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EUROSYSTEM

European Insurance and Occupational Pensions Authority

Policy options to reduce the climate insurance protection gap

Discussion Paper

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Contents

Executive summary

Extreme weather and climate events can have significant macroeconomic implications. While the economic impact of such events in Europe has been manageable historically, it is expected to rise over time as catastrophes become more frequent and more severe due to global warming.

Catastrophe insurance is a key tool to mitigate macroeconomic losses following extreme climate-related events, as it provides prompt funding for reconstruction and should incentivise risk reduction and adaptation. The overall societal cost of a disaster depends not only on the severity of the initial damage but also on how swiftly reconstruction can be completed. However, reconstruction can be prolonged and may even be incomplete in the absence of sufficient resources. Insurance pay-outs reduce uncertainty and support aggregate demand and investment for reconstruction, enabling economies to recover faster and limiting the period of lower economic output. By contrast, without insurance, households and firms have to finance post-disaster recovery mainly with savings, credit and/or uncertain government relief, which is likely to be much less efficient.

Only about a quarter of climate-related catastrophe losses are currently insured in the EU. This insurance protection gap could widen in the medium to long term as a result of climate change, partly because repricing of insurance contracts in response to increasingly frequent and intense events may lead to such insurance becoming unaffordable. This would further increase the burden on governments, both in terms of macroeconomic risks and in terms of fiscal spending to cover uninsured losses. This may raise government debt burdens of EU countries and increase economic divergence. 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.

This discussion paper sets out possible actions which should be considered to tackle this protection gap and mitigate catastrophe risks from climate change in the EU by means of insurance coverage and adaptation measures. These efforts should be complementary to ambitious mitigation policies to tackle climate change and reduce associated catastrophe risks, and should not be seen as a substitute for such policies. The actions discussed in this paper have been designed to fulfil the following main objectives:

- help provide prompt insurance claim pay-outs after a natural disaster;
- incentivise risk mitigation and adaptation measures;
- be complementary to existing insurance coverage mechanisms;
- require the sharing of costs and responsibilities across the relevant stakeholders to ensure “skin in the game” and reduce moral hazard;

- lower the share of economic losses from major natural disasters borne by the public sector over the long term.

The paper uses the term “ladder approach” in the context of indicating the share of losses from natural disasters borne by various parties at different loss layers. It builds on the existing frameworks of private insurance and public sector intervention, and discusses the case for some coordination of public sector efforts at the EU level. Private (re)insurance should be the first line of defence to cover losses from climate-related natural disasters. The use of financial markets to transfer risks via catastrophe bonds (cat bonds) may also support the reinsurance of such risks. However, as natural catastrophe risks are expected to grow and become more difficult to insure, policymakers need to consider putting in place more sophisticated frameworks to deal with extreme weather events and minimise future costs to taxpayers. These include public-private partnerships (PPPs) and ex ante public backstops – which could be reinforced by an EU-wide component – together with suitable safeguards and incentives to promote risk mitigation. The purpose of such approaches is not to provide blanket government guarantees for uninsured losses but to enhance efficiency in the use of public funds and reduce moral hazard relative to the typical status quo of unconditional government support after disasters.

While higher private insurance coverage is beneficial and desirable, insurance provision should be carefully designed to ensure that it encourages adaptation and reduces vulnerability to climate-related catastrophes over time. The design of insurance policies can provide incentives to policyholders for risk reduction and adaptation while limiting moral hazard (e.g. via impact underwriting). To this end, it is also essential that (re)insurers continue to incorporate climate change risks in their own risk management to ensure the long-term sustainability of their business model.

Capital market instruments, such as cat bonds, can complement insurance schemes to provide prompt liquidity for reconstruction after disasters. They can also help to pass on part of the tail risk assumed by private (re)insurers and/or PPPs to capital markets. Capital market instruments, which are often used together with traditional reinsurance, provide two key benefits: (i) diversification in the form of an alternative source of capital and (ii) a lower premium for overall coverage.

The public sector can prepare for contingent liabilities related to climate-related catastrophes by enhancing its ex ante disaster risk management strategy. This could include supporting ex ante contingent financing by creating fiscal buffers, such as national reserve funds. It could also include risk transfer and measures that support private insurance solutions, such as public-private insurance schemes that pool and diversify risks, or capital market products that transfer part of the risk to investors. Governments can support and encourage the development of an active market for the issuance and trading of cat bonds, for example by lowering issuance costs. Better measurement of fiscal expenditures related to climate-related extreme weather events would also help to manage fiscal risks and ensure better preparation before disasters occur.

PPPs at the national level can support the overall functioning of the insurance market by providing additional coverage either via direct insurance or by

indemnifying a private (re)insurer against extraordinary events. While the private insurance sector can provide extensive expertise in prompt loss assessment and pay-outs, public authorities can improve the legal framework and act as a reinsurer of last resort. The design of PPPs should ensure that the costs and responsibilities associated with having a resilient catastrophe insurance coverage programme are shared between the public and private sectors. Furthermore, PPPs should leave a portion of the economic costs uninsured to limit moral hazard. Mandatory coverage (i.e. a requirement for everyone to insure against catastrophes) and/or mandatory offers (i.e. a requirement for insurers to offer catastrophe cover alongside, say, property insurance) could also help to tackle moral hazard. PPPs already exist in some European countries to manage specific disaster risks.

For less frequent, large-scale disasters, an EU-wide public scheme for natural disaster insurance covering a broad range of weakly correlated hazards could complement national schemes. Pooling risks at the EU level could help to reduce the economic costs of catastrophes and accelerate recovery and reconstruction efforts, while incentivising and promoting ex ante risk reduction via both mitigation and adaptation measures. Any EU-wide fund should be additional to existing funding for tackling climate change, and should have safeguards to address moral hazard, such as making access conditional on Member States implementing agreed adaptation strategies and meeting their emissions reduction targets. Such a fund would complement the EU's climate policies and related initiatives, such as the renewed sustainable finance strategy, and leverage on the experience from existing tools for disaster relief that are not currently adapted to increasing needs related to climate change, such as the EU Solidarity Fund (EUSF).

Wider EU policy initiatives, such as the capital markets union (CMU), could also help to further develop and integrate EU financial and insurance markets. This could improve the accessibility and size of the pool of private funding available to tackle the climate insurance protection gap.

Finally, in the banking sector, risks associated with a lack of insurance against climate-related disasters may trigger higher capital needs for existing lending and could lower credit supply. Targeted prudential/macroprudential regulations may therefore be needed to enhance the banking sector's resilience to the implications of a persistent climate insurance protection gap.

This discussion paper does not reach firm conclusions on specific policies that need to be implemented to tackle the climate insurance protection gap. Rather, its aim is to solicit feedback on the possible policy actions set out. The European Central Bank (ECB) and the European Insurance and Occupational Pensions Authority (EIOPA) will continue to undertake further analysis of these policy options, taking into account comments received on this paper.

The ECB and EIOPA would welcome comments and feedback on all aspects of this paper. Comments should be sent to this email, ideally by 15 June 2023: ecb_eiopa_staff_protection_gap@eiopa.europa.eu

Introduction

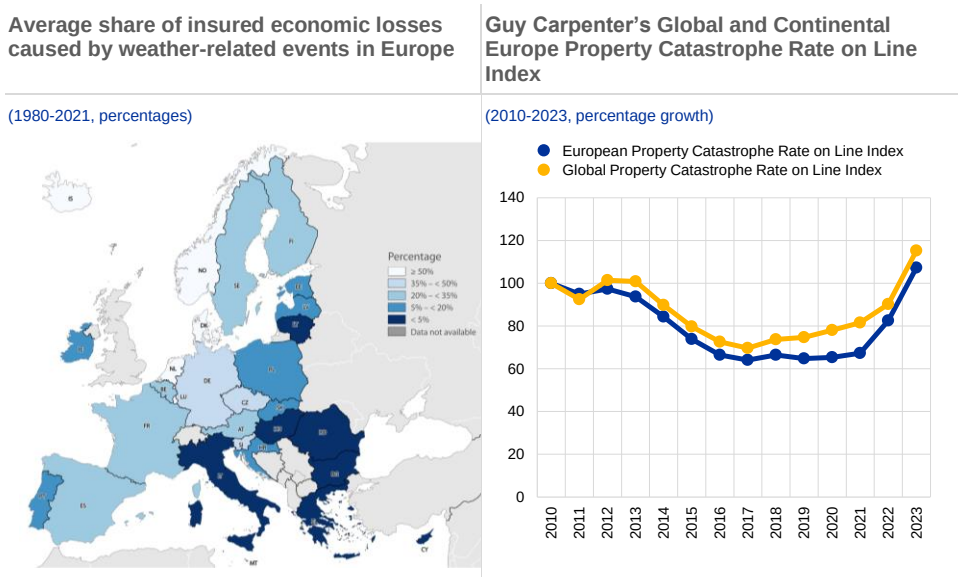
This discussion paper identifies policy options to tackle the widening climate insurance protection gap – i.e., the uninsured portion of the economic losses caused by climate-related natural disasters – while incentivising adaptation and mitigation in light of the expected increase in the frequency and severity of such events due to climate change. It argues for a ladder approach to natural catastrophe insurance, considering options for: (i) enhancing private insurance and deepening cat bond markets; (ii) developing possible shared resilience solutions between public and private entities at national level; and (iii) identifying risk pooling and diversification opportunities that could be explored at a European level.

Such policies need to be considered alongside ambitious measures to tackle climate change and reduce associated catastrophe risks by cutting greenhouse gas emissions and transitioning towards a net zero economy, and should not be seen as a substitute for such measures. It is also not possible to insure against all catastrophe risks, nor would doing so be desirable in the context of incentivising adaptation to climate change.

Only about a quarter of the losses caused by extreme weather and climate-related events in the EU are currently insured, and in several countries this share is below 5%. (**Chart 1, left panel**). There are several structural reasons for this insurance protection gap, including underestimation of the likelihood and potential impact of catastrophes and moral hazard, for example if sovereigns are expected to cover residual uninsured losses after a catastrophe occurs.

Chart 1

The share of insured economic losses related to natural catastrophes in Europe is low and could decline in the medium to long term, while property catastrophe premium indicators have been increasing recently, albeit from historically low levels



Sources: Left panel: EIOPA dashboard on insurance protection gap for natural catastrophes, European Environment Agency (EEA) CATDAT; right panel: Guy Carpenter and Artemis.
Notes: The data points in the right panel indicate the Rate on Line charged at the beginning of each year.

Climate change poses several challenges for the provision of insurance. First, a greater frequency and severity of natural disasters could generate higher than foreseen claims, increasing insurers' underwriting and liquidity risks, and putting pressure on their solvency. In addition, changes in climate and weather, exacerbated by non-linearities and feedback loops that can accelerate the temperature rise, mean that past losses could become unreliable for estimating future losses. Climate change could also affect the randomness and correlation of events across regions or countries, reducing the potential to diversify underwriting portfolios. Finally, demand side issues for the uptake of insurance products should also be addressed. For instance, as consumers might not fully understand the coverage they buy, expectation gaps may arise, and consumers may not be aware of the actual protection gap in their policies.

As catastrophes become more frequent and more severe, insurance becomes more valuable from a macroeconomic and societal perspective (**Section 1**). At the same time, as insurance claims increase, premiums are likely to rise and/or coverage fall, thereby widening the protection gap (**Chart 1, right panel**). Swiss Re estimates that there were USD 120 billion of catastrophe losses globally in 2022, well above the past ten-year average of USD 81 billion. And six consecutive years of above-average losses have driven property catastrophe reinsurance prices higher in recent years, with European rates increasing by 30% at the January 2023 renewals according to the international brokerage group Howden. Besides damages from catastrophes, high inflation, the Russia-Ukraine conflict, and years of low interest rates have also contributed to the magnitude of recent price increases.

