headquarters, rather than the actual locations of operations.

Addressing these challenges requires better data collection, including more granular exposure data, and information on insurance coverage and premiums. However, it may be useful to start with a simple approach and refine it over time. This strategy can raise awareness, build capacity, inform disclosure and regulatory reporting, and advance climate risk modelling. It is also important to extend these assessments to other financial market segments beyond the banking sector.

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