Economic Watch

Assessing the economic impact of extreme climate events: Evidence from the Valencia floods

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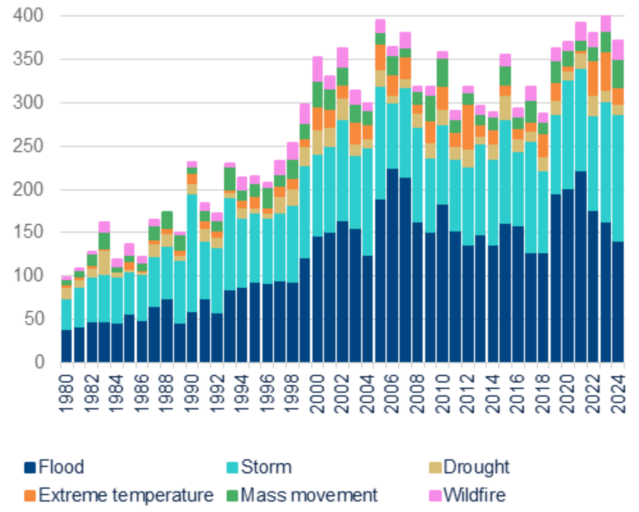
This note presents a framework for estimating the employment impact of floods in Spain, combining imputed damage estimates (using EM-DAT) with a spatial panel data model. Extreme flooding events tend to cause job losses and generate spillovers across regions. However, timely recovery aid can help to mitigate these impacts. The DANA flood in Valencia serves as a case study that demonstrates both the accuracy of the framework and its relevance for policymaking.

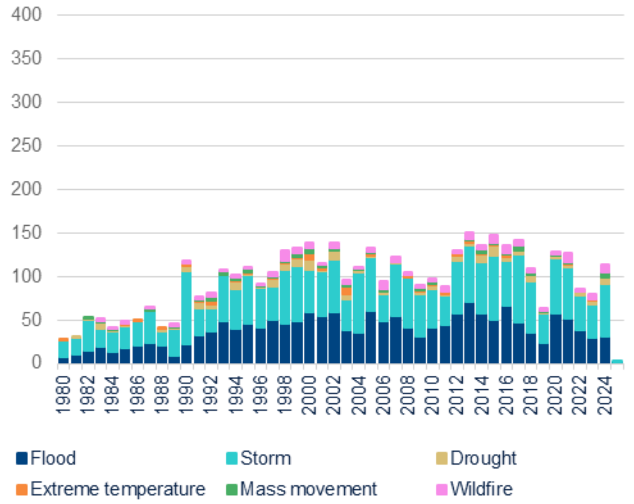
Climate-related acute physical risks are becoming increasingly frequent, posing serious risks to economies around the world. **Yet quantifying their economic impact remains a challenge. A key hurdle is data availability:** while global databases like EM-DAT catalogue major natural disasters, they often **lack estimates of the resulting economic losses.** Between 1980 and 2025, 36% of recorded acute climate events worldwide lack data on economic damages, with the coverage for floods being even more limited, at just 32%. This gap makes it difficult to learn from past events and to plan effectively for future ones (see Figures 1 and 2).

Figure 1. **WORLD CLIMATE-RELATED ACUTE EVENTS.** 1980-2025. NUMBER OF EVENTS



Source: BBVA Research from EM-DAT.

Figure 2. **WORLD CLIMATE-RELATED ACUTE EVENTS WITH DAMAGE INFO.** 1980-2025. NUMBER OF EVENTS



Source: BBVA Research from EM-DAT.

At BBVA Research, we set out to address this challenge by developing an analytical framework to consistently assess the economic consequences of extreme climate events. Our goal is not only to measure the impacts after such events occur, but also to enable forward-looking scenario analysis. We would like to be able to answer the following questions: If a flood struck an economic region, what would be an initial estimate of the economic damage? Given that figure, how many jobs might be lost, and how quickly could they bounce back? Our approach aims to provide evidence-based answers to such questions, to better inform risk management and policy planning[1].