The design of private insurance policies can address these market failures to some extent (**Section 2.1**), for example by incorporating risk mitigation and adaptation measures in insurance premiums, or by introducing mandatory or quasi-mandatory insurance. Measures to help deepen cat bond markets could also play an important role (**Section 2.2**).

However, climate-related risks are unlikely to be sufficiently insured by the private sector, so additional risk-sharing solutions, such as PPPs, might be needed to provide a backstop to private (re)insurance (**Section 2.3**). In Europe, PPPs already exist in, for example, Spain, France and the United Kingdom. Depending on the design of these schemes, both insurers and reinsurers hold some of the risk alongside government, while policyholders can be incentivised to adapt and reduce risks, thereby reducing moral hazard. This contrasts with the prevailing situation in relation to many catastrophes, where a low private insurance share poses substantial moral hazard since governments, and thus taxpayers, are expected to cover the costs of catastrophes after they have occurred.

Governments can play an additional role in managing financial risks before catastrophes occur. Risk management instruments include disaster reserves, catastrophe funds and cat bonds. But lack of awareness and limited data on catastrophe risks (and on the funds spent on prevention) can hamper the design of risk management strategies. Climate-related fiscal risks are also, so far, largely absent from national fiscal sustainability frameworks. As a consequence, financing generally occurs after the catastrophe through ad hoc reallocations of funds from budgets at local, national and European levels. These potentially large contingent liabilities should be recognised on the balance sheets of fiscal authorities. This would increase the transparency of higher climate-related risks borne by sovereigns and facilitate more structured decision-making on the prudence of accelerating adaptation spending versus bearing costs after catastrophes occur.

The European Commission recently published a new EU strategy on adaptation to climate change, which includes the objective of reducing the insurance protection gap.[1] But a common EU-level approach to disaster risk management is lacking, with legal requirements fragmented across hazards and countries. For less frequent, large-scale catastrophes and weakly correlated hazards, an EU-wide fund that complements national schemes could help to reduce the economic costs of catastrophes by pooling risks and accelerating recovery and reconstruction efforts, while incentivising and promoting risk reduction and adaptation (**Section 2.4**). The fund could be invested in liquid, investment-grade green bonds, thereby also allowing the fund to support complementary efforts to mitigate climate change and reduce global warming. The fund and should have safeguards to tackle moral hazard, such as making access conditional on Member States implementing agreed adaptation strategies and meeting their emissions reduction targets.

The policy options set out in this discussion paper also intersect with and complement wider financial sector policy initiatives (**Section 3**). These include the need to make further progress on the CMU and to consider whether targeted

[1] See "EU Adaptation Strategy" on the European Commission's website.

prudential/macroprudential regulations in the banking sector may be needed to enhance its resilience to the implications of a persistent climate insurance protection gap.

This paper is not intended to reach firm conclusions on specific policies that should be implemented to tackle the climate insurance protection gap. Rather, its aim is to solicit feedback on the possible policy actions set out. The ECB and EIOPA will continue to undertake analysis of these policy options, taking into account the comments received on this paper.

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1 The economic relevance of the climate insurance protection gap

As climate-related disasters become more frequent and severe, the risk of abrupt economic and financial losses increases. Catastrophe insurance[2] is a key tool to mitigate these losses, but insurance coverage is expected to decrease or become more expensive as a result of climate change.[3] Increased losses from natural disasters linked to climate change could prompt insurers to limit the coverage they offer or charge unaffordable premiums. This could impair the ability of households and firms to finance reconstruction after disasters. It may also pose financial stability risks and reduce credit provision in countries with large financial sector exposures to natural catastrophes. Furthermore, it may further increase the burden on governments, both in terms of macroeconomic risks and in terms of fiscal spending to cover uninsured damage. This section explores these channels and provides evidence of their economic relevance.

1.1 Implications for the macroeconomy

Climate-related extreme events can cause significant economic disruption that may persist over time. Direct aggregate catastrophe losses in the EU amounted to €487 billion in the period between 1980 and 2020.[4] While this implies that the average impact per annum has been limited, i.e. under 0.1% of GDP, this does not necessarily hold for individual years, when losses may be more significant, or at regional level, as lower income countries suffered the highest relative losses (**Chart 2**). The costs of climate-related natural disasters are also expected to rise across EU countries over the course of this century. For example, Gagliardi et al. (2022) estimate that, even in a 1.5°C global warming scenario, related losses across the EU will nearly double by 2050 and triple by the end of the century, with costs being significantly higher under a 2°C or 3°C average temperature increase. In addition, direct losses refer only to the damage caused directly by natural disasters when they occur and in the immediate aftermath.

Catastrophes typically also have an adverse indirect impact on subsequent GDP growth and inflation. This refers to losses related to changes in short and medium-term economic production and consumption owing to, for example, the interruption of

2 Catastrophe insurance is an umbrella term to refer to insurance cover against a wide range of high-severity events, including both natural and human-made disasters. In the context of this discussion paper, catastrophe insurance refers to insurance (private or public) against weather and climate-related natural disasters whose impact is expected to worsen as a result of climate change. It also includes "secondary perils", i.e. events that occur with higher frequency but with moderate severity and could either occur independently (such as thunderstorms) or as a secondary effect of a major event (such as hurricane-induced precipitation).

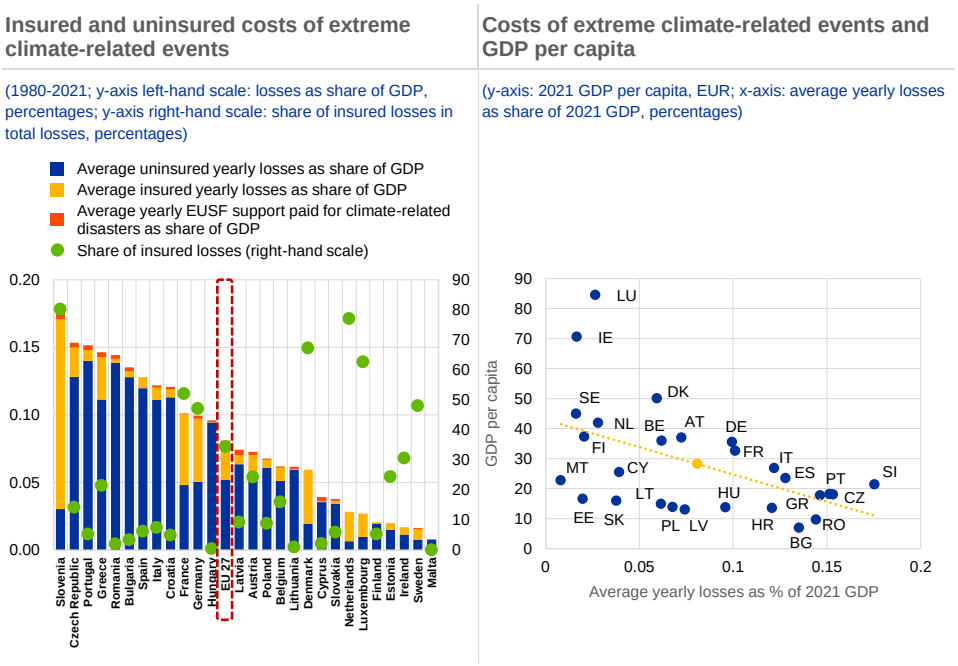
3 See IAIS and SIF (2021). Some insurers recently announced their plans to cut natural catastrophe coverage, as the incidence of natural catastrophes exceeds what models have been anticipating. See, for example, InsuranceERM (2023).

4 See EEA (2020).

economic activities or recovery paths. This can affect regional and national GDP growth and consumer price inflation (see Noy, 2009; Felbermayr and Groeschl, 2014; Kousky, 2014; Klomp and Valckx, 2014; Parker, 2018; Botzen et al., 2019; Kahn et al., 2021).

Chart 2

Direct aggregate catastrophe losses may appear limited in the EU, but costs can be sizeable in relative terms for individual years and regions



Sources: CATDAT, Eurostat, EUSF data and ECB calculations.
Notes: Both panels include data only on EU countries. Left panel: The figures presented in this chart are based only on CatDat and do not account for PPPs or other factors affecting the share of insured losses. The yearly insured and uninsured losses are calculated as average over the aggregate estimates of losses between 1980 and 2021 included, while EUSF support paid for climate-related disasters is an average between 2002 and 2021. GDP and GDP per capita are dated 2021. There have been no applications for financial support for Denmark and Finland under the EUSF.

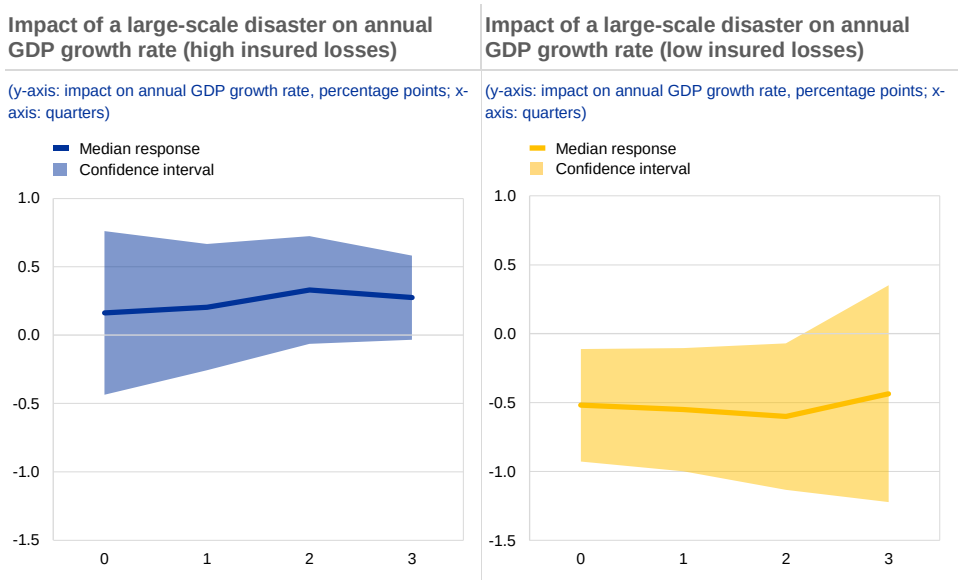
Catastrophe insurance plays an important role in mitigating the negative macroeconomic effects of disasters. First, it enables the economy to recover faster by promptly providing the necessary funds for reconstruction and limiting the period of lower output. The overall welfare costs of a disaster depend not just on the severity of the initial damage but also on how swiftly reconstruction can be completed. The reconstruction phase can be prolonged and may even be incomplete in the absence of sufficient resources, potentially leading to supply chain disruptions (Carter et al., 2007; Islam and Winkel, 2017). Insurers' pay-outs reduce uncertainty and support aggregate demand and investment for reconstruction, which helps to accelerate recovery from disasters. Second, catastrophe insurance can increase resilience by improving the understanding and assessment of climate change risks and promoting risk reduction and adaptation measures. Third, it allows the mutualisation of risks and their transfer to private (re)insurance companies, which can provide expertise and incentives for resilience, efficiency and reliability.

Empirical evidence confirms that the impact of disasters on GDP growth depends on insurance coverage (von Peter et al., 2012; Poontirakul et al., 2017; Fache Rousová

et al., 2021). For example, a large-scale disaster causing over 0.1% of GDP worth of direct losses can reduce GDP growth by around 0.5 percentage points in the quarter of impact if the share of insured losses is low, i.e. below 35% of the total (**Chart 3**). The adverse effect on GDP growth also persists over the subsequent three quarters. However, if a high share of damages is covered by insurance, the indirect impact on GDP growth may be significantly reduced.

