

## **“Imagine that’s no border”: The case of transnational floods**

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### **Extended Abstract**

Modern societies and economies are facing the challenge of disasters of natural origin as never before. While climate change, increasing urbanisation, and excessive anthropisation of natural landscapes are making natural hazards more impactful in terms of frequency, magnitude, and damage (Botzen et al., 2019), new technologies, an increased awareness and understanding of these phenomena and a higher acknowledgment from policymakers can prepare societies to reduce or even nullify the harmful effects of such hazards (Clarke and Dercon, 2016; Breglia and Modica, 2025a).

In a general context where the frequency and magnitude of extreme weather events are increasing, there is also an important impact on the flood recurrence intervals (De Ruiter et al., 2020; Kreibich et al., 2022; Merz, et al., 2021) and resilience is becoming increasingly important. In fact, the climate crisis has intensified these regional challenges because, as reported by CRED (2023), damages (and especially flood damages) are rising because of the combined effects of climate change and of the increased exposure of assets and populations in flood-prone zones, together with land consumption (Hoeppe, 2016). On a global scale, over 90 % of recorded disasters since 1980 have been weather- or water-related, making hydrogeological hazards the dominant category of catastrophic events (CRED, 2023).

Many natural hazards can be considered intrinsically transboundary because they transcend regional and national borders (Pandey et al., 2023). This fact can have significant cross-border implications, both in terms of managing the hazards and also in the post-event impacts (McLean and Bas, 2020). Among these hazards, floods are globally one of the most significant risks (Lodi et al., 2023), accounting for approximately the 40% of the total damage worldwide (Alexander, 2018). Furthermore, floods can often be transboundary because the rivers in basins cross national and regional borders, while intense rainfall systems cover wide regions irrespective of political boundaries, and upstream water management decisions (such as dam releases, land-use changes, or deforestation) can significantly amplify downstream flood risk in neighbouring countries. In the case of extreme weather conditions, river basins may overflow, and the impact travels through the entire river system without regard for jurisdictional boundaries and borders.

However, the borders between different countries can make more difficult to undertake a series of emergency actions, such as emergency responses, resource allocation, and reconstruction funding. Conversely, well-institutionalized cross-border regions can leverage joint mechanisms for early warning, evacuation, and recovery (Kanteler & Bakouros, 2024), such as cross-country river commissions that can increase preparedness and recovery efficiency (Kalogiannidis, 2024; Paprotny et al., 2018).

While the literature typically focuses on flood risk, it often pays limited attention to transboundary issues (Rahayu et al., 2024). The few studies that, to our knowledge, do address this issue tend to be more focused on managerial aspects - such as prioritizing disaster risk reduction interventions - rather than the impacts and recovery processes (Arfa et al., 2025; Rahayu et al., 2024). This gap leaves an open question regarding whether and how the presence of a border shapes the consequences of flooding.

Specifically, two considerations motivate the emphasis on borders. First, border regions can facilitate rapid knowledge diffusion if cross-border networks are institutionalized, and this is particularly relevant in the case of Europe (Miörner, et al., 2018). Second, on the other hand, borders function as a line of separation that can lead to the partition of competencies, asymmetric disaster risk management, and uneven access to resources in the reconstruction activities (Collins, 2009). In such contexts, whether regions sit on an internal administrative border or an international frontier may shape both the immediate shock transmission and the subsequent recovery trajectory. This paper addresses the gap above by examining the short-to-medium-term effects of the recent 2013

European flood event on regional economic performance and asks two main questions: i) Do border regions exhibit distinct GDP growth trajectories after major transnational floods? ii) Through which channels do post-disaster border regions influence each other via spillovers?

These two questions relate to two strands of literature: i) the resilience across European regions (e.g., Cainelli et al., 2019) and ii) the economics of flooding and climate disasters (e.g., Donnini et al., 2020; Lima and Barbosa, 2019). Regarding the first point, borders play a role in shaping regional and sovereign integration, broader or smaller market access, and also policy spillovers (e.g., Capello et al., 2018; Hippe et al., 2024; Jakubowski and Wójcik, 2024). This led to an important differentiation of the border regions. For instance, some of them may benefit from cross-border agglomeration through institutional cooperation, while others may be considered poorly connected and peripheral (Meideiros et al., 2021), which has an evident impact on the resilience of European regions. Furthermore, Hippe et al. (2024) demonstrate that European border regions follow specific convergence and resilience patterns distinct from interior areas.