Methodology: From acute physical risks data to economic impact

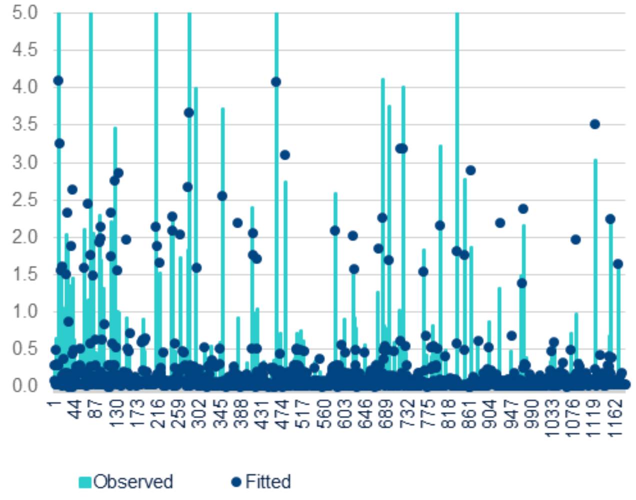
Our approach involves two layers of analysis. First, we construct a **proxy or instrument to quantify the severity of acute physical risks in economic terms.** Second, we feed that proxy into a model to **estimate the effect on regional employment,** capturing both local effects and spillovers to other regions.

1. **Estimating economic damage when data is missing.** We begin with historical acute physical risks records. EM-DAT provides a comprehensive list of flood events (among other hazards), including when and where they occurred, as well as metrics like fatalities and people affected. However, many of these records lack estimates of the economic damage caused[2]. To address this gap, **we develop a cross-section model of flood damage using the subset of events with available data.** In this global model, **the dependent variable is the economic loss from a flood**, expressed as a percentage of the country's GDP. **The predictors include indicators of the event's severity-such as the flood's mortality rate, its duration as a percentage of the year, and population density** as a proxy for capital stock and infrastructure exposure. Importantly, we **account for non-linear relationships, allowing us to test the fact that extreme events often result in disproportionately large losses**. To capture this effect, we include variables that specifically flag the most severe floods, such as dummy variables for events in the top percentiles of damage. **Our findings reveal while moderate floods typically lead to relatively modest losses, the most extreme events cause significantly higher damage costs relative to GDP.**

   In essence, **the outcome of the first step in our modeling approach is a "damage function" capable of predicting the economic loss from a flood, even in the absence of official reports or when they are not yet available.** Our model fits the historical data well, allowing us to impute losses for flood events without reported damage. This enhances our dataset with an estimated shock size for each event (as illustrated in Figures 3 and 4). These predicted damage values then serve as a proxy for the disaster's economic severity in the second modelling step. For a more detailed explanation of the econometric methodology, please refer to the supplementary slides accompanying the publication.

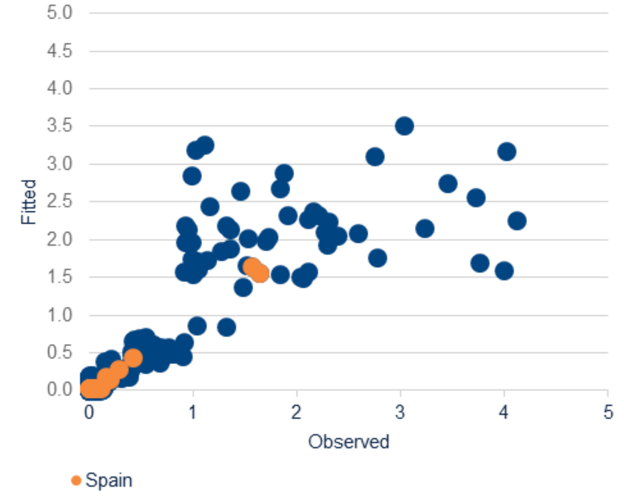
1: It should be emphasized that the employment-focused approach can be generalized to any other indicator of economic activity flows- for example, GDP- or to any other measure relevant to the analysis.
2: Economic damage refers to the monetary value of direct and indirect losses caused by a disaster. Direct damages include the destruction of infrastructure, housing, agriculture, and other assets. Indirect damages encompass the broader economic impacts such as loss of income, business interruption, reduced productivity, and disruptions to supply chains or markets.

