# Fiscal consequences of extreme weather risks in Europe

Key Messages

- Many EU member states are still in the early stages of designing and implementing their climate change adaptation strategies, which means that there are ample opportunities to consider an iterative risk management process, where state-of-the art scientific information on risk (hazard, exposure and vulnerability) is mainstreamed into economic and fiscal decision-making.
- The CATSIM model is one entry point for informing further implementation. The model helps to understand a government's fiscal position to take on its explicit and implicit con-tingent disaster liabilities.
- Explicit liabilities may, for example, include the rebuilding of damaged public infrastructure.
- Implicit liabilities include providing relief and support to both the private sector and households in order to cover estimated losses.
- Unlike costs of ageing , which are estimated and projected using common underlying assumptions and shared widely with public and relevant institutions, assessing climate related fiscal cost is a new field of inquiry, particularly in terms of integration with a climate change scenario approach.
- The Shared socioeconomic pathways scenarios (SSPs) provide a useful framework for linking climate change to demography, and other socioeconomic trajectories. (This kind of approach has high potential for being effective in linking various fiscal policy concerns and designing appropriate fiscal risk managing policies under changing climate and socio-economic trends.)
- Two innovative approaches have been developed for further taking the CATSIM approach forward.
- The scorecard approach gives a broad, birds-eye-view of inter-related issues such as longer-term fiscal sustainability, ageing and climate risk facing EU member states by ex-amining both the structural drivers of fiscal pressure (such as baseline population projec-tions, growth potential and fiscal consolidation needs), as well as the cyclical and sto-chastic fiscal pressure arising from macroeconomic and climate variability (i.e. flood risks).
- A stochastic assessment allows for a more detailed assessment of climate risk management options at the national level.

## Context

Given the ongoing societal debate over what might be the most favourable course of action in terms of adaption and risk management, cost-benefits, acceptability, viability and any other implications of adaptation policies should be evaluated within the context of other pressing longer-term structural issues, such as the 'greening' of tax and investment, population ageing and longer-term sustainable growth at the regional and global level.

The fiscal costs of climate extreme events are becoming an increasingly important topic within the EU context. For example, the European Policy Commission (EPC) has established an internal working group on energy and climate change at the EU level, exploring aspects such as the macroeconomic impacts of 2020 GHG targets, green growth strategy and transition pathways to a low-carbon economy. More details can be found here.

The CATSIM model has been used to gauge the fiscal costs of extreme events, and for purposes of explicitly linking up to climate change, this insight presents innovative approaches for as-sessing the fiscal implications of extreme weather events in the context of strategies for dealing with climate change. Furthermore, it shows the prospects of the Stochastic Debt Evaluation with the help of a case study.

Policy and methodological developments

To model the fiscal and economic risk of extreme events, the CATSIM framework has been developed. This framework assists policymakers to quantify public sector risk of extreme events

and develop predisaster risk management strategies. For that, the estimates of a country's direct monetary risk and their risk tolerance relative to the fiscal resources available are evaluated. Public and private sector losses due to flood events are estimated and compared to the financial resources available, such as reserve fund, budget diversion and international and domestic bor-rowing (Figure 1). Hence, CATSIM helps to understand a government's fiscal position to take on its explicit and implicit contingent disaster liabilities-the innovation being to plan for contingent (i.e. probabilistic) events and risks. Explicit liabilities may, for example, include the rebuilding of damaged public infrastructure, whereas implicit liabilities include providing relief and support to both the private sector and households in order to cover estimated losses.

For this analysis, CATSIM has been extended to consider both short- and longer-term changes in the frequency, severity and duration of extreme weather events resulting from climate change. As a consequence, extreme event risks (in terms of potential capital stock losses) across an illustrative range of climate scenarios (with a time horizon of 2030 in the short-term and 2050 in the long-term) can be quantified. This methodology also helps to indentify the fiscal repercussions in terms of public debt trajectories and to identify options for better fiscal planning to reduce and finance risks.

