

FSI Insights

on policy implementation

No 65

Mind the climate-related protection gap – reinsurance pricing and underwriting considerations

by Christoph Möhr, Jeffery Yong and Manuela
Zweimueller

March 2025

JEL classification: G18, G22, G28, Q28, Q54

Keywords: climate change, insurance supervision,
financial stability

FSI Insights are written by members of the Financial Stability Institute (FSI) of the Bank for International Settlements (BIS), often in collaboration with staff from supervisory agencies and central banks. The papers aim to contribute to international discussions on a range of contemporary regulatory and supervisory policy issues and implementation challenges faced by financial sector authorities. The views expressed in this paper are solely those of the authors and do not necessarily reflect those of the BIS, the International Association of Insurance Supervisors, the Basel-based committees or the Swiss Financial Market Supervisory Authority.

Authorised by the Chair of the FSI, Fernando Restoy and the Chair of the IAIS Executive Committee, Shigeru Ariizumi.

This publication is available on the BIS website (www.bis.org). To contact the BIS Global Media and Public Relations team, please email media@bis.org. You can sign up for email alerts at www.bis.org/emailalerts.htm.

© *Bank for International Settlements 2025. All rights reserved. Brief excerpts may be reproduced or translated provided the source is stated.*

ISSN 2522-249X (online)

ISBN 978-92-9259-843-3 (online)

Contents

- Executive summary 1
- Section 1 – Introduction 3
- Section 2 – Reinsurance market structure 6
- Section 3 – The roles of reinsurance in the context of climate change..... 12
- Section 4 – Safety and soundness perspectives 17
- Section 5 – Protection gap implications28
- Section 6 – Risk adaptation role of reinsurers31
- Section 7 – Concluding remarks..... 33
- References37
- Annex 1 – Basic forms of reinsurance43
- Annex 2 – The Swiss and French systems for NatCat insurance.....45
- Annex 3 – Risk reduction and transfer systems for climate-related risks50
- Annex 4 – Conceptual description of reinsurance underwriting54

Mind the climate-related protection gap – reinsurance pricing and underwriting considerations¹

Executive summary

Climate change is increasingly breaking records. From record breaking temperature highs to record breaking economic and insured losses from climate-related events in certain regions, climate change is contributing to adverse impacts in various sectors and amongst the general population. Since 2020, annual insured losses from natural catastrophes (NatCats) have exceeded the USD 100 billion mark globally. The impact of climate-related events on economic and societal resilience has increased attention amongst policymakers, standard-setting bodies and financial authorities. One of the areas of focus is on reinsurance, given the indispensable role it plays in global risk diversification and in supporting the underwriting ability of primary insurers including climate-related risks. In this context, insurance supervisors may have an interest in how reinsurance can contribute to the safety and soundness of financial institutions, the growing (re)insurance protection gap, as well as the role of (re)insurers in supporting climate risk adaptation and mitigation.

From a safety and soundness perspective, retreating reinsurance coverage can impact the solvency of primary insurers. To underwrite NatCat risks, primary insurers rely on affordable reinsurance to transfer part of the underwritten risks to reinsurers. However, a range of factors, from increasing costs of rebuilding or repair to expanding populations and properties in NatCat prone areas, are testing the limits of the availability and affordability of (re)insurance coverage. On top of this, climate change is contributing to increased uncertainties (and therefore risks) for certain NatCat events. As a result, insurers may pass on the higher costs to policyholders. Alternatively, as their risk appetite is affected by reinsurance availability, they may cease to underwrite certain risks altogether. Another potential consequence is that some insurers may retain greater volumes of underpriced risks, which may adversely impact their solvency position. Underpriced or inadequately underwritten insurance products may threaten their financial position.

The reinsurance protection gap, which in this paper refers to the shortfall between reinsurable and actually reinsured losses, may contribute to financial stability risks. NatCat events that result in the destruction of properties or the disruption of businesses may reduce property collateral values and borrowers' capacity to repay. As a result, there is increased risk of mortgage and business loan defaults, potentially adversely impacting the banking sector. Parts of uninsured losses, especially in terms of infrastructure damage, will need to be borne by governments, which may have fiscal implications. In some jurisdictions, especially emerging markets and developing economies (EMDEs), economically vital sectors such as agriculture and tourism may be particularly vulnerable, as local insurers may not be able to offer insurance protection for those sectors in the absence of capacity amongst global reinsurers. The lack of affordable access to critical insurance products such as home or flood insurance may also have other far-reaching economic and social consequences, further exacerbating financial stability risks. Provided that risks are reinsurable, the reinsurance sector can play a market stabilising role and support

¹ Christoph Möhr (Christoph.Moehr@finma.ch), Swiss Financial Market Supervisory Authority; Jeffery Yong (Jeffery.Yong@bis.org), Bank for International Settlements; and Manuela Zweimueller (Manuela.Zweimueller@iais.org), International Association of Insurance Supervisors. We are grateful to Rodrigo Coelho, Juan Carlos Crisanto, Jonathan Dixon, Bernhard Mayr and Hanne van Voorden for their helpful comments. We also extend our appreciation to the insurance authorities, reinsurers, reinsurance brokers and risk modellers who generously shared their perspectives during interviews, noting that statements made in the paper may not necessarily fully reflect their views. We would also like to thank Anna Henzmann who provided valuable administrative support.

the availability of insurance – thus countering financial stability risks by absorbing extreme financial losses arising from climate change impacts.

To counteract retreating reinsurance coverage for climate-related NatCat events, it is essential to make climate-related risks insurable at affordable – but risk-based – levels. To contribute to the continued availability and affordability of reinsurance coverage, governments, the insurance industry and supervisors need to work together to support risk adaptation measures. Climate risk adaptation measures need to be pursued to bring risk levels down and to be taken into account explicitly in insurers' and reinsurers' pricing and underwriting practices, which may not currently be the case. The interests of primary insurers and reinsurers need to be aligned, in terms of underwriting adequately priced insurance products as well as properly acknowledging risk adaptation measures. Therefore, reinsurers' pricing can be an important signal to insurers, reflecting underlying risk levels.

From an underwriting perspective, reinsurers are pursuing their own net-zero goals in various ways, including providing reinsurance coverage to support new green technology and the phasing down of underwriting carbon-intensive sectors. Views are mixed as to whether insurance supervisors have a role to play in incentivising reinsurers to contribute to such risk mitigation efforts. Nevertheless, it is acknowledged that net-zero goals can contribute to slowing down or even reversing climate change, thus reducing the increase in both the frequency and severity of climate-related NatCat events. As a result, insured losses could be more contained, thus contributing to the safety and soundness of (re)insurers, which justifies the proactive approach taken by some supervisors in this regard.

As private reinsurers may not be able or prepared to underwrite climate-related risks, public-private partnerships may become increasingly important to correct market failures and address risk accumulation. Nevertheless, the extent to which public sector reinsurance schemes can cover increasing climate-related losses is limited. The policy options and trade-offs in establishing a public sector reinsurance scheme need to be weighed carefully. There might be unrealistic expectations that governments will continue to subsidise reinsurance premium rates despite mounting climate-related insured losses. In addition, there is a risk that moral hazard may prevent adaptation and mitigation measures from being implemented. As insured losses continue to mount, even well run public-backed reinsurance schemes may face losses due to underpricing and/or increasing claims.

While highly relevant, reinsurance alone cannot resolve the issues of affordability and availability in the insurance market. It can only be part of a wider policy response to the climate crisis and potential further climate change impacts. Climate scientists are clear that we are crossing a number of climate tipping points and the world looks set to exceed our carbon budget to limit global temperature increase to not more than 1.5 or 2 degrees Celsius. This implies substantially more property damage and business interruptions as physical losses become more frequent and severe. Even though climate change itself may not currently be the dominant factor in driving up insured losses, there might be high NatCat exposures in certain regions and therefore, careful monitoring of climate change-related developments is needed. The increasing uncertainty in loss patterns due to volatility caused by climate change can pose challenges for reinsurers' pricing and underwriting practices. Against this backdrop, additional multi-stakeholder collaboration is required, including across borders, to contribute to the transition to net zero. At the same time, risk adaptation measures need to be accelerated as an "insurance policy" against failed transition.

Section 1 – Introduction

- 1. Scientific studies confirm that human-caused climate change is contributing to physical risk manifestation in different parts of the world.**² 2024 was the hottest year on record and despite various net-zero commitments, greenhouse gas (GHG) emissions continue to rise.³ As a result of human activities, the earth continues to warm. This is likely contributing to the intensification of weather events, which includes tropical cyclones and flooding, which are now the costliest natural perils in the 21st century on a cumulative basis.⁴ While it is acknowledged that not all weather-related events can be attributed to climate change, the increasing frequency and severity of certain weather-related events are likely due to climate change.⁵ These weather-related events may become more frequent and more severe under current climate policies, which the United Nations Environment Programme (2024) estimated could lead to a temperature increase of 3.1 degrees Celsius over the course of this century.⁶
- 2. Both insured and uninsured populations and businesses are being adversely impacted by climate change.** Insured businesses are seeing increasing premiums and/or reducing insurance coverage for climate-related natural catastrophe (NatCat) events,⁷ for example on their properties due to increasing flood or wildfire risks. The uninsured or under-insured are exposed to higher risks and face increasing difficulties in obtaining affordable coverage for certain climate-related risks. Businesses face increasing challenges arising from more frequent or severe climate-related events, including the destruction of agricultural produce and other business interruption losses. Obtaining affordable insurance to mitigate the financial consequences of such losses may be vital to protect businesses, including in core economic sectors.
- 3. Reinsurance plays a significant role in enabling insurers to underwrite insurance.** The primary role of reinsurance is to enable the transfer of insurance risk from primary insurers and to diversify the risks. Reinsurance premiums need to be risk-based to ensure the ongoing financial soundness of reinsurers.⁸ Increasing risks – including for climate-related coverage – and increasing risk uncertainties are driving up reinsurance premiums and/or reducing coverage. As a result, some reinsurers may no longer be able to sustainably provide coverage. While it may be desirable from a prudential perspective that reinsurers are becoming more cautious in underwriting and pricing certain NatCat risks, this has a knock-on effect on insurance availability and affordability. As insurers are finding it more difficult to transfer certain NatCat risks to reinsurers, they will in turn increase premiums or reduce coverage. In the end, these developments contribute to the widening of the protection gap.
- 4. Climate change impacts on the affordability and availability of insurance coverage may have wider economic and financial stability implications.**⁹ The Financial Stability Board (2025)

² See Intergovernmental Panel on Climate Change (2023).

³ See World Meteorological Organization (2025).

⁴ See Aon (2025).

⁵ See World Weather Attribution. Gallagher Re (2024) reported that in Q3 2024, there were 49 economic loss events of more than USD 1 billion that were considered “climate-related” events.

⁶ At a temperature increase of 3 degrees Celsius, Armstrong McKay et al (2022) project that multiple climate tipping points will be crossed, triggering large-scale and potentially irreversible changes in certain earth climatic systems with potential consequences for natural disasters.

⁷ This paper is mainly focused on climate-related NatCat events, though the ideas presented may also apply to other types of NatCat. For brevity, the term NatCat refers to climate-related NatCat in this paper.

⁸ In this paper, the term “insurer(s)” may include reinsurer(s), and the term “insurance” may include “reinsurance”. Whenever the term “reinsurer(s)” or “reinsurance” is used, it does not preclude “insurer(s)” or “insurance”. The term “reinsurance” is used to include “retrocessions” ie the transfer of insurance risks from a reinsurer to another reinsurer.

⁹ Swiss Re (2024a) provided estimates of economic losses arising from weather-related perils in selected countries.

highlighted potential cross-border risk transmission that may occur through the global reinsurance market if losses trigger a combination of premium increases and reduced coverage. This trend may lead to previously insured assets becoming uninsurable, thus potentially impacting other parts of the financial system. The *Global insurance market report*¹⁰ by the International Association of Insurance Supervisors (IAIS) highlighted potential spillover effects to the broader financial system should NatCat losses not be covered by insurance. In the United States, climate change is increasing non-renewals of homeowners' insurance¹¹ and rising insurance costs have contributed to inflationary pressures.¹² In Quebec, the withdrawal of insurance coverage has prompted certain banks to stop mortgage lending for flood-prone properties.¹³ Central Bank of Ireland (2024) highlighted how the flood protection gap can transmit to other parts of the financial system, affecting the availability of credit, especially to small businesses in areas at risk of flooding. A supervisor from an emerging market and developing economy (EMDE) reported that the creditworthiness of farmers could be affected by severe droughts, possibly exacerbated by a lack of insurance. Furthermore, fiscal implications may arise should uninsured losses, eg damaged infrastructure, need to be borne by governments. NatCat losses to business segments critical for EMDEs and their development, such as agriculture or tourism, may have destabilising economic and societal implications.

5. **Insurance supervisors have an interest in reinsurers' pricing and underwriting approaches due to potential prudential implications.** Reinsurers' approaches to pricing and underwriting climate-related physical risks may directly impact their own solvency and that of the primary insurers. From a microprudential perspective, the risk transmission channels of climate change to (re)insurers' balance sheets are well documented.¹⁴ For example, reinsurers can be exposed to climate-related physical risks when underwriting certain NatCat risks such as wildfires, hurricanes or floods.

6. **Insurance supervisors are increasingly paying closer attention to the insurance protection gap and the role of reinsurance in this regard.** There is growing international interest in assessing and addressing the insurance protection gap, not only from a financial inclusion perspective but also due to its potential impact on financial stability.¹⁵ The IAIS has concluded that addressing issues related to the affordability and availability of insurance for NatCat events (ie protection gaps) is of growing importance to insurance supervisors – and is also of relevance to society's resilience at large. IAIS (2023a) identified five areas of supervisory activity to narrow NatCat protection gaps: (i) assessment of insurance protection gaps; (ii) improvement of consumer financial literacy and risk awareness; (iii) incentivising risk prevention and the reduction of insured losses; (iv) creating an enabling regulatory and supervisory environment to support the availability of insurance and the uptake of coverage; and (v) advising government and industry, including on the design and implementation of public-private partnerships or insurance schemes. As insured losses from climate-related events increase, reinsurance prices, over time, are likely to increase as well, and coverage could become more restricted or selective. The reduced availability and affordability of reinsurance has a knock-on effect on primary insurers. As they would need to retain more risks, and therefore maintain higher levels of capital, some insurers are reducing their exposures by increasing premium rates or reducing coverage, thus exacerbating the protection gap. Box 1 outlines the components of the reinsurance protection gap covered in this paper.

¹⁰ See IAIS (2024a).

¹¹ See Chairman United States Senate Committee on the budget (2024).

¹² See Quiroz-Gutierrez (2024).

¹³ See Long (2024).

¹⁴ See IAIS (2021, 2018) and Network for Greening the Financial System (2020).

¹⁵ See G20 (2025).

Reinsurance protection gap

IAIS (2023a) outlined two possible definitions of the insurance protection gap. A common definition of the protection gap is the uninsured portion of actual economic losses. Another definition is the uninsured portion of insurable losses, acknowledging that not all economic losses may be insurable.

In the context of this paper, these definitions can be extended and applied to describe the reinsurance protection gap with regard to physical and transition risks:

- Physical risk – the portion of reinsurable losses from physical risk, including climate-related NatCat events, that are not reinsured.^①
- Transition risk – “phasing down” of carbon-intensive sectors. Insured risks may not be reinsurable because of reinsurers’ underwriting exclusions or their phasing down policies including net-zero commitments.
- Transition risk – “scaling up” of net-zero activities. A shortage of affordable reinsurance capacity for net-zero activities such as new green technologies could arise, for example, due to the lack of reinsurers’ experience in underwriting such technologies and uncertainties associated with the risks from such technologies.

This paper distinguishes between the two aspects of transition risk to underscore the different ways in which reinsurance pricing and underwriting can impact them. It is acknowledged that there are views that consider both aspects in a consolidated way under the broad heading of transition risk.

① It is acknowledged that the protection gap is not solely due to climate-related NatCat events, nor is it solely attributable to the lack of reinsurance. Other factors, such as lack of consumer awareness, can drive the protection gap.

7. While some (re)insurers may not currently view climate change as a significant risk driver, insurance supervisors are increasingly concerned about the financial implications of climate change going forward.¹⁶ Quantitative evidence of the financial impact of climate change on financial institutions to date is limited and the financial impact of climate change is often not separately disclosed by (re)insurers. Nevertheless, the risks and opportunities are indisputable, be it the more frequent and severe physical risks or, on the positive side, if there are new technological breakthroughs that can accelerate the net-zero transition. Regardless of immediate concerns over the impact of climate change on the (re)insurance sector, most insurance supervisors view climate change developments and the changing risk landscape with concern from two main perspectives: (i) the impact of climate-related financial risks on the safety and soundness of (re)insurers and the financial system more generally; and (ii) the availability and affordability of certain insurance coverage. Regardless of the causes of increasing economic losses from NatCat events, the impact is clear – increasing losses are pushing up premium rates and reducing the availability of insurance coverage, thus widening the insurance protection gap.

8. Insurance supervisors are stepping up actions to incorporate climate-related risks within prudential frameworks. It is generally accepted that climate change risks manifest in traditional risk categories, including insurance risk. Existing regulatory frameworks could thus capture heightened insurance risk from the increasing frequency and severity of climate-related insured events. Nevertheless, an increasing number of insurance supervisors are publishing guidelines and supervisory expectations on how insurers, including reinsurers, should manage their climate-related risks, including in their pricing and underwriting activities. While general sound risk management practices also apply with respect to climate-

¹⁶ Views within the industry appear to be split as to whether climate change is a significant issue. While some reinsurers may not view climate change as a significant risk, a survey in PWC and Centre for the Study of Financial Innovation (2023) ranked climate change as the number one risk for the reinsurance sector, with growing concerns that some areas and types of businesses could become uninsurable.

related risks, the unique nature of climate change, such as its potential non-linear impact due to climate tipping points and its potentially systemic nature, require special attention.

9. **This paper aims to inform policy discussion on the potential implications of reduced availability and/or affordability of climate-related reinsurance coverage associated with reinsurers' pricing and underwriting activities.**¹⁷ Section 2 describes the reinsurance market structure; Section 3 describes the role of reinsurance in addressing physical and transition risks; Section 4 outlines safety and soundness perspectives around these activities; Section 5 describes how protection gaps can arise and the relevant policy implications; Section 6 covers the significance of the role of reinsurers in climate risk adaptation; and Section 7 concludes.

Section 2 – Reinsurance market structure

Reinsurance market structure

10. **The global reinsurance sector is concentrated and the ranking of individual reinsurers by premiums written has been relatively stable.**¹⁸ The top three reinsurers account for more than 33% of net reinsurance premiums written by the top 40 reinsurers, the top five for more than 50%, and the top 10 for more than 70%. The life reinsurance market is more concentrated than the non-life reinsurance market. The ranking of reinsurers by premiums written has been relatively stable since the 1980s. Despite the net reinsurance premiums written by the top 40 reinsurers increasing by more than 100% from 2008 to 2022, the top five reinsurers remained identically ranked in the years considered (2008, 2017, 2021, 2022 and 2023), and nine of the top 10 reinsurers in 2008 and 2022 were identical.¹⁹ The main movements in the rankings of the top 10 reinsurers since 1980 are due to mergers and acquisitions and the exit of one company from the sector.²⁰

11. **The reinsurance sector is comprised of players with different profiles, from globally active reinsurers to domestic government-backed reinsurers.** Of the top 10 reinsurers by net reinsurance premiums written in 2023,²¹ all except China Re are globally active private sector reinsurers. There are four

¹⁷ The paper is based on desktop reviews and interviews with the following insurance authorities, reinsurers, brokers and NatCat model providers: Australian Prudential Regulation Authority, Bermuda Monetary Authority, Office of the Superintendent of Financial Institutions (Canada), European Insurance and Occupational Pensions Authority, L'Autorité de contrôle prudentiel et de résolution (France), German Federal Financial Supervisory Authority, Insurance Regulatory and Development Authority of India, Financial Services Agency of Japan, Namibia Financial Institutions Supervisory Authority, Monetary Authority of Singapore, Swiss Financial Market Supervisory Authority, Prudential Regulation Authority (United Kingdom), National Association of Insurance Commissioners (United States), Lloyd's of London, Munich Re, Swiss Re, ZEP-Re, Willis Towers Watson, and Moody's RMS. The statements made in the paper are not necessarily reflective of the positions of the interviewed institutions.

¹⁸ See S&P Global (2024c). The top 10 reinsurers by net reinsurance premiums written for non-life and life reinsurance in 2023 are, in decreasing order: Munich Re (Germany), Swiss Re (Switzerland), Hannover Re (Germany), Berkshire Hathaway (USA), Lloyd's of London (UK), SCOR (France), China Re (China), Reinsurance Group of America (USA), Everest Re (Bermuda) and PartnerRe (Bermuda). There are also large reinsurers based in India, Japan, South Korea and Spain. There are other rankings eg AM Best top global reinsurance groups based on 2023 performance.

¹⁹ See S&P Global Ratings' top 40 global reinsurers (2023 and 2024c) and S&P Global (2018).

²⁰ See Outreville (2012). Mergers and acquisitions: Berkshire Hathaway's acquisitions of General Re (USA) and Cologne Re (Germany); Swiss Re's acquisitions of Mercantile & General Re Group (UK) and Employers Re; SCOR's acquisition of Converium (formerly Zurich Re); Munich Re's acquisition of American Re; and the exit of Gerling Global Re (Germany) from the reinsurance market.

²¹ See S&P Global (2024c).

public sector reinsurers in the top 40.²² Around 75% or more of the non-life reinsurance premiums of these public sector reinsurers stem from domestic business.²³ The business models of public sector reinsurers may differ from the business models of private sector reinsurers. In particular, they may have preferential access to domestic primary insurance cessions (eg Africa Re²⁴ and GIC Re²⁵) or be required to provide reinsurance upon request by domestic primary insurers (eg Caisse Centrale de Réassurance (CCR)).

