Flood risk case study: Iterative Climate Risk Management

Aim of PACINAS

The project PACINAS (Public adaptation – Investigating the Austrian adaptation strategy) addresses the costs of adaptation to climate change for the public budget and the associated macroeconomic effects. Case studies on city, provincial and federal level made it possible to estimate the current adaptation deficit and the potential future costs of adaptation up to 2050. The project focuses on adaptation costs due to extreme events such as flooding, mass movements and heat stress as well as on activity fields of the Austrian adaptation strategy (BMLFUW, 2012) with high relevance for the public budget (agriculture, forestry, water, protection from natural hazards, catastrophe management, transport, cities and urban green). PACINAS was carried out by the Wegener Center of the University of Graz in cooperation with the Umweltbundesamt, AIT and IIASA.

Context of the case study

Much of the concern about climate change is related to projected shifts in the occurrence of extreme weather and periodic climatic events such as heatwaves, droughts and floods, and the economic impacts (the losses) that they cause. Although science has identified that climate change has the potential to alter the frequency, duration and intensity of such natural hazards, the evidence that climate change is already increasing the economic impacts associated with these events has not yet been made (Bouwer, 2011; IPCC, 2012; Mechler et al., 2014). The rise in observed losses over recent decades has been primarily attributed to socioeconomic trends, rising exposure of people and capital at risk, while acknowledging that an influence of climate change on trends in losses cannot be excluded (IPCC, 2012).

Despite these uncertainties, recent disasters in Austria, such as the floods in 2002, 2005 and 2013, have highlighted the need for tackling climate-related risks. This requires jointly fostering climate change adaptation and disaster risk management, and linking both domains using the concept of iterative climate risk management (Watkiss et al., 2014; Schinko et al., 2016).

One key actor of concern for advancing climate risk management is the public sector. It has to step in to guarantee the local provision of disaster risk management by planning ahead for extreme event risk. Disaster risk constitutes a contingent liability, i.e. costs that accrue only in case of an event. However, not considering these contingent liabilities ex-ante (i.e. before they arise) in the public long-term budgeting process may eventually lead to severe fiscal stress once an extreme event occurs.

Aim of the case study

Based on a detailed analysis of current and future flood risk in Austria, with a special focus on the fiscal effects of flood risk, we set out to test the concept of iterative climate risk management (ICRM). This concept links climate change adaptation and disaster risk management within a process-oriented decision support framework. Additionally, based on the empirical and modeling results, as well as the insights gained from dialogue with key stakeholders, a further goal was to establish a generic ICRM framework applicable to other decision contexts.

Methods employed

The following methods and tools were employed:

- A broad stakeholder dialogue with Austrian disaster risk management as well as climate change adaptation experts and practitioners;
- Comprehensive budget analyses with a focus on the Austrian disaster fund;
- State of the art economic flood risk modelling with IIASA's CATastrophe SIMulation (CATSIM) framework.

Results of the case study

Disaster risk management as early adaptation

In the current Austrian disaster risk management practice, climate change considerations do not play a major role and are not explicitly taken into account in the deliberations by the public agencies responsible for the implementation of DRM measures. The interview partners stated that the main reason for this is the considerable uncertainty associated with regional modeling of climate risks. In part, however, climate change considerations are already implicitly taken care of. By continuously reviewing and integrating new scientific knowledge on climate change (e.g. emerging early trends and changes in variability that exacerbate existing risks or create new risks) the practitioners are adjusting their

decisions over time with scientific and empirical evidence. Hence, disaster risk management in Austria is evolving to include early adaptation to climate change, addressing current variability (and the existing adaptation deficit) while mainstreaming climate change in decision processes.

Role of the Austrian disaster fund

The key instrument for financing public sector disaster risk management in Austria is the Austrian disaster fund. The larger part of the fund's resources is earmarked to finance protective DRM measures (73%), while smaller parts of the annual deposits are reserved for remedial payments following major catastrophic events (18%) and to pay for equipment for fire departments (9%). Severe floods in 2002, 2005, and 2013—with cost estimates for the 2002 and 2013 floods amounting to more than Euro (EUR) 3 billion (Habersack et al., 2004) and EUR 0.9 billion (BMI, 2014), respectively-led to the situation that the fund's usual annual deposits , which are linked to the overall economic development and tax revenue in any specific year, were not sufficient to cope with the losses of these catastrophic events. Hence, special laws were enforced which provided an ad hoc increase of resources for the disaster fund to cover the increased annual payments from the fund (shown in Figure 1).