Chart 3

Insurance helps to maintain GDP growth after a natural disaster, while uninsured losses are estimated to have an adverse effect on GDP growth



Sources: EM-DAT, Organisation for Economic Co-operation and Development (OECD) and authors' calculations (taken from Fache Rousová et al., 2021).
Notes: The sample includes 45 countries for which the OECD provides quarterly GDP data from 1996 to 2019. Insured and uninsured losses are imputed for most events where data on total damages are available. The values are imputed on the basis of country-specific regression models, where the dependent variable is the share of insured losses in total damages and the explanatory variables include the log of total damage and dummies for eight different types of disaster (drought, earthquake, extreme temperature, flood, mass movements (e.g. landslides), storms, volcanic activity, wildfire) to the extent applicable for a given country. The charts show the impact of large-scale natural disasters (i.e. with total damage larger than 0.1% of GDP, which represents the third quartile of the loss distribution) when the share of insured losses is high (above the median of 35%) (left panel) and low (i.e. below the median of 35%) (right panel). The estimates are obtained using a panel regression model where the dependent variable is the year-on-year difference in the log of GDP and the explanatory variables include two dummies capturing large-scale disasters with a high and low share of insured losses respectively (included with up to three lags) and country and quarterly fixed effects. For the quarter including the date(s) of the disaster (t=0) and the three subsequent quarters, the y-axis measures the percentage point impact of the disaster on the year-on-year annual growth rate at the end of that quarter. Results are robust to the exclusion of earthquakes and volcanic activity events from the sample, although the significance of the estimates decreases, as earthquakes tend to lead to particularly large damages.

However, as insurance coverage is expected to fall with global warming, the future impact of catastrophes may be greater than similar events in the past. Expected annual damages from climate-related catastrophes in the EU and the United Kingdom are estimated to increase from a baseline of 0.17% of GDP to 0.29% in 2050 if global temperatures increase by 2°C on average by 2050 and there are no adaptation or mitigation measures. With this scale of direct losses, the level of GDP could be 3% lower in 2050 in a scenario of no insurance compared to a scenario of full insurance (Fache Rousová et al., 2021).[5] Economic models which fail to account

[5] These estimates rely on the estimated annual damages from climate-related catastrophes in Feyen et al. (2020) based on different representative concentration pathways (RCPs) and empirical analysis by Fache Rousová et al. (2021).

for this mechanism may underestimate the full magnitude of the macroeconomic costs of climate change.

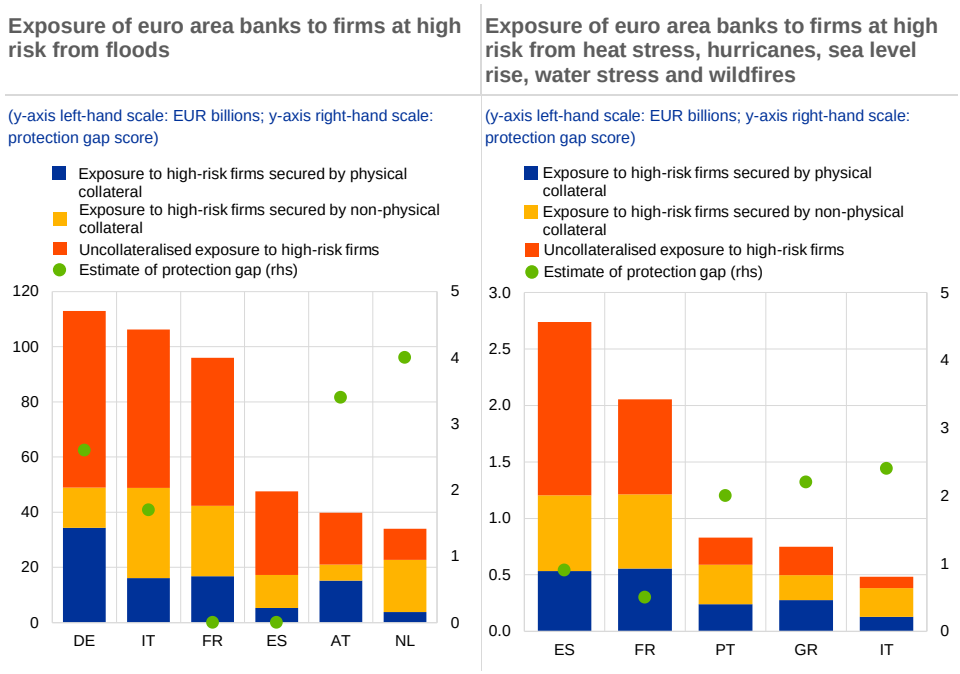
1.2 Implications for the financial system

Natural disasters can be a source of systemic risk for financial institutions and financial markets through two main channels (see Worthington and Valadkhani, 2007; Carney, 2015; IAIS and SIF, 2018; NGFS, 2019; BoE, 2019; FSB, 2020; Alogoskoufis et al., 2021; BCBS, 2021; ECB/ESRB, 2021). First, physical damage of assets can lead to reduced collateral values and/or substantial repricing of loans and securities for financial institutions exposed to high-risk areas. Second, physical risks can lead to supply chain disruptions, which can, in turn, cause large losses for the real economy and on financial institutions' balance sheets. In both cases, a high concentration of key economic activities in high-risk areas can amplify such losses, giving local events wider significance. This can result in a lower provision of credit in high-risk areas and to lower income borrowers, especially from less well-capitalised or less profitable banks (see Garmaise and Moskowitz, 2009; Klomp, 2014; Cortés and Strahan, 2017; Faiella and Natoli, 2018).

Insurance can increase banks' resilience to such shocks by mutualising and transferring collateral and property losses to (re)insurance companies, which are better equipped to manage their climate-related exposures (see ECB/ESRB, 2021; Alogoskoufis et al., 2021). By accelerating reconstruction, insurance can also help to reduce losses from supply chain disruptions. Finally, a lack of insurance may prevent the qualification of some property as eligible collateral, potentially increasing the exposure of banks to credit risk.

Chart 4

The insurance protection gap can increase the exposure of banks to physical risk and reduce the value of collateral



Sources: EIOPA pilot dashboard on insurance protection gap for natural catastrophes, Moody's 427 and ECB calculations (ECB/ESRB, 2022).
Notes: Credit exposures to non-financial corporations (NFCs) above €25,000 are considered; the NFC location used to assign risk levels refers to the head office and the location of subsidiaries of the largest listed firms. Only NFCs domiciled in areas that are classified as high risk, either present or projected, are included. The country breakdown refers to the firm's domicile. The total collateral value at instrument level is capped at the value of the instrument. The protection gap of firms is proxied by the estimate of today's protection gap score of its country and differs across hazards (0 = no risk, 1 = low risk, 2 = low/medium risk, 3 = medium/high risk, 4 = high risk). Left panel: flood risk. Right panel: all other hazards, such as heat stress, hurricanes, sea level rise, water stress and wildfires.

Around 75% of the exposures of euro area banks to firms subject to high or increasing flood risk is uncollateralised or secured by physical collateral that is also exposed to physical risk, i.e. €370 billion (**Chart 4, left panel**). This raises concerns, especially in countries with a large insurance protection gap. The potential losses for banks exposed to high-risk firms (or households) would be significant should extreme floods intensify or hit a large share of those who are vulnerable. The exposure of euro area banks to firms subject to other climate-related hazards – such as heat stress, hurricanes, sea level rise, water stress and wildfires – is much lower, but it is also mostly uncollateralised or secured by vulnerable physical collateral (**Chart 4, right panel**).

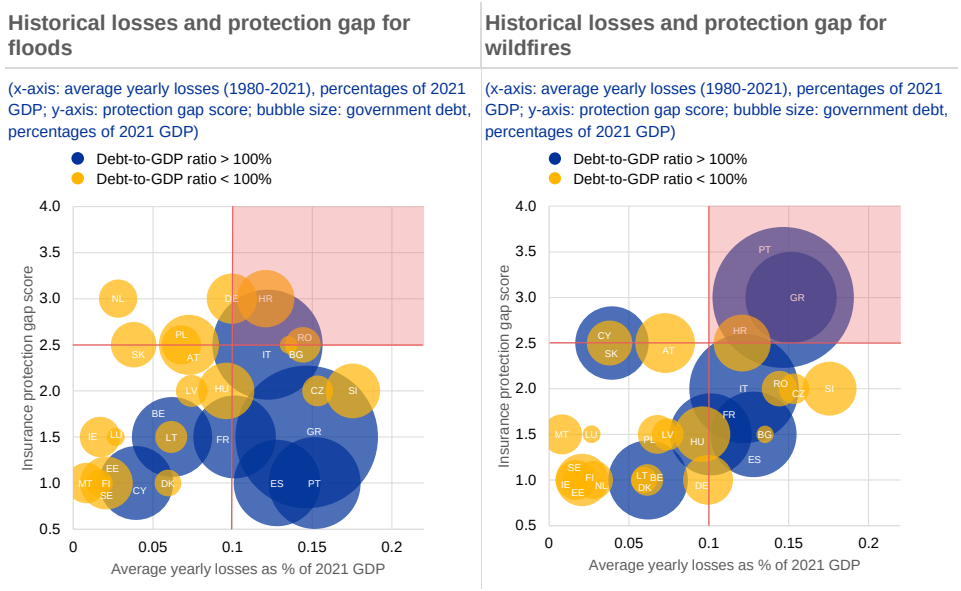
1.3 Fiscal implications

Catastrophe risks can adversely affect a country's public finances and debt sustainability due to: (i) higher fiscal costs following disasters, for example from higher social assistance expenditures and relief payments, and lower tax revenues; (ii) investment needs for adaptation and risk mitigation; and (iii) direct losses on government assets, which can all affect credit quality and debt financing rates (Zenios, 2022). These costs may cause deviations in fiscal outcomes from those that

were forecast (Gamper et al., 2017). A recent analysis by Gagliardi et al. (2022), which simulates the fiscal shocks of natural disasters in 13 EU countries, projects debt-to-GDP ratios to be on average 2.3 and 2.7 percentage points higher by 2032 in 1.5°C and 2°C global warming scenarios respectively.[6] Pressures on fiscal expenditures may also arise in periods of generally lower growth following disasters, as capital is typically absorbed by reconstruction activities rather than new investments. Lower economic growth also reduces government tax revenues. The scale of contingent fiscal liabilities from growing climate-related catastrophes – which are potential liabilities that materialise if catastrophes occur – therefore increases the need for well-designed disaster risk management tools and risk-sharing/transfer mechanisms that can enhance resilience.

Chart 5

Some countries suffering historically high catastrophe losses as a share of GDP also have a large insurance protection gap, which can weigh on debt sustainability



Sources: EIOPA dashboard on insurance protection gap for natural catastrophes, EEA, Eurostat, ECB GFS and ECB calculations.
Notes: The x-axes refer to the average yearly losses (data from the EEA) from floods and wildfires respectively between 1980 and 2021 relative to GDP (data from Eurostat). The size of the bubble is proportional to the country's debt-to-GDP ratio. The y-axes refer to EIOPA's estimated protection gap score, ranging from 0 to 4 (0 = no gap, 1 = low, 2 = medium, 3 = high, 4 = very high). Each protection gap score is country and peril-specific. The red shaded areas indicate countries with both a high protection gap and high average losses, the thresholds for which are set at a protection gap score of 2.5 out of 4 and 0.1% of GDP respectively.