Figure 3. **WORLD, CLIMATE-RELATED FLOOD EVENTS AND THEIR IMPACT IN TERMS OF GDP: OBSERVED VS. FITTED VALUES.** EVENTS IN THE SAMPLE



Source: BBVA Research.

Figure 4. **WORLD, CLIMATE-RELATED FLOOD EVENTS AND THEIR IMPACT IN TERMS OF GDP: OBSERVED VS. FITTED VALUES.** EVENTS IN THE SAMPLE



Source: BBVA Research.

2. **From damage to employment - a Spatial Dynamic Panel:** In the second stage of our analysis, we investigate how floods damage translate into employment flows. We select employment as the dependent variable due to its availability, frequency, and near-weekly updates.

   We estimate a dynamic spatial panel model using monthly employment data for each Spanish province. This econometric approach analyzes changes in employment within a given province, **accounting for both flood shocks occurring within that province and those in other provinces, while incorporating appropriate time lags.** The model allows us to capture both direct effects (the immediate impact of a flood on the province where it occurs) and indirect effects (spillovers to other provinces through economic linkages). **To quantify interregional spillovers, we construct a spatial weight matrix based on economic ties** (i.e. inter-province trade flows). Provinces with strong trade relationships are more closely linked in our model[3].

   We also incorporate temporal dynamics by including lagged terms, allowing us to capture the effects of a flood in the months following the event rather than focusing solely on its immediate impact. This matters because economic impacts can unfold with some delay. In fact, we find that the most noticeable drop in employment typically materializes with a one-month lag rather than instantaneously.

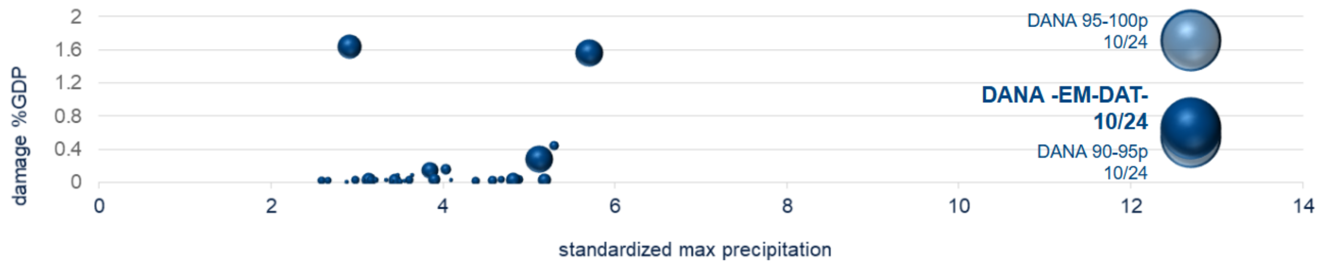
   Finally, we include a measure of post-disaster financial assistance. Spain's public insurance consortium provides payouts for catastrophic events such as floods, and we incorporate the volume of these insurance indemnities disbursed in the aftermath. This variable helps us assess how recovery funds influence the trajectory of employment -essentially capturing the rebound effect when financial aid is deployed. Again, for a more detailed explanation of the econometric methodology, please refer to the supplementary slides accompanying the publication.

3: Therefore, if Province A experiences a major flood, not only could employment in Province A decline, but provinces with significant trade ties to Province A may also suffer employment losses due to disrupted supply chains or reduced demand. By including the weighted sum of flood shocks from other regions as regressors, our model tries to estimate how these shocks propagate spatially across the economy.

Case study - the Valencia DANA Flood

Figure 5 below shows the floods included in our sample, which covers the period from 1980 up to just before the DANA event[4]. The chart plots economic damage (as a percentage of GDP) on the y-axis and climatic severity-proxied by normalized maximum precipitation per province and month-on the x-axis. The size of each bubble reflects the number of fatalities associated with each event.

Figure 5. **SPAIN, 1980-2024. STANDARDIZED MAXIMUM PROVINCIAL PRECIPITATION** -X AXIS-**, DAMAGES** -Y AXIS-**, AND FATALITIES** -SIZE OF THE BUBBLE-



Source: BBVA Research.