12. Despite its concentration, the private sector reinsurance market is generally competitive.

The reinsurance market is characterised by a diverse array of players, including established global reinsurers, regional specialists and niche providers. This diversity fosters a competitive environment and reinsurers may innovate and refine their products and services to attract and retain clients. The reinsurance market is relatively dynamic, with existing reinsurers or new entrants often filling gaps left by exiting players. In addition, the annual repricing of reinsurance contracts, particularly for non-life reinsurance, is competitive, with reinsurers typically competing for shares of reinsurance contracts through a process comparable to a (sealed bid) auction. The negotiating power of reinsurers and with it the level of reinsurance premiums that reinsurers can charge have historically oscillated between periods of hard and soft markets (the so-called reinsurance (rating) cycle), suggesting that the private sector reinsurance market contains mechanisms that correct deviations in premium levels.²⁶

13. Reinsurers with a limited ability to diversify risks across geographies, markets or sectors may face challenges in underwriting climate-related risks.

Several NatCat monoline reinsurers expanded into other lines of business more than ten years ago, which may indicate that maximising diversification across multiple insurance lines in addition to geographies is beneficial.²⁷ For smaller reinsurers, achieving the same degree of diversification as very large global reinsurers may be challenging due to fixed costs associated with global presence and expertise. If losses from climate-related risks and their correlation increase with climate change, the limited diversification of smaller reinsurers may cause problems. Nonetheless, smaller reinsurers may rely on retrocessions to partially address the challenges they face in terms of their resulting overall exposure from the underwritten risks.

14. The proportion of NatCat risks that is transferred from insurers to reinsurers varies widely across jurisdictions and insurers.

Cession ratios²⁸ for property premiums written from 2014 to 2016 for around 30 countries are estimated to be higher in low-income than in high-income countries.²⁹ High-income Organisation for Economic Co-operation and Development (OECD) countries have an average cession ratio of only 15.4%, while non-OECD and middle-income countries have an average cession ratio of 33.4%. To the extent that reinsurance primarily covers low-frequency, high-severity losses, the share of large NatCat losses that is covered by reinsurers can be considerably higher than these cession ratios

²² China Re (position 7), General Insurance Corp of India (GIC Re, position 18), CCR (France, position 30) and Africa Re (Nigeria, position 38), whose shareholders include certain African states and African and global insurers and reinsurers. CCR is owned and explicitly backed by the French state and, since selling its majority share in its international reinsurance business in CCR Re in 2023, almost only writes public sector reinsurance business, for the most part covering NatCat in France.

²³ China Re's foreign non-life reinsurance premiums were around 25% of total non-life reinsurance premiums in 2023, according to our own calculation based on China Re (2023). Of GIC Re's reinsurance premiums in 2022–23, about 69% were domestic according to GIC Re (2023). Africa Re's international gross premiums are about 25% of total gross premiums in 2023 (see Africa Re (2024)).

²⁴ See Africa Re (2024).

²⁵ See GIC Re.

²⁶ See Box 3 for an explanation of the reinsurance (rating) cycle.

²⁷ See Bermuda: Re+ILS (2018), Insurance Insider (2013), and Scor (2012).

²⁸ Cession ratios are the ratios of reinsurance premiums to primary insurance (ie gross) premiums. They can, on aggregate, be used as broad estimates of the risk transferred.

²⁹ OECD (2018).

indicate, specifically in years in which there are few very large NatCat losses.³⁰ In contrast, in 2023, when annual losses were dominated by more frequent mid-sized losses, the largest global reinsurers retained only 10% of total NatCat losses.³¹ Reinsurers themselves may transfer some of their risks via retrocession to other (re)insurers and/or through alternative risk transfer to capital markets. The majority of the top 50 reinsurers retrocede between 5 and 30% of their gross non-life reinsurance premiums.³²

15. **Alternative risk transfer instruments supplement and compete with traditional reinsurance.** Major NatCat events in the 1990s in the United States, such as Hurricane Andrew, were viewed as industry loss events of such magnitude that the insurance and reinsurance industry began to look for alternative methods to cover such risks. Alternative risk transfer involves risk transfers directly to investors in capital markets, often in the form of tradable securities (insurance-linked securities (ILS)). The ILS market capacity in terms of dedicated capital in 2023 is estimated to be around 20% of dedicated traditional reinsurance capital.³³ Currently, property catastrophe (cat) bonds are among the most common ILS. For investors, cat bonds work like other bonds except that coupon and principal payments are reduced and used to pay for losses if a pre-defined, typically low-probability, high-impact catastrophic event occurs.³⁴

16. **In deciding whether to use reinsurance or alternative risk transfer, insurers consider various factors.** These factors include the cost of the risk transfer and the risks to the insurers. Alternative risk transfer instruments may benefit from reduced cost of capital by attracting a wider pool of investors and may offer insurers multi-year arrangements (instead of the annual contracts that are typical, at least for traditional non-life reinsurance).³⁵ On the other hand, alternative risk transfer may not be available for certain types of risk, and alternative risk transfer capacity can be less stable and more opportunistic than traditional reinsurance. As such, insurers may be less able to rely on ongoing affordable risk capacity and business relationships that may exist in the traditional reinsurance market. Traditional reinsurance may, in many cases, be cheaper than alternative risk transfer, as setting up and placing a reinsurance contract in the private sector reinsurance market may be less costly than establishing an alternative risk transfer arrangement. In alternative risk transfer, compensation is not always based on actual losses (eg in the case of parametric triggers), in which case insurers are exposed to basis risk. In general, alternative risk transfer might be cheaper than traditional reinsurance for globally very large low-frequency risks.³⁶

17. **Primary insurers in EMDE jurisdictions rely on global reinsurance to underwrite climate-related risks as well as for products or technology that can support the net-zero transition.** Primary insurers, especially in EMDEs, may not have sufficient local market reinsurance capacity and so are particularly exposed to the global reinsurance market. A concentrated global reinsurance market may possibly dictate terms (eg increasing premium rates and/or attachment points) that primary insurers may have no choice but to accept, and which may, due to the interconnectedness of the global reinsurance

³⁰ See also IAIS (2023b).

³¹ See S&P Global (2024b). The low share of risk transferred to the largest 19 reinsurers is mainly because many secondary perils, including hailstorms and convective storms, caused property losses that were too small to be covered in reinsurance arrangements.

³² As measured by the ratio of net written premium to gross written premium.

³³ See Evans (2023).

³⁴ See Artemis (2025).

³⁵ See Federal Reserve Bank of Chicago (2018).

³⁶ Unlike traditional reinsurance, the risk transferred in an alternative risk transfer transaction is often fully funded with dedicated funds, ie it is fully collateralised. This has several disadvantages: it restricts risk transfer to settings where total indemnity is limited, may limit diversification and might make the arrangements more expensive. On the other hand, it has the advantage for insurers that it reduces the reinsurer default/credit risk. Götze and Gürtler (2021) found from empirical analysis that “[...] the added value of cat bonds mainly stems from non-indemnity bonds and reveals that (non-indemnity) cat bonds are valuable under high reinsurer default risk, low basis risk and in high-risk layers.”

market, also be caused by climate-related disasters in other jurisdictions.³⁷ This can limit EMDE primary insurers' capacity to offer insurance products that cover climate-related risks to their customers in those markets.

Public sector reinsurers

18. **Public-private partnerships in the form of public sector (re)insurance can help support the insurability of NatCat risks.**³⁸ OECD (2021) provides an overview of worldwide public-private partnership insurance and reinsurance schemes, which are collectively called "catastrophe risk insurance programmes". The OECD paper focuses on the coverage of residential and/or commercial buildings and/or contents against NatCat risks (including climate-related risks) or terrorism. The OECD paper and some authorities interviewed for this paper concluded that such catastrophe risk insurance programmes can support the availability and affordability of insurance coverage for catastrophe perils, particularly flood risks. The public sector may be involved in such risk transfer systems by providing public sector insurance (eg New Zealand, Spain, Switzerland and the United States), public sector reinsurance³⁹ (eg Florida and France) or explicit government guarantees (eg France, New Zealand and Spain). Public sector entities may also be involved in prescribing premium rates for private sector insurers (eg France), providing prior approval of premium rates (eg California) or subsidising premiums (eg India).⁴⁰

19. **The design of existing public sector NatCat insurance or reinsurance schemes is diverse and they differ in subtle ways.** For example, schemes can differ in terms of the NatCat perils covered. The perils covered in the French "CatNat" system include floods, droughts, cyclones/hurricanes, earthquakes, volcanic eruptions, tsunamis, landslides and avalanches, while the United States National Flood Insurance Program (NFIP) and the UK's Flood Re only cover flood risk. In some schemes, NatCat insurance is mandatory and provided by public sector insurers (eg the Swiss KGV system) or private sector insurers (eg some cantons in the Swiss GUSTAVO system).⁴¹ In other schemes, NatCat insurance is provided by private sector insurers under prescribed premiums and is not mandatory (eg France and some cantons in the Swiss GUSTAVO system). The French public sector reinsurer CCR must provide reinsurance to any French insurer on request.

20. **Public sector NatCat insurance or reinsurance schemes also differ in terms of who is eligible for cover, the indemnity limits provided, whether there is a government guarantee and how premiums and policyholder retentions are determined.** In the French system, primary insurance premiums do not differentiate between policyholders with different risk levels, but insurance deductibles can be raised under certain conditions linked to risk reduction measures. Some schemes have indemnity limits per event, so that large losses may not be fully covered (eg Natural Catastrophe Insurance of Iceland). Some schemes have an unlimited government guarantee (eg France and Spain). In some schemes, public sector insurers or reinsurers are intended to be "providers of last resort" (eg California FAIR plan⁴² and UK Flood Re) by providing cover for risks that are deemed uninsurable by the private sector. Some public sector reinsurers (eg UK Flood Re) have been set up explicitly as a temporary solution with a clear end date, after which the private sector reinsurance market is expected to take over. Such temporary solutions

³⁷ See Australian Competition and Consumer Commission (2024).

³⁸ Governments in several jurisdictions have created insurance schemes for natural catastrophes, some of which may provide reinsurance coverage for primary insurers. The World Forum of Catastrophe Programmes is an informal network of such schemes. See [here](#) for a summary of the different set ups.

³⁹ The European Union is considering a two-pillar system to enhance resilience to NatCat risks at national and EU levels. The two pillars build on existing EU structures and are consistent with an EU reinsurance scheme and an EU disaster fund. See European Central Bank and European Insurance and Occupational Pensions Authority (2024).

⁴⁰ See OECD (2021).

⁴¹ See Annex 2 for a comparison of the Swiss and French natural catastrophe insurance systems.

⁴² The [California FAIR plan](#) was established to provide coverage to residents and businesses who cannot obtain private insurance.

usually require regular reviews of the scheme (eg every five years in the United Kingdom) to ensure that the private sector market will be able to take over at some point.

21. **Many public sector reinsurers, including certain reinsurance providers of last resort, may rely on affordable private sector reinsurance capacity.** CCR in France and the Spanish public sector insurer Consorcio de Compensación de Seguros⁴³ have an unlimited government guarantee and do not (retro)cede their risks to the private sector. Most other public sector reinsurers rely to some extent on affordable retrocession to private sector reinsurance markets. Examples include the California FAIR plan,⁴⁴ the Swiss KGV system and public sector reinsurers in India and certain African jurisdictions. The reliance on private sector reinsurance may be because global reinsurers can diversify risks across geographies and economic sectors to lower the cost of reinsurance, which may not be easily achieved by national or regional public sector reinsurance schemes. Retreating reinsurance coverage globally could thus adversely impact even schemes of last resort, such as the California FAIR plan.

22. **Public sector reinsurers can help close the reinsurance protection gap and correct private reinsurance market failure.**⁴⁵ In this paper, reinsurance market failure means the lack of affordable reinsurance coverage provided by private reinsurers. Some jurisdictions have introduced public sector insurance schemes to plug the protection gap in areas in which private sector (re)insurers are not able/willing to underwrite. Public sector reinsurers can adopt pricing strategies that private reinsurers may not be able or willing to offer. For example, the pricing principles of the Australian Cyclone Reinsurance Pool does not include a profit margin and explicitly recognises risk adaptation measures through premium discounts.⁴⁶

23. **Public sector insurance or reinsurance schemes appear to be more sustainable when they include risk reduction measures, specifically climate risk adaptation, and involve mandatory insurance.** There are different ways in which such schemes can contribute to risk reduction, from giving incentives for implementing risk adaptation measures – including lower premiums or deductibles (eg the Australian Cyclone Reinsurance Pool⁴⁷ and the French CatNat system) to directly investing part of the premiums in risk adaptation measures (Swiss KGV system). Public schemes in which insurance is mandatory tend to be based on a high degree of solidarity between policyholders in that losses are mutualised and premium differentiation may be limited, ie premiums may not fully reflect the loss potential of higher-risk policyholders. Higher-risk policyholders may exhibit moral hazard behaviour and may not be incentivised to implement risk reduction measures. If left unchecked, this may strain the solidarity underpinning the scheme and its financial health. Ways to address moral hazard from mandatory insurance with limited premium differentiation include time limitations for the scheme, variable deductibles and loss limits, and restricting eligibility to high-risk areas in conjunction with mandatory adaptation measures.

⁴³ The Spanish public catastrophe insurance scheme, Consorcio de Compensación de Seguros, has not had to rely on risk transfer to private reinsurers, despite experiencing a combined ratio of over 380% for its crop insurance product line. The insurer is expected to cover most of the estimated EUR 3.5 billion insured losses (mainly from motor and homeowners' insurance) from the floods in Valencia in October 2024. World Weather Attribution has estimated that the rainfall was about 12% more intense and twice as likely to occur than it would have been without global warming.

⁴⁴ The California FAIR plan reportedly has a USD 200 million surplus and USD 2.5 billion in reinsurance. See Assembly Insurance Committee (2024).

⁴⁵ See Caisse Centrale de Réassurance and Australian Reinsurance Pool Corporation.

⁴⁶ See Australian Reinsurance Pool Corporation (2024). Australian Competition and Consumer Commission (2024) reported that the Australian Cyclone Reinsurance Pool has resulted in some cost savings for insurers writing policies in higher cyclone risk regions of Australia. The pool's pricing formula includes incentives for risk reduction and offers discounts on reinsurance premiums for properties that have undertaken risk adaptation measures.

⁴⁷ Unlike reinsurance coverage offered by some private sector reinsurers, the Australian Cyclone Reinsurance Pool explicitly recognises risk adaptation measures by offering premium discounts for home insurance policies that have undertaken flood and cyclone mitigation activities.

24. **Public-private partnerships can support the availability and affordability of reinsurance protection against climate-related risks.** The Hazards Insurance Partnership⁴⁸ in Australia is a collaboration between the government and the insurance industry, including public sector and private sector reinsurers, charged with identifying areas in which insurance affordability and availability are at risk, and developing policy solutions to reduce risks and costs. Such close collaboration can accelerate implementation of risk adaptation measures through accommodative government policies, supported by private sector insurance solutions. The Climate Resilience Dialogue at the European Commission level fostered the exchange of views between public and private sector players on how to narrow the insurance protection gap by addressing the losses incurred from climate-related disasters. The group identified measures on how the insurance industry can contribute to climate risk adaptation, from actions to increase insurance penetration to creating a supportive environment for more investments in climate risk adaptation measures.⁴⁹

25. **For public sector reinsurers that have been set up as temporary arrangements, a major challenge is how to exit the market in an orderly manner and transfer the reinsurance role back to the private sector.** Careful consideration is needed to terminate or phase-out government support,⁵⁰ which requires, among other things, restoring the functioning of the private sector reinsurance market and/or reducing the insured risks, eg through risk adaptation measures.⁵¹ Potential concerns in the shift from public to private reinsurers could arise, for example, from contingent liabilities that may result from potential future financial obligations to the government if private reinsurers turn out to be unable to manage the insured risks effectively. Concerns may also arise from the potential mutualisation of losses involving taxpayers that could result from reinstating publicly backed reinsurers if future private reinsurance capacity turns out to be inadequate.

26. **The pros and cons of setting up publicly backed risk transfer schemes or investing more in risk adaptation or a combination of the two are open for debate.** Some jurisdictions may prefer investing in risk adaptation to avoid moral hazard and adverse selection issues that can arise from a public-private partnership scheme. On the other hand, publicly backed reinsurers may be better aligned with government policies in supporting climate policy goals, for example by easier direct cross-agency collaboration to incentivise risk adaptation measures. In anticipation of future climate change impacts and given sufficient financial resources, policymakers may decide to pursue both public sector schemes and investing in risk adaptation measures. There are analyses⁵² showing that investments in risk adaptation measures against NatCat risks can result in a reduction of losses from enhanced resilience that is significantly higher than the investment. Publicly backed risk transfer schemes would thus also benefit from such measures.

⁴⁸ See [Hazards Insurance Partnership | NEMA](#).

⁴⁹ See [Climate Resilience Dialogue \(2024\)](#).

⁵⁰ The UK Flood Re, a joint industry and government initiative, is expected to end in 2039.

⁵¹ See [Foundation for Prevention of the Public Insurance Companies for Real Estate \(2022\)](#).

⁵² See [Swiss Re \(2024a\)](#).

Section 3 – The roles of reinsurance in the context of climate change

27. **Reinsurance is a key risk management tool that insurers rely upon to transfer insurance risks that they underwrite.**^{53,54} The IAIS Insurance Core Principles (ICPs)⁵⁵ define reinsurance as “insurance purchased by an insurer (the ceding insurer) to provide protection against certain risks, primarily underwriting risks of the insurance policies issued by the insurer.” A key function of reinsurers is to diversify insurance risks across jurisdictions, sectors and market players, or transfer them to financial markets through so-called alternative risk transfer transactions, often in the form of tradable securities such as cat bonds. The ICPs point out that geographical diversification of risk is a key element of primary insurers’ and reinsurers’ capital and risk management. By transferring insurance risks across borders to reinsurers or capital markets, primary (re)insurers in a jurisdiction and the entire jurisdiction can benefit from reduced concentration of insurance risk exposures. Risk pooling and diversification on a global scale may allow reinsurers to carry risk at a lower cost than primary insurers, thereby lowering the cost of risk for primary insurers and thus potentially for policyholders.

28. **In most markets, primary insurers rely heavily on the availability and affordability of reinsurance to underwrite insurance risks, specifically NatCat risks.**^{56,57} In a sample of 16 large international insurers (including reinsurers) writing predominantly non-life business, considered in IAIS (2023b), reinsurance reduces the NatCat value-at-risk (used as a proxy for the amount of capital required for NatCat risks) of these insurers by approximately half on average.⁵⁸ With the actual reinsurance coverage in place, if a 99.5% value-at-risk NatCat event were to occur, the solvency ratio of the insurers would drop by 34% on average. Without reinsurance coverage, it would drop by 67%. The impact is likely considerably higher for smaller, local insurers, especially in EMDEs, which rely on global reinsurers to take on some of the risks they underwrite to mitigate potentially concentrated large insured losses. Such insurers may thus be significantly more vulnerable to increasing reinsurance premium rates or reducing reinsurance coverage.

29. **Traditional reinsurance products covering climate-related physical risks are typically classified by insurance lines of business (LOBs) and forms of cover.** LOBs are split between life and health, and non-life reinsurance. They typically cover specific objects or activities against specific hazards. Acute physical risk from weather-related perils such as wind, flood, drought, heat waves and hail can, for example, damage buildings (covered by property insurance), crops (agricultural insurance), cars (motor insurance) and can cause illness (health insurance) and death (life insurance). Reinsurance coverages can be treaty or facultative, and proportional or non-proportional.⁵⁹ Property catastrophe reinsurance treaties are often in the form of per event excess-of-loss covers (non-proportional treaty reinsurance), where a reinsurer’s losses are only triggered beyond a certain attachment point. In this sense, reinsurers typically cover low-frequency, high-severity events (tail risk).

⁵³ Australian Prudential Regulation Authority (2008) underscored how sound reinsurance management can increase an insurer’s capacity to underwrite insurance business.

⁵⁴ See Annex 3 for how reinsurance fits within the broader risk reduction and transfer systems for climate-related risks.

⁵⁵ See IAIS (2024b).

⁵⁶ See Climate Resilience Dialogue (2024).

⁵⁷ One [report](#) estimated that 80% of the insurance payouts (totalling between USD 2 and 3 billion) for Hurricane Beryl in July 2024 were funded by reinsurers. See Geer (2024).

⁵⁸ NatCat events include earthquake, which is a significant NatCat peril but is not directly affected by climate change.

⁵⁹ See Annex 1 for further elaboration on the different types of reinsurance coverage.

30. **Increases in the frequency and severity of climate-related NatCat events are contributing to the increased volatility of insured losses.**^{60,61} Since 2020, the annual global insured losses from NatCat events have exceeded the USD 100 billion mark every year.⁶² Secondary perils, especially severe convective storms (SCS), were the main drivers of recent annual insured NatCat losses.⁶³ Graph 1 shows the evolution of insured and economic losses arising from NatCat events over the last 15 years. Insured losses have increased at an average rate of 3.9% per year.⁶⁴ Climate change is believed to be responsible only for a smaller part of these increases to date. For example, according to Swiss Re (2024b), annual SCS-related insured losses in the United States have increased by about 8% per year since 2008. Separating out the different contributors to SCS losses shows that, after adjusting for general inflation (2.2%), increased exposure values due to economic and population growth, urbanisation and wealth accumulation are the main drivers of the losses (2.3%). Another factor is cost increases in the construction sector (1.2%). Climate change effects are also a factor, but there are still many uncertainties around the associated losses (1%).

⁶⁰ OSFI (2023) describes how increasing physical risk can increase the cost to reinsure certain weather-related events. Australian Prudential Regulation Authority (2024b) cited the increased impact of severe weather events on the hardening of the reinsurance market in Australia and globally, leading to higher retentions and reinsurance costs, and putting pressure on non-life insurance availability and affordability. Actuaries Institute (2024) stated that home insurance premium increases in Australia in 2023 were primarily due to increased reinsurance costs driven by the rising cost of perils.