In this context, insurance coverage can help to mitigate fiscal pressures from disasters, especially for countries with high physical risk (Melecky and Raddatz, 2011). When most losses are uninsured, governments typically finance recovery and reconstruction activities, which increases sovereigns' gross financing needs or leads to a sub-optimal allocation of public funds.[7] Expectations of such unconditional government support after disasters can also create moral hazard and lower

6 See European Commission (2022).

7 In 2021, summer floods hit central European countries causing damages totalling €46 billion, of which only €11 billion was insured. Germany responded by committing up to €30 billion to fund reconstruction efforts (see Federal Ministry of Finance, 2021).

incentives for households and firms to adapt and reduce their vulnerability to climate-related catastrophe risks, thereby worsening the losses suffered during disasters.

Climate-related catastrophes are also likely to have asymmetric effects on the fiscal stability of European countries, as economies differ significantly in their climate risk exposures, vulnerabilities and resilience. Some countries suffering high historical losses from disasters (relative to GDP) also exhibit a large insurance protection gap (red shaded areas in **Chart 5**). Among these countries, some have a high debt-to-GDP ratio, which can reduce their fiscal space to respond to disasters in the absence of well-designed risk management tools.

2 Potential policy measures to reduce the climate insurance protection gap – the ladder approach

In light of the negative economic implications of the climate insurance protection gap, this section explores potential policy measures to tackle this gap and mitigate catastrophe risks from climate change by means of enhanced insurance coverage and adaptation measures. These measures are designed, as a minimum, to:

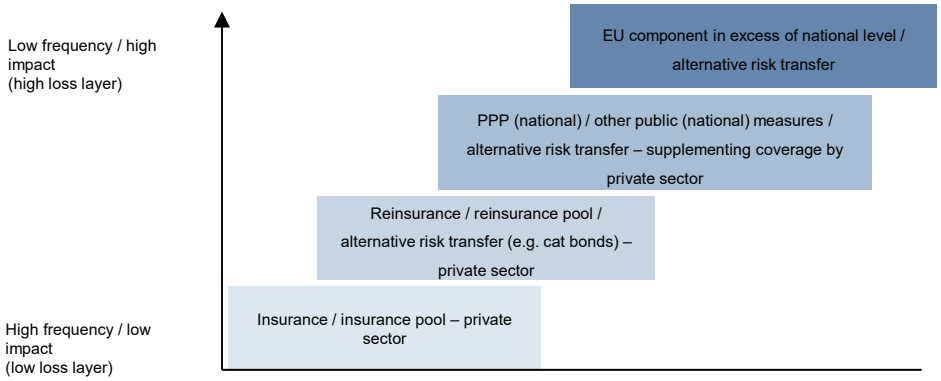
- help to provide prompt insurance claim pay-outs in the aftermath of a natural disaster;
- incentivise risk mitigation and adaptation measures;
- be complementary to existing insurance coverage mechanisms;
- require the sharing of costs and responsibilities across the relevant stakeholders to ensure “skin in the game” and reduce moral hazard;
- lower the share of economic losses from major natural disasters borne by the public sector over the long term.

While it is important to increase insurance coverage from current levels, this may not be sufficient to tackle the protection gap sustainably. As climate change is expected to increase the frequency and severity of extreme events, insurance coverage will probably continue to become more expensive and/or less available. An increase in insurance should therefore happen in tandem with measures that can help mitigate the underlying risks, especially as some risks might prove to be uninsurable.

This discussion paper uses the term “ladder approach” in the context of indicating the share of losses from natural disasters borne by various parties at different loss layers (**Figure 1**).

Figure 1

The ladder approach to catastrophe insurance



Source: Authors.

Primary insurers who sell policies to individuals and businesses tend to operate in low to moderate loss layers that are characterised by relatively high-frequency, low-impact events. They are typically either unable or unwilling to bear the full magnitude of losses from low-frequency, high-impact events such as natural disasters[8] (high loss layer). They cede residual risks from these types of events to reinsurers, who operate in a global reinsurance market to diversify across geographies and achieve economies of scale. Additionally, some reinsurers buy reinsurance from other reinsurers (retrocession), which provides further diversification. Alternative risk transfer mechanisms such as cat bonds are also used to spread the residual risks to a broader set of capital market investors.

However, modelling and insuring losses becomes more challenging, even for reinsurers, in the case of extreme events that are very rare but can cause very substantial economic damage when they occur. At such very high loss layers, the traditional model of reinsurance starts to reach its limits, causing reinsurers to either charge very high premiums or stop underwriting catastrophe risks altogether ("hard market"). This has a knock-on effect on primary insurers and policyholders – they must either pay a very high premium or bear the risk themselves (retention). As such, climate-related risks may not be sufficiently insured by the private sector, and this problem is expected to worsen with global warming. Public sector intervention may then become necessary to supplement the insurance provided by the private sector.

The ladder approach builds on the existing frameworks of private insurance and public sector intervention at the national level. It is aimed at making the private sector more resilient to climate-related catastrophes. PPPs at the national level can play an important role by facilitating and incentivising risk mitigation and adaptation measures, while promoting broad-based insurance coverage. The ladder approach

[8] Property insurance contracts in Europe are often multi-risk and cover all or a subset of weather-related perils (EIOPA, 2022). Actual coverage and market practices differ between countries, including within Europe. For instance, in some countries, storm/hail, flood and/or wildfire coverage may be included in property insurance contracts by market practice or by law, while in others this may not be the case. In addition, insurance policies can offer insurance protection for all or only a subset of property-related losses (i.e. building, content and business interruption-related losses).

also makes the case for possible coordination of public sector efforts at the EU level in order to manage the residual risks in excess of planned capacity at the national level. The purpose of these approaches is not to provide unconditional taxpayer-funded financial guarantees for uninsured losses but to enhance efficiency in the way public funds are used and reduce moral hazard relative to the typical status quo of unconditional and sometimes poorly targeted government support after disasters. Over time, this should help ensure that private insurance markets continue to function in an orderly manner in the face of climate change induced risks and reduce the need for government financial intervention. Ex ante clarity from the government about its role in compensation of damage is important for private insurance markets to be effective. Moreover, increased insurance uptake and more resilient private insurance markets should translate into a lower share of economic losses borne by the public sector.

2.1 Layer 1: Low to moderate loss layers: potential measures to enhance private insurance and impact underwriting

While further insurance penetration is beneficial and desirable, insurance provision should be carefully designed to ensure that it encourages adaptation and reduces vulnerability to climate-related catastrophes over time. Insurers should provide incentives for risk reduction and adaptation by, for example, promoting risk awareness and providing risk-based incentives linked to premiums (see Linnerooth-Bayer et al., 2019). Enhanced coordination between the public and private sectors in relation to risk assessment practices and standards would also be helpful. While directly reducing preventable damages from catastrophes and increasing resilience, such measures would also support insurability and help to limit the risk of a widening insurance protection gap.

Impact underwriting is an underwriting and pricing strategy aimed at incentivising the policyholder to implement ex ante (structural) measures and reduce exposure to climate-related hazards.[9] The price of insurance and the contractual terms and conditions under which insurance is offered are strong signals of the level of risk. Therefore, risk-based incentives linked to premiums help enhance the awareness of policyholders of current vulnerabilities. And premium discounts can provide incentives to implement adaptation and mitigation measures that minimise physical risk exposure to climate-related hazards. For example, premium reductions could be associated with homes meeting certain standards with respect to flood-proofing in flood-prone areas or protection against storms, and with the use of real-time weather data and alert systems in relation to crop insurance. The cost of implementing the risk reduction measure could be compensated by a lower premium.

Integration of climate adaptation measures in insurance products requires not only innovative product design but also coordination between insurers and public authorities. For example, standardisation of risk assessment practices can help in the recognition of adaptation measures in insurance contracts. Similar approaches

[9] See EIOPA (2021a).

exist in the US insurance market, for instance on the basis of the FORTIFIED programme of the Insurance Institute for Business and Home Safety (IBHS), which provides recommendations on climate-related risk prevention measures related to wind, hail and wildfire risks.[10] In the US, the National Flood Insurance Program (NFIP) offers lower premiums when flood mitigation measures are in place, and in some states policyholders can obtain premium discounts on their property insurance if the property meets certain standards.

Affordability and accessibility alone may not be sufficient to ensure high levels of private insurance coverage against catastrophes. Behavioural traits, information availability and the way insurance is sold significantly influence consumer demand for insurance. In particular, a lack of policyholder awareness about climate change and related adaptation measures is a key factor influencing the demand for corresponding insurance products.[11] Climate-related risk awareness could be raised by, for example, dedicated information campaigns targeted at individual policyholders, ideally incorporating granular information about the effects of climate change on the policyholder's risk exposure at a local level. Information campaigns or web-based tools could also be used to raise awareness about adaptation measures and their potential effectiveness in risk reduction.

2.2 Layer 2: Higher loss layers: potential measures relating to reinsurance and catastrophe bonds

Reinsurance

Reinsurance plays a key role in managing risk from low-frequency, substantial-impact events such as hurricanes, wildfires and major floods ("high loss layer"). Diversifying such risks becomes progressively more challenging at higher loss layers. Large reinsurers often diversify across geographies and exploit economies of scale to access and utilise capital more efficiently. Some reinsurers purchase their own insurance from other reinsurers (retrocession). Bilateral agreements between (re)insurers can become extremely complex, involving a combination of various types of reinsurance (e.g. proportional vs non-proportional).[12]

One criticism of the non-life insurance and reinsurance industry is that the contracts for risks such as catastrophe risk (and other non-life risks in general) are structured and priced annually. While this feature shields (re)insurers from the effects of material mispricing of risk, it also does little to encourage the incorporation of climate change considerations into the design and pricing of reinsurance because there is always the "short cut" of adjusting the premium after one year. Long-term insurance contracts, which provide a guaranteed price (or guaranteed ceiling and floor price) over a term from 3 to as much as 25 years, could significantly foster adaptation by

[10] See "FORTIFIED Solutions", IBHS and "Regulatory Framework for FORTIFIED Insurance Incentives", IBHS.

[11] See EIOPA (2023).

[12] Proportional reinsurance involves compensation to the reinsured in proportion to their losses, whereas non-proportional reinsurance, such as stop-loss reinsurance, compensates the reinsured beyond a specified level of loss (but up to a limit).

providing greater incentives for the insured to invest in cost-effective property-level resistance and resilience measures (Maynard and Ranger, 2012). In practice, however, there are potential trade-offs associated with multi-year non-life insurance contracts.[13] Such contracts could decrease flexibility and choice for customers, because customers would not easily be able to renegotiate contracts or switch to an alternative (re)insurer. They may also increase the risk of insolvency of (re)insurers and add to the complexity of catastrophe risk modelling. Without the possibility to reprice the contracts annually, (re-)insurers are likely to charge higher premiums at the outset to absorb such risks.

Alternative risk transfer – catastrophe bonds

The chain of risk transfer from insurers to reinsurers helps to improve insurability in high-risk areas and reduce the volatility of insurance pay-outs. However, at the highest loss layers, the cost of capital required to cover the exposure may simply become uneconomical for private institutions. Cummins and Trainar (2009) argue that for such risks, issuing equity shares may not be the best way to access the capital markets. This is where alternative risk transfer mechanisms such as insurance-linked securities (ILS) can be useful.

(Re)insurers often use alternative risk transfer mechanisms that tap capital from sources other than the company shareholders (traditional reinsurance) to bolster their risk-bearing capacity. Cat bonds are a type of ILS that transfers insurance risk to capital market investors. (Re)insurers typically use cat bonds to manage exposure to very low probability, high-impact events. Investors put up capital when buying these securities and bear the insurance risk in exchange for a coupon. If the covered event occurs, investors stand to lose all or part of the amount paid upfront. Like other forms of securitisation, such as mortgage-backed securities (MBS) that pool mortgage loans in a special purpose vehicle (SPV), a cat bond also pools investors' capital in an SPV. While the income paid to investors from an MBS is linked to the credit risk of the mortgage borrowers, in the case of a cat bond it is linked to the modelled expected loss from the insured event. A given issuance of a cat bond can have multiple tranches, each with a different level of expected loss and corresponding income level for investors. The counterparty default risk in a typical cat bond transaction is virtually zero, because the paid-up capital is held in a secure collateral account. This contrasts with a traditional reinsurance contract, which carries the risk that the reinsurer might be unable to pay claims if the insured risk materialises in the future.