As it can be seen in figure 1, the CATSIM framework compares public and private sector losses due to flood events compared to the financial resources available, such as national reserve funds, budget diversion and international and domestic borrowing.

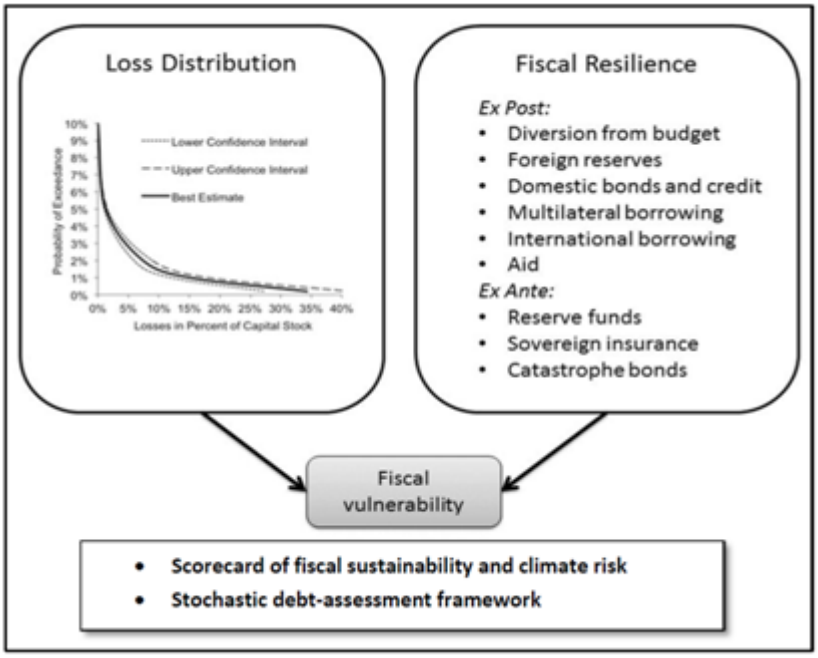


**Figure 1: CARSIM Framework, Source: ECONADAPT.**

The methodology has been extended in two directions: A climate risk scorecard and stochastic debt assessment to take account of the future risk of climate extreme events (focusing on the projected impacts of extreme riverine flooding).

- The scorecard approach gives a broad, birds-eye-view of inter-related issues such as longer-term fiscal sustainability, ageing and climate risk facing EU member states by examinining both the structural drivers of fiscal pressure (such as baseline population projections, growth potential and fiscal consolidation needs), as well as the cyclical and stochastic fiscal pressure arising from macroeconomic and climate variability (i.e. flood risks).
- The stochastic assessment allows for a more detailed assessment of climate risk management options at the national level.

Furthermore, Shared Socioeconomic Pathway scenarios (SSPs) can be used to further extend the

CATSIM approach. SSPs are “reference pathways describing plausible alternative trends in the evolution of society and ecosystems over a century timescale, in the absence of climate change or climate policies,” which allow for the standardization of assumptions and storylines used in integrated assessments. With the help of these scenarios, different factors can be included, such as future trends of demography, economic growth, and the degree of economic integration. When SSPs are built using finer geographical and temporal resolutions, they can describe key aspects such as urban versus rural populations, patterns of international trade, environmental quality, technological progress, governance and institutional development, etc. To assess future risks for EU member states by the CATSIM approach, the projected GDP and demographic composition can be used for the SSP, as this case study shows.

**Stochastic Debt-Sustainability—methodological considerations**

Stochastic debt assessment is commonly used as part of fiscal risk analysis applied in various countries and contexts, where debt dynamics equations are built based on baseline projections of macroeconomic variables, and the impacts of financial shocks to debt trajectories are evaluated (IMF 2006; Medeiro 2012; Ellor and Urvova 2012; IMF 2012). Unlike other methods, that focus solely on macroeconomic variability and longer-term non-stochastic costs of ageing, the innovative stochastic debt assessment developed here and for the first time applied to the case of Austria incorporates the additional stochasticity due to the future contingency of climate extreme events.