⁶¹ United States Department of Treasury (2025) referenced a study explaining the correlation between increases in reinsurance pricing and increased insured losses globally from natural catastrophes. In the United States, while reinsurance is relevant to insurers of all sizes, regional and local homeowner insurers may be more affected than national homeowner insurers by changes in reinsurance cost and availability.

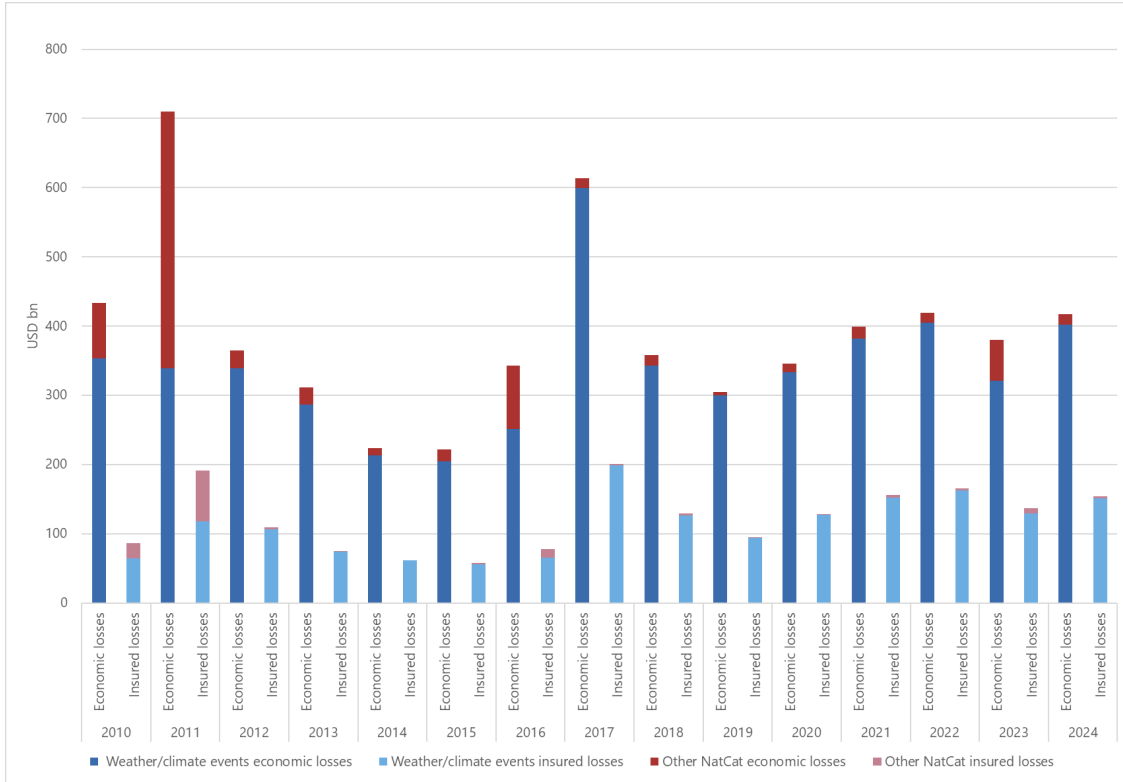
⁶² See Gallagher Re (2025).

⁶³ Secondary perils are natural catastrophes that can happen relatively frequently and locally, and typically generate low- to medium-sized losses (Swiss Re (2024b)). Severe convective storms are a key type of secondary peril. The Royal Meteorological Society defines convective storms as severe local storms associated with thunder, lightning, heavy rain, hail, strong winds and sudden temperature changes. Another example of a secondary peril that is becoming more material is wildfire.

⁶⁴ See Gallagher Re (2025). Uninsured economic losses vary significantly by region, with Asia, Africa, Latin America and the Middle East having the largest protection gap of over 80%.

Global economic and insured losses arising from NatCat, depicting the portion stemming from weather/climate events (blue) and other NatCat losses (red)

Graph 1



Source: Gallagher Re (2025), figures adjusted for inflation using the US Consumer Price Index.

31. **Going forward, climate change is expected to contribute more significantly to increases in global insured NatCat losses.** According to Swiss Re (2024b), insured NatCat losses are expected to continue increasing at an annual rate of between 5 and 7% in a world of fast evolving risk landscapes caused mostly by economic growth and urbanisation, and the associated accumulation of assets that need insuring. In addition, hazard intensification for certain perils and regions due to climate change could compound property damage outcomes. This implies that insured losses from NatCat could double in 10 years.⁶⁵ Insurance premiums for physical risks from NatCat events could increase by 50% by 2030, reaching between USD 200 and 250 billion globally.⁶⁶ For example, coastal areas affected by tropical cyclones could be exposed to more rainfall as temperatures increase, which may push reinsurance prices in those areas beyond affordable limits. This is despite a considerable part (roughly two thirds) of economic losses from NatCat currently being uninsured.⁶⁷

32. **Despite increasing frequency and severity of climate-related NatCat events, global reinsurers remain financially sound.** Climate-related reinsured losses appear, at least for now, to primarily impact the profitability and not the solvency of reinsurers. IAIS (2024a) reported slightly improved aggregate solvency ratios and profitability of selected global reinsurers, recovering from a spike in insured losses from NatCat events in 2022. S&P Global (2024a) reported that the operating performance of the

⁶⁵ Swiss Re (2024b).

⁶⁶ Howden and BCG (2024).

⁶⁷ According to Swiss Re (2024b), 62% of the USD 280 billion losses in 2023 were uninsured.

top global reinsurers has been improving despite increasing NatCat events.⁶⁸ Nevertheless, increasing climate-related NatCat losses can contribute to pressures across all types of reinsurance entities, including publicly backed schemes. For example, the French public reinsurer CCR (2024b) increased its premium surcharge from 12% to 20% in 2023 to cover increasing NatCat claims. It estimated that there is a 15% probability of the reinsurer requiring state support.

33. **While most discussion around climate change and reinsurance is focused on its role in providing coverage for physical risks, reinsurance can also have an impact from a transition risk perspective.** From a pricing and underwriting perspective, reinsurers are pursuing their net-zero goals in various ways, including by providing coverage for new green technologies (“scaling up”) and/or limiting coverage for carbon-intensive sectors (“phasing down”). From a microprudential perspective, reinsurers’ involvement in underwriting green technologies to pursue net-zero transition policies may present new risks. Some reinsurers may be considering limiting coverage for carbon-intensive sectors. However, limiting coverage for carbon-intensive industries may have broader economic and financial stability implications. As such, insurance supervisors would also have an interest in monitoring reinsurance developments from a transition risk perspective. Box 2 elaborates further on the relevant activities of reinsurers, from an underwriting and pricing perspective, in pursuit of addressing climate risks and their own net-zero goals.

Box 2

Reinsurers’ activities – transition risks and net-zero goals

While some insurance authorities have mandates to support the transition to a low-carbon economy, others may not interpret their mandates to contain such objectives. Net-zero goals could contribute to potentially slowing down or even reversing climate change, thus reducing the increase in the frequency and severity of climate-related NatCat events. As a result, insured losses may be more contained, thus contributing to the safety and soundness of (re)insurers. Such developments may also help maintain the affordability and availability of NatCat insurance and reinsurance coverage. Some prudential authorities may take the view that they do not have a mandate to encourage reinsurers to contribute to net-zero goals.^① Other authorities may encourage (re)insurers to engage with their clients on the risks they face and on climate risk mitigation measures that they can take, and thus indirectly influence a transition to net zero.^② The Network for Greening the Financial System (NGFS) sees the engagement of financial institutions with clients as a useful tool for transition planning, to influence the client’s business profile, and help manage financial risk from climate change and business transformation.^③

Reinsurance can contribute to “scaling up” green technologies that enable the reduction of greenhouse gas emissions. Scaling up involves reinsurers actively facilitating the growth of sustainable technologies and renewable energy projects by offering reinsurance coverage solutions to address the unique risks associated with these innovations.^④ This not only enables and helps with the de-risking of investments in green technology but may also accelerate the adoption and integration of green technologies into the mainstream economy. Reinsurers may, through their underwriting, provide cover across the value chain for products or services that support climate risk mitigation. These include renewable energy such as photovoltaic installations, heat pumps and wind farms, as well as rail systems, greener buildings, environmental restoration, carbon sequestration and carbon credits. For renewable energy, for example, reinsurance might cover the risks associated with the construction (engineering), operations (property) and performance (financial losses) of solar or wind parks, including damage from physical risk. It is estimated that insurance cover may be required for USD 10 trillion of investment in financing the climate transition through to 2030.^⑤ Reinsurers could be considered “transition enablers”.^⑥

Reinsurers may have commercial interests in reinsuring new technologies or supporting their development through their risk management expertise. This could be a forward-looking move for access to alternative sources of business in the future to compensate for the loss of existing business such as carbon-intensive sectors/assets that may

⁶⁸ The net combined ratio of the top 19 global reinsurers in 2023 was 91.5%, better than the previous five-year average of 99.8%. The combined ratio measures insurance claims and expenses payouts over premium receipts – so a ratio below 100% is desirable. In 2023, there were many mid-sized property NatCat event losses from secondary perils, including hailstorms and convective storms, that were too small to be covered in reinsurance arrangements. See S&P Global (2024b).

disappear due to transition efforts. In terms of supporting new technologies, Lloyd's of London has traditionally been a global reinsurance marketplace that enables the underwriting of new risks. It continues to provide reinsurance for new green technologies. Other large insurance and reinsurance market players are also exploring innovations and providing cover for green technologies. Transition to net zero may therefore play a role in their longer-term business strategy.

The pricing approaches of reinsurance coverage that support the scaling up of transition activities may need to be adjusted due to the lack of historical data. Assessing and pricing risks associated with new technologies and activities can be more uncertain, especially given limited loss experience. Some direct insurers may thus not currently be inclined to write much of this business or may reinsure out most of the risks. Alternative approaches may be used to price new innovative scaling up of reinsurance products. For example, Lloyd's of London is considering using environmental, social and governance (ESG) ratings when pricing insurance products. Another pricing approach is to find existing products with similar features and use these as proxies.^⑦ Through trial and error in a controlled fashion (eg limiting the volume of business), pricing can improve over time as loss experience emerges. Some reinsurers may allocate a certain portion of their underwriting volume to such risks to gain insights, knowledge and expertise (eg through their risk engineers).^⑧ For reinsurance covering green technologies, a good understanding of the manufacturers, production processes and products can help reinsurers to price appropriately.

Some reinsurers may seek to limit coverage for carbon-intensive sectors with a view to pursuing their own net-zero transition goals. Where it occurs, this involves a strategic and gradual reduction in underwriting certain sectors and industries that are heavily reliant on fossil fuels and other carbon-intensive activities. Such underwriting policies may not necessarily be driven by perceived or evidenced higher insured risks. On a voluntary basis, some large insurers and reinsurers have committed, eg in their transition plans, to transition to net zero and publish their efforts.^⑨ The commitment could involve slowing down or stopping (new) reinsurance coverage for certain carbon-intensive sectors.

It is critical that the reduction in reinsurance capacity in carbon-intensive sectors, where it occurs, is done in a thoughtful way. An abrupt and indiscriminate withdrawal could lead to economic disruptions with potential financial stability implications. Some reinsurers may provide continued reinsurance of these sectors, gradually phasing them down on the basis that their underwriting approach has an effect on how these industries reduce their carbon impact. Reinsurers can also support insurers' efforts by sharing knowledge. This is, for example, also promoted by the United Nations-led and convened Forum for Insurance Transition to Net Zero (FIT). Engaging with counterparties to support them in transitioning to a lower carbon footprint may be deemed more desirable than withdrawing reinsurance coverage to such entities. For example, while Japan's Stewardship Code does not explicitly refer to the transition to net zero, it fosters the principle of engagement and dialogue with investee companies, ie clients, with regard to sustainability, including ESG factors.^⑩ Such principles can also be applied to the engagement and dialogue of reinsurers with their industrial clients from carbon-intensive sectors.

The underwriting policy of some global reinsurers to phase down coverage of carbon-intensive sectors may also have unintended consequences for emerging markets and developing economies (EMDEs). In practice, it seems that phasing down of reinsurance capacity from carbon-intensive sectors is primarily being undertaken by reinsurers based in the European Union due to the European Commission's commitments contained in the 2019 European Green Deal to reduce greenhouse gas emissions to zero by 2050 and to become the first climate-neutral region.^⑪ As primary insurers, especially in EMDEs, may rely on reinsurance capacity based in the European Union to support their vital (yet potentially carbon-intensive) economic sectors, reinsurance withdrawal in these sectors can have wide-ranging economic impacts in these jurisdictions. Reinsurers' policies, that are set by the groups' headquarters based in advanced jurisdictions can leave a reinsurance protection gap open in EMDEs. Such gaps may ultimately need to be covered by governments in those jurisdictions. Other players, including captive reinsurers, may enter the market in carbon-intensive jurisdictions and address the gap to a certain extent, providing the reinsurance capacity needed to support the transition of aligning or aligned entities in these economies.^⑫

^① BaFin (2023) does not set its own criteria for assessing the effectiveness of financial products in relation to ESG objectives. ^② See MAS (2023). ^③ See Network for Greening the Financial System (2024). ^④ For example, Korean Re (2024) expects a premium increase of over 130% for eco-friendly energy including solar, wind and hydroelectric power by 2050, compared with 2023. ^⑤ Howden and BCG (2024). ^⑥ Global reinsurers have entities that provide direct coverage to green technology, which may contribute to the overall diversification of those reinsurers. ^⑦ Such approaches have been used in the past, for example when car insurance was first introduced following the mass production of cars. ^⑧ For example, at Lloyd's of London, "green products" may receive pricing discounts and up to 3% of a syndicate's annual business plan is permitted to account for underwriting innovative technologies, including those relating to green/transition matters, subject to monitoring of the performance and profitability of the business and the syndicate sharing experience

and learning within Lloyd's Lab. ⑨ The United Nations-led and convened Forum for Insurance Transition to Net Zero (FIT) is a new structured dialogue and multi-stakeholder forum to support the necessary acceleration and scaling up of voluntary climate action by the insurance industry and key stakeholders. The aim is to foster the availability of insurance and finance for transition projects and technologies, and net-zero activities. One of FIT's priorities is developing new net-zero insurance concepts. FIT included in its initial priorities the development of a net-zero transition plan framework for insurance market participants. ⑩ See Japan Financial Services Agency (2020). ⑪ See European Commission (2019). ⑫ Glasgow Financial Alliance for Net Zero (2022) defines aligned entities as those that are already aligned to a pathway to limiting the increase to 1.5 degrees Celsius; and aligning as those that are committed to transitioning in accordance with such pathways.

Section 4 – Safety and soundness perspectives

34. **Regulatory or supervisory interest in reinsurance underwriting and pricing for climate-related risk can be multi-faceted.** From a safety and soundness perspective, there may be concerns around how the increasing frequency and severity of NatCat events can impact insurers' and reinsurers' solvency. From a protection gap perspective, concerns can be around the affordability and availability of climate-related (re)insurance coverage. Reinsurers' risk management expertise and their role in facilitating climate risk adaptation and mitigation measures may contribute positively to maintaining the availability and affordability of NatCat insurance and supporting the transition to net zero. In this section, we examine reinsurance pricing and underwriting of climate-related risks from a safety and soundness perspective.

Regulatory/supervisory mandates

35. **The IAIS has recently updated its ICPs to emphasise the importance of insurance supervisors paying attention to climate change.**⁶⁹ Individual risks are often interconnected and may have an amplifying effect on other risks. This is the case with climate-related risks. Supervisors and insurers should consider how to assess and address issues such as risk management⁷⁰ and governance, valuation of assets and liabilities, and conduct of business in light of such interconnectedness. Additionally, supervisors and insurers should have an understanding of the different characteristics of risks and their resulting impact, to help determine how to manage material risks, which may involve more proactive and forward-looking approaches. For example, insurers should consider how climate-related risks may change conditions for asset-liability management, especially, but not only, when the liabilities have a long duration.

36. **A growing number of insurance authorities are issuing guidelines or supervisory expectations on climate-related risks.**⁷¹ Such guidelines or supervisory expectations typically call for insurers and reinsurers alike to take a strategic approach to managing climate risks. The main regulatory reason for having specific guidelines on climate risk management is that climate-related risks are evolving quickly, with potentially significant impact on the insurance sector including the level of insurance premiums. New York Department of Financial Services (2021) highlighted the distinctive nature of climate-related risks, including how, over time, certain physical risks could become uninsurable if the low-carbon transition happens too slowly or too late. It noted that some insurers are already limiting coverage or exiting the market entirely in regions that experience frequent climate-related natural disasters.

⁶⁹ See IAIS (2024b), which reflects the endorsed update to the ICPs including with regard to climate change.

⁷⁰ Including own risk and solvency assessment (ORSA), stress testing and scenario analysis to fully capture the dynamic nature of climate-related risks.

⁷¹ See APRA (2021).

37. **Insurance authorities can address climate-related risks in their prudential regulatory and supervisory regimes, even without an explicit mandate.** Very few of the sampled authorities have explicit mandates on climate-related risks.⁷² Other authorities may consider that, as climate-related risks manifest in “traditional” risk categories such as credit risk, insurance risk and operational risk, they are already indirectly captured in prudential frameworks.⁷³ Understanding an authority’s mandate with regard to climate-related risks is important. This is because an authority’s mandate drives its expectations with respect to regulated firms, including reinsurers, about how they should deal with climate-related risks, including in underwriting and the pricing of reinsurance products. In addition to such a microprudential lens, authorities with financial stability or macroprudential mandates may be concerned with potential systemic risk that may arise from a lack of reinsurance coverage in relation to climate change or cross-sectoral interlinkages.⁷⁴

38. **In general, insurance authorities included in this paper do not differentiate between direct insurers and reinsurers in terms of how such entities should address climate-related risks.**⁷⁵ This is in line with international standards (the ICPs) that, in general, do not distinguish between the different types of (re)insurance entities in prudential regulatory and supervisory frameworks. Supervisors also view it as desirable not to differentiate between primary insurers and reinsurers in order to maintain a uniform approach to addressing climate-related risks across the insurance and reinsurance players, thus promoting a consistent standard of risk management. However, accumulation risks in reinsurance may need particular attention especially where there are requirements for mandatory cession to local reinsurers.

39. **An overarching principle is to tailor regulatory requirements and/or supervisory oversight to the materiality of climate-related risks.** (Re)insurers that are less exposed to climate-related risks may be subject to proportionate risk-based regulations. Several authorities have provided guidance to (re)insurers on how to determine the materiality of climate-related risks, including with respect to their underwriting portfolios.⁷⁶ As highlighted by New York Department of Financial Services (2021), it is important to recognise that smaller (re)insurers may not necessarily be less exposed to climate-related risks. Specifically, compared with larger insurers, they may be exposed to higher concentration risk, as they may be less able to diversify risks and may be exposed to more concentrated regional exposures. BMA (2023) sets out a general principle that (re)insurers should conduct a materiality assessment of their exposure to climate change risks. The guidance focuses on “single materiality” (how climate change

⁷² ACPR and EIOPA have explicit mandates related to climate-related risks. See ACPR (2019) and Official Journal of the European Union (2010). It is acknowledged that certain insurance authorities with market conduct responsibilities may also address climate-related risks in their regulatory frameworks. Market conduct issues are beyond the scope of this paper.

⁷³ Bank of England (2024) highlighted that financial risks from climate change can manifest as increasing underwriting risks. Swiss Financial Market Supervisory Authority (2023) clarified that climate risks are not a separate risk category, rather they are risk drivers of existing risk categories. BaFin (2023) does not treat financial climate risks as a new type of risk, rather climate-related risks are monitored as part of existing risk categories though it acknowledges climate risks entail specific challenges for risk management. APRA (2024) expects, in its prudential practice guide on climate change financial risk, that changing climate is dealt with in line with APRA’s existing risk management and governance requirements and also provides guidance to assist an institution to manage climate risks.

⁷⁴ In the period 2022–24, ACPR, together with Bank of France, prepared and executed a climate stress test for the insurance sector in France, which due to the choice of short- and long-term scenarios, enabled the assessment of the impacts of climate change on the stability of institutions and the financial system alike (see ACPR (2024)).

⁷⁵ OSFI (2023) goes further, covering not only direct insurers and reinsurers but also other financial institutions such as banks.

⁷⁶ New York Department of Financial Services (2021) provides quantitative guidance as well as an overarching principle that states: “A risk may also be considered material where knowledge of the risk could influence the decisions or judgment of an insurer’s board, management, supervisors, or other relevant stakeholders.” EIOPA (2022) provides application guidance on running climate change materiality assessments, following three steps: (i) define the business context where the (re)insurer would be exposed to climate change risks (eg lines of business); (ii) elaborate on possible impacts on the (re)insurers’ exposure (physical/transition risk); and (iii) assess the relevance to the (re)insurers’ business, ie its materiality (reflect impact, probability and time horizon in a materiality matrix). If climate change risks are material, climate change scenarios need to be defined and executed; if not, it needs to be explained in the ORSA why these climate risks are not material.

impacts the risks of the (re)insurers). Nevertheless, the authority also expects (re)insurers to consider “double materiality” (the impact of (re)insurers on climate change) by focusing on issues that may return and affect their reputation with stakeholders and their strategy in the short, mid or long term, as a consequence their own financial performance and operations.

40. **Insurance regulatory oversight may not always extend to public sector reinsurance schemes.** Regulatory requirements explored in this paper apply without exception to private reinsurers. In practice, not all public sector reinsurance entities were found to be supervised by prudential regulatory authorities.⁷⁷ Unregulated public sector reinsurance entities may be exposed to risks arising from inadequate underwriting and non-risk-based pricing, which may adversely impact their long-term viability.