Cat bonds offer several benefits to both investors and (re)insurers. They allow catastrophe risk to be transferred to a wider set of investors, thereby diversifying (re)insurers' sources of capital. Unlike traditional non-life insurance, cat bonds are typically structured to provide cover over multiple years, which can help to deliver some of the benefits mentioned above. Using a combination of traditional reinsurance and cat bonds can also lower the overall cost of coverage for (re)insurers, as higher loss layers are likely to be more expensive to reinsure through traditional reinsurance alone (Trottier and Lai, 2017). This is because when the

[13] See EIOPA (2021a).

magnitude of potential losses and the correlation among risks increases, the cost to the sponsor of holding an adequate amount of capital (or buying reinsurance) to cover the catastrophe exposure may be higher than the premium demanded by investors in cat bonds (Cummins and Trainar, 2009).[14]

Investors in cat bonds benefit from low correlation with equity and credit markets. As such, cat bonds can provide useful diversification, particularly during episodes of crisis and high market volatility (Demers-Belanger and Lai, 2020). Investors in the environmental, social and governance (ESG) space are also turning to cat bonds as an instrument for impact investment – an investment strategy aimed at generating social or environmental benefits while delivering financial gains. For example, investors in cat bonds intermediated by the World Bank to enhance resilience against natural disasters in lower income countries include pension funds, insurers and other institutional asset managers. Furthermore, collateralised assets from several cat bonds have been invested in green initiatives. Cat bonds can therefore potentially combine impact underwriting with impact investment. **Box 1** discusses further details about the market that help to motivate potential policy measures.

On the other hand, capital market investors can be opportunistic about buying cat bonds and may not be a reliable source of capital over the long term. Certain conditions could trigger a sudden retreat of investors. These include an increase in interest rates, which would diminish search-for-yield behaviour, underestimation of underlying risks by either party or any situation that is not favourable to a "quick-entry, quick-exit" model. By contrast, traditional reinsurers, who typically place more emphasis on relationships with their counterparties, are more likely to keep providing reinsurance capacity across market cycles. Furthermore, the success of cat bonds as an asset class relies on well-functioning securitisation arrangements and linkages with financial market participants outside the (re)insurance sector. These linkages can be a potential vulnerability in times of financial market distress.

Box 1
A closer look at the cat bond market

Despite the potential benefits for both (re)insurers and investors, cat bonds are not an easy substitute for traditional reinsurance, especially in Europe. The market for cat bonds started to develop in the mid-1990s in the aftermath of Hurricane Andrew (1992). That period witnessed a decline in the supply of reinsurance and an increase in premiums – conditions referred to as a "hard market". High insured losses compelled (re)insurers to re-examine their catastrophe risk exposures and consider alternative forms of reinsurance, including cat bonds. Subsequent hard markets in 2002 and 2006, following the 9/11 attacks and hurricanes Katrina, Rita and Wilma respectively, also saw increased issuances of cat bonds. The market has continued to grow materially in terms of size and the variety of risks covered, but has remained largely dominated by issuances covering US-based perils. To put the market size in perspective, cat bonds had USD 35.5 billion in capital outstanding at the end of 2022, compared to USD 467 billion in traditional reinsurance capital at the end of August 2022.

[14] The "sponsor" is the party that cedes the insurance risk. This is different from the SPV, which is set up by or on behalf of the sponsor and is the issuer of a cat bond.

The process of issuing a cat bond involves obtaining an independent assessment of the risks being covered by the bond. This is important for investors because it mitigates the concern that the sponsor will underwrite excessive risk or have better information on the risk. A positive externality of this process is easier access to pricing and risk data for industry outsiders, who can analyse such data to obtain insights into catastrophe risk pricing. In the traditional reinsurance market, this information is only available to market participants such as underwriters and brokers. This process also means that the risks that have better coverage by risk modelling service providers and represent sizeable insurance markets around the world (e.g. US windstorms, US earthquakes and Japanese earthquakes) tend to feature most prominently in cat bond transactions. European perils still represent a relatively small portion of bonds currently outstanding. Part of the reason for this lies in the high transaction costs involved in executing a cat bond transaction, which inter alia involves setting up a special purpose vehicle (SPV), hiring an independent risk modelling agent and marketing securities.

In recent years, several bonds covering catastrophe risks in certain lower-income countries have been placed successfully in the market. These bonds are intermediated by the World Bank, which leverages its expertise to make the reinsurance and capital markets accessible to countries with limited direct access to insurance. Strikingly, World Bank intermediated cat bonds have been priced more favourably (for sponsors) than other outstanding cat bonds – meaning that issuers had to pay a lower reinsurance premium per unit of expected loss.[15] Since these bonds cover risks in less-developed countries with more limited access to international reinsurance markets, this seems contradictory to the notion of well-modelled risks in large insurance markets dominating the cat bond market. There are several reasons for this:

- The perils covered by World Bank cat bonds are exotic (i.e. not the typical ones which are dominated by US perils) and therefore provide even more diversification to investors than other cat bonds.
- World Bank cat bonds are mostly parametric – meaning that pay-outs are triggered on the basis of a parameter reaching a threshold value (e.g. windspeed in a windstorm), irrespective of the actual damage caused. Such instruments require less expertise in determining the claims pay-out compared to indemnity triggers. They also reduce the chances of investors' capital being "trapped" for prolonged periods due to disputes between the (re)insurer and the (re)insured. Parametric insurance, however, may not have the intended benefit if a substantial loss event occurs while the parameter thresholds for triggering pay-outs are marginally missed.
- Repeated transactions over time with consistent terms and conditions can lower issuance costs and make it easier for investors to assess the risk-reward balance. An experienced issuer that is well recognised in the market may be able to influence the issuance spread in its favour.

While this discussion illustrates how the various characteristics of a cat bond may be customised to strike an equilibrium between the preferences of the sponsor and the investor, it also underscores its role as a risk transfer mechanism that is complementary to, and not a substitute for, traditional (re)insurance.

[15] See Financial Protection Forum (2021).

Potential measures for greater and more effective use of cat bonds in both the private and public sector

Policy measures could be undertaken at both national and EU level to foster greater and more effective use of cat bond markets in both the private and public sector, thereby helping to reduce the climate insurance protection gap.

Issuing a cat bond in Europe is currently expensive and the process of setting up an ILS vehicle is more cumbersome than in some non-European jurisdictions. Despite the higher issuance costs, some well-known (re)insurers in the EU/European Economic Area have, however, chosen to issue cat bonds via SPVs domiciled in Ireland, thereby benefitting from being in a Solvency II jurisdiction. Among other things, this simplifies the calculation and reporting of capital requirements for Solvency II (re)insurers.

Public authorities in the EU could consider measures that help to foster a more vibrant cat bond market for the private sector. Some governments outside the EU have already taken concrete steps to attract issuers of cat bonds to their jurisdictions. For example, in 2021 the Bermuda Monetary Authority (BMA) amended the licensing and registration process for entities looking to issue ILS such that it can be completed within three business days.[16] In 2021 the Insurance Authority of Hong Kong announced a two-year pilot scheme to incentivise insurance companies to issue ILS in Hong Kong.[17] Among other things, the Hong Kong scheme offers a grant to cover the upfront issuance costs for eligible ILS. Similarly, in 2021 the Monetary Authority of Singapore (MAS) announced a grant scheme covering issuance costs for qualifying ILS.[18]

Cat bond issuance by the public sector has been increasing over time, along with the number of countries that participate in issuance.[19] A prominent example is the California Earthquake Authority (CEA), a local state agency that underwrites residential earthquake risks in the United States and has established itself as a well-recognised issuer in the cat bond market. As discussed further in **Section 2.3**, PPPs may be able to pool residual risks at higher loss layers more efficiently than the private sector. They may then be able to securitise part of this pool in the form of cat bonds. While a cat bond issued by a national PPP would typically cover risks that are limited geographically to the Member State concerned, a platform at the EU level could be used to identify securitisation opportunities to pool residual risks from multiple national PPPs. This could be made possible by improving the exchange of information on catastrophe risks and combining expertise on underwriting and placement of securities at the EU level. Evidence from World Bank intermediated cat bonds (see **Box 1**) also suggests that multi-country cat bonds issued on a repeated basis would probably benefit from, among other things, lower overall operational and issuance costs relative to individual single-country issuances. Over time, data on catastrophe modelling and the pricing of risks gathered as part of issuing cat bonds

16 See BMA (2021).

17 See Insurance Authority of Hong Kong (2021).

18 See MAS (2021).

19 See Ando et al. (2022).

could also help to drive efficiencies in future issuances and inform policymaking on natural disaster risk financing at the national and European level.

Cat bonds issued by the public sector at the national level could also serve as an investment option for funds pooled as part of any EU-level measures (see **Section 2.4**), provided they meet the criteria for these funds. If and when such a bond is triggered following a major natural disaster, the principal amount could be made available for pay-out promptly. Otherwise, the investment earns a coupon. The overall market for cat bonds would also benefit from such transactions.

2.3 Layer 3: National measures – the role of the public sector

2.3.1 Public disaster risk management measures

Given the potentially significant macroeconomic, financial stability and welfare consequences of natural disasters, especially when insurance coverage is limited, there is a two-fold role for public sector intervention. First, the public sector can contribute to decreasing the insurance gap by helping to enhance private (re)insurance coverage beyond current levels. Second, the public sector can prepare itself better for the risks stemming from the uninsurable part of the insurance gap. Both roles may become increasingly important as global warming leads to more frequent and severe climate-related catastrophes, and the approach of the public sector to managing disaster risk can be crucial in influencing resilience.

Currently, public support is often provided via emergency relief agreed after a disaster has struck. Governments typically increase taxes, reallocate funds from other budgeted activities and/or issue bonds to raise the financial resources that are needed to repair public infrastructure and support affected households and firms.[20] Such ex post government relief can create uncertainty for households and firms who may be unsure about when or whether they will receive support, with possible adverse macroeconomic consequences. Since it is typically unconditional, such relief can also create moral hazard as it does not provide incentives to households and firms to adapt and reduce their vulnerability to catastrophe risks.

The public sector can prepare for these contingent liabilities by enhancing its ex ante disaster risk management strategy. This can include supporting ex ante contingent financing and risk transfer by, for example, creating national reserve funds, working with the private sector to establish public-private insurance schemes that pool and diversify risks (see **Section 2.3.2**) or exploiting capital market products that transfer part of the risk to investors. Such approaches can ensure timelier, more certain access to funding after disasters. In addition, they may be more efficient and better targeted than ex post disaster relief if they foster and leverage strong cooperation with the private (re)insurance sector, thereby potentially also helping to address and

[20] In some cases, particularly in less-developed countries, the international community provides assistance through specific loans and aid (e.g. from the World Bank). In the EU, countries can also apply to the EUSF for grant funding after natural disasters, as discussed further in Section 3.4.

limit the distributional impact of catastrophes within countries. They may also increase incentives for firms and households to adapt, by requiring gradual risk reduction and adaptation measures that would help lower prospective losses when a disaster strikes, thereby also limiting moral hazard (see Box 2). As such, ex ante public sector disaster financing approaches may be able to provide timelier, more efficient relief for the same, or possibly even lower, fiscal share in the total outlay compared to continuing with the status quo.