Using a production function approach enhanced for a detailed representation of the composition of labour as employed in Cuaresma (2015), economic output can be estimated based on baseline projections of population, and disaggregated according to age-brackets and educational status for each scenario; this allows for the existing ageing-related cost-estimates to be recalibrated according to the new IPCC scenarios. The use of IPCC scenarios is important to ensure that climate change mitigation and adaptation costs are examined in a manner consistent with each socioeconomic scenario.

To simulate flood risks and macroeconomic variability simultaneously, the empirical relationships between flood damages (both insured and uninsured) and macroeconomic variables are evaluated to determine whether these two sources of variability are statistically related (and should therefore be treated as dependent risk). To further align the modelling framework to alternative scenario assumptions adopted under the IPCC shared socioeconomic pathways, projected costs of population ageing were also adjusted to reflect the alternative demographic trajectories assumed in current EU level assessment and IPCC scenarios.

A broader application of CATSIM to Europe indicates a variety of challenges facing EU member states with regard to longer-term costs as a result of climate extreme events. In many countries, public debt increased sharply following the financial crisis of 2008-2009 due both to structural elements (decline in revenue and an increase in the growth-interest rate differential) and expansionary spending. This study also shows the relative contribution of an increase in ageing-related costs. These are highest in counties such as Belgium, Germany, Lithuania and Slovenia, where age-related expenditure could add approximately 9-12% of additional expense to the public budget from now until 2050. With regard to climate change and extreme events, assuming the observed average insured rate remains constant and there are no major changes in flood mitigation measures, a cluster of countries, such as Hungary, Slovenia, Bulgaria, Slovakia, Latvia, Czech, Romania and Lithuania for example, are estimated to likely face the combined challenge of fiscal consolidation and management of climate extreme events due to flooding.

With regards to the short-term costs of climate change mitigation for the period leading up to 2020, high financial pressure (to achieve the mitigation goals) was modeled for countries such as Latvia and Romania and lower, or indeed negative, for countries such as Bulgaria, Latvia, Greece, Malta and Finland. Based on past variability of macroeconomic indicators, countries such as Hungary, Slovakia, Bulgaria and Czech Republic will likely face highly volatility stemming from both macroeconomic variability and flood risk.

Main implications and recommendations

Extreme weather events pose a threat to financial consolidation of countries' budgets, especially when these events occur in combination with other challenges, such as ageing-related costs, fiscal consolidation or high financial volatility. This challenge is exacerbated under scenarios of climate change that suggest increased intensities, duration and frequencies of rainfall. The CATSIM methodology can be used to highlight the importance of mainstreaming associated climate risk considerations into fiscal planning. This kind of fiscal mainstreaming not only involves probabilistic estimates of climate-related economic damage and losses, which can be provided by CATSIM. Mainstreaming of climate risk into existing fiscal sustainability assessments via a scorecard approach can also link climate concerns to wider socioeconomic concerns, such as rising demography-related public expenditure. Members of existing working groups set up at the EPC, such as the Ageing Working Group and the Climate Working Group, are some of the key recipients of such information of fiscal mainstreaming exercise. Given the high uncertainty of climate change related issues, fostering open discussion among stakeholders are key to enhancing the institutional culture of learning, and the wider involvement of stakeholders across public, private and civil society.

CATSIM serves to model the fraction of adaptation-related costs of the total costs of single countries. It is imperative to consider the analytical challenges related to major economic events, such as the financial crisis in 2008/2009. The unpredictability of economic developments rises strongly with the time horizon, which has to be considered when estimating costs in 2030 or even 2050.

Overall, however, the CATSIM model and analytical innovations presented here can be useful in order to provide insight on general trends and costs linked to macroeconomic and demographic variables as well as climate risks, which is instrumental for developing sound policies that tackle the challenges arising from climate as well as socioeconomic and demographic change.

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Further Information
Pan-European Assessment of Fiscal Consequence of Climate Extremes [pdf]
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