Risk management

41. **There are supervisory expectations that (re)insurers integrate aspects related to climate change in their underwriting and pricing policies.** The Australian Prudential Regulation Authority (APRA) encourages (re)insurers to identify economic sectors that have higher/lower exposures to physical and transition risks by considering criteria such as vulnerability to extreme weather events, GHG emissions and potential exposure to changes in climate-related policy and technology.⁷⁸ The assessment results can be used by (re)insurers to establish policies and procedures when underwriting such sectors. In practice, reinsurers, when applying the APRA guidance, can establish an underwriting and pricing policy that differentiates between high- and low-risk sectors in terms of exposure to climate change. BMA (2023) expects (re)insurers to assess their policyholders’ climate risk exposure, as it relates to their capacity to provide coverage, as part of their underwriting risk assessment. Sectors with higher climate risk exposures should be further assessed. Insurers should also consider their ability to continuously offer innovative solutions for customers, including supporting climate change adaptation and mitigation, even when physical risks increase.

42. **General risk management requirements to assess underwriting risk exposures may prompt reinsurers to limit underwriting volumes or apply criteria to fit their risk appetites.** BMA (2023) expects insurers to determine risk management actions depending on risk appetite and type of risk. This could include actions such as engagement with policyholders for risk mitigation and reduction, change of policy conditions and pricing approach, or the decision to limit certain business lines or grow others. While assessing climate risks, insurers are encouraged to consider the wider sustainability implications of underwriting certain lines of business, which may result in revisions to their underwriting strategy, risk tolerance and limits.

43. **There are regulatory requirements or supervisory expectations for primary insurers to consider the availability and affordability of reinsurance coverage.**⁷⁹ Insurance supervisors expect insurers to consider reinsurance availability and affordability as part of their enterprise risk management framework, including potential reliance on foreign reinsurance capacity by domestic insurers. APRA (2008, 2023a) lay out the authority’s expectations on the policies and procedures that insurers should have in place with regard to their reinsurance arrangements. Insurers are expected to assess the adequacy of reinsurance arrangements over the previous 12 months and the likelihood of similar cover continuing to be available in future years.

44. **Own risk and solvency assessment (ORSA) requirements are being extended to explicitly address climate-related risks that can arise from reinsurers’ underwriting activities.**⁸⁰ Central Bank

⁷⁷ For example, Flood Re in the United Kingdom is regulated by the Prudential Regulation Authority and Financial Conduct Authority, and the French CCR by ACPR.

⁷⁸ See APRA (2021).

⁷⁹ See Central Bank of Ireland (2023).

⁸⁰ See EIOPA (2022).

of Ireland (2023) expects insurers to consider the availability and affordability of reinsurance in their ORSA. This can help insurers prepare for possible reinsurance capacity issues. APRA (2021) encourages insurers, on a voluntary basis, to consider the impact of climate risks, if deemed material, in their ORSAs. EIOPA (2022) provides application guidance on running climate change materiality assessments. It states that if climate change risks are material then climate change scenarios need to be defined and executed and if such risks are not deemed to be material, the ORSA must explain why the climate risks are not material. In its recently adopted ICPs, the IAIS explicitly referred to climate risks as an external factor to be included in the ORSA consideration of material risks.⁸¹ Some insurers who perform scenario analysis, which encompasses qualitative and quantitative elements, integrate these analyses into their ORSAs.⁸²

45. **Regulation usually requires insurers to identify potential concentration of reinsurance counterparties and for reinsurers to manage their aggregate exposures, including for climate risk.** Climate risk management guidance may cover concentration risk to which reinsurers may be exposed. BaFin (2020) suggests that supervised institutions review their risk strategy with regard to sustainability risks. One of the questions that reinsurers can consider is the identification of any concentration from reinsuring several direct insurers from the same region. BMA (2023) expects insurers to review their largest reinsurance counterparties and assess their credit quality. Insurers are required to submit a written Reinsurance Management Strategy to APRA⁸³ that includes information on any concentration of reinsurance programmes with reinsurance counterparties that could result in large exposures or reduce diversification benefits. Requiring such a regulatory submission is a good way to assess the extent of insurers' reliance on reinsurance in order to be able to provide coverage for climate-related risks.

Reinsurance underwriting

46. **Reinsurers' underwriting policies and practices for considering climate-related risks are similar in some ways to those for other risk drivers.** The underwriting process described in Annex 4 would consider climate change as a potential risk driver, among other drivers. Underwriting decisions of reinsurers are typically informed by, among other factors, the NatCat models used by the reinsurers. These NatCat models integrate historical data, meteorological science and advanced analytics to simulate and estimate the likelihood and potential impact of climate-related NatCat events such as hurricanes, floods and wildfires.

47. **General risk management guidelines are also relevant for the underwriting of climate-related risks.** These guidelines typically require reinsurers to have an underwriting policy that specifies the terms and conditions under which insurance risks can be accepted. It is up to individual reinsurers to determine their own underwriting policies – including how they might respond to climate change impacts – along the three aspects of physical risks, scaling up and the phasing down of transition activities in pursuit of their own net-zero goals.

48. **Some insurance authorities have explicit expectations on reinsurers' underwriting practices for climate-related risks.** Central Bank of Ireland (2023) encourages reinsurers to consider how they can identify solutions to ensure continued protection to policyholders, including incentives for risk adaptation measures via risk-based pricing and contractual terms. BaFin (2020) expects (re)insurers to identify and analyse any potential sustainability risk, including climate risks, as part of their underwriting process. Risks should only be accepted/underwritten if they are consistent with the firms' risk strategy and appetite. The supervisor highlights reputational risks and liability risks as specific risks that (re)insurers also may need to

⁸¹ See IAIS (2024b). ICP Guidance 16.12.1 states that: "The insurer should consider in its ORSA all material risks that may have an impact on its ability to meet its obligations to policyholders, including in that assessment a consideration of the impact of future changes in economic conditions or other external factors (such as the insurer's exposure to climate-related risks over short, medium and long terms)."

⁸² See IAIS (2024b).

⁸³ See Australian Prudential Regulation Authority (2008).

consider when underwriting climate-related risks. The Swiss Financial Market Supervisory Authority (2024) expects insurers with material nature-related financial risks to address such risks in a range of activities, including pricing and underwriting.

49. **One of the most important conditions for reinsurers to underwrite policies issued by primary insurers is adequate, risk-based pricing of those policies.** If policies are underpriced by primary insurers, reinsurers may decline to reinsure those policies, impose higher premiums, or set more stringent terms and conditions such as higher attachment points or lower coverage limits. In the context of climate change, insurance coverage against physical risk may be underpriced for various reasons, for example, an overly competitive market, primary insurance rate controls or underestimation of risks by primary insurers. Also, models might underestimate the extent to which climate change may already have significantly affected NatCat losses.

50. **Reinsurers, to date, typically consider climate change aspects in their longer-term business strategy rather than in their short-term underwriting decisions.** The view of some reinsurers is that climate change aspects may currently not be as relevant for short-term underwriting decisions because non-life reinsurance contracts covering NatCat-related risks are typically renewed and can be repriced annually, with the possibility of adjusting premiums or other terms and conditions or withdrawing depending on recent loss events. These reinsurers consider climate change to be a longer-term development, which may have had limited impact on NatCat loss experience so far, and is therefore primarily relevant for their longer-term business strategy.

51. **So far, most major reinsurers do not consider climate change, in itself, to be a key driver of underwriting decisions.** This may seem counterintuitive when considered against media reports of severe weather-related events all over the world, which some commentators may automatically attribute to climate change. However, attributing a specific weather-related event to climate change based on conclusive scientific evidence is notoriously difficult – although it should be noted that significant progress has been made in this area in recent years.⁸⁴ On the other hand, it is equally controversial to dismiss climate change as a factor that can influence reinsurers' underwriting decisions.⁸⁵ Reinsurers are working on gaining a better understanding of how and where climate change could intensify NatCat events.⁸⁶

Reinsurance pricing

52. **Some authorities have issued requirements or expressed supervisory expectations for reinsurers to explicitly consider climate-related risks in their pricing practices.** Central Bank of Ireland (2023) is explicit about expectations for (re)insurers to consider climate-related risks in their underwriting and pricing. BMA (2022) encourages reinsurers to keep improving modelling capabilities of physical risks and assess the suitability of available vendor models, including for pricing and underwriting purposes. The authority cited how the evolving impact of claims inflation, which, in combination with increasing physical climate change risk, has the potential to materially impact the industry, the effects of which may or may not be easily absorbed by pricing increases. On the other hand, climate risk-related guidelines or supervisory expectations do not (yet) explicitly require capital charges or add-ons on higher climate exposures.⁸⁷ Nonetheless, pricing considerations for climate risks are implicitly covered in most cases, and the implications of climate risks on pricing usually need to be considered by such guidelines and supervisory expectations.

⁸⁴ See, for example, www.worldweatherattribution.org.

⁸⁵ See Lara, [California's Sustainable Insurance Strategy](#).

⁸⁶ See Swiss Re (2024a).

⁸⁷ See Australian Prudential Regulation Authority (2021).

53. **In general, supervisors expect reinsurance products to be priced adequately in order to safeguard the safety and soundness of reinsurers.**⁸⁸ Significant and continued underpricing of reinsurance products, including those that cover climate-related risks, can lead to losses and potentially to solvency problems for reinsurers. Insolvent reinsurers are not in anyone's interest as they will not be able to pay claims filed by primary insurers, who may then have difficulties paying policyholders or face liquidity issues. Inadequate pricing of reinsurance products could also lead to unexpected and potentially significant earnings and capital volatility of reinsurers.

54. **Further, insurance supervisors may deem it desirable for there to be stable reinsurance capacity at stable reinsurance rates.** To achieve this, reinsurers need to be able to charge premiums that are commensurate with the risks underwritten (ie "risk-based"), impose appropriate terms and conditions (eg attachment points, limits and exclusions) or decline business that they deem underpriced. The European Union's Solvency II regime⁸⁹ requires reinsurers to assess and manage risks from potentially adverse changes in the value of insurance liabilities that may arise from inadequate pricing, including from sustainability risks. New York Department of Financial Services (2021) expects insurers to consider demand elasticity, including whether increasing climate-driven costs can be managed through premium increases and whether premiums might become so high that certain climate risks become uninsurable.

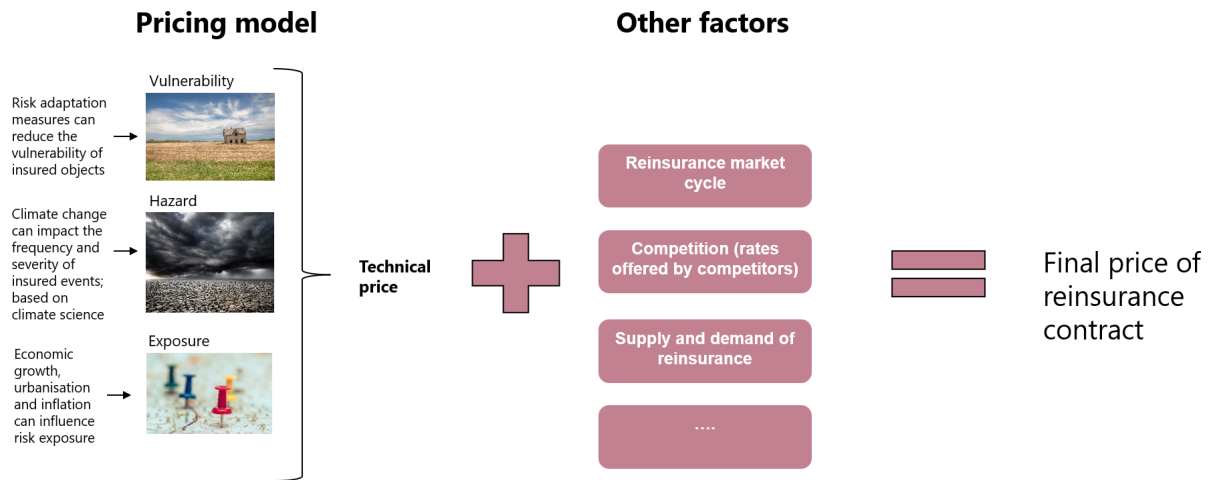
55. **The technical price of a reinsurance contract can be viewed as a reinsurer's estimated cost to fulfil its obligations under the contract.** In general, the technical price of a reinsurance contract, including for climate-related risks, is calculated as the sum of the estimated expected losses ("expected value of future losses"), expenses and a loading for risk. The loading takes account of the estimated volatility of losses and potentially the uncertainty, and tends to be higher the greater the volatility (and uncertainty). The loading is often identified as the cost of capital – that is, the compensation expected by shareholders for their exposure to potential losses. The technical price of a contract calculated in this way depends on how much the contract diversifies with the other contracts of the reinsurer. In practice, estimating a technical price is complex, even for the most advanced reinsurers, and subject to considerable uncertainty, especially given the low-frequency, high-severity nature of many NatCat risks ("tail risks").

56. **The actual transaction prices of reinsurance contracts are determined not only by the technical prices but also by other factors.** For insurance supervisors, it may therefore be challenging to assess the extent to which changes in actual reinsurance premium rates are driven by the impact of climate change on technical prices. Reinsurers may temporarily accept transaction prices below technical prices for various reasons, including business strategy to retain or gain market share, or to maintain relationships with primary insurers or brokers. This is especially relevant during periods of weaker reinsurer negotiating power, which are referred to as "soft markets".⁹⁰ During hard markets, on the other hand, reinsurers may be able to charge prices above technical prices. The corresponding market forces leading to the reinsurance (rating) cycle (see Box 3) are thus a major factor influencing pricing. Another factor is the loss experience on the contract, where reinsurers may be under pressure to reduce premiums if they have not recently incurred losses and insurers may face upward pressure on premiums after reinsurers suffer considerable losses. Following large NatCat losses, which tend to simultaneously affect many insurers in a particular market, reinsurance rates may increase as reinsurers ask for "payback" for the losses incurred (or reinsurers may impose higher attachment points or lower coverage limits). Graph 2 illustrates the elements that influence the pricing of reinsurance contracts.

⁸⁸ BaFin (2020) stated that the increasing intensity and/or frequency of climate-related events such as storms or floods should be appropriately reflected in the assessment of premium risk.

⁸⁹ See Official Journal of the European Union (2014).

⁹⁰ Box 1 describes soft and hard markets in a reinsurance rating cycle.



Source: authors' elaboration.

Conceptual description of reinsurance pricing

The nature of the reinsurance underwriting process (Annex 4) means that for a reinsurer to price a reinsurance contract can mean different things. It can mean determining a price, in particular to provide as a quote, but it can also mean deciding whether an offered price is acceptable. These two tasks are not necessarily equivalent, partly because reinsurers may accept prices higher or lower than their technical prices (ie the prices that satisfy their profitability targets), for example, depending on whether the market is hard or soft.

More fundamentally, reinsurance contracts typically do not have unique technical prices. This is because (i) traditional reinsurance contracts are typically not traded with reliable market prices; (ii) technical prices, specifically given the low-frequency, high-severity nature of natural catastrophe risks, are estimates with considerable uncertainty; and (iii) technical prices of reinsurance contracts are, in general, specific to a reinsurer and depend on its whole portfolio of contracts. One reason for (iii) is diversification: a reinsurer may be able to accept a lower price for a product that better diversifies its portfolio. For example, if reinsurer A's portfolio is mainly exposed to flood risk in Thailand, writing an additional contract that is mainly exposed to flood risk in Thailand is likely to provide less diversification than for reinsurer B with a portfolio mainly exposed to North Atlantic hurricane risk, to the extent that large floods in Thailand and large North Atlantic hurricanes are uncorrelated. The technical price of the flood contract may thus be lower for reinsurer B than for reinsurer A. More generally, the technical price may depend on the reinsurer because certain costs that go into the technical price, such as administrative expenses and the cost of capital, do not scale linearly with volume.

The reinsurance (rating) cycle

The reinsurance cycle is intended to quantify changes in profitability over time in terms of how high the price is relative to the cover provided. It refers to the empirically observed oscillation between hard and soft market periods, in particular driven by supply and demand. In a soft market, reinsurers may be faced with less favourable terms and conditions including premiums that may be lower or even inadequate. The existence of the reinsurance cycle can be interpreted as an indication that the private sector reinsurance market contains mechanisms that correct deviations in premium levels.①

Estimating reinsurance cycles is not straightforward and depends on assumptions and simplifications that make the estimates uncertain. This is because year-to-year changes in premiums, which are the natural starting point for quantifying the reinsurance cycle, are affected by various factors other than changes in profitability, such as changes in the underlying insurance portfolio structure (eg volume and riskiness) and changes in terms and conditions of the reinsurance contracts (eg coverage exclusions, attachment points, limits and multi-year contracts with locked rates). Extracting changes in profitability requires identifying and quantifying the other factors, generally requiring assumptions and simplifications.

Some estimated reinsurance cycles are publicly available. One is the Risk-adjusted Property-Catastrophe Reinsurance Rates-on-Line Index from Howden.^② According to this index, property catastrophe reinsurance rates can change year on year by up to 30% and can be more than two times as high in a hard than in a soft market. The index showed high rates (index around 300) in 2006, decreased until 2017 (index around 130) and since then has increased (2024 index around 320). Guy Carpenter's Global Property Catastrophe Rate-on-Line Index^③ has a similar shape with smaller changes. The current hard cycle is supposed to continue and the Monte Carlo meetings in September 2024 (Rendez-Vous de Septembre) confirmed reinsurance renewal at relatively stable rates and possibly tightening terms and conditions for NatCat perils.

Technical prices and market stability

Basing reinsurance premiums on technical prices calculated from sound loss models may contribute to market stability as opposed to, for example, premiums that are set by directly reacting to recent loss experience or simply according to the prevailing reinsurance cycle. Because of the variability in year-on-year loss experience specifically for NatCat perils due to the low-frequency, high-severity nature of these risks, premiums set directly according to recent loss experience may overshoot in both directions and become volatile. Technical prices, on the other hand, should take explicit account of the volatility of NatCat loss experience, ideally including changes in loss potential over time due to climate change, and allowing for proper risk differentiation and allocation. The misallocation of reinsurance capacity could lead to reinsurers suddenly changing their pricing and underwriting activities, which could impair market stability. Such misallocation can be reduced by proper risk allocation based on technical premiums.

① Indications for drivers of reinsurance cycles are, for example, provided in by Evans (2019) and McGillivray (2020). ② See Howden. ③ See Guy Carpenter (2025).

57. **The technical price of reinsurance contracts covering NatCat risks is typically estimated using NatCat loss models.** At a high level, the loss models estimate the frequency and severity of NatCat events, and the resulting distribution of the losses to the reinsurer from the contract, including the expected loss. A NatCat loss model typically covers a specific peril (eg flood) for a specific geographical area (eg Thailand), capturing specific types of damage (eg to buildings and contents, or motor vehicles). Typical NatCat loss models are structured along the hazard, vulnerability, exposure and financial modules:⁹¹

- The hazard module models the frequency and intensity of relevant events across the covered geographical range.
- The exposure module contains the characteristics of the insured properties under the contract, such as location, property value, construction type and occupancy.⁹²
- The vulnerability module translates hazard and exposure to the likely damage, depending on the intensity of an event and the characteristics of the properties.
- The financial module translates damage to monetary losses to the reinsurer.

58. **Vendor model providers and reinsurers currently seem to adjust NatCat models used for pricing reinsurance contracts only to a limited extent for climate change effects.** Climate change has not yet become a key pricing factor, despite increasing insured NatCat losses in recent years. A rationale

⁹¹ See Moody's RMS, US National Association of Insurance Commissioners (NAIC) and Swiss Re (2024a,b).

⁹² See Whitaker (2016).

frequently given is that many non-life reinsurance contracts covering climate-related risks are typically renewed and can be repriced annually, which allows for the integration of recent losses. Also, for example, more weight may be given to more recent loss experience when calibrating the models.⁹³ In addition, climate change itself is often not considered the key driver of NatCat losses to date. Verisk (2024) estimates that climate change currently accounts for approximately 1% of the annual increase in NatCat losses, and that the main factors were exposure growth and inflation. Swiss Re (2024b) similarly emphasised factors such as claims inflation, increasing exposures and values, but also exposure concentrations in hazardous areas due to economic growth, urbanisation and spatial expansion. Nevertheless, there is some consensus that climate change may already be impacting certain perils such as wildfire and that the impact of climate change on certain NatCat events will be more significant in the future (“changing risk landscape”).

59. **There are challenges associated with using NatCat models to price reinsurance products.**⁹⁴ The different results produced by different NatCat models for the same NatCat risks may give rise to uncertainties over which model to use. There are also uncertainties regarding the extent to which the hazard parameters are influenced by climate change. Some risks cannot be modelled and priced accurately because the insured population is too small. Without reliable pricing models, reinsurers may not have the confidence to underwrite risks in those markets.

60. **It cannot be ruled out that NatCat models underestimate the current impact of climate change on NatCat losses.** The low-frequency, high-severity nature of NatCat losses implies that realised NatCat losses can be volatile from one year to the next, which means that many years of experience may be needed to calibrate a model as it can be difficult to distinguish random fluctuations from trends with confidence. For pricing, the loss potential for the upcoming year needs to be modelled. Therefore, adjustments for trends such as increasing losses from climate change are potentially applied only when there is a high degree of confidence that there is a trend. This implies that models may underestimate the extent to which climate change may already have significantly affected NatCat losses.⁹⁵ Global climate models that feed into NatCat pricing models may be underestimating the impact of climate change.⁹⁶ Further, there are views that the vulnerability parameters in NatCat models may not be appropriate under future climate change scenarios, as they may not have been calibrated for the ranges relevant at those times. Similarly, IAIS (2024a) concluded that supervisors and insurers need to allow for the inherent uncertainties in estimates when using models for decision-making.

61. **There are a handful of established NatCat models that many reinsurers use to estimate technical prices of NatCat reinsurance contracts.** While some reinsurers have developed their own internal NatCat models, many use third-party commercial NatCat loss models (“vendor models”).⁹⁷ These models cover a selection of peril and region combinations, eg Tropical Cyclone North Atlantic or Flood Europe. Where vendor models do not cover specific perils, reinsurers may develop their own pricing models.