From a fiscal perspective, the choice between ex ante and ex post instruments also involves a trade-off between providing one-off fiscal support after a disaster has struck, which has a sudden impact on public finances, and providing or subsidising insurance, which entails upfront investment. The magnitude of ex post fiscal support depends on the costs of catastrophes. In Europe, in the past these costs have typically been small relative to GDP, but with heterogeneity across countries and years (see **Section 1.1**). More severe catastrophes in the future could have the potential to affect some countries' solvency and liquidity abruptly, with possible implications for the accessibility and cost of sovereign financing.

Fiscal authorities should plan for the contingent liabilities related to the physical risks from climate change (OECD, 2017 and 2021).[21] To help governments gauge the possible future budgetary risks from climate change, the scenarios used for debt sustainability analysis (DSA) in the EU should be augmented to include climate risks and to reflect macroeconomic projections that consider region-specific physical risks, as also highlighted by the European Commission (2022).[22] According to these stylised stress tests, for selected EU Member States and in the context of the European Commission's standard DSA risk framework, there is a need to adopt mitigation and adaptation policies, including insurance and climate-resilient debt instruments, to boost countries' financial resilience to climate change and dampen the potential fiscal impact of climate-related events in the long term.

More generally, countries should develop their fiscal frameworks to identify and account for the costs of natural disasters, adaptation and mitigation in order to make informed trade-offs. This requires better information and data and improved governance and management of climate risks.[23] Pro-active measures on the vulnerability of buildings, planning rules that determine the location of exposures and climate change-resilient public investments are also likely to be important elements of a resilient society. This may also include (potentially highly contentious) discussions about managed retreat from particularly exposed areas.

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21 See, for example, Aligishiev et al. (2022).

22 For a conceptual framework on how to include climate change effects on growth and public finances in public debt sustainability analysis, see European Commission (2020a).

23 Initiatives to improve climate-related governance standards include the Task Force on Climate-related Financial Disclosures, which is supported by many companies and central banks, but only a few EU Member States. The Inter-American Development bank has developed an Index of Governance and Public Policy in Disaster Risk Management for Latin American countries.

2.3.2 Public-private partnerships

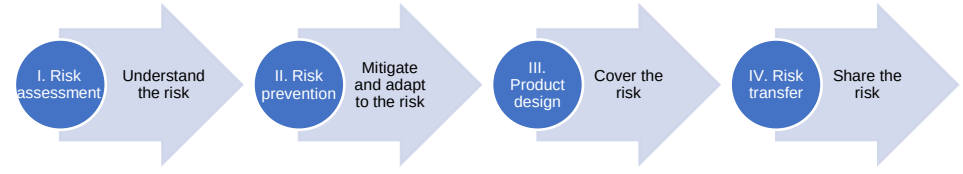
PPPs are insurance schemes which provide government financial support that supplements the losses insured by the private sector. They can support the overall functioning of the insurance market by providing additional coverage either via direct insurance or by indemnifying a private (re)insurer against extraordinary events.

PPPs are already in place in some European countries to manage particular disaster risks (see **Table 1**). For example, Caisse Centrale de Réassurance (CCR) in France provides reinsurance for natural disaster-related risks. The coverage must be included in all property insurance policies. But to be eligible for compensation via the scheme, the damage must be covered by private property insurance to begin with. Thus the scheme relies on the insurance industry network to ensure widespread coverage. Similarly, Consorcio de Compensación de Seguros (CCS) in Spain provides cover for catastrophe risks which is mandatorily linked to the valid taking out of an insurance policy (typically from private insurers) in certain lines of business. Such mandatory inclusion of catastrophe risks is often a key element of public and/or PPP insurance schemes.

Mandatory insurance coverage, which is the requirement for everyone to insure against catastrophes, and/or the mandatory offer of cover, which is a requirement for insurers to offer catastrophe cover alongside, for example, property insurance, entails certain trade-offs. It can help to improve insurability in high-risk areas via mutualisation. Limiting the scope of coverage may lead to the very gaps that such a scheme aims to address. On the other hand, mandatory insurance schemes supported by the public sector may turn out to be regressive and end up subsidising development in hazardous locations and increasing residual risk (Owen and Noy, 2019) (see **Box 2**). In addition, without appropriate safeguards, improved affordability of catastrophe insurance may disincentivise risk reduction and adaptation measures. For example, the National Flood Insurance Program (NFIP) in the United States requires properties in high-risk flood areas to have flood insurance for mortgages from government-backed lenders. Until 2021 the NFIP charged the same amount for insurance, regardless of the value of the property and the share already insured privately. The Federal Emergency Management Agency (FEMA) then adjusted this mechanism to ensure that insurance prices reflected risks at the individual building level, thereby strengthening incentives for risk reduction.

Figure 2

Elements of a shared resilience solution



Source: EIOPA (2020).

The design of PPPs should consider the four elements of a shared resilience solution: (i) risk assessment, (ii) risk prevention, (iii) product design and (iv) risk

transfer (**Figure 2**).[24] This implies that certain steps should be considered before deciding on the specifics of risk-sharing arrangements. First and foremost, a sound understanding must be developed of the underlying risks, for instance via enhanced sharing of information on catastrophe risk modelling. Second, pro-active measures for risk mitigation and adaptation should be preconditions for public sector involvement. Third, the insurance products should be designed in a manner that is easy for the policyholder to understand and provide the appropriate coverage at an affordable premium.

As such, PPPs should do more than just provide a financial backstop. They should ensure that the costs and responsibilities associated with having a resilient catastrophe insurance coverage programme are shared between the public and private sectors, with "skin in the game" retained for the latter. Furthermore, policyholders should also retain part of the risk to mitigate moral hazard, or could alternatively be offered reduced premiums in return for implementing risk mitigation measures.

Table 1

Indicative classification of natural catastrophe insurance arrangements in European countries

National property insurance schemes covering residential and commercial assets for coastal floods, river floods, wildfires and windstorms

	Voluntary private market	Semi-voluntary private market	Mandatory private market	Semi-voluntary PPP market	Mandatory PPP market
Premium type	Risk-based	Flat Risk-based	Flat	Flat Risk-based	Flat
Insurance coverage	Voluntary	Voluntary	Mandatory	Voluntary	Mandatory
Mortgage insurance coverage	Voluntary	Mandatory (by banks)	Mandatory (by law)	Mandatory (by banks)	Mandatory (by banks)
Present in…	Austria, Italy, Finland	Most EU countries (across central, southern, and eastern Europe)	Liechtenstein	Spain, Denmark	France

Sources: EIOPA dashboard on insurance protection gap for natural catastrophes and ECB calculations.
Notes: "Risk-based premiums" reflect the insured risk, while "flat premiums" refer to premiums set as a fixed percentage of the total value insured (see the Technical Description of the EIOPA dashboard on insurance protection gap for natural catastrophes). Schemes covered are for both commercial and residential assets and for coastal floods, river floods, wildfires and windstorms. An initial division into insurance scheme clusters was obtained by running k-means cluster analysis on a sample of 157 national schemes and related information retrieved from EIOPA's dashboard. To allow such analysis, only national schemes without any missing information for any of the categories were considered, thus reducing the initial sample of 224 schemes (as included in the dashboard) to 157. Only EU countries' national schemes were included in the analysis, plus Liechtenstein to provide an example of the mandatory private market category. In the dashboard, each national scheme is specified by country (EU Member States plus Liechtenstein), by each of the four perils and by type of asset (commercial or residential) – obtaining a matrix of 28 x 4 x 2. Inspired by Tesselaar et al. (2020).

[24] See EIOPA (2020).

2.4 Layer 4: EU-level measures

A possible European insurance component

Approaches to disaster risk management vary significantly across EU countries (**Table 1**). This partly reflects the varying geographical and climatological characteristics of Member States, which leaves them exposed to different climate-related perils (e.g. coastal floods, river floods, wildfires and windstorms). This leads to a historically weak cross-country correlation of large climate-related disasters, which rarely affect multiple EU countries at the same time.

Given this, there may be diversification and risk pooling benefits that could be exploited at the EU level, especially in relation to very large disasters. In particular, a strengthened European fiscal component for natural disaster relief could complement national insurance schemes by making financial assistance for reconstruction available to Member States following large, infrequent disasters. Such an approach could help to close the climate insurance protection gap further, while also providing incentives for Member States to enhance national insurance coverage and pursue risk mitigation, including adaptation and mitigation measures. By helping to tilt the scales further towards ex ante disaster risk solutions, an EU-wide scheme could even reduce the overall share of expenditure in relation to climate-related catastrophes borne by the public sector compared to the status quo of mostly national-level emergency post-disaster relief.

The EU currently provides only limited disaster relief, which is not specific to climate-related events, in the form of the EUSF. Member States can request some financial assistance for emergency relief and reconstruction from the EUSF for non-insured damages following major disasters[25], but pay-outs are small compared to the overall costs of such events. Initial pay-outs following a disaster are capped at 25% of the total envisaged contribution and may not exceed €100 million per Member State. Between 2002 and 2021, the EUSF has, on average, covered 15% of the costs of eligible emergency operations[26] and 3% of total direct damages across all covered disasters. The EUSF's current annual budget is around €500 million, which can be carried over if unused or advanced if exhausted, but it fell under the 2021-2027 multiannual budget agreement, even though the EUSF's scope was simultaneously broadened to cover public health emergencies.[27] This makes it difficult for the EUSF to meet current demands,[28] especially given recent large climate-related catastrophe costs incurred by several European countries. For example, the summer 2021 flood disaster cost Germany alone more than €40 billion, adding to the €35 billion already borne by the country after the 2018 and 2019 summer heatwaves and droughts (see Prognos, 2022). This imbalance between demand and maximum pay-out of the EUSF is likely to become even more evident as the frequency and severity of

[25] Major disasters are defined as disasters incurring direct damage above €3 billion in 2011 prices, or 0.6% of gross national income (GNI), or 1.5% of a NUTS 2 region's GNI. See Council Regulation (EC) No 2012/2002 of 11 November 2002 establishing the European Union Solidarity Fund (OJ L 311, 14.11.2002, p. 3).

[26] Determined under Council Regulation (EC) No 2012/2002.

[27] See European Commission (2023).

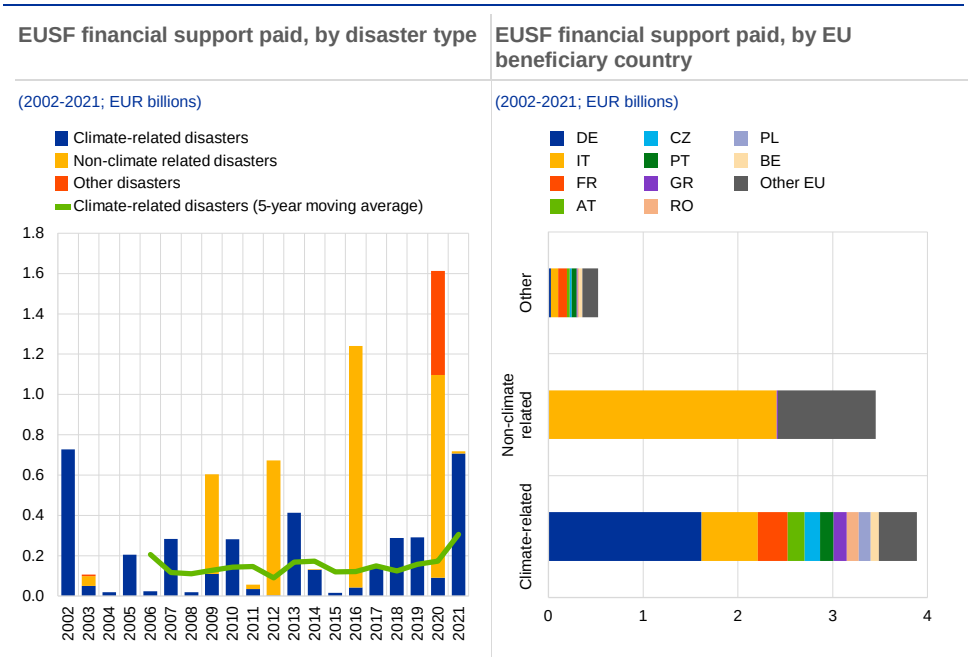
[28] ibid.

climate-related catastrophes rises with global warming. In addition, as the EUSF is designed purely as a solidarity tool, it does not provide any incentives to take preventive measures – such as requesting adaptation or disaster risk management measures from national governments (see Hochrainer-Stigler et al., 2017).