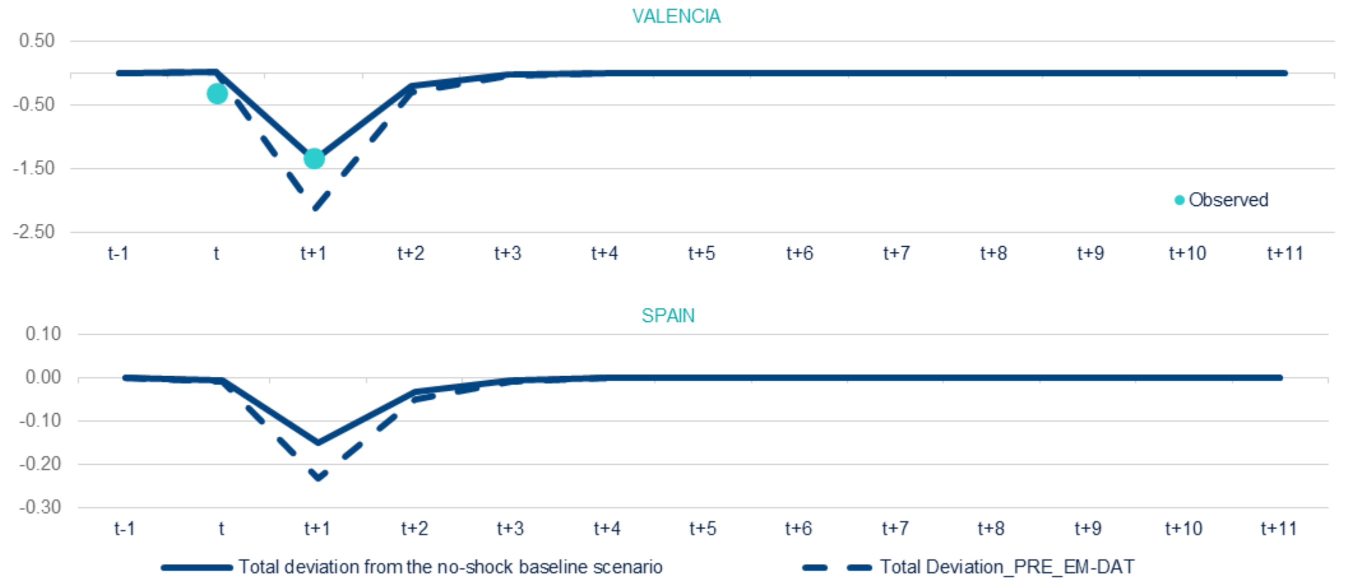
Based on its precipitation levels and fatalities, it was already apparent from Figure 5 that the DANA event would be historically significant. So, what damage did our initial model predict for the DANA?

The projected losses vary depending on the assumed damage percentile -that is, how severe the acute physical risks are expected to be (ex-ante). In the early aftermath of the event -prior to the release of any official estimates- our model forecasted that the DANA could result in economic losses ranging from 0.55% (90-95th percentile) to 1.71% (95-100th percentile) of GDP, depending on its severity ranking. The midpoint estimate was 1.1%[5].

Based on this shock, our model predicted that employment in the province of Valencia would fall by about 2.2 percentage points relative to the counterfactual (no-disaster) trend, and to shave around 0.2 percentage points off total employment at the national level in the short term (dashed black line in Figure 6). Later, when EM-DAT official data came in, it indicated an economic cost near the lower end of our range (around 0.65% of GDP). **Using that number to update our estimates, we obtained an employment decline of roughly 1.4 percentage points in Valencia** (solid black line in Figure 6). **The observed data showed that Valencia's accumulated employment did indeed dip by about 1.5–1.6 points at its worst, very close to our model's prediction.** This validation gave us confidence that even using limited real-time information, our approach could provide a reliable read on the economic fallout of the event.

4: While older, more severe events exist, we limited our analysis to post-1980 episodes to ensure data reliability.
5: The Spanish authorities mobilized emergency resources amounting to nearly 1.1% of GDP.