62. **Third-party vendor models require heightened supervisory attention.** Not all authorities currently review the NatCat models that reinsurers use to price NatCat reinsurance contracts (unless the models are also used for regulatory capital purposes). This may be because they take a principles-based approach not to interfere in business decisions, which leaves reinsurers to determine their strategic

⁹³ S&P Global (2021) surveyed 21 of the largest global reinsurers and found that only 35% explicitly allow for climate change in their pricing.

⁹⁴ The challenges associated with pricing climate-related products as mentioned in Khoo and Yong (2023) equally apply to the pricing of NatCat reinsurance.

⁹⁵ Bloomberg (2024) reported that Hurricane Helene that hit the United States in September 2024 was considered a one in a 1,000 year event using historical data, but due to global warming, such an event is expected to occur with a return period of 70 years now. This is one example that suggests that NatCat models may underestimate the likelihood of certain NatCat events.

⁹⁶ See Schmidt (2024) and Financial Times (2024).

⁹⁷ The most common vendor models are Moody’s RMS and Verisk (formerly AIR).

direction and operational procedures as long as the overarching goal of remaining solvent is met. However, a strong reliance on a concentrated set of NatCat model providers may require specific supervisory attention. While individual reinsurers have the flexibility to adjust the models based on their own assumptions and may use several models, including their own internal NatCat models, to compare, review and plausibility-check model results, the concentration may require closer monitoring by supervisors as any miscalibration may impact multiple reinsurers simultaneously, potentially leading to group herding behaviour with potential systemic implications.

Solvency requirements

63. **Reinsurance plays a critical role in maintaining the solvency of primary insurers.** In most solvency regimes, reinsurance is recognised as a risk mitigant that can be used to achieve capital relief. Retreating reinsurance coverage for climate-related products can adversely impact insurers' solvency positions.⁹⁸ IAIS (2023b) highlighted that reinsurance is a significant risk mitigation factor for NatCat risks, potentially reducing the capital needs of selected insurers by half. In some markets, due to more restrictive reinsurance, primary insurers have to bear larger losses themselves. So far, increasing climate-related insured losses have not impacted the solvency position of insurers very significantly. However, a major concern relates to increasing volatility and uncertainty in the frequency and severity of NatCat events due to climate change, as this makes pricing and underwriting more uncertain.

64. **The extent to which reinsurance is considered a risk mitigant in capital adequacy frameworks could play a role in the take-up of reinsurance by direct insurers.** In most capital adequacy frameworks, reinsurance that involves genuine risk transfer can partially offset capital adequacy requirements of direct insurers.⁹⁹ As a result, insurers may have an incentive to take up reinsurance to reduce their capital requirements. Capital frameworks that recognise how risk adaptation measures can reduce climate-related risk exposures may further incentivise insurers and reinsurers to support those measures.

65. **Usually, capital adequacy frameworks impose capital requirements to address the concentration of insurance risks underwritten by insurers.** Insurers may have a concentrated risk exposure, for example by geographical location, and may therefore need to hold capital to absorb potential unexpected losses from such concentration. Reinsurance arrangements could help mitigate such risk. As such, reinsurance may be recognised in the capital requirement, to reduce charges for concentration risk.¹⁰⁰

66. **Some supervisors are considering climate change when (re)calibrating regulatory capital requirements for (re)insurers.** EIOPA (2021b) outlined how the European Union Solvency II capital requirements for the NatCat module in the standard formula can be reviewed and, if necessary, adjusted regularly to take account of climate change impacts. In April 2024, EIOPA issued for public consultation its 2023/24 (re)assessment exercise of the NatCat standard formula for different NatCat perils such as flood, windstorm and hail. In light of climate change, new scientific insights and recent catastrophic events, EIOPA deems it important to ensure that the NatCat parameters of the Solvency II standard formula remain valid and proposed adjusting the risk factors for perils like flood, hail, earthquake and windstorm.¹⁰¹

67. **Capital adequacy frameworks that are overly stringent on reinsurance exposure may have unintended consequences on the availability and affordability of reinsurance coverage.** Relevant

⁹⁸ Aon (2024) commented that, while increasing retention level by reinsurers can improve their profitability, it can also increase retained losses for insurers many of whom are struggling to improve their pricing and underwriting of sustain increased catastrophes.

⁹⁹ See Australian Prudential Regulation Authority (2023a).

¹⁰⁰ See APRA (2023b). Meanwhile, APRA (2023c) also permits the use of catastrophe bonds and insurance-linked securities as reinsurance, subject to APRA approval.

¹⁰¹ See EIOPA (2025).

requirements include credit risk capital requirements for reinsurance recoverables and, more specifically, collateral requirements. In some jurisdictions, certain reinsurers, typically domiciled in a foreign jurisdiction, will need to post collateral against the reinsured amount up to reinsurance liabilities (minus premiums) in order for the amount to be considered as a risk mitigant that provides capital relief to primary insurers. Such collateral is supposed to address the counterparty default risk present in reinsurance transactions but may make it expensive for primary insurers to seek reinsurance, including for climate-related coverage.

68. **Capital frameworks that allow the use of internal models may influence the ways in which reinsurers price or underwrite climate-related risks.** Supervisors, as part of the model validation process, may review how assumptions on the frequency and severity of NatCat events are set by reinsurers. In doing so, they might try to understand how climate change is factored in calibrating the models, though they may not necessarily require an explicit allowance of climate change risk drivers, as this can be challenging to do from a technical standpoint. Some supervisors may take the view that the isolation of climate change impact may not be necessary, or the efforts needed may not be commensurate with the benefits. What is more important is to ensure adequacy of pricing based on the model results, given that such capital models should be used for actual pricing purposes, in order to pass the use test.

Supervision

69. **Industry self-assessment surveys on reinsurance pricing and underwriting practice can be helpful in providing benchmarks that reinsurers can use to see where they are vis-à-vis their peers.** Insurance authorities can facilitate this process by publishing good practices identified from the survey results. This can be a way to indirectly contribute to addressing the availability and affordability of reinsurance, instead of issuing reinsurance-specific guidance or supervisory expectations.

70. **Stress tests can be a good way to assess the potential impact of climate change on reinsurance availability and affordability.** ACPR (2024) reported significant reliance on reinsurance to provide NatCat coverage and ceded reinsurance risk may lead to losses for reinsurers under adverse scenarios. The qualitative survey revealed that some insurers plan to increase premiums and/or impose higher deductibles to cope with physical risks.

71. **Various supervisory techniques can be used to assess premium adequacy.** As premium adequacy can be a subjective exercise, one possible approach that supervisors can consider is to benchmark rates across the industry to identify outliers. In assessing vendor pricing models, one aspect is to assess the appropriateness of data inputs and parameters/assumptions used.¹⁰² Another approach is to assess the different models by entering the same climate-related inputs and reviewing the variability of the results across the models. Supervisors may require firms to explain how they have allowed for climate-related risks in their underwriting/pricing models and the justification. This includes explanations of how they deal with different outputs.

72. **Onsite inspections may be needed to assess the premium adequacy of reinsurance programmes due to the proprietary nature of some of the vendor models.** As the vendor models may be used by multiple reinsurers, it may be important to assess these models to avoid potential systemic outcomes if they react in the same way in producing the pricing outputs. Nevertheless, this risk can be mitigated by multiple validation levels within firms and the model providers themselves. In addition, reinsurers typically set parameters and assumptions to reflect their individual circumstances, which may alleviate the model concentration risk. Supervisors may also review reinsurance programmes of primary insurers onsite to assess if the coverage is sufficient and well incorporated in insurers' risk management frameworks. Some authorities may even assess how risk adaptations are considered in the pricing and underwriting of insurance products.

¹⁰² It is acknowledged that not all insurance supervisors review pricing models used by (re)insurers.

73. **Supervisory cooperation can help monitor and address issues arising from reinsurance developments in relation to climate-related coverage.** Cross-border supervisory cooperation is particularly important given the wide geographical footprint of the major global reinsurers. Supervisors can exchange information to ascertain reinsurance premium rate increases and/or withdrawals and identify the drivers for such developments. Appropriate actions can be considered to address such trends if warranted.

74. **EMDE jurisdictions rely a lot on foreign reinsurance capacity, but EMDE supervisors may not have full knowledge of how regulatory oversight of those foreign reinsurers can impact their local markets and may have only limited intervention powers.** EMDE supervisors may not supervise the reinsurers that provide cover in their jurisdictions, which limits EMDE supervisors' intervention possibilities. Another challenge is that those foreign reinsurers may offer reinsurance products that are not well suited for the local markets. As insurance penetration is already low in these jurisdictions, the lack of reinsurance capacity may exacerbate the protection gap.

Other requirements/regulatory approaches

75. **Some authorities may require insurers to retain a certain percentage of risks in the local jurisdiction.** For example, the Insurance Regulatory and Development Authority of India requires branches of international insurance groups to retain at least 50% of their underwritten risks in India. Such requirements may be aimed at building the local insurance industry and retaining capital within the domestic financial sector. In certain EMDE jurisdictions, it is compulsory for local insurers to cede a portion of business underwritten to a local reinsurer. By pooling risk at the local reinsurer, which then purchases cover from global reinsurers, it might be possible to get a better deal, provided the reinsurance premium is priced adequately.¹⁰³ Such requirements can be helpful to ensure the availability of reinsurance for climate-related coverage. If the pricing is regulated, the affordability of reinsurance coverage can be ascertained. On the other hand, local reinsurers may be exposed if the risks accepted were not priced adequately.

76. **Other regulatory agencies (besides insurance supervisors) may be responsible for monitoring the pricing of climate-related reinsurance products.** For example, the Australian Competition and Consumer Commission monitors pricing of home insurance by insurers that are reinsured by the public cyclone reinsurance pool to ascertain whether the savings from the cyclone pool are being passed through to policyholders. The Florida Commission on Hurricane Loss Projection Methodology¹⁰⁴ has a group of experts who evaluate models and actuarial methodologies for projecting hurricane and flood losses to ensure rates are neither excessive nor inadequate.

Section 5 – Protection gap implications

77. **Prudential authorities with a sole mandate to safeguard the safety and soundness of (re)insurers may currently only indirectly consider the affordability and availability of (re)insurance products.**¹⁰⁵ On the one hand, the affordability and availability of (re)insurance coverage for climate-related risks may be viewed mainly as the role of governments. On the other hand, prudential authorities may indirectly consider this policy issue as part of their regulatory and supervisory frameworks, eg as part of a market development objective in addition to the main mandates. Some authorities may have an

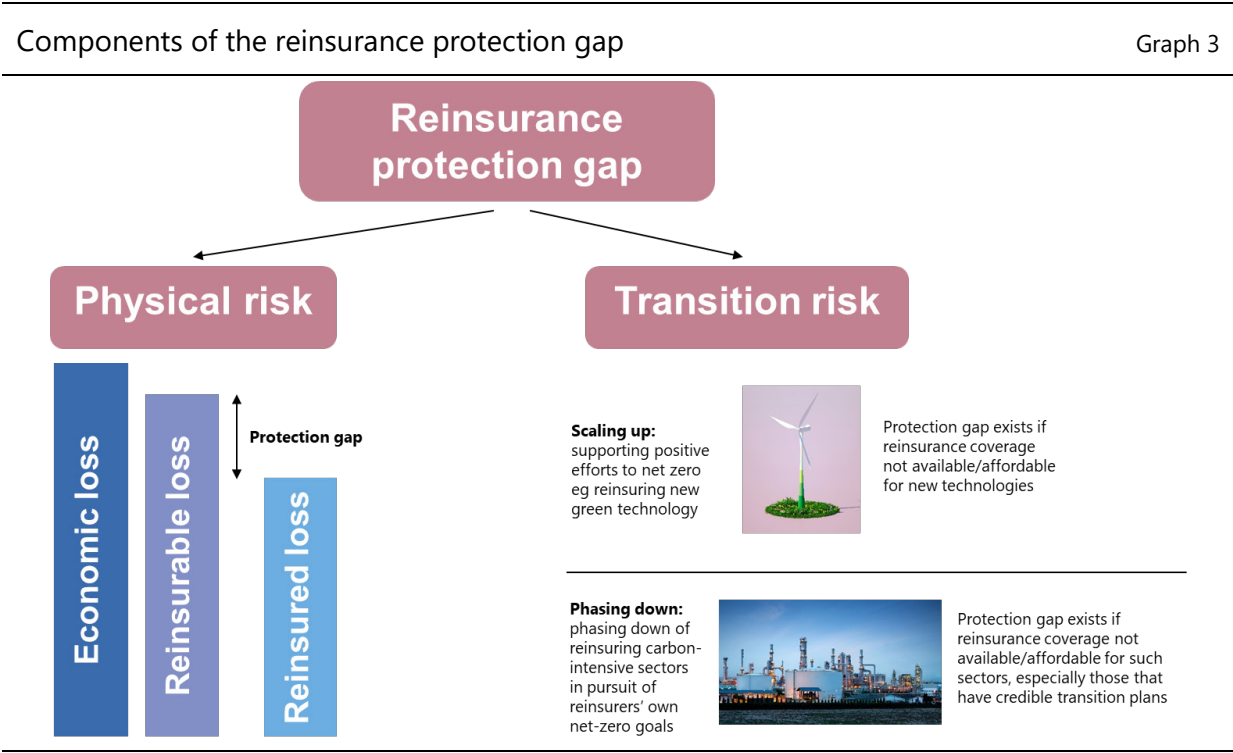
¹⁰³ Rather than each local insurer dealing separately with global reinsurers, the local reinsurer can pool the risks from local insurers and negotiate collectively with those global reinsurers.

¹⁰⁴ See [Florida Commission on Hurricane Loss Projection Methodology](#).

¹⁰⁵ The focus of this paper is on how reinsurance could impact the protection gap. It is acknowledged that addressing protection gaps requires a holistic approach, with consideration of the entire insurance value chain.

interest in the affordability and availability of (re)insurance coverage due to the impact of NatCat losses on the real economy and potentially on financial stability.¹⁰⁶ At a broader policy level, authorities are unlikely to view the regulation or supervision of a shrinking insurance industry or an industry that is regarded as not fulfilling societal expectations as a success. IAIS (2023a) stated that it is of growing importance to insurance supervisors to address issues related to the affordability and availability of insurance for NatCat events. While financial inclusion and market development mandates naturally encompass addressing protection gaps, action in support of narrowing NatCat protection gaps can also contribute to the supervisory mandates of policyholder protection and financial stability.

78. **Some prudential authorities have laid out their active role in addressing the (re)insurance protection gap.**¹⁰⁷ In the context of this paper, the insurance protection gap includes the reinsurance protection gap, which can arise with respect to three aspects of physical and transition risks: reinsurance for climate-related physical risks, reinsurance for upscaling technologies to accelerate net zero and the phasing down of reinsurance cover for carbon-intensive sectors. Graph 3 summarises the components of the reinsurance protection gap. Some prudential authorities may also take an interest in protection gaps from a consumer protection perspective.



Source: authors' elaboration.

79. **Reinsurers' underwriting and pricing policies and practices are having a direct impact on the NatCat protection gap.** Selecting which risks to underwrite, at what terms and conditions, and at a risk-based price is critically important in maintaining the safety and soundness of reinsurers. Yet, these can have a profound knock-on impact on primary insurers, markets and potentially the wider financial system. Reinsurers' pricing and underwriting policies and practices can exacerbate the insurance protection gap.

¹⁰⁶ European Central Bank and European Insurance and Occupational Pensions Authority (2023) noted that a widening insurance protection gap may also pose financial stability risks and reduce credit provision in countries with large banking sector exposures to catastrophe risk events.

¹⁰⁷ NAIC (2024) lays out a comprehensive strategy on climate resilience, including a number of actions related to risk adaptation and closing the protection gap. The European Union has created a platform called Climate-ADAPT to share adaptation knowledge, which includes use cases beyond insurance.

For example, the Central Bank of Ireland (2024) pointed out that reduced reinsurance capacity could lead to increased premiums for flood insurance cover for consumers and businesses. This could lead to more restrictive underwriting by insurers, further widening the protection gap.

80. **Reinsurance capacity for physical risk has recently reduced in certain markets/geographies, with reinsurance becoming more expensive and restrictive.** Reinsurers play a critical role in absorbing climate-related NatCat losses.¹⁰⁸ Yet, in line with increasing insured losses and other contributing factors, some reinsurers have increased premium rates¹⁰⁹ or attachment points,¹¹⁰ reduced coverage limits of reinsurance contracts or withdrawn coverage for certain parts of the world.¹¹¹ Some have tightened reinsurance policy terms and conditions (for example, expanding their list of coverage exclusions) to control their own risk. Reducing reinsurance capacity for physical risk to date is due to a combination of factors. These include increases in NatCat losses, but also uncertainty about the impact of climate change. In some cases, this is exacerbated by primary insurance premiums that have not increased in line with the exposure and losses, and may thus lead to adverse risk selection. According to some, it has become more difficult to obtain reinsurance for higher-frequency, low-severity NatCat risk coverage as reinsurers are increasingly reinsuring only higher losses by moving to higher attachment points. This trend is restricting primary insurers' capacity to underwrite climate-related and other risks.¹¹² Nevertheless, the issue is not as easy or clear cut as usually reported, due to a variety of factors besides climate change that are influencing underwriting decisions, such as strategic portfolio focus, client segmentation and risk appetite.

81. **As climate change accelerates, if reinsurance capacity does not increase or even becomes more restrictive, the risks retained by insurers will likely increase further unless they decide to limit coverage or not renew.** The increasing frequency of NatCat events may further challenge the insurers' capacity to pool these losses. This may become a systemic risk concern in markets where most insurers rely heavily on reinsurance availability and affordability provided by a small number of reinsurers to manage their insurance risk exposures. This trend, if left unabated, can further impair the availability and affordability of climate-related insurance coverage for households and businesses and increase economic losses, which may pose a threat to government budgets. There could also be cross-border implications. Central Bank of Ireland (2024) commented that reinsurance cost and capacity can be impacted by climate change effects in other countries, resulting in reduced capacity to cover flood risk in Ireland. Insurance Council of Australia (2023) explained how extreme weather events not only in Australia but globally contributed to increasing the cost of reinsurance by between 20 and 30% in 2023.

82. **In response to reinsurance market tightening, some insurers have already increased premium rates, reduced coverage or stopped providing cover for certain NatCat perils in certain regions.** The Australian Competition and Consumer Commission (2024) cited evidence from insurers that

¹⁰⁸ See European Systemic Risk Board (2015), OECD (2018) and Swiss Re (2015).

¹⁰⁹ See Reserve Bank of Australia (2023) and Reserve Bank of New Zealand (2024). BMA (2024), based on an industry survey comprising mainly reinsurers, reported the industry's view that increasing frequency and severity of natural catastrophe losses globally and in specific regions is contributing to a lack of affordable insurance products. Government of Japan (2021) stated that increased natural disasters and insurance losses will possibly drive up claim payments and reinsurance premiums. Australian Prudential Regulation Authority (2024a) reported the inability of parts of the Australian community to access adequate insurance due partly to the impact of severe weather events, inflationary pressures and increases in the cost of reinsurance.

¹¹⁰ Attachment points (also known as retention levels) refer to the specific threshold of loss at which reinsurance coverage begins to apply. It is the amount of loss that a primary insurer must retain and absorb before the reinsurer starts to pay under the terms of a reinsurance contract.

¹¹¹ See Bloomington, IL (2024) in California stopping coverage of homeowners' insurance for various reasons including increasing reinsurance costs. Fliegelman (2023) reported limited reinsurance availability in Florida and California due in part to increasing frequency and severity of weather-related losses. See also Voa Africa (2023).

¹¹² Moody's Ratings (2023) highlighted that, in response to greater natural catastrophe losses, reinsurers have increased premium rates for primary insurers; and both reinsurers and insurers have invested in catastrophe models for "secondary" perils to better estimate losses, and have reconsidered the areas where they do business.

showed increasing insurance premiums for cyclone cover due to a range of reasons, including hardening global reinsurance markets and extreme global weather events. In certain markets, new insurers may enter the market, but they may charge higher premiums than the insurers who left. This trend, in the end, will make climate-related insurance coverage less available and/or less affordable. By contrast, some markets do not foresee reduced reinsurance capacity even under adverse climate risk scenarios.¹¹³

83. **For EMDE insurers, it can be challenging to obtain NatCat reinsurance coverage from global reinsurers due to limitations in NatCat models.** Many of the common NatCat models do not cover all geographical regions relevant to EMDE insurers due to a lack of data and insurance market depth. Furthermore, global reinsurers may not have sufficient data available to allow them to underwrite reinsurance coverages confidently. To add to this, EMDE insurers rely on global reinsurers not only for reinsurance coverage but also for know-how and technical expertise from product design and risk modelling to pricing and underwriting. As such, losing global reinsurance presence may negatively impact the development of local insurance markets, including in economically essential sectors such as agricultural insurance.

84. **It is important to recognise that pricing requirements imposed on primary insurers can impact reinsurance availability and affordability.** Underpriced insurance products may not be accepted by reinsurers, or they may be subject to more stringent reinsurance terms and conditions, such as higher attachment points. In jurisdictions where the pricing of NatCat insurance is regulated or controlled, primary insurers have incentives to reinsure those risks as much as possible on a treaty basis to their local, mostly state-backed reinsurer – ie to pass risks to the public sector to avoid risk concentration exposures of underpriced coverage on their own balance sheets.

85. **In response to a widening protection gap, a common first step that insurance supervisors are taking is to collect relevant data.** The data can be sourced from regular supervisory reporting or specific data requests¹¹⁴ from the industry. Currently, mainly exposure data and insurance sector data are collected (IAIS (2024a)) but only a few supervisors collect climate-specific data (eg flooding locations/patterns). The data can be useful to identify trends in climate-related insurance coverage (eg property insurance) and assess the capacity of the reinsurance market or size of the protection gap. Horizontal reviews of specific product lines may be useful to understand potential affordability and availability issues. Several insurance supervisors (eg in the United States) are focusing on home insurance specifically. Monitoring of reinsurance markets, for example whether treaties are renewed – and if so, on what terms and conditions – can be useful to identify potential issues in terms of reinsurance availability and affordability. Nevertheless, it can be challenging to identify relevant metrics or indicators, clearly define data standards and ensure consistent data collection, including from other supervisory institutions. It may also be difficult in practice to identify climate-related losses in reinsurance claims as reinsurance contracts typically cover multi-perils. Moreover, it is difficult to conclusively attribute specific insured losses to climate change.¹¹⁵

Section 6 – Risk adaptation role of reinsurers

86. **Some supervisors are advocating the concept of impact underwriting, which encourages (re)insurers to contribute to climate risk adaptation and mitigation as part of their underwriting practices.** EIOPA (2019, 2021a) reference “impact underwriting” as an underwriting practice which is risk-

¹¹³ See ACPR (2024).