Despite the EUSF's limitations, it has enjoyed broad uptake among EU Member States. Overall, of the 121 accepted applications submitted by EU countries since 2002, 73% have been climate-related (with floods accounting for more than 50% of all applications), 15% have been related to public health emergencies and 12% have been related to earthquakes or volcanic eruptions. Notably, the amount of funds allocated to climate-related catastrophes has been increasing recently (**Chart 6, left panel**). Such funds have also benefitted 25 different Member States, with Germany being the top recipient (**Chart 6, right panel**), underlining the relevance of disaster relief for major climate-related catastrophes events across most EU Member States.

Chart 6

Accepted applications to the EUSF for climate disaster relief have increased recently and are spread across the EU



Sources: EUSF data and ECB calculations.
Notes: Both panels cover only the 121 accepted applications submitted by EU countries (all countries except Denmark and Finland) between 2002 and 2021 to the EUSF. "Climate-related disasters" include floods, storms, wildfires and droughts; "non-climate-related disasters" include earthquakes and volcanic disasters; "other disasters" include health emergencies and one man-made disaster (the November 2022 Prestige oil spill off the Spanish coast).

A strengthened European fiscal component for climate-related catastrophe insurance would be beneficial for several reasons. First, while observing the EU principle of subsidiarity, it would be more cost-efficient to pool risks and provide some of the financing at the European level rather than entirely at the national level, given that infrequent large climate-related disasters display weak correlation across EU Member States and across time, and future economic damages from such disasters are highly uncertain. Second, it could provide funding where acute relief and reconstruction costs (including adaptation costs) would otherwise very severely

stretch national private and public financing capacity. Third, it could add value when compared with current EU disaster relief instruments via, for example, greater financing power, insuring new risks or providing support on different terms. In particular, if sufficiently attractive and large enough to provide credible incentives, the European fiscal component could have a transformative power above and beyond its financial firepower by making access to funding conditional on specific requirements, such as strengthening private and public sector catastrophe insurance at the national level or meeting certain risk management, mitigation or adaptation standards. This would ultimately help enhance the insurability of damages from climate-related disasters and, moreover, minimise associated economic costs and possible negative spillovers among EU Member States.

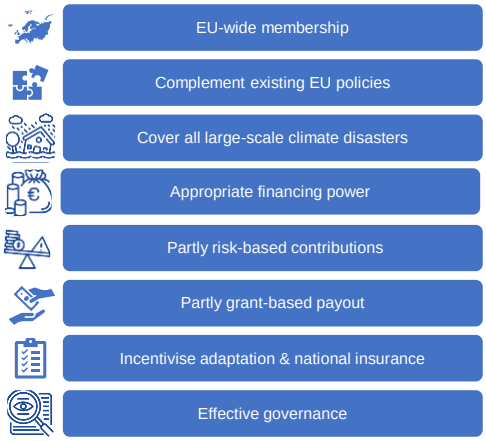
At the same time, differences in the risk profiles of Member States, owing to geographical factors and divergent risk management practices, make the creation of a European fiscal component challenging, from both an operational and a political perspective. While pooling risks would enhance risk diversification as discussed above, it may imply some permanent transfers between regions or countries, and this should be considered in the design and financing structure of any EU fund.

Key principles for a public European backstop solution for climate-related natural disaster risks for EU Member States

A European public component for climate change-related disaster insurance would ideally embed several desirable features and principles to help ensure that it reduces the insurance protection gap effectively and efficiently, while also minimising both the overall costs from future climate-related disasters and the share of these costs borne by the public sector (**Figure 3**). These principles should reflect the nature of climate-related catastrophe risks. They should also draw lessons from the design of other EU-level instruments beyond the EUSF, such as the European Stability Mechanism (ESM), the Single Resolution Fund (SRF) and the EU recovery fund (i.e. Next Generation EU and the Recovery and Resilience Facility) (**Table 2**). These instruments have very different objectives and functions, but they tend, for example, to provide a degree of risk-sharing or solidarity by providing funding for agreed purposes and to make access to financing conditional on specific measures to be taken by recipients.

Figure 3

Key principles for a European public insurance scheme for climate-related natural disaster risk



Source: Authors.

First, as in the case of the EUSF, a fiscal component at European level should be EU-wide.[29] An EU-wide scheme would benefit from the strongest risk pooling and risk diversification, have more funds at its disposal and ultimately have a greater beneficial impact on EU economic resilience than a scheme with more limited participation. Such an approach would also be consistent with key climate objectives and policies being defined at EU level, such as emissions reduction targets and the EU Emissions Trading System.

Second, the scheme should complement and add value beyond existing EU policies and instruments for disaster relief, such as the EUSF. It is therefore important to consider the extent to which existing instruments may be remodelled in line with the outlined principles in order to contribute effectively to reducing the insurance protection gap. One possibility could be to focus a new scheme on providing financial support to Member States for reconstruction, accounting for adaptation needs, on which the EUSF contributes relatively little, and focus the latter on immediate emergency relief. It is also important that any funding which supports reducing the insurance protection gap is not provided at the expense of funding for other climate-related initiatives, in particular initiatives related to mitigation.

Third, an EU-wide scheme should cover all relevant types of climate-related hazards facing EU Member States, such as storms, floods and wildfires, but with a clear focus on infrequent large-scale disasters. This will be key for risk diversification and pooling benefits. Given the different distribution of specific disaster types and associated risks across Member States and EU regions, a wide scope of climate-risk coverage would also help to ensure the scheme's relevance across Member States.

Fourth, sufficient funding should be available to provide meaningful and swift support for large-scale climate disasters. A small fund with a limited pay-out capacity would not be credible for tackling major events. A prefunded solution based on regular,

[29] In addition to EU Member States, countries negotiating to join the EU can also apply for EUSF funding.

cumulative contributions from all Member States would be an effective option to achieve a fund of meaningful size. As there are opportunity costs to putting aside funds which may only be drawn on to a limited extent in the short term, total contributions would have to be calibrated to estimated needs. In this regard, it would be efficient to provide any EU scheme with a borrowing capacity to raise funds against either its stock of cumulative contributions or Member State guarantees in the event of large pay-outs, especially given uncertainties around the costs of future economic losses from climate-related disasters.[30] To enable swift pay-outs following large disasters, such borrowing by the scheme could be allowed on a discretionary basis up to a certain ceiling, beyond which further borrowing would have to be agreed at a political level. Under all setups, any accumulated contributions could be invested in investment-grade, liquid green assets, such as bonds compliant with the proposed EU green bond standard, thereby also allowing the fund to support complementary efforts to mitigate climate change and reduce global warming.

Fifth, contributions or guarantees to the scheme should have a risk-based component. The premium structure for Member State contributions should be designed both to incentivise Member States to take appropriate risk reduction measures, including mitigation and adaptation, and to account for their different geographical climate catastrophe risks. A risk-based component in Member State contributions would also help to address issues related to moral hazard (see **Box 2**). At the same time, contributions should maintain some solidarity element given the shared nature of the climate change challenge and individual Member States' limited control over the occurrence of specific catastrophes.

Sixth, as with the EUSF, pay-outs should, at least in part, be in the form of grants to achieve some mutualisation of climate change catastrophe risks. While loan-based support would help fiscally weaker Member States, who could benefit from more favourable borrowing conditions and immediate access to funds, catastrophe risks would still remain a national responsibility. Loan support would also increase public debt levels of the Member States concerned, adversely affecting their debt sustainability. In contrast, the cost of support in the form of grants would be shared by all Member States and would not directly affect national public debt levels.

Seventh, sufficient safeguards should be in place to minimise costs to the scheme. In particular, it must provide credible incentives for Member States to implement adaptation and mitigation measures and reduce the insurance protection gap at a national level. As with the EUSF, the scheme should only be triggered by large, infrequent disasters above a predefined threshold. Pay-outs from the scheme should be conditional on insurable damages being covered by private and public-private schemes at the national level, and could cover only a predefined share of the uninsurable, total public costs to ensure that governments keep sufficient "skin in the game" to pursue ambitious adaptation strategies. Full access should also be conditional on Member States having implemented agreed adaptation strategies and meeting their emissions reduction targets.

[30] See, for instance, Lenaerts et al. (2022).

Eighth, the scheme should have an effective governance structure to guarantee swift pay-outs while ensuring fair and transparent use of funds. Considerations around the degree of discretion and speed in the management and pay-out of funds would have to be balanced against requirements for checks, democratic accountability and transparency. A balance could be found whereby daily management and pay-outs up to a certain ceiling could be decided by the European Commission based on predetermined and politically agreed criteria. Funds would be disbursed to national governments, which would have to provide regular reports on how they are being used. Pay-outs would occur in stages, with a sizeable share disbursed within a set timeframe after the initial request from the Member State concerned, and could be suspended in the case of inadequate use or insufficient reporting.

Box 2
Addressing moral hazard

Moral hazard arising from private insurance

Avoiding moral hazard is a core issue in the design of insurance. Moral hazard represents the risk that the insured party will engage in riskier behaviour in expectation of compensation from the insurer, resulting in higher overall claims for the insurer. The greater the information asymmetry between the insurer and the insured, the higher the risk of moral hazard. Insurers mitigate the financial impact of moral hazard through, among other things, deductibles (i.e. a portion of the loss to be paid by the insured party before the coverage kicks in) and limits to coverage, as well as by offering discounts on premiums when the insured party does not make any claims or takes action to reduce the risk of loss. In traditional reinsurance, the reinsurer can use its technical expertise to assess the risks being ceded by the insurer and hence reduce the impact of moral hazard. In a cat bond transaction, capital market investors face greater moral hazard risk from the party that cedes the risk. This is mitigated by obtaining an independent assessment of the risks being covered by the bond.

Certain measures aimed at reducing the insurance protection gap may risk an increase in moral hazard, as there can be a trade-off between post-disaster insurance payments and ex ante adaptation. For example, mandatory insurance can disincentivise high-risk households and firms from investing in risk mitigation and adaptation by compensating them after disasters.[31] For this reason, impact underwriting and risk-based incentives linked to premiums can be useful to reduce this moral hazard and the related negative impact on welfare.

Moral hazard and the role of the public sector

Moral hazard is not only present between the parties involved in private insurance; it can also be an issue between private insurance parties and the public sector, or between different levels of the public sector. For example, private insurance parties may rely on an explicit or implicit government backstop – such as post-disaster aid – and reduce their own insurance coverage or adaptation

[31] Cohen and Werker (2008) find that expectations of international aid following a disaster reduce countries' investments in disaster preparedness. Similarly, Lewis and Nickerson (1989) show theoretically that federal aid for disaster relief reduces individuals' expenditure on protecting their property from harm. Federal aid can also create adaptation-related moral hazard in other contexts. For example, Annan and Schlenker (2015) demonstrate that federally subsidised yield guarantees reduce farmers' incentives to adapt to extreme heat.

efforts, or lower levels of government may neglect their role in the enforcement of regulations, as the potential losses are covered by higher levels of government.