Figure 6. **IMPACT ON EMPLOYMENT GROWTH CAUSED BY THE DANA** (PP, M/M)-

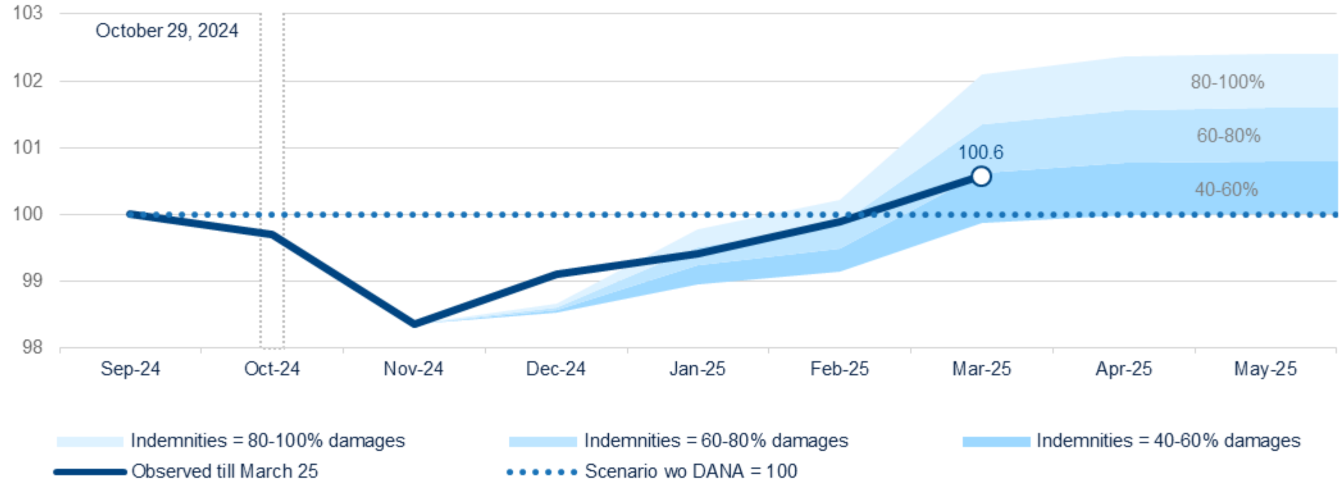


Source: BBVA Research.

Valencia's experience also underscored the critical importance of rapid recovery efforts. The province's employment rebounded more quickly than expected -indeed, faster than observed in previous events and as captured by our model- largely due to the payouts provided after the flood. It is also possible that some of the aid was advanced by the affected individuals (through credit), and thus we may be observing its impact even before the funds have been officially received. These payouts covered a significant portion of the losses and injected much-needed liquidity for reconstruction. **According to our analysis, when payouts exceed approximately 40% of the estimated damages** (as was the case in Valencia), they effectively neutralize much of the negative impact on employment growth. In other words, the multiplier for aid is significantly higher than the one for damages. By March 2025, Valencia not only had recovered but was experiencing a net increase in employment due to reconstruction activities and financial aid. This outcome underscores how timely financial support can significantly mitigate the economic impact of acute physical risks. Figure 7 illustrates the model's estimate of recovery under different levels of aid, represented as a percentage of total damages.

However, it is important to emphasize that while employment being higher than in a scenario without the DANA event suggests a recovery, it does not indicate full recovery. The disaster caused significant destruction of capital, which means that employment must remain above its pre-disaster trend for some time to rebuild the capital stock. In this context, both employment and GDP are flow variables, whereas the destroyed capital stock recovery might follow a different temporal pattern, which falls beyond the scope of this study.

Figure 7. **SOCIAL SECURITY AFFILIATION IN THE PROVINCE OF VALENCIA (SEP 2024=100). IMPACT OF INSURANCE CONSORTIUM INDEMNITIES ON EMPLOYMENT***