Clearly, this heterogeneity is also particularly relevant when addressing climate-related disasters. In fact, when considering flooding and its impacts on the economy, literature shows that the interaction between the natural events and other regional socio-economic characteristics, such as exposure, vulnerability, and adaptive capacity, can produce severe disasters according to the severity and magnitude of the events but also on the degree of preparedness of these regions (Blessing et al., 2017; Huang and Wang, 2020; Lim and Skidmore, 2019; Lodi et al., 2023). Undoubtedly, Europe has a very peculiar institutional environment, namely, it is constituted by an integrated single market segmented by national borders and, within the EU, a series of strategies that are able to collectively respond to external shocks, such as the European Union Solidarity Fund (EUSF) and the Union Civil Protection Mechanism (UCPM). These mechanisms, while providing crucial support for the recovery of affected regions from various types of shocks, strongly depend on the governance capacity and also the cross-jurisdictional cooperation among affected countries; these factors could vary systematically across regions.

Understanding whether borders amplify or mitigate the consequences of extreme events may be crucial, given the numerous impacts of extreme weather conditions that European Countries are experiencing. In fact, the European Environment Agency (2025) estimates that annual average climate-related event losses exceeded €18 billion in the period 1980–2024. Furthermore, according to the European Commission (2023), the European Solidarity Fund has helped mobilize more than €8 billion for 127 disasters (107 natural hazards and 20 health emergencies) in 24 Member States between 2002 and 2022. Most of those funds resulted from flood damage – for example, €100 million to Slovenia to finance the damage caused by a devastating flood in August 2023 and approximately €450 million to Italy for the flood in Emilia–Romagna in 2022 (European Commission, 2023).

Recovery and reconstruction policies, historically always present in case of a disaster, represent from an economic perspective a sort of “double shock”, where the impact of such recovery processes can alleviate, offset, or even outweigh initial losses after a disaster (Breglia and Modica, 2025b). Cunado and Ferreira (2014) found that floods can have a positive and significant average impact on per capita GDP growth, limited to the developing countries and for moderate floods. Other studies, however, found that severe floods can have a negative effect, resulting in a reduction of approximately 1.5% in annual GDP growth (Panwar and Sen, 2019).

Europe is a particularly relevant case study, especially since the EU Floods Directive (2007/60/EC) that aims at increasing the resilience of flood prone regions, promoting an increasingly interconnected river-basin planning and the creation of basin authorities, even at cross country level such as the International Commission for the Protection of the Danube River (ICPDR) (Nones and Pescaroli, 2016). The institutionalization of transnational disaster governance makes Europe a unique empirical setting for assessing how border regions react to shared shocks. Thus, hydrogeological events, such as the 2013 Central European floods, offer quasi-experimental opportunities to test whether proximity to an international border, and the presence of cross-border governance mechanisms, affected medium-term economic resilience.

For these purposes, we study one of the largest cross-country basin-scale events that happened in Europe. Specifically, we analysed the 2013 floods, which primarily affected the Danube and Elbe rivers. It generated record river levels across Germany, Austria, and the Czech Republic, with spillovers toward Hungary, Slovakia, and Switzerland. The event was large enough to trigger substantial financial assistance and a multi-country response.

In this context, this event can be considered a transnational disaster because the flood affected several countries sharing the Danube and Elbe basins, thus requiring multiple states to coordinate emergency and recovery actions.

More in detail, we build a panel for European regions consistent with the EEA geography (EU plus associated countries) and identify treated NUTS-3 regions exposed to the 2013 floods using EM-DAT, the CRED global disaster database reporting standardized event characteristics and impacts, HANZE (Historical Analysis of Natural Hazards in Europe), a high-resolution European dataset reconstructing historical flood extents and exposure since the late nineteenth century (Paprotny et al., 2024), and EU DG-REGIO open database for European regional disaster risk prevention policies. We then explore the heterogeneity of the effects by estimating a triple difference-in-differences (DDD) model by combining the temporal difference considering the pre- and post-event, the shock difference by comparing treated and untreated regions, and the institutional differences captured by the border status (e.g., being a bordering region or a non-bordering one).

The results indicate a negative and statistically significant flood effect on regional GDP growth in the post-event period, as well as a nuanced, condition-dependent border effect. In the baseline DDD, being located on a border is associated with a positive interaction with the flood shock: border regions that are affected and neighbored by affected regions experience relatively better post-shock GDP growth than their non-border counterparts. When border regions adjoin unaffected areas, the border premium disappears. Complementary DiD models reinforce the idea that the border advantage is not intrinsic but emerges when cross-border coordination becomes salient, precisely the situation in a transnational flood, even after accounting for regional disaster risk reduction expenditures.

This paper contributes to the literature on regional resilience and the analysis of disaster impacts, highlighting how the primary economic effects of transboundary natural hazards, in general, and flooding specifically, depend not only on physical exposure but also on the institutional geography of borders. This is particularly true in areas such as the EEA, where transboundary integration is pronounced. In fact, borders are often porous and embedded in dense cross-border governance architectures, meaning they can either amplify or attenuate disaster impacts.