As with private insurance, moral hazard should therefore be taken into account in the design of schemes that involve the public sector in some form. One way to do this is by matching, insofar as possible, the responsibility for providing disaster relief with the responsibility for enforcing the relevant regulations (e.g. planning regulations). Other policy options are to incentivise risk mitigation and adaptation either in the design of the insurance itself or through other policies. Recent evidence from the United States shows that, while the moral hazard effects from disaster aid reduce adaptation, federal subsidies for investment in adaptation are more than sufficient to correct for this moral hazard (Fried, 2021).[32] A crucial consideration concerning the insurance protection gap is that the public sector is currently in any case the holder of the residual risk, which makes it liable for large climate-related catastrophe losses that are likely to increase in frequency and magnitude. Policies aimed at enhancing both adaptation and mitigation of climate-related events are therefore needed to increase the resilience of the economy to climate change and reduce the insurance protection gap.

Moral hazard arising from a possible EU-wide scheme

With a common backstop for climate disaster costs, the moral hazard risk from a possible EU-wide scheme is that Member States will not make sufficient effort to reduce climate risks and the insurance protection gap at the national level, thereby exposing any EU-wide scheme and the EU economy as a whole to higher residual risks when disaster strikes. For example, in the presence of an ill-designed common backstop which supports recovery after disaster strikes, Member States may become less inclined to:

- implement measures to increase private sector insurance and reinsurance of climate-related risks;
- set up adequate public-private partnerships or risk transfer arrangements;
- build up appropriate fiscal buffers;
- implement adaptation strategies (e.g. regarding building standards and rules on building in flood-prone areas or other areas exposed to climate catastrophe risks);
- meet emissions reduction targets.

To address these moral hazard concerns, certain mechanisms, controls and safeguards could be introduced into any EU-wide scheme. For example, access to an EU-wide scheme could be conditional on Member States having implemented agreed adaptation strategies and obligations to curb climate change and the risks associated with it. Implementing commonly agreed regulations and standards (including some minimum standards on building regulations), and consistent adaptation strategies, could also be a prerequisite to creating an EU-wide scheme, the aim being that Member States should have similar (minimum) public and private arrangements in place to reduce the insurance protection gap in their jurisdictions. As with private insurance, there could also be a deductible to be paid by other layers of protection before an EU-wide scheme covers any

[32] The resulting adaptation is estimated to reduce the damage from climate change by approximately 30% and the associated welfare costs by approximately 5% (Fried, 2021).

losses. This would mean that common funds would only be available for the tail risk associated with major events, thereby helping to curb moral hazard.

3 Complementarity with wider EU policy initiatives

The policy options set out in this discussion paper to address the climate insurance protection gap also intersect with and complement some wider policy initiatives. These include the EU strategy on adaptation to climate change, and initiatives relating to the EU's CMU and the incorporation of climate risks into banking supervision.[33]

As part of the new EU strategy on adaptation to climate change adopted by the European Commission in February 2021, the Climate Resilience Dialogue provides a forum for private sector (re)insurers, policymakers and other stakeholders to exchange views on how to address the losses from climate-related disasters and to identify how the insurance industry can contribute more to climate adaptation.[34] This discussion paper can inform this debate.

By enhancing the resilience of the EU insurance sector, measures aimed at reducing the climate insurance protection gap can help strengthen EU capital markets, notably the green segment. A robust insurance sector is not only important to protect against the rising catastrophe risks associated with climate change; it is also a prerequisite for greater institutional investment in green capital markets. The ladder approach proposed in this discussion paper would help to ensure that the insurance sector can better manage the risks emanating from climate-related natural disasters. It is thus complementary to ongoing efforts, as notably outlined in the 2021 EU Sustainable Finance Strategy[35] and the 2020 CMU action plan,[36] to address the protection gap, integrate climate and sustainability risks into insurers' risk management, and enhance insurance companies' contribution to the green transition, including via capital market instruments such as European long-term investment funds (ELTIFs). The Solvency II review proposals of the European Commission outline, among other things, measures that contribute to these goals.[37] They would also require EIOPA to review regularly the scope and the calibration of parameters of the standard formula pertaining to natural catastrophe risk.[38]

Further progress on the EU's CMU and sustainable finance agendas is also important in helping to mobilise the private funding needed to reduce the climate insurance protection gap. Initiatives to promote the depth, liquidity and cross-border integration of EU capital markets can contribute to growing the universe of investors in green projects and financial products, including cat bonds. To this end, EU policymakers need to make swift progress on implementing the outstanding policy

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33 See ECB (2022a).

34 See "EU Adaptation Strategy" on the European Commission's website.

35 See European Commission (2021a).

36 See European Commission (2020b).

37 See European Commission (2021b).

38 See EIOPA (2021b).

proposals under the 2020 CMU action plan. These are aimed in particular at increasing the information available to investors about companies and financial products, the tax treatment of equity, and the harmonisation of insolvency laws and withholding taxes. In addition, further progress on improving sustainability disclosures and the ongoing work on agreeing a common standard for EU green bonds can help to direct more funding towards green projects.[39]

Finally, regarding the banking sector, as discussed in **Section 1.2**, a lack of insurance may increase risks associated with lending secured by property exposed to climate-related catastrophes or prevent some property qualifying as collateral. This may trigger higher capital needs for existing lending and could lower credit supply. However, physical risk can also be mitigated by improving adaptation of properties. Given these considerations, targeted prudential/macroprudential regulations in the banking sector may be needed to enhance its resilience to the implications of a persistent climate insurance protection gap.[40]

[39] See Born et al. (2021).

[40] See, for example, the proposed amendments to Article 208, paragraphs 3b and 5, in the review of the Capital Requirements Regulation, aimed at (i) reinforcing the requirement for banks to monitor the insurance of immovable properties taken as credit protection against the risk of damage, including from physical risk, and (ii) clarifying the relevance of improvements to the "resilience, protection and adaptation to physical risks of the building or housing unit". In addition, in the context of the Thematic Review on Climate and Environmental Risks (ECB, 2022b), the ECB identified as good practice for banks to consider the availability of insurance schemes and government protection schemes in bank lending policies.

4 Conclusion

Catastrophe insurance plays a key role in mitigating the losses arising from extreme weather and climate events. Only a quarter of such losses are currently covered in Europe, resulting in burdens on individual households and businesses, and macroeconomic and fiscal costs at the local, regional and national levels. Addressing this insurance protection gap would provide substantial economic benefits. Climate change – which is likely to drive more frequent and more devastating catastrophes – adds greater urgency to the need to reduce the protection gap, particularly given that it may cause the gap to widen further.

This discussion paper suggests possible actions which should be considered to reduce the climate insurance protection gap, incentivise risk mitigation and adaptation measures, and lower the share of economic losses from major disasters borne by the public sector. In particular, it proposes a ladder approach that builds on the existing frameworks of private (re)insurance, cat bonds and national public sector interventions. It also discusses the possible case for more concerted and forward-looking policy coordination and intervention at the national and EU level in relation to particularly severe disasters.

The paper aims to foster discussion and solicit feedback on the principles, framework and possible policy actions. The ECB and EIOPA will continue to analyse the implications of the insurance protection gap and the policy options set out in this paper and would welcome comments and feedback on all aspects of its content. Comments should be sent to this email, ideally by 15 June 2023: ecb_eiopa_staff_protection_gap@eiopa.europa.eu

5 Appendix

Table 2
Existing wider EU policy initiatives

	EU Solidarity Fund	Next Generation EU/Recovery and Resilience Facility	Single Resolution Fund	European Stability Mechanism
Description	An EU instrument which provides financial support (grants) to Member States in the event of a major natural disaster that, in principle, is non-insurable. Support for both structural and temporary repairs as well as acute relief to the population.	A temporary EU instrument (expires 2026) to provide both grant and loan-based financial support to Member States for financing of (post-)pandemic recovery on the basis of national recovery plans, approved at EU level and subject to meeting pre-defined milestones.	A common fund for bearing the resolution costs, after application of a bail-in, arising when large or cross-border banks in the banking union fail and are put into resolution.	The ESM provides financial assistance to euro area countries experiencing or threatened by severe financing problems. This assistance is granted only if it is proven necessary to safeguard the financial stability of the euro area as a whole and of ESM members.
Size	Up to €500 million (2011 prices) per year, plus the unspent allocation from the previous year.	Up to €723.8 billion over the entire period 2021-2026, of which €385.8 billion is available in loans and €338 billion in grants.	Approximately €55 billion (target level is 1% of all covered deposits).	The ESM has a lending capacity of €500 billion.
Funding	Financed by exceptional borrowing by the Commission on behalf of the EU based on higher national commitments to the EU budget.	Financed by exceptional borrowing by the Commission on behalf of the EU based on higher national commitments to the EU budget. Allocation of funds between Member States based on pre-agreed criteria with a "solidarity" aspect (Member State GDP, population and unemployment).	Risk-based ex ante fees paid by banks.	The ESM has €80 billion of paid-in capital and an additional €620 billion in "callable" capital to be contributed when requested. These sums put the ESM in a strong position to borrow on the bond markets.
Backstop	No	No	ESM: In the event that the SRF is depleted, the ESM can act as a backstop and provide a revolving credit line with a nominal cap set at €68 billion.	No
Safeguards	Only accessible for major disasters, defined as above €3 billion in 2011 prices, or above 0.6% of GNI of the EU Member State/accession country concerned, or 1.5% of regional GNI), or public health emergency (above €1.5 billion in 2011 prices, or more than 0.3% of Member State GNI). Only partial coverage of damages, and pay-outs limited to €500 million/year.	Member States have to complete structural reforms as part of national recovery plans, whereby the greater the funding received, the greater the emphasis there is on reforms.	The contributions are allocated to different "national compartments" during the transitional period. These are progressively being merged and will cease to exist after 2023. Bail-in of at least 8% before the SRF can contribute towards absorbing losses or recapitalising a bank (which is capped at a 5% contribution). Banks are subject to minimum requirements for own funds and eligible liabilities (MREL).	The ESM can use several instruments: loans within a macroeconomic adjustment programme, primary and secondary market purchases, precautionary credit lines, loans for indirect bank recapitalisation, and direct recapitalisation of institutions. All instruments have safeguards, i.e. eligibility and conditionality criteria. Some criteria are set very high, e.g. for direct recapitalisation of institutions, and have therefore never been used.

	EU Solidarity Fund	Next Generation EU/Recovery and Resilience Facility	Single Resolution Fund	European Stability Mechanism
Governance	The European Commission assesses applications and prepares implementing decisions to be approved by the Council.	Subject to Member States meeting the agreed milestones and targets in their national recovery plans, the European Commission prepares implementing decisions to be approved by the Council.	The Single Resolution Board (SRB) decides on the use in a resolution scheme. Once the SRB has adopted a resolution scheme, it sends it to the European Commission. The scheme may enter into force only if no objection is raised by the Commission or the Council within a period of 24 hours.	The ESM governing bodies are the Board of Governors and the Board of Directors. The Board of Governors is the highest decision-making body of the ESM. It comprises government representatives of each of the 19 ESM shareholders with responsibility for finance.
Legal basis	Article 175(3) and Article 212(2) of the Treaty on the Functioning of the European Union, Council Regulation (EC) No 2012/2002 of 11 November 2002 establishing the European Union Solidarity Fund and Regulation (EU) No 661/2014 of the European Parliament and of the Council of 15 May 2014 amending Council Regulation (EC) No 2012/2002 establishing the European Union Solidarity Fund.	Borrowing is governed by the EU Recovery Instrument Regulation. Use of funds is largely governed by the Recovery and Resilience Facility Regulation.	Established under the Single Resolution Mechanism Regulation. An intergovernmental agreement between euro area Member States (and Member States which have entered into close cooperation with the ECB and joined the Single Supervisory Mechanism) governs the transfer of funds to the SRF.	The ESM Treaty.

Source: Authors.

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