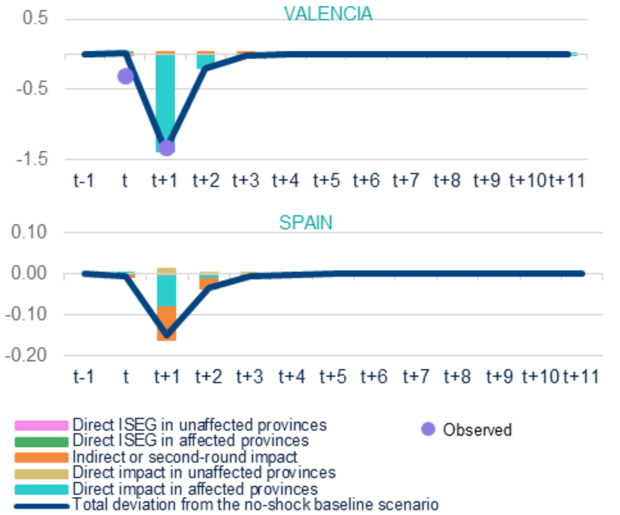
*: The shaded bands in the chart represent the estimated impact on employment under various levels of indemnity disbursement, relative to the damages caused by the DANA event, assuming a payout schedule consistent with that observed in past disasters.
Source: BBVA Research.

Key findings and insights

Non-linear impacts of extreme events: Small flooding events have negligible effects on overall employment, with the economy absorbing those minor shocks almost imperceptibly. However, when an extreme flood strikes (defined as two or more standard deviations above the mean)**,** the effect is sizable and statistically significant**.** In other words, **only beyond a certain severity threshold do floods significantly drag down employment and economic activity.** This non-linearity suggests that policymakers and businesses should pay particular attention to the tail-risk events: the rare but very severe acute physical risks that can cause outsized damage.

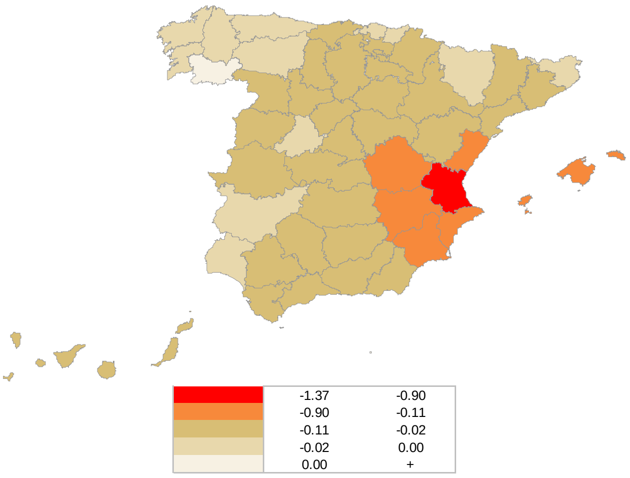
Spatial spillovers of acute physical risks: We find no clear evidence of direct (immediate) effects in unaffected but nearby regions. However, the **model does suggest the presence of second-round spatial spillovers, as well as dynamic effects that contribute to the diffusion and persistence of the shocks on employment.** While the disaster zone itself always bears the brunt of the impact, other regions experience the shock indirectly. For example, in the case of a major flood in Valencia, our model indicates that overall employment in Spain fell slightly as a result of the event- even provinces with no flooding experienced a minor slowdown. The reason is that Valencia's economy is interconnected with the rest of the country. When Valencia took a hit, businesses elsewhere that depended on trade with Valencia also suffered losses. In our analysis of that event, roughly half of the total employment impact in Spain was due to these indirect effects occurring outside of Valencia. This highlights that even a localized disaster can become a national economic concern if it strikes a key region with many linkages (see Figures 8 and 9).

Figure 8. **IMPACT ON EMPLOYMENT GROWTH CAUSED BY THE DANA** (PP, M/M)



Source: BBVA Research.

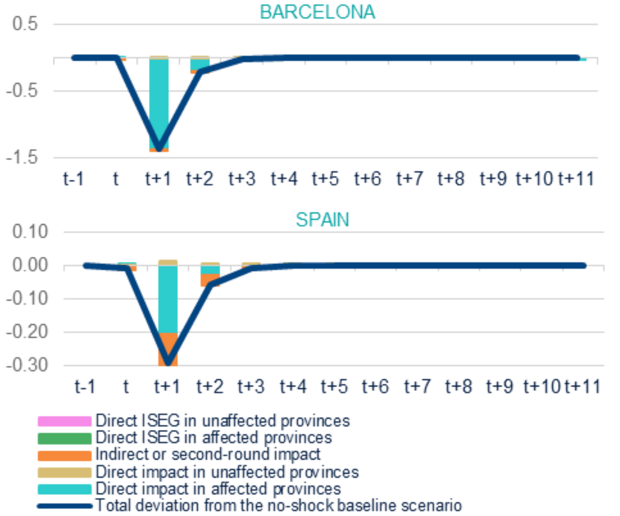
Figure 9. **IMPACT ON EMPLOYMENT GROWTH IN NOVEMBER 2024 DUE TO THE DANA** (PP, M/M)



Source: BBVA Research.