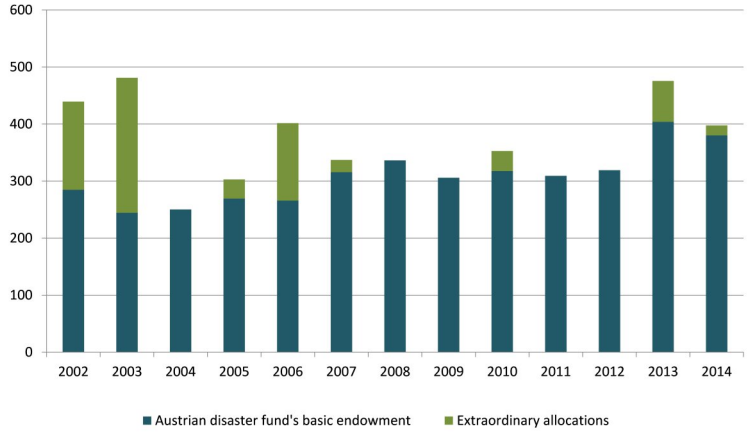

Figure 1: Annual Payments by the Austrian disaster fund financed from its basic endowment and from extraordinary allocations based on special laws (in 2002 and 2005) and federal government resolutions (since 2010), 2002-2014 (in million EUR). The extraordinary allocations were dispersed in the year of the event and in subsequent years. Source: Schinko et al. (2016)

Source: Schinko et al. (2016)

The fact that the losses caused by the floods in 2002, 2005, and 2013 put Austria's main vehicle to finance DRM—the disaster fund—under pressure, can be seen as a first evidence that the current approach to financing DRM in Austria is insufficient to sustainably cope with catastrophic climate-related events. The diversions from the general federal budget, which were necessary to provide additional resources for the Austrian disaster fund, put additional stress on the Austrian federal budget. Our analysis thus leads to the conclusion that the current approach to financing catastrophic risk in Austria is not a long-term solution to manage low-frequency, high-impact events such as extreme floods and other climate risks.

Future fiscal flood risk up to 2050

The analysis employed the probabilistic risk-based economic CATSIM framework and compared the results of expected direct economic flood losses from the model with the Austrian disaster fund. We find that in the base year of 2015, the fund's endowment dedicated to the compensation for damages due to extraordinary extreme events, amounting to EUR 72 million, is not sufficient to cover the expected direct losses of EUR 258 million for this year (Figure 2). The model then estimated the future expected annual flood losses in 2030 and 2050 in Austria and compared this to the business as usual funding of deposits in the Austrian disaster fund. The analysis found that the business as usual endowment of the Austrian disaster fund dedicated to the compensation for damages will not be sufficient to cover expected annual losses of EUR 354 million for 2030 and EUR 511 million for 2050. Severe stress could be put on the disaster fund's financial resilience and additional ad-hoc budget payments would become necessary more frequently. About two thirds of this increase in expected direct flood losses can be attributed socioeconomic development, the other one third to climate change (Jongman et al., 2014).

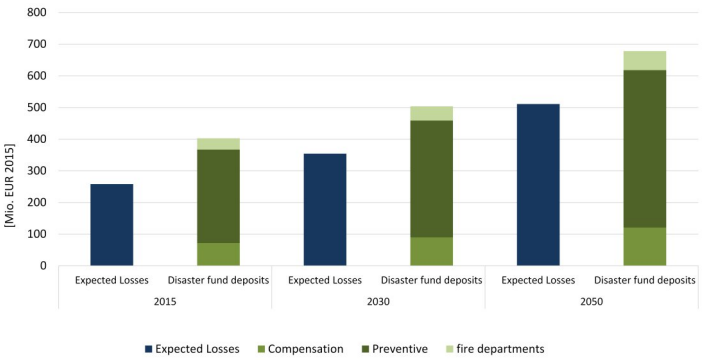

Figure 2: Development of expected annual flood losses from 2015 to 2030 and 2050 under current levels of flood protection (in blue) compared to the development of disaster fund deposits (in green) under business as usual (assuming a real GDP growth rate of 1.5 % p.a.) (in million EUR 2015).

Source: Schinko et al. (2016)

The probabilistic modeling results can extend the analysis of flood risk by providing not only information about the changes in average losses but also about changes in extreme risk. When talking about catastrophic events it is the low probability, high impact events that should matter most in

decision making, as when these events occur, they impose severe stress on federal budgets and can overburden risk instruments, such as the Austrian disaster fund, exactly at the moment when they are needed the most.