¹¹⁴ See NAIC’s data call and APRA (2024a,c). APRA (2024c) involved the five largest non-life insurers to assess how household insurance affordability could change over the medium term in the context of climate-related risks.

¹¹⁵ EIOPA’s [Catastrophe Data Hub](#) provides NatCat from insured exposure and insured losses perspectives.

based from an actuarial perspective, integrating ESG considerations. New (re)insurance products addressing risks from climate change should promote risk adaptation or mitigation, and use forward-looking pricing assumptions to adjust product pricing and design. MAS (2020) encourages (re)insurers to assess their clients' ability and willingness to introduce risk mitigation measures as part of their underwriting assessment. For a customer that does not manage its environmental risk (including climate-related risks) adequately, the (re)insurer may reflect the cost of the additional risk in the insurance premiums, applying limits on the underwriting exposure and reassessing the customer relationship, including declining future transactions and exiting the relationship. In short, the concept of "impact underwriting" strives to incentivise the implementation of climate change adaptation and/or mitigation through pricing and underwriting.

87. **Some insurance authorities are taking proactive actions to directly contribute to risk adaptation measures in order to improve the availability and affordability of climate-related insurance coverage.**¹¹⁶ An example is the Strengthen Alabama Homes programme, which provides grants to homeowners to strengthen their properties against wind damage. They can then receive discounts on the wind portion of their homeowners' insurance premiums of between 20 and 60%, depending on the level of fortification, as mandated by the Alabama Department of Insurance.¹¹⁷ New York Department of Financial Services (2024) encourages homeowner insurers to offer free or discounted risk adaptation tools and services as part of wider efforts to contain increasing losses and insurance premiums in light of the growing severity and frequency of climate-related events.

88. **Pricing models should reflect how climate change and climate risk mitigation and adaptation measures can affect the hazard, vulnerability and exposure modules.** Climate risk adaptation can affect the vulnerability (eg flood protection measures can reduce the vulnerability of buildings), exposure (eg by moving building construction away from areas prone to natural perils such as floodplains or coastlines) and hazard (eg ecological forestry can reduce the wildfire hazard). Climate risk mitigation can primarily affect the hazard (eg by reducing the increase in frequency or intensity of climate-related perils such as floods, as well as other related risks such as diseases) and can, in principle, also affect vulnerability (eg by reducing the increase in vulnerability of insured objects, people or activities due to climate change).

89. **Commonly used NatCat models can capture climate risk adaptation measures in the technical prices of reinsurance contracts.** To enable reinsurers to capture climate adaptation impacts in NatCat models, the exposure data provided to them should reliably identify such adaptation measures and the models should be reliably calibrated to measure their impact. Measures not specific to individual insured objects, such as flood defences, may be directly captured in the underlying data eg in the hazard module, or if the locations of the insured objects are provided in the exposure data. Measures specific to individual insured objects need to be captured in the exposure data by reliably defined and credibly assigned characteristics of the insured objects.¹¹⁸ Without clear evidence of risk reduction and/or confidence that the exposure data on the measures are credible, reinsurers may not recognise such risk adaptation in their pricing models.

90. **Increasing reinsurance premiums that are based on technical prices can serve as risk signals.** Such premiums ideally reflect the heightened risk, including that from increasing uncertainties from NatCat events. Risk-sensitive premiums can provide signals that, for example, discourage development in disaster-prone areas by making it more expensive to insure properties there. As a result, they can contribute to

¹¹⁶ See Government of Japan (2021).

¹¹⁷ Federal Insurance Office (2023) lists other states that have similar requirements for insurers to explicitly recognise risk adaptation measures in premium pricing. The US NAIC maintains a [list](#) of mitigation measures describing actions that policyholders can take to reduce their risk exposure for individual properties as well as state requirements for mitigation premium discounts.

¹¹⁸ See Archipelago (2022).

guiding developers, policymakers and communities towards more risk-aware decision-making. By recognising and responding to these financial signals, stakeholders can make more informed choices about where and how to build, ultimately improving long-term resilience against the impacts of climate change.

91. **Even though climate risk adaptation can reduce physical risk impacts, thus sustaining the availability and affordability of climate-related coverage, they may not always be taken into account in reinsurance underwriting.**¹¹⁹ By recognising risk reduction through climate adaptation measures in reinsurance premiums and underwriting, reinsurers can provide incentives for primary insurers and ultimate policyholders to take such measures. Yet, reinsurers may not always take risk adaptation measures into account when underwriting reinsurance contracts. This is the case even though ceded portfolios may implicitly include such measures and pricing models can, in principle, allow for such measures. Possible reasons for this include reinsurers lacking sufficiently detailed information on individual risk adaptation measures, possibly due to an inability to verify that the measures are undertaken or because there may not be concrete evidence that such measures can reduce insured losses. There is anecdotal evidence from Australia that there may be a lag of up to five years until risk adaptation measures can prove themselves and receive benefit in reinsurance contracts. There are also views that individual risk adaptation measures are less often considered by reinsurers than collective or aggregate risk adaptation measures, such as tightening building codes or community-wide measures.

92. **Reinsurers can collaborate with a number of public and private sector organisations that have a direct mandate to support risk adaptation measures.**¹²⁰ For example, the Insurance Bureau of Canada, a non-life industry association, works with consumers and government agencies to promote flood risk prevention measures. In Australia, the ACT Multi Hazard Advisory Council is a government body that provides advice on natural disasters, including prevention measures. Federal Emergency Management Agency (FEMA), a US government agency, not only provides disaster assistance and emergency management but also flood risk maps, and supports communities adopting and enforcing higher-standard building practices as well as property owners elevating their homes.

Section 7 – Concluding remarks

93. **The policy considerations related to reinsurance pricing and underwriting for climate-related risks can be viewed in terms of the following three aspects: physical risk, scaling up transition and reinsurers' phasing down of coverage to carbon-intensive sectors to pursue their own net-zero goals.** The main policy issue in the context of physical risk is the availability and affordability of reinsurance coverage and how this may have knock-on effects on the availability and affordability of insurance coverage against physical risks, especially NatCat. For scaling up transition, the issue relates to the enabling role of reinsurance in supporting the acceleration of green technology and the risks arising from such new technologies. With regard to phasing down reinsurance of carbon-intensive sectors, where it occurs, the concern relates to the impact on the financial system and the broader economy, including the reinsurance protection gap that could arise from such activities. It is important to recognise that carbon-intensive entities may already have sound transition plans.

¹¹⁹ Swiss Re (2024a) estimated that adaptation measures can outweigh their costs by multiples ranging between two to one and 11 to one. The National Institute of Building Services (2021) estimated that risk adaptation saves up to USD 13 per USD 1 invested on average for natural disaster exposures in the United States. CCR (2024a) directly recognised risk adaptation measures through reinsurance commission provided to primary insurers.

¹²⁰ For example, [Institute for Catastrophic Loss Reduction](#) in Canada, [FEMA](#) in the United States and [Asian Disaster Preparedness Centre](#).

94. **Reinsurers' cautious pricing and underwriting approaches amidst rising claims and related cost is appropriate from a risk management perspective but may widen the protection gap.** Soundly managed reinsurers would typically underwrite and price reinsurance products on a risk-based approach, which also provides an important risk signal to insurers. As insured losses of NatCat events mount, reinsurers may increase their rates or restrict coverage. While climate change is contributing to the increasing losses, other factors such as a growing number of properties (with increasing values) and populations in climate-vulnerable areas currently play a greater role. Regardless of the cause of the increasing losses, steps need to be taken to support the continued availability and affordability of reinsurance coverage. But mandating reinsurers to provide coverage on a loss-making basis is not a prudent policy choice.

95. **One of the main prudential concerns arising from reduced reinsurance availability and/or affordability, in tandem with an increase in NatCat risks as a consequence of climate change, is the potential financial impact on primary insurers.** Insurers may end up retaining more risks, which may adversely impact their solvency position unless they reduce their underwriting portfolio, increase their capital or otherwise transfer the insured risks to capital markets. Reduced reinsurance could also adversely impact primary insurers' underwriting performance and increase profit volatility, which may lead to an increase in premiums for policyholders and/or more restrictive underwriting, potentially increasing insurance protection gaps. If such a trend continues, supervisors may need to more closely monitor reinsurance availability and the capital adequacy of insurers, especially in jurisdictions where there is an increasing reinsurance protection gap.

96. **As climate change drivers (hazard, vulnerability and exposure) increase over time, reinsurers' capital needs for their NatCat risks may also increase.** Higher capital requirements may further constrain the availability of reinsurance coverage for climate-related risks, as reinsurers may impute the higher cost of capital to insurers in their premium pricing. There could be a downward spiral in terms of an amplifying feedback loop between increased risks and higher capital needs, ultimately exacerbating the reinsurance protection gap. On the other hand, fresh capital may enter the market, influencing pricing, as well as overall supply and demand of reinsurance capacity.

97. **Reduced availability and affordability of reinsurance coverage may drive primary insurers to seek alternative risk mitigation measures, which may give rise to other risks.** For example, insurers may resort to transferring their insurance risk to capital markets through cat bonds and ILS. Such alternative risk transfer instruments can expose insurers to additional risks such as basis risk, counterparty credit risk, market risk and risk transfer to non-regulated entities.

98. **The reinsurance protection gap may contribute to financial stability risks.** From a physical risk perspective, increasing insured losses may financially strain public-private reinsurers, which may lead to the need for liquidity support.¹²¹ Cross-sector and cross-border spillover, for example from uninsurable properties, could also have financial stability implications.¹²² On the other hand, the reinsurance sector can play a market stabilising role by absorbing extreme financial losses arising from climate change impacts. Of course, this shock-absorbing capacity would only work if the risks are reinsurable.

99. **The confluence of risks materialising can jeopardise the stability of the (re)insurance sector and the broader financial system.** The risks are heightened if multiple, potentially uncorrelated events occur at the same time. For example, never before experienced mega-hurricanes might coincide with severe financial market turmoil. There could be an accumulation of a series of related NatCat events from the same peril (such as several hurricanes in a row) or different perils (eg torrential rain after a severe draught) exacerbating the damage.¹²³ The accumulation of seemingly uncorrelated risks may not be

¹²¹ See Moreno (2025).

¹²² See Financial Stability Board (2025).

¹²³ See The Actuary report (2024).

captured in existing risk models, and may catch many off guard, including financial institutions and authorities. Moreover, rising reinsurance costs may have spillover effects to other sectors, including households and the banking sector.¹²⁴

100. **The reinsurance protection gap may widen further in the future without concerted efforts to address its root causes.** As climate change may contribute over time to increasing the frequency and severity of certain NatCat events, combined with increasing urbanisation and value concentration in climate-exposed areas, and coupled with increasing rebuilding/repair costs, the mounting insured losses will flow through to insurers and reinsurers, increasing premium rates or reducing coverage. To slow or reverse this trend, multiple efforts addressing the root causes will be needed – from government policies to reduce GHG emissions, to taking risk adaptation measures to minimise damage when a NatCat occurs. This may include “building back better”, such as the restoration of physical infrastructure and zoning plans that avoid populating flood plains. At the extreme, financial stability policy decisions may need to reflect the impact of these decisions on inflating the cost of repair and rebuilding, which feeds into the widening of the reinsurance protection gap.

101. **There are several key considerations for insurance supervisors and policymakers to support the continued availability and affordability of reinsurance coverage for climate-related natural perils.** First, it is critical that premiums for insurance coverage of climate-related perils are adequate, reflecting the risks of the underlying perils. Second, risk adaptation measures are critical to support the continued availability and affordability of such coverage. The interest of primary insurers and reinsurers need to be aligned, in terms of underwriting adequately priced insurance products as well as properly acknowledging risk adaptation measures.

102. **To contribute to the continued availability and affordability of (re)insurance coverage, governments, the (re)insurance industry and supervisors are investing considerable effort in supporting risk adaptation measures.** But these efforts will be futile if risk adaptation measures are not considered in reinsurance underwriting and pricing. Insurance authorities may have an important role to play here by contributing to local, regional and national policies on risk adaptation; providing insight on how (re)insurance can support risk adaptation measures; and providing information on where the limits lie as to what the insurance industry is able to contribute. Greater effort to better integrate the work of bodies supporting risk adaptation measures in reinsurance pricing and underwriting are needed, for example to ensure that evidence for the effectiveness of such measures is available to reinsurers.

103. **Insurance authorities and policymakers face various trade-offs when dealing with the affordability and availability of reinsurance coverage for climate-related risks.** Closing the protection gap should not simply imply reinsurers taking more risks at a low(er) price. For example, there is a trade-off between ensuring the safety and soundness of reinsurers versus having affordable reinsurance products. Regulatory measures to improve the affordability/availability of reinsurance, such as controlling reinsurance premiums, making reinsurance coverage mandatory or extending the duration of reinsurance coverage could limit reinsurers’ ability to diversify risks. This, in turn, could adversely impact reinsurers’ underwriting results and eventually their financial soundness. On the other hand, risk-based pricing of reinsurance coverage for physical risks may result in overly high premiums, resulting in reinsurers pricing themselves out of the market. Yet, persistent losses from climate-related insurance coverage may eventually force reinsurers to withdraw from a particular market. As such, careful consideration of the unintended consequences of policy actions on reinsurers’ viability is salient.

104. **Public-private partnerships may become increasingly important to correct market failures and risk accumulation, but there is a limit on the extent to which public sector reinsurance schemes**

¹²⁴ Reserve Bank of Australia (2023) highlighted that reduced insurance affordability may shift risks to households and businesses that may not be well suited to bear those risks. Lower insurance coverage on assets/properties that banks recognise as collateral, would mean banks face greater potential losses on their lending in areas more affected by NatCat. Actuaries Institute (2024) further stated that financial stress on a borrower (after a NatCat event) could lead to loan default, resulting in losses for the lender.

can support increasing climate-related losses. The policy options and trade-offs in establishing a public sector reinsurance scheme need to be weighed carefully.¹²⁵ For example, in EMDE jurisdictions in particular, the expectation that the government will continue to subsidise reinsurance premium rates may not be desirable if climate-related insured losses continue to increase such that fiscal capacity is exceeded. Attention also needs to be paid to potential moral hazard, eg insufficient investment in adaptation measures. Furthermore, public sector reinsurance schemes may strongly rely on retrocession by global reinsurers for tail risks. As fiscal positions become tighter, governments may default on premium payments on retrocession, leaving such public sector reinsurance schemes financially exposed when climate-related events manifest. Reinsurance schemes may lose the trust of local insurers if they do not fully pay them out when an insured event occurs. Local insurers may then not take up the reinsurance coverage and consequently restrict the climate-related coverage they offer. Even well run public-backed reinsurance schemes may face losses,¹²⁶ potentially due to underpricing and/or increasing claims.

105. **Reinsurance developments in response to climate change impacts may reverberate across borders and require global efforts.** Many local reinsurers rely on retrocession to global reinsurers. As such, they are exposed to how global reinsurers adapt their underwriting and pricing to climate-related events that occur in other jurisdictions. This could have economic implications for vital sectors in a jurisdiction, such as agriculture and tourism. Additionally, in jurisdictions where carbon-intensive sectors are critical to the economy, local insurers may not be able to offer coverage due to lack of reinsurance capacity from foreign reinsurers that have net-zero commitments. This could similarly have economic implications for those critical sectors. Therefore, given the importance of global reinsurance players, cross-jurisdictional supervisory cooperation is critical, including the sharing of data and information to enable a full view of the sector.

106. **Reinsurance alone is not sufficient to ensure continued availability and affordability of climate-related insurance coverage.** Insurers can use tools other than reinsurance, including alternative risk transfer mechanisms such as ILS and cat bonds, bearing in mind the risks arising from those instruments. In addition, other measures¹²⁷ are needed to sustain the availability and affordability of insurance coverage, including increasing public awareness on the need for insurance and the importance of risk adaptation measures. Insurance authorities and indeed the (re)insurance industry alone cannot resolve the looming affordability and availability crisis. While they have an important role to play, they need to work in concert with other parties, including governments/policymakers, the scientific community and academia.

107. **Climate scientists are clear that we are crossing climate tipping points and the success of carbon capture technology is doubtful.**¹²⁸ The world looks set to exceed the carbon budget to keep the global temperature increase below 1.5 or 2 degrees Celsius. It is likely that physical risks will become more frequent and severe, leading to much more property damage and business interruption. Against this backdrop, multi-stakeholder collaboration is needed to contribute to the transition to net zero and, at the same time, accelerate risk adaptation measures as an “insurance policy” against failed transition.

¹²⁵ See Commonwealth of Australia (2021) for a discussion on options available to a cyclone reinsurance pool, including the pros and cons of voluntary/mandatory participation by insurers.

¹²⁶ See GIC Re (2024).

¹²⁷ Parliament of Australia (2024) proposed that carbon-intensive companies contribute to funding the rising cost of insurance through the imposition of levies.

¹²⁸ See Möller et al (2024).

References

- Actuaries Institute (2024): "Home insurance affordability and home loans at risk", August.
- Africa Re (2024): *Annual report and accounts 2023*.
- Ahmed, S and J Rambarran (2024): "World Bank should course-correct for more flexible cat bond trigger conditions in the wake of Jamaica's experience with Hurricane Beryl", *Insights: financial protection*, July.
- Amaral, R (2024): "France moves to reform natural catastrophe scheme", *Insurance Day*, 28 May.
- Aon (2024): "Reinsurance market dynamics", January.
- (2025): *Climate and catastrophe insight*.
- Archipelago (2022): "Taming catastrophe models", June.
- Armstrong McKay, D, A Staal, J Abrams, R Winkelmann, B Sakschewski, S Loriani, I Fetzer, S Cornell, J Rockström and T Lenton (2022): *Exceeding 1.5°C global warming could trigger multiple climate tipping points*, September.
- Artemis (2025): "Catastrophe bonds and ILS outstanding by trigger type", www.artemis.bm/dashboard/cat-bonds-ils-by-trigger/.
- Assembly Insurance Committee (2024): "The California fair plan", *California State Assembly*, March.
- Australian Competition and Consumer Commission (2024): *Insurance monitoring – third report following introduction of a cyclone and cyclone-related flood damage reinsurance pool*, September.
- Australian Prudential Regulation Authority (APRA) (2008): *Prudential practice guide: GPG 245 reinsurance management strategy*, July.
- (2021): *Prudential practice guide CPG 229 climate change financial risks*, November.
- (2023a): "Prudential standard GPS 320 reinsurance management", *Insurance (Prudential Standard) Determination*, no 9, May.
- (2023b): "Prudential standard GPS 116 capital adequacy: insurance concentration risk charge", *Insurance (Prudential Standard) Determination*, no 6, May.
- (2023c): "APRA's reinsurance requirements and the use of insurance linked securities", *Letters*, August.
- (2024a): *Annual Report 2023–24*, September.
- (2024b): "Consultation on targeted adjustments to general insurance reinsurance settings", *Letters*, November.
- (2024c): *Insurance climate vulnerability assessment*, December.
- Australian Reinsurance Pool Corporation (2024): *ARPC Annual Report 2023–24*.
- Autorité de contrôle prudentiel et de résolution (ACPR) (2019): "Climate change: which risks for banks and insurers", *Analysis and Synthesis*, October.
- (2024): "Climate stress-test: the ACPR encourages insurers to keep up their efforts towards the integration of climate risk", May.
- Bank of England (2024): "Enhancing banks' and insurers' approaches to managing the financial risks from climate change", *Supervisory Statement*, SS3/19, November.
- Bermuda: Re+ILS (2018): *A singular perspective*, October.
- (2024): *Cat bonds come under scrutiny*, August.

Bermuda Monetary Authority (BMA) (2022): *2021 climate risk exposure survey report*, May.

——— (2023): “Management of climate change risks for commercial insurers”, *Guidance Notes*, March.

——— (2024): *Bermuda insurance market sustainability results report 2023*, May.

Bloomberg (2024): “Why a 1,000-year deluge can happen anytime”, *Green Daily Newsletter*, 18 October.

Bloomington, IL (2024): “State farm general insurance company: update on California”, *Good Neighbor Stories*, March.

Caisse Centrale de Réassurance (CCR) (2024a): *Financial report 2023*, November.

——— (2024b): *A recurring climate change-related loss experience, but an exceptional capital gain on the disposal of CCR Re*, April.

Central Bank of Ireland (2023): “Guidance for (re)insurance undertakings on climate change risk”, March.

——— (2024): “The flood protection gap”, October.

Chairman (2024): “New Data Reveal Climate Change-Driven Insurance Crisis is Spreading”, *United States Senate Committee on the budget*, December.

China Re (2024): *2023 Annual Report*.

Climate ADAPT: “Discover the key services, thematic features and tools of Climate-ADAPT”, climate-adapt.eea.europa.eu/en.

Climate Resilience Dialogue (2024): *Climate resilience dialogue*, Final Report, July.

Commonwealth of Australia (2021): *Cyclone and related flooding reinsurance pool: regulation impact statement*, Department of the Treasury, May.

European Central Bank and European Insurance and Occupational Pensions Authority (2023): *Policy options to reduce the climate insurance protection gap*, Discussion Paper, April.

——— (2024): *Towards a European system for natural catastrophe risk management*, December.

European Commission (2019): “Communication from the Commission: the European Green Deal”, 11 December.

European Insurance and Occupational Pensions Authority (EIOPA) (2019): “EIOPA’s technical advice on the integration of sustainability risks and factors in the delegated acts under Solvency II and IDD”, April.