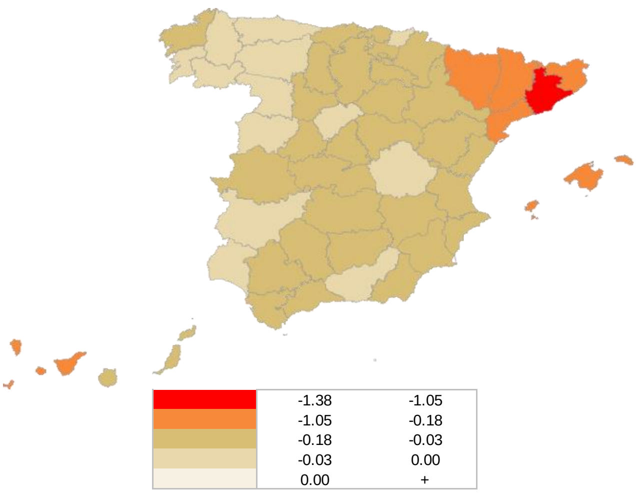
Why location matters: Our model underscores that *where* an acute physical risk strikes is critical for its aggregate impact. We used the model to simulate a flood of the same magnitude as the 2024 DANA (in terms of damage as a percentage of Spanish GDP), but hypothetically affecting Barcelona instead -one of Spain's largest and most economically interconnected provinces. The result was a considerably larger effect on national employment. As Barcelona accounts for a greater share of the economy, a direct hit there would hurt overall growth more, and its extensive links would spread the shock further. In this scenario, the majority of the nationwide impact would stem from direct losses in Barcelona itself, accounting for approximately two-thirds of the total effect. The remaining impact would arise from spillovers to other regions, which are also larger compared to the case of Valencia (see Figures 10 and 11).

Figure 10. **IMPACT ON EMPLOYMENT GROWTH CAUSED BY THE DANA** (PP, M/M)



Source: BBVA Research.

Figure 11. **IMPACT ON EMPLOYMENT GROWTH IN NOVEMBER 2024 DUE TO THE DANA** (PP, M/M)



Source: BBVA Research.

Robustness of results

We subjected our findings to a battery of robustness checks. For instance, we repeated the analysis using actual meteorological measures (like recorded maximum precipitation) as an alternative to our estimated damage proxy, and we tried different specifications of the spatial linkages between provinces. The core results remained essentially unchanged. This consistency suggests that our conclusions are not driven by specific modeling choices.

Conclusion and policy implications

Understanding and mitigating the impact of acute climate risks is increasingly critical. **Our study offers a robust framework to estimate these impacts in a timely manner, even in the absence of complete or immediately available official damage data. The approach is highly adaptable, allowing it to be tailored to various types of acute physical risks and geographic contexts.** As such, it serves as a valuable tool for climate risk analysis and the formulation of effective policy responses.

For policymakers and planners, our findings highlight a few priorities. First, prepare for tail acute physical risk events, as these inflict the most significant economic harm. Second, recognize that an event hitting a critical economic region can have far-reaching effects, so resilience planning should account for the economic geography of risk. Third, ensure that rapid post-disaster funding mechanisms are in place -swift insurance payouts or emergency aid can significantly reduce economic losses by jump-starting the recovery process.

In short, while we cannot prevent extreme climate events, we can certainly improve our ability to predict their economic fallout. Additionally, public authorities can implement adaptation measures that would significantly help mitigate the impact; however, we will leave that analysis for a future study. In this context, **data-driven tools like the one we developed allow us to answer "what if" scenarios with more confidence, guiding decisions that make our economies more resilient.** Being able to quantify potential losses and the benefits of swift interventions will be crucial as we navigate an increasingly volatile climate future.

(Detailed quantitative results and technical details are available in our slide deck for readers interested in the specifics.)

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