Support decision making under uncertainty

To deal with the substantial uncertainties associated with future climate-related risks, and with future contingent climate-related fiscal liabilities which are expected to increase substantially due to socioeconomic development and climate change, we identify the need for an ICRM approach linked to theories of advanced learning.

ICRM is based on the idea that current decisions are constrained by imperfect knowledge and cognitive bias and acknowledges the uncertainties and complexities inherent in social–ecological systems interacting with climate-related risk. Hence, theories of learning are at the core of its methodology and translate into the necessity for cycles of revision in practice.

ICRM encourages flexibility and can help decision makers to avoid maladaptation and taking irreversible decisions. It allows for an adjustment of decisions over time with evidence and will eventually contribute to more robust policy response pathways.

An ICRM process first deals with current climate variability (and the adaptation deficit) and then considers potential future impacts of climate change within a framework of decision making under uncertainty. No-regret and low-regret measures, which do not primarily focus on climate change adaptation, may however – as a co-benefit – contribute to climate change adaptation in the longer term. Such measures contribute to a reduction in current climate risks and build resilience e.g. by pursuing disaster risk reduction.

A generic ICRM framework

Building on insights from research and application, and the evidence generated in the Austrian case study, we distill the major building blocks of a generic iterative CRM framework (Figure 3). The framework comprises multiple methods and tools, since the ICRM approach is not limited by a strict formal methodology and is applicable to other contexts with similar risks (e.g. drought).

The generic CRM framework (Figure 3) consists of four steps and is embedded in a comprehensive participatory process:

- Step (1) includes monitoring existing instruments, new scientific knowledge on climate change (e.g. emerging early trends and changes in variability that exacerbate existing risks or create new risks), natural hazard data (e.g. hydrological data) and loss databases.
- Step (2) is a model-based analysis of climate risks acknowledging the uncertainties associated with climate change and socioeconomic developments.
- Step (3) evaluates the fiscal effects of climate risk according to different risk layers (e.g. flood risk return periods).
- Step (4) introduces updates for the measures already in place or the implementation of new instruments framed around the building blocks risk prevention, risk financing, and risk budgeting.
- Following evaluation and learning, this then feeds into the next cycle, starting at Step (1) again.

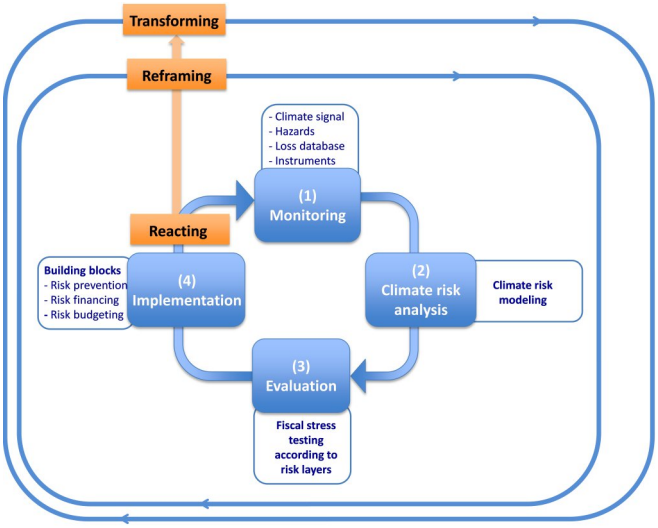

Figure 3: Iterative framework for climate risk management embedded in a comprehensive learning process.

Source: Schinko et al. (2016)

Main conclusions

The recent extreme events have revealed the urgent need for early adaptation, i.e., the need to deal with the current adaptation deficit based on current climate variability and weather extremes. In addition, the EU flood directive calls for an explicit analysis of climate change as a driver of future flood risk.

An ICRM strategy allows for a systemic analysis and response to the current disaster risk management practice and present and future climate-related risks. An integral element of this process is to assess how best to deal with damages and losses from catastrophic events ex post and how future investments into preventive and protective ex ante measures can be most efficiently implemented.

There is the potential to integrate an ICRM approach into the Austria DRM practice to help it take on board emerging evidence and trends, with a learning cycle and updates to ensure it is responding to changing socio-economic trends and future climate risks.

Key findings

Current disaster risk management and natural hazard management practice in Austria can be seen as early adaptation to climate change.

The financial resilience of Austria's disaster fund is jeopardized today already and this risk will increase in the future up to 2030 and 2050; ad-hoc budget diversion to address major events could become more frequently.

An iterative climate risk management (ICRM) strategy is useful for tackling current and future climate-related risks, which are expected to increase due to climate change and socioeconomic developments.

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