——— (2021a): *Report on non-life underwriting and pricing in light of climate change*, July.

——— (2021b): *Methodological paper on potential inclusion of climate change in the Nat Cat standard formula*, June.

——— (2022): *Application guidance on running climate change materiality assessment and using climate change scenarios in ORSA*, August.

——— (2025): *Opinion on the 2023/2024 reassessment of the Nat Cat standard formula*, 30 January.

European Systemic Risk Board (2015): *Report on systemic risks in the EU insurance sector*, December.

Evans, S (2019): “True hard markets rare, fleeting and unlikely in this phase of cycle: Fitch”, *Artemis*, 26 November.

——— (2023): “ILS capital outpaced AM best/Guy Carpenter forecast to hit \$100bn in 2023”, *Artemis*, 29 December.

Federal Financial Supervisory Authority (BaFin) (2020): *Sustainability risks: BaFin publishes guidance notice*, 16 January.

——— (2023): *BaFin’s sustainable finance strategy*, July.

Federal Insurance Office (2023): *Insurance supervision and regulation of climate-related risks*, June.

Federal Reserve Bank of Chicago (2018): "Catastrophe bonds: a primer and retrospective", *Chicago Fed Letter*, no 405.

Financial Stability Board (2025): Assessment of climate-related vulnerabilities: analytical framework and toolkit, January.

Financial Times (2024): The world is warming faster than scientists expected, March.

Fliegelman, A (2023): "Wind, fire, water, hail: what is going on in the property insurance market and why does it matter?", *Office of Financial Research Blog*, 14 December.

Foundation for Prevention of the Public Insurance Companies for Real Estate (2022): Disaster insurance in Switzerland: the cantonal public sector insurance system, October.

G20 (2025): Sustainable Finance Working Group: 2025 presidency and co-chairs note on agenda priorities, January.

Gallagher Re (2024): Natural catastrophe and climate report: Q3 2024, October.

——— (2025): Natural catastrophe and climate report 2024, January.

Gebäudeversicherung Kanton Zürich (2023): Geschäftsbericht 2023.

Geer, J (2024): RVS 2024: "Swiss Re P&C CEO urges education and risk mitigation to combat rising natcat losses", *Insurance ERM*, September.

GIC Re (2023): 51st Annual Report 2022–23.

——— (2024): Investor presentation – Q3 FY 2024 financial results presentation, February.

Glasgow Financial Alliance for Net Zero (2022): Financial institution net-zero transition plans: fundamentals, recommendations and guidance, Final Report, November.

Götze, T and M Gürtler (2021): "Risk transfer beyond reinsurance: the added value of cat bonds", *The Geneva Papers on Risk and Insurance*, 31 May.

Government of Japan (2021): Climate change adaptation plan, 22 October.

Guy Carpenter (2025): Global Property Catastrophe Rate-On-Line Index, www.artemis.bm/global-property-cat-rate-on-line-index/.

Howden and BCG (2024): The bigger picture: the \$10 trillion role of insurance in mobilising the climate transition.

Insurance Council of Australia (2023): Insurance catastrophe resilience report 2022–23, September.

Insurance insider (2013): Death of the property cat reinsurer?, October.

Intercantonal Reinsurance Association (2019): Natural catastrophes insurance cover: individual system summary updates.

Intergovernmental Panel on Climate Change (2023): "Climate change 2023: summary for policymakers", *Synthesis Report*.

International Association of Insurance Supervisors (IAIS) (2018): Issues paper on climate change risks to the insurance sector, July.

——— (2021): Application paper on the supervision of climate-related risks in the insurance sector, May.

——— (2023a): A call to action: the role of insurance supervisors in addressing natural catastrophe protection gaps, November.

——— (2023b): Global insurance market report (GIMAR), December.

——— (2024a): Global insurance market report (GIMAR), December.

—— (2024b): *Insurance core principles and common framework for the supervision of internationally active insurance groups*, December.

Japan Financial Services Agency (2020): *Principles for responsible institutional investors: Japan's stewardship code*, March.

Jarzabkowski, P, E Cacciatori, K Chalkias and R Gallagher Rodgers (2022): *"Disaster insurance in Switzerland: the cantonal public sector insurance system"*, *Foundation for prevention of the public insurance companies for real estate*, Report, October.

Kearse, N (2024): *Practice note: catastrophe bonds 101: the what, the why and the how*, ALSF, March.

Khoo, F, and J Yong (2023): *"Too hot to insure – avoiding the insurability tipping point"*, *FSI Insights on policy implementation*, no 54, November.

Korean Re (2024): *Sustainability report 2023*, September.

Lara, R: *"California sustainable insurance strategy"*, *California Department of Insurance*.

Long, C (2024): *"Desjardins no longer offering mortgages for houses in some flood zones"*, *CTV News*, February.

McGillivray, G (2020): *"Hard, harder, hardest: Where are we in the cycle?"*, *Insurance Blogs*, January.

Möller, T, A Högner, C-F Schleussner, S Bien, N Kitzmann, R Lamboll, J Rogelj, J Donges, J Rockström and N Wunderling (2024): *"Achieving net zero greenhouse gas emissions critical to limit climate tipping risks"*, *Nature Communications*, August.

Monetary Authority of Singapore (MAS) (2020): *Guidelines on environmental risk management (insurers)*, December.

—— (2023): *Consultation paper on guidelines on transition planning (insurers)*, October.

Moody's Ratings (2023): *"Reinsurers defend against rising tide of natural catastrophe losses, for now"*, *Special Report*, January.

Moreno, C (2025): *"California Assembly Members introduce insurance legislation to protect homeowners"*, *Robert Rivas*, January.

National Association of Insurance Commissioners (NAIC) (2024): *National climate resilience strategy for insurance*, March.

National Institute of Building Services (2021): *Mitigation saves: mitigation saves up to \$13 per \$1 invested*.

Network for Greening the Financial System (2020): *Guide for supervisors: integrating climate-related and environmental risks into prudential supervision*, May.

—— (2024): *NGFS: transition plan package*, April.

New York Department of Financial Services (2021): *Guidance for New York domestic insurers on managing the financial risks from climate change*, November.

—— (2024): *"Offering of loss mitigation tools and services and discounts for the installation of loss mitigation devices and systems"*, *Insurance Circular Letter*, no 3, May.

Office of the Superintendent of Financial Institutions Canada (OSFI) (2023): *"Climate risk management"*, *Guideline*, no B-15, March.

Official Journal of the European Union (2010): *"Regulation (EU) no 1094/2010 of the European Parliament and of the Council of 24 November 2010 establishing a European Supervisory Authority (European Insurance and Occupational Pensions Authority)"*, November.

——— (2014): "Commission delegated regulation (EU) 2015/35 supplementing Directive 2009/138/EC of the European Parliament and of the Council on the taking-up and pursuit of the business of insurance and reinsurance (Solvency II)", October.

Organisation for Economic Co-operation and Development (OECD) (2018): *The contribution of reinsurance markets to managing catastrophe risk*, December.

——— (2021): *Enhancing financial protection against catastrophe risks: the role of catastrophe risk insurance programmes*.

Outreville, J (2012): "The world's largest reinsurance groups: a look at names, numbers and countries from 1980 to 2010", *Assurances et gestion des risques, Insurance and Risk Management*, vol 80, no 1.

Parliament of Australia (2024): "Select committee on the impact of climate risk on insurance premiums and availability", *The Senate*, November.

PWC and Center for the Study of Financial Innovation (2023): *Reinsurers rank their top risks: reinsurance banana skins survey 2023*.

Quiroz-Gutierrez, M (2024): "Jerome Powell just revealed a hidden reason why inflation is staying high: The economy is increasingly uninsurable", *Fortune*, 12 March.

Raschka, P and H Weck-Hannermann (2007): "Charity hazard: a real hazard to natural disaster insurance?", *Science Direct, Environmental Hazards*, vol 7, issue 4, pp 321-329.

Reserve Bank of Australia (2023): *Financial stability review*, October.

Reserve Bank of New Zealand (2024): *Financial stability report*, May.

Schmidt G (2024): "Climate models can't explain 2023's huge heat anomaly – we could be in uncharted territory", *Nature*, March.

Scor (2012): *Property Cat: key strategic issues and trends ahead*, December.

S&P Global (2018): *The top global reinsurers are breaking away from the pack*, September.

——— (2021): *Global reinsurers grapple with climate change risks*, September.

——— (2023): "S&P Global ratings top 40 global reinsurers and reinsurers by country: 2023", September.

——— (2024a): "Reinsurers show growing appetite for natural catastrophe risks", August.

——— (2024b): "Global reinsurers must maintain discipline to cement strong performance amid casualty risks", September.

——— (2024c): "S&P Global ratings' top 40 global reinsurers in 2024 and reinsurers by country", September.

Swiss Financial Market Supervisory Authority (2022): *Elementarschadenversicherung in der Schweiz (ES-Versicherung): Historie und Anwendungsbereich*, April.

——— (2023): *FINMA guidance 01/2023: developments with regard to the management of climate risks*, January.

——— (2024): "Nature-related financial risks: management of climate- and other nature-related financial risks", *Circular 2026/1*, December.

Swiss Re (2015): *The essential guide to reinsurance*.

——— (2024a): *Changing climates: the heat is (still) on: hazard intensification set to compound economic losses*, February.

——— (2024b): *Comprehensive guide to parametric insurance*, February.

—— (2024c): Natural catastrophes in 2023: gearing up for today's and tomorrow's weather risks, *Sigma*, no 1, March.

The Actuary (2024): "Insurers face record claims following Canada's catastrophic summer", September.

United Nations Environment Programme (2024): Emissions gap report 2024, October.

United States Department of Treasury (2025): Analyses of US homeowners insurance markets, 2018–2022: climate-related risks and other factors, January.

United States Senate Committee on the Budget (2024): Next to fall: the climate-driven insurance crisis is here – and getting worse, Staff Report, December.

Vereinigung Kantonalen Gebäudeversicherungen (VKG) (2023): "Rechnungslegungs- und Bewertungsgrundsätze".

Verisk (2024): "Verisk 2024 Global modeled catastrophe losses", September.

Voa Africa (2023): "Climate change leads reinsurers to reduce their coverage", September.

Whitaker, D (2016): "Catastrophe modelling", Oasis Loss Modelling Framework.

World Forum of Catastrophe Programmes: www.wfcatprogrammes.com/documents/20142/34113/Comparative+table_Sep24.xlsx/5778ac65-2dfb-7bb6-1098-e497a46b735b.

World Meteorological Organization (2025): "WMO confirms 2024 as warmest year on record at about 1.55°C above pre-industrial level", press release, 10 January.

World Weather Attribution: World Weather Attribution – Exploring the contribution of climate change to extreme weather events

Zentrum für Europäischen Verbraucherschutz (2023): "Studie: Das französische System der Elementarschadenversicherung", November.

Annex 1 – Basic forms of reinsurance

Traditional reinsurance

The two basic forms of reinsurance are treaty and facultative reinsurance.¹²⁹

The most common basic form of (traditional) reinsurance is treaty (or obligatory) reinsurance. In treaty reinsurance, an entire portfolio of risks of the cedant is covered on a predetermined basis. A reinsurance treaty may cover all insurance policies that the cedant (primary insurer) will write in the upcoming year in a specific line of business (eg household property or motor liability), or in some cases multiple lines of business. For example, a reinsurance treaty may specify through its terms and conditions that it covers a specific portion of the losses caused by weather-related perils on all property insurance policies in Australia that the cedant will write in the upcoming year. The reinsurance premium of a treaty is typically contractually fixed by a predetermined calculation, for example, as a fixed rate (percentage) of the total premiums of the covered primary insurance policies. For household and building property policies, catastrophe covers frequently include not only weather-related perils potentially exposed to climate change such as hurricanes, typhoons, storms, hail and floods, but also earthquakes. This can make it more challenging to attribute changes in underwriting and pricing to the potential impact of climate change on individual perils.

The other basic form of reinsurance is facultative reinsurance. In facultative reinsurance, a single risk of the cedant is reinsured with terms and conditions including premiums specific to the risk. Facultative reinsurance is at present mostly used to cover additional risks above and beyond what is covered by treaty reinsurance. Facultative reinsurance is also used for innovative technologies in their initial stage of application or in their pilot phase, for example, for wind and solar parks, hydrogen and battery storage.

Treaty and facultative reinsurance can be proportional or non-proportional. In proportional reinsurance, each reinsurer takes a pre-agreed ratio of the premiums and liabilities (losses) of each covered insurance policy. For quota share reinsurance, this ratio is the same for all policies; for surplus reinsurance, it depends on the policy. The reinsurer also compensates the insurer for a portion of its acquisition and administrative costs through the reinsurance commission. In addition, the reinsurance commission serves as the price for the proportional reinsurance.

In non-proportional reinsurance such as excess of loss (XOL) reinsurance, the reinsurance pays the portion of each applicable loss of the cedant above a pre-agreed fixed loss amount (variously called excess point, deductible, net retention, attachment point or priority), typically up to another pre-agreed fixed loss amount (cover limit). The premium for non-proportional reinsurance is typically expressed as a rate (percentage) of the underlying insurance premiums. Non-proportional reinsurance covers differ by how the applicable loss amounts are defined. For per policy XOL covers, the amount is the loss per single insurance policy. For per event XOL covers, it is the sum of all losses caused by an event on the relevant policies. For stop loss or aggregate XOL covers, the sum is over all relevant losses over the treaty period. Natcat reinsurance is often in the form of per event XOL. As an example, for the cedant's total losses from any flood event on their insurance policies in Germany, a per event XOL may cover the portion that exceeds USD 100 million up to a limit of USD 100 million per flood event, subject to an annual aggregate limit of USD 200 million. Such covers thus typically cover lower-frequency, higher-severity losses (tail risk).

Similar to insurance policies, reinsurance contracts for non-life insurance typically have a cover period of one year. Cover periods for life reinsurance contracts can be longer.

Traditional (re)insurance is often indemnity-based, that is, payouts are calculated from the actual losses experienced. In parametric (or index-based) (re)insurance, on the other hand, payouts are a pre-agreed amount when a pre-defined event occurs and pre-defined event parameters are met or exceeded,

¹²⁹ Eg Swiss Re (2015).

as measured by an objective parameter or index (eg a measure of soil moisture for drought insurance) or as determined by an independent third party (eg the loss from the event as calculated by a natcat model). With parametric (re)insurance, there can be basis risk in the form of deviations between payouts and the actual loss experienced. Parametric (re)insurance has become an important instrument for agricultural insurance and for covering weather-related risk in developing economies. Hybrid covers are also sometimes used, where a parametric trigger is combined with an indemnity mechanism (such as the percentage of damaged crops according to satellite images).

The reinsurance programme of an insurer often consists of several reinsurance treaties and potentially additional facultative reinsurance covers. A NatCat reinsurance programme may contain several per event XOL treaties covering layers of NatCat event losses. For example, the first layer (treaty) might cover USD 100 million in excess of USD 100 million of each total NatCat event loss of the insurer. The second layer may cover USD 200 million in excess of USD 200 million, and so on. Reinsurance treaties typically have an annual aggregated limit to the reinsurance compensation.

It is common for the risk transfer chain from policyholders to primary insurance and then to reinsurance – including retrocession and alternative risk transfer (see below) – to move from high-frequency, low-severity losses to low-frequency, high-severity losses.

Alternative risk transfer

Alternative risk transfer (also called “alternative reinsurance”, “alternative capital” and “third-party capital”) is risk transfer to investors in capital markets, often in the form of tradable securities.¹³⁰ It refers to instruments such as catastrophe (cat) bonds, insurance-linked securities (ILS), industry loss warranties, collateralised reinsurance and sidecars. Cat bonds, for example, are fixed income instruments that provide coupon and principal payments to investors unless a pre-defined, typically low-probability, high-impact, catastrophic event occurs.¹³¹ Alternative risk transfer arrangements may have a cover period of one or several years and may, in particular, transfer risk from insurers or reinsurers. Some alternative risk transfer arrangements, specifically certain cat bonds, are not indemnity-based but parametric covers, which exposes them to basis risk (see above).¹³²

AM Best estimates the capacity (in terms of capital) of the ILS market in 2023 to be around USD 100 billion, of which property cat bonds and collateralised reinsurance each represent slightly less than 50% and sidecars less than 10%, compared with an estimated capacity (in terms of capital) of above USD 450 billion for traditional reinsurance.¹³³

Alternative risk transfer differs from traditional reinsurance in several characteristic ways. One difference is that the risk is not necessarily transferred to regulated (re)insurance companies but often takes the form of tradable securities. For alternative risk transfer, the risk transferred in a specific transaction is often fully funded with dedicated funds, ie it is fully collateralised as is the case, for example, for collateralised reinsurance and also many cat bonds. Generally, when investing in a portfolio of alternative risk transfer transactions instead of directly in the share capital of a (re)insurer, the investments in the different transactions tend to be isolated to some extent from each other. For example, for typical cat bonds, the paid-up capital is held in a secured collateral account that is invested in highly rated securities.

¹³⁰ IAIS Glossary.

¹³¹ Eg Kearse (2024).

¹³² See for example: Ahmed and Rambarran (2024), Bermuda:Re+ILS (2024) and Swiss Re (2024b).

¹³³ Evans (2023).

Annex 2 – The Swiss and French systems for NatCat insurance

Switzerland and France have distinctive risk reduction and transfer systems in place for the coverage of residential and commercial buildings against NatCat,¹³⁴ with comparatively small insurance protection gaps.¹³⁵ The following table summarises and compares the systems, which are subsequently explained in more detail.

		Swiss KGV system ¹ (in 19 out of 26 Swiss cantons)	Swiss GUSTAVO system ² (in seven out of 26 cantons, includes "Elementarschadenpool")	French CatNat system ³
	Private or public sector?	Public	Private	Private
Insurance	Is it mandatory for insurers to offer cover or for clients to purchase it?	Both are mandatory	In some cantons, both are mandatory In other cantons, both are not mandatory but there is mandatory coverage extension for building property and homeowners insurance (fire insurance) to NatCat perils	There is mandatory coverage extension for damage insurance (such as multi-risk housing, commercial buildings and automobile) to NatCat perils ⁴
	Premiums	Prescribed within the system Some risk differentiation ⁵	Prescribed within the system No risk differentiation	Prescribed within the system No risk differentiation
Insurance pool		Yes (for most cantons)	Yes (for most)	No
	Private or public sector?	Private	Private	Public (reinsurer CCR)
Reinsurance	Is it mandatory for reinsurers to offer cover or for insurers to purchase it?	Both are not mandatory	Both are not mandatory	It is mandatory for CCR to provide reinsurance upon request It is not mandatory for insurers to purchase reinsurance with CCR
	Premiums	Agreed between insurer and reinsurer	Agreed between insurer and reinsurer	Agreed between insurer and reinsurer
Link to risk reduction/adaptation		Part of premiums dedicated to risk reduction/adaptation, including: - non-binding proposals to policyholders - prescriptions and implementations with government	No	Risk reduction plans incentivised by variable deductibles

¹³⁴ To be more precise, it covers weather-related perils. The Swiss system mainly does not include earthquakes.

¹³⁵ See Swiss Re (2024a) and OECD (2021).

Risk-sharing between private and public sectors	Normal risk	Public (and potentially private)	Private	Private and potentially public
	Tail risk	Private (and potentially public)	Private	Potentially public
	Extreme tail risk	Policyholder or public, no explicit backstop	Policyholder or public, no explicit backstop	Potentially public, explicit backstop

¹ KGV is the common abbreviation for the German, kantonale Gebäudeversicherungen. ² GUSTAVO is an acronym of the names of the member cantons. ³ CatNat is the common abbreviation for the French, Le régime des catastrophes naturelles. ⁴ Excluding earthquakes. ⁵ Premiums are potentially adequate in aggregate over the whole population, but differentiate between policyholders with different levels of risks only to a limited extent. In this specific case, they differentiate between policyholders in different cantons but not within cantons.

Introduction

The Swiss system for NatCat insurance consists of two schemes split by cantons. In 19 out of 26 cantons, there is mandatory insurance through cantonal public sector insurance monopolies (“KGV system”). This covers around 80% of Swiss buildings and insured values. In the remaining cantons, private sector insurers provide uniform (standardised) natural perils cover with government-prescribed premiums (“GUSTAVO system”,¹³⁶ including the “Elementarschadenpool”) for the cantons Geneva, Uri, Schwyz, Tessin, Appenzell Innerrhoden, Wallis (Valais) and Obwalden. The natural perils cover is mandatory in some of these cantons. In the remaining cantons of the GUSTAVO system, it is not mandatory, but requirements to have national hazard insurance cover in place as a condition for taking out a mortgage contribute to a high take-up rate. The natural perils cover is mandatorily linked to the building and household insurance policy, ie those who buy such property cover also receive and pay for natural perils cover (for the perils covered by the scheme). The terms and conditions (covered perils and objects, set deductibles and limited sum insured) and the premiums (de facto tariffs) for the natural perils part of the policy are legislated in the Insurance Supervision Ordinance (Verordnung über die Beaufsichtigung von privaten Versicherungsunternehmen (AVO)) and the Insurance Supervision Act (Versicherungsaufsichtsgesetz (VAG)) and supervised by the Swiss Financial Market Supervisory Authority (FINMA). The involved insurers jointly submit a proposal for the tariffs to FINMA. FINMA reviews the proposal and decides on the tariffs to be used by all involved insurers.

Both the Swiss systems and the French CatNat system (Le régime des catastrophes naturelles) cover multiple natural perils and use prescribed premiums that either do not at all or only partially differentiate between policyholders with different risks. So, they mutualise losses with cross-subsidisation between policyholders and rely on increased solidarity between insureds. Both systems contain risk adaptation elements. A major difference is that in the KGV system, the public sector covers higher-frequency, lower-severity losses (“normal risk”), whereas in the French CatNat system, it also or exclusively covers lower-frequency, higher-severity losses (“tail risk”). The Swiss system has no government backstop or guarantee. It ultimately transfers some tail risk from public sector insurers to the reinsurance market and thus relies on affordable private sector reinsurance capacity.¹³⁷ The French system transfers risk from private sector insurers to the public sector reinsurer Caisse Centrale de Réassurance (CCR).¹³⁸ CCR has an explicit unlimited government guarantee and does not cede its CatNat risks to the reinsurance market, so tail risk is then covered by the public sector.

¹³⁶ GUSTAVO is an acronym of the names of the member cantons (Swiss Financial Market Supervisory Authority (2022)).

¹³⁷ Or, of course, reinsurance capacity from foreign public sector reinsurers.

¹³⁸ To be precise, insurers are not obliged to reinsure with CCR.

Swiss KGV system

In the Swiss KGV system, it is mandatory to purchase insurance for buildings (“fire insurance policy”) covering a wide range of weather-related perils (in addition to fire) from the public sector cantonal insurers (Kantonale Gebäudeversicherung (KGV)). This insurance covers the full reconstruction value of the building structure without limits, in excess of a deductible. The KGVs are required to provide cover in almost all cases. The premium is a percentage of the insured value of the building, with the same percentage for all buildings within a canton, but percentages may differ for different cantons. So, premiums are partially risk-based in that they differentiate by riskiness between cantons but not within cantons. Building contents is only covered in some cantons, and business interruption is not covered. Additional cover can be purchased voluntarily from private sector insurers. The KGVs are not supervised by FINMA but by the cantonal parliaments.

Of the 19 cantonal KGVs, 18 are members of, and finance, the inter-cantonal reinsurance association (Interkantonaler Rückversicherungsverband (IRV)), which provides reinsurance exclusively to the KGVs, manages the inter-cantonal insurance pool (Interkantonaler Risikogemeinschaft Elementar (IRG)) and provides analyses and expertise. In the IRG, the portion of total annual weather-related peril losses of each KGV that exceed the KGV-specific threshold (50-year return period annual losses) up to the IRG’s aggregate capacity (CHF 1.2 billion) are pooled across KGVs and settled within the IRG by being distributed among the KGVs and the IRV. For annual losses below KGV-specific thresholds, the IRG provides individual reinsurance solutions to the KGVs. The IRV additionally negotiates reinsurance deals for the KGVs in aggregate in the private sector reinsurance market, which includes reinsurance for parts of the IRG.¹³⁹ Losses to the IRG are thus, in general, shared between the KGVs, the IRV and the private sector reinsurance market.¹⁴⁰

Swiss GUSTAVO system

In the GUSTAVO system, the national hazard insurance cover, which protects against weather-related perils, is provided by private sector insurers. In some cantons, property fire insurance is mandatory and must in addition cover weather-related perils at prescribed premiums. In other cantons, fire insurance is not mandatory but if it is purchased, the national hazard insurance cover must be included at prescribed premiums. The national hazard insurance cover is limited per event by policyholder and per event in the aggregate. Premium tariffs for the national hazard insurance cover are a uniform percentage of the sum insured, with the same tariff for all policyholders in all GUSTAVO cantons, so they do not differentiate between policyholders with different risk. Many but not all insurers pool a specific part of their weather-related peril losses in the Elementarschadenpool up to an indemnity limit per event. The Elementarschadenpool is reinsured in the private sector reinsurance market.

French CatNat system

The insurance part of the French CatNat system¹⁴¹ is in some respects similar to the GUSTAVO system for the cantons without mandatory property insurance. The provision of homeowners’/building property insurance (Assurance multirisques habitation (MRH)) by private insurers is not mandatory and neither is its purchase by households/private property owners, tenants or businesses owners. However, take-up is very high, as it is required for renting or purchasing property. If purchased, it must include cover for natural perils at prescribed premiums and with regulated terms and conditions. The premiums for natural peril covers are a prescribed uniform percentage of the MRH insurance premiums and as such do not differentiate between policyholders with different risk profiles. To incentivise risk reduction

¹³⁹ Intercantonal Reinsurance Association (2019).

¹⁴⁰ Eg VKG (2023).

¹⁴¹ Eg Zentrum für Europäischen Verbraucherschutz (2023).

(adaptation) measures at the municipal level, insurance deductibles can be raised by the state for municipalities that have experienced NatCat losses but have not set-up risk reduction plans.

The reinsurer CCR, which is a private company (Société anonyme) that is 100% owned by the French state and supervised by the French supervisory authority ACPR, is required to provide reinsurance for NatCat risk to private sector insurers, upon request. The insurers are not required to purchase reinsurance with CCR but most do. CCR offers quota share reinsurance by which it reinsures 50% of the losses for a percentage of NatCat premiums (on average 44%) that is agreed between the insurer and CCR. CCR also offers unlimited stop loss reinsurance for annual losses in excess of an agreed deductible for a premium agreed between the insurer and CCR. CCR does not purchase retrocession for its NatCat business. For its explicit unlimited state guarantee, CCR pays the state a percentage of its NatCat premiums. It has used the state guarantee once since 1982 (in 2000 for the losses of 1999). CCR used to also write international reinsurance through its 100% subsidiary CCR Re and was one of the top 30 reinsurers in the world by written premiums in 2022.¹⁴² Some insurers purchase additional cover in the private sector reinsurance market.

Risk reduction/adaptation

In the KGV system, a specified part of the premiums for property insurance is used for risk reduction (against fire as well as natural perils).¹⁴³ This includes typically non-binding proposals to homeowners on design features at the building permit phase and partial financing of improvements in post-disaster reconstruction. It also includes collaboration with local and federal authorities on the development of building standards and risk maps, including restrictions on construction in high-risk areas, and involvement in the definition of infrastructure projects to reduce risk and damage that are funded by cantonal or national government.

Risk reduction is an integral part of the French CatNat system through plans for the prevention of foreseeable natural perils (PPRN) that are developed at the municipal level. A PPRN may, for example, prohibit the construction of buildings in specific areas or allow it only under specific conditions. PPRNs are not mandatory but are incentivised through the possibility of increasing insurance deductibles.

Outlook

A publication¹⁴⁴ commissioned by the KGVs states that “the experience so far appears to suggest that the system works best for maximising protection to a society when mandatory multi-peril insurance is coupled with a systemic view of mitigation and prevention”. Making insurance mandatory and further extending the pool of risks by including multiple perils potentially allows increased benefit from diversification and charging lower premiums. Implementing risk reduction measures (“mitigation and prevention”) may allow for a reduction in economic losses and thus charging lower premiums. A system is exposed to moral hazard if it has mandatory insurance (or where an insurer is obliged to provide insurance) that relies on the mutualisation of risk with cross-subsidisation by not charging risk-based premiums and it is not, at the same time, incentivising or implementing risk reduction (adaptation). An investigation in the publication commissioned by the KGVs on the US National Flood Insurance Program (NFIP) and the UK Flood Re system appears to show that it can be challenging for systems to adapt their remit to the changing nature of risk and, specifically, to include risk reduction.¹⁴⁵

¹⁴² See S&P Global (2023). Transfer of control occurred in 2023 to a consortium of majority shareholders; CCR now holds 25% of minority shares.

¹⁴³ Gebäudeversicherung Kanton Zürich (2023).

¹⁴⁴ See Jarzabkowski et al (Oct 2022).

¹⁴⁵ See Disaster insurance in Switzerland: the cantonal public sector insurance system (Oct 2022).

The French CatNat system is currently undergoing reform commissioned by the French government following seven consecutive years of losses incurred by the scheme and specifically by CCR.¹⁴⁶ Proposals include maintaining the solidarity principle for the premiums; increasing the surcharge on property premiums for NatCat cover and linking it to a suitable index to be defined; and reducing moral hazard by introducing stronger incentives for risk reduction through the extended ability to increase deductibles.

¹⁴⁶ Eg Amaral (2024).

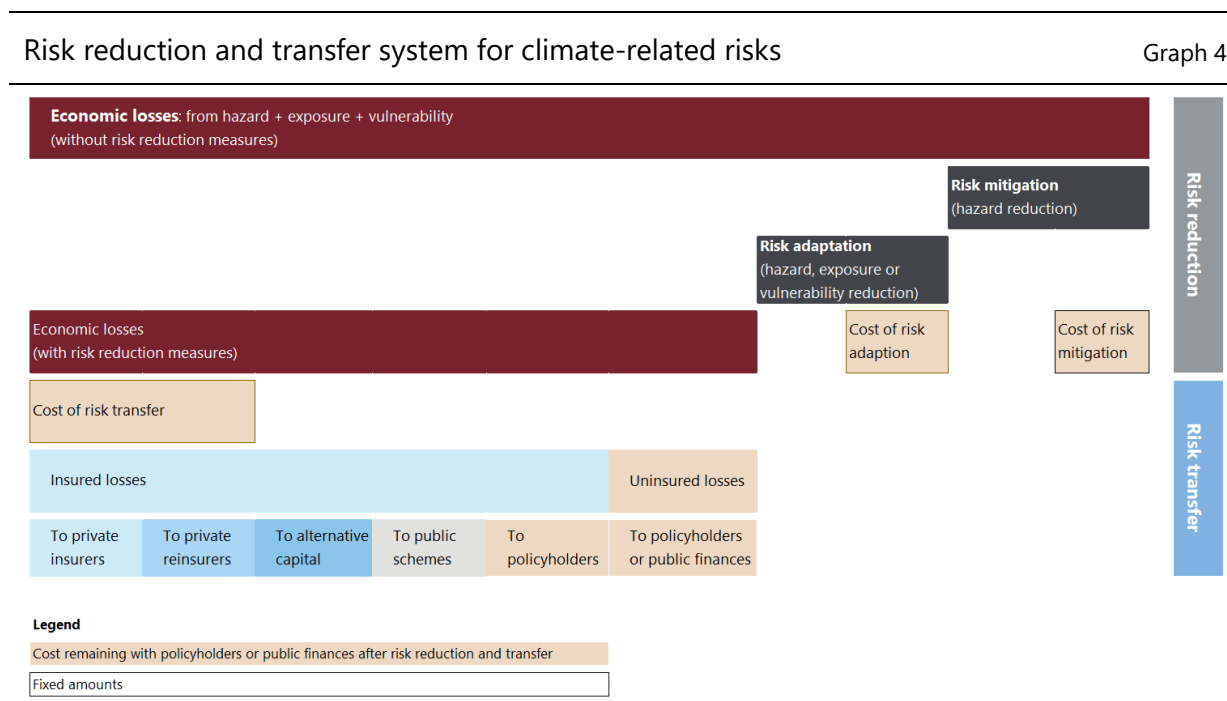
Annex 3 – Risk reduction and transfer systems for climate-related risks

Climate-related risks materialise in economic losses. For example, weather-related NatCat events such as storms or floods can cause damage to houses. Economic losses, specifically from climate-related physical risk, can be described as the financial cost of the damage caused by the:

- **hazard** (eg the frequency and severity of NatCat events from a specific weather-related peril such as storm or flood);
- **exposure** (eg value and characteristics of the buildings and their contents that might be exposed to the hazard; population growth or accumulation of assets in areas exposed to hazards are important drivers); and
- **vulnerability** of the exposure to the hazard (eg according to the characteristics of the buildings, their susceptibility or damageability to the given intensity of a hazard).

A risk reduction and transfer system (also called “catastrophe risk insurance programme”¹⁴⁷ or subsumed under public-private partnerships¹⁴⁸) is a system in which economic losses from climate-related risks are, in a first step, potentially reduced through risk mitigation (net-zero measures) and risk adaptation (the two terms are here summarised as risk reduction) and, in the second step, subsequently shared between different public and private parties typically including insurers and reinsurers (risk transfer). Reinsurance is typically an element of such a system, but it needs to be understood within the entire system comprising risk reduction and risk transfer because only the entire system provides a complete view of how risks are dealt with. Specifically, the extent to which risk transfer and risk reduction are linked within a system is important.

The following graph illustrates a risk reduction and transfer system for climate-related risks.



Source: authors' elaboration.

¹⁴⁷ OECD (2021).

¹⁴⁸ European Central Bank and European Insurance and Occupational Pensions Authority (2023).

Risk reduction

Climate-related risks in terms of potential economic losses can be reduced ex ante through risk reduction, which refers here to **climate risk mitigation and adaptation** measures.¹⁴⁹ This reduction of risk amounts to reducing the risk of economic losses, ie the potential for uncertain and especially large economic losses, for a largely fixed cost investment in risk mitigation or adaptation measures.¹⁵⁰

Climate risk mitigation measures have the potential to reduce future economic losses specifically by limiting the future increase in the hazard, ie in the frequency or severity of natural perils due to climate change. Climate risk adaptation measures can, in particular, affect the vulnerability and the exposure. For example, flood defences and implementing building standards that provide for greater resilience may reduce the vulnerability of houses to floods or storms. The exposure to flood events may be reduced, for example, by moving building construction from areas prone to natural perils such as floodplains or coastlines to less exposed areas. Climate risk adaptation measures can also reduce hazards, for example ecological forestry reducing wildfire hazard.

Risk transfer

Risk transfer arrangements allow sharing risks between the originally affected parties (eg property owners) and other parties, including private sector insurers and reinsurers, investors in capital markets through alternative risk transfer, and public sector entities. In typical arrangements, the originally affected parties retain some of the risk, ie some of the losses, for example in the form of insurance deductibles. An example of a risk-sharing mechanism is the “ladder approach to catastrophe insurance”¹⁵¹ set out for the European Union. In this concept, in moving from high-frequency, low-impact to low-frequency, high-impact events, losses may be assumed sequentially first by policyholders, then by private sector insurers and/or private sector insurance pools, followed by private sector reinsurers and/or private sector alternative risk transfer or public sector national mechanisms and, finally, similar to a backstop, by a public sector European Union component.

For the parties ceding risk, the risk transfer replaces the potential for uncertain economic losses by a largely fixed cost, specifically premiums. For the parties assuming the risk, the situation is reversed. Ideally, a risk transfer arrangement is beneficial to the ceding parties because it allows them to transfer away risk that they cannot bear in that the risk exceeds their financial resources (“insolvency risk”) or because it is profitable in that the premiums are lower than their cost of retaining the risk (“profitability”). For the assuming parties, ideally, it is profitable in that premiums are higher than their cost of assuming the risk and, at the same time, they can bear the risk without exceeding their financial resources. This risk transfer mechanism can work if there is **diversification** in the sense that it is unlikely that the ceding parties all incur losses at the same time. However, diversification cannot make any transaction profitable for the assuming parties unless the premiums exceed the expected losses.

Diversification of risks is a way to reduce risks and achieve a reduction of capital needed. One way for the parties to benefit from diversification is by **pooling** their risks among themselves, without any premiums. By pooling, the parties **mutualise losses**: the financial resources of all parties, including those that did not incur losses, can be used to finance the losses of the parties that did. Diversification within the pool reduces any party’s:

¹⁴⁹ Climate risk mitigation refers to measures to limit climate change and climate risk adaptation refers to measures to adjust to the consequences of climate change.

¹⁵⁰ In the graph, largely fixed amounts such as the cost of climate risk adaptation and climate risk mitigation are visualised by borders around the rectangles.

¹⁵¹ European Central Bank and European Insurance and Occupational Pensions Authority (2023).

- insolvency risk, eg the likelihood that its financial resources are depleted; and
- own loss volatility, which may imply that all parties have lowered the cost of bearing the risk.

However, in a risk pool, the financial resources of any party are still potentially fully exposed to the risk. This can be minimised by transferring the risks to another party (an insurer) for a premium. The insurer needs to have its own financial resources (so that premiums can be less than the full financial resources of the ceding parties). This risk transfer allows for benefiting from diversification in largely the same way as pooling, by using the premiums of all ceding parties and potentially the insurer's own financial resources to pay for the losses of the ceding parties that incur losses. At the same time, the risk transfer to the insurer shields the ceding parties' financial resources net of the premiums from the risk transferred.

The potential for diversification within a pool or for an insurer is limited when losses are too frequent and predictable or when specifically large losses tend to occur simultaneously. The latter is typical for NatCat including from weather-related perils, as these can lead to simultaneous losses to many policyholders in a specific geographical area. In this case, insurers may cede significant parts of these risks to reinsurers, which may be able to diversify risks worldwide. Reinsurers, in turn, might cede peak risks, ie risks of very large and widespread losses, to other (re)insurers through retrocession or via alternative risk transfer to investors in capital markets.

The potential for diversification tends to increase with the size of the pool and thus of the mutualisation. For this reason, for example, a system in which **insurance is mandatory** and coverage is multi-peril might be able to provide more affordable insurance, because the pool of policyholders and the types of losses covered are larger. Many systems with mandatory insurance contain **public schemes** with public sector insurers or reinsurers, potentially explicit government guarantees or backstops, prescribed premiums or state subsidised premiums.

Mutualisation through risk pooling is based on **solidarity** among the policyholders: the premiums of those that were fortunate not to incur losses are used to pay for the losses of those that were unfortunate. Solidarity is taken further in a system that does not have fully **risk-based premiums**, ie where **premium differentiation** (differential pricing) is limited in that premiums do not fully distinguish between policyholders exposed to different levels of risks. From an actuarial point of view, some policyholders are charged too much and others too little; in this sense, there is **cross-subsidisation**. For example, this happens if households highly exposed to flood are charged the same premium as households with lower flood exposure. Such a system thus relies on **mutualisation with cross-subsidisation** and thus on a higher degree of solidarity. On the other hand, cross-subsidisation allows for the lowering of premiums for high-risk parties and can thus potentially increase the **availability and affordability** of insurance coverage. Another type of cross-subsidisation is through **public sector subsidies** where, for example, insurance premiums are partly or fully paid by the government.

Solidarity may reach its limit in a system with **moral hazard**, especially when it is enforced through mandatory insurance or when it is mandatory for an insurer to provide insurance, such as for public sector insurers of last resort. As an example, in a system in which premium differentiation is limited and thus does not reward risk reduction (eg adaptation), policyholders may neglect to take measures to reduce risk that would be available to them, eg to reduce flood vulnerability by building flood protection or to reduce exposure by not building in hazardous locations, or they might even act in a way that increases risk. Options to reduce moral hazard include **risk reduction incentives** such as capturing risk reduction measures by premium differentiation or varying policyholder retentions (eg deductibles) or providing expertise or public sector subsidies for risk reduction. Another option is to make risk reduction measures mandatory, eg by imposing specific building standards or prohibiting building in specific locations.

A system in which insurance is not mandatory can have another type of moral hazard called **charity hazard**.¹⁵² This means that parties do not purchase insurance, specifically against natural hazards,

¹⁵² See Raschky and Weck-Hannemann (2007).

because they expect to receive ad hoc government support if they were to incur losses from such an event. Specifically, in a system in which some insurance is mandatory (eg car insurance and health insurance) but not other types of insurance (eg NatCat insurance), individuals might read this as a signal and conclude that the government would have made NatCat insurance mandatory if it were a significant risk and if no government support after such an event would be forthcoming, thus contributing to a lack of **risk awareness**.

In a system in which insurance is not mandatory and premiums lead to cross-subsidisation, **adverse selection** may occur. For example, it may be that only the high-risk households, whose premiums are too low, purchase insurance, especially those that have already incurred losses. As a consequence, cross-subsidisation may no longer be possible, and the system may become loss-making.

Annex 4 – Conceptual description of reinsurance underwriting

Insurance Core Principle 13 requires that ceding insurers have a reinsurance programme that is appropriate to their business and forms part of their overall risk and capital management strategies. An insurer's reinsurance programme may, in general, consist of several treaties. Each reinsurance treaty is characteristically split up between several reinsurers, with each reinsurer writing a share (proportion) of each treaty of the programme. This means that each reinsurer gets its proportion of the reinsurance premium and is liable for its proportion of any reinsurance losses. Splitting the reinsurance programme among different reinsurers mitigates the cedant's credit and concentration risk from individual reinsurers and may reduce prices through increased competition between reinsurers. It may, however, make placing the entire reinsurance programme more challenging. Reinsurance programmes are typically structured and placed by reinsurance brokers acting as financial intermediaries.

Non-life reinsurance programmes typically have a cover period of one year and are renewed annually at specific dates. Life reinsurance programmes might have a longer cover period. There are key reinsurance renewal periods around the inception dates of the renewed programmes. The renewals for 1 January have a particular focus on programmes in Europe and 1 April is a key renewal date for Asia, in particular Japan, South Korea and India. Additionally, mid-year renewals are important in the United States. Upon each renewal, the terms and conditions may change, including premiums and the proportions written by different reinsurers in the programme.

One important driver of changes, upon renewal, to terms and conditions – including premiums – are changes in the negotiating power of the reinsurance industry as a whole in view of supply and demand, leading to hard and soft markets, simultaneously affecting all insurers and reinsurers to some extent. In a hard market, reinsurers may generally achieve higher prices and tighter terms and conditions. Another important driver is the recent loss experience of the specific programme - reinsurers may be under pressure to reduce premiums when they have incurred no or only small losses in the last few years, and insurers may be under pressure to pay higher premiums when reinsurers have recently incurred considerable losses.

The reinsurance premiums and potentially other elements of the terms and conditions are usually determined during the renewal season by splitting up the programme between reinsurers in a process similar to an auction, often coordinated by brokers. The prices may be the same for all reinsurers (concurrent bidding) or potentially different (non-concurrent bidding). A typical two-step process may be as follows.

In a first step, the prices and other terms and conditions are set. To this end, the broker may ask selected major reinsurers to provide quotes, that is, to propose prices and potentially other terms and conditions for the programme. The broker then sets the prices of the contracts based on these quotes, potentially its own estimates of the technical prices from loss models, and other factors such as whether the market is hard or soft, the desirability and recent loss experience of the specific reinsurance programme and the negotiating power of the broker.

In a second step, the proportions of the treaties of the programme allocated to each reinsurer are set. The brokers typically offer shares to a wider group of reinsurers and set the final shares depending on the supply of reinsurance. It is possible that the reinsurance programme is not ceded completely and some risk remains with the insurer. This may be because the insurer may prefer to retain some risks given the prevailing reinsurance price levels or the insurers' risk appetite and capacity.