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Macroeconomic impact of extreme weather events

Key takeaways

- *Different types of extreme weather event have different transmission channels to economic activity and inflation.*
- *An analysis of eight major economies in the Americas shows that droughts reduce economic output over the two years after they occur due to lasting effects on agriculture, forestry and electricity production.*
- *It also shows that, while droughts and wildfires temporarily increase food prices and droughts and storms raise energy prices over the following three months, in general there is no persistent impact on inflation.*
- *Considering the trade-off between growth and inflation, monetary policy may have to react differently in different circumstances: by tightening if price impacts are large and threaten to become persistent, and by loosening if events destroy physical capital and have lasting effects on economic output.*

Extreme weather events can impose high economic costs in the affected areas by reducing economic output and increasing prices, in addition to the social hardship they cause. The intensity and frequency of most extreme weather events have been rising and are likely to increase further. The January 2025 wildfires in California destroyed large stocks of housing and displaced many jobs. Major droughts in southern Africa and floods in other parts of the continent in 2024 had a significant impact on food prices. In Asia, large floods in 2024 affected millions of people in Bangladesh, India, Nepal and the Philippines.

This Bulletin, prepared by the BIS Americas Office, looks at the macroeconomic impact of extreme weather events in the Americas. The choice to focus on the Americas is not intended to suggest that such events are relevant only to the Americas, but their macroeconomic impact is already tangible in the region. Recent studies show that extreme weather events significantly affected economic output and inflation in major countries in the Americas (eg Aguirre et al (2024); Almeida et al (2024)). Based on empirical analyses of eight major economies in the region, this Bulletin shows that droughts reduce GDP over the next two years due to their lasting effects on agriculture, forestry and electricity production. It also finds that droughts and wildfires temporarily increase food prices, and droughts and storms temporarily raise energy prices, but that there is no persistent impact on food, energy and core inflation.

Therefore, an appropriate monetary policy response to extreme weather events depends on the nature of the shock and its impact on output and inflation. Tightening monetary policy may be appropriate in order to anchor inflation expectations, if fiscal measures or insurance payouts prop up demand after an extreme weather event and the price impact is large and threatens to become persistent. By contrast, loosening monetary policy may be appropriate if an extreme weather event destroys physical capital and has lasting effects on aggregate output while inflation expectations remain anchored.

Channels of the macroeconomic impact of extreme weather events

The specific channels of economic impact, and their persistence, depend greatly on the type of weather event (Table 1). Storms, droughts and floods can immediately destroy farmland, firms' physical capital,

housing and human life. Extreme temperatures may have a less direct and short-lived impact by reducing labour productivity and labour supply due to health effects.

Stylised and theoretical economic impact of extreme weather events[1] Table 1

Event type	Transmission channel	Speed and persistence of impact
Extreme temperatures	Economic activity ↓ (indirectly from labour productivity ↓ and potentially consumption ↓) Inflation ↔	Immediate impact on labour productivity and consumption. Increasing and longer-lasting impacts (eg health effects, loss of life) as extreme temperatures become more intense and frequent.
Precipitation and floods	Initial effect: economic activity ↓ (directly from capital stock ↓, farmland ↓, labour supply ↓); consumption ↓ inflation ↑ Medium-run effect: economic activity ↑ (capital and housing investment ↑, farmland ↑, labour supply ↑); consumption ↓ inflation ↔	Immediate decline in supply and short-term increase in inflation. Destruction of physical capital has persistent negative effects on the level of output, but capital investments for reconstruction can support subsequent growth. Slow-moving effect on consumption due to reduced household wealth and reduced consumption spending due to reconstruction expenses.
Droughts	Economic activity ↓ (direct impact as agricultural production ↓ and hydroelectric energy production ↓, potentially activity ↓ in water-intensive industries and water transportation) Inflation ↑ (direct impact as food prices ↑, potentially energy prices ↑ in countries with high reliance on hydroelectric energy)	Immediate reduction in food supply and potential effect on hydroelectric energy supply (where applicable) with a lagged effect on inflation depending on the severity of the shock. Recovery can be swift if a drought is short but protracted in the case of severe and long droughts.
Storms	Same as precipitation and resulting floods	Land use may recover faster than in the case of precipitation and resulting floods.

[1] The effects are ceteris paribus and do not take into account any potential mitigating measures such as relief efforts or fiscal measures. The magnitude of the effects depends on the size of the shock – more extreme shocks have a more pronounced and persistent impact.

Source: BIS elaboration.

Droughts can affect economic output through other channels. Given the high share of hydroelectric power in total electricity production in many Latin American countries, droughts can have an impact on inflation via hydroelectric production. For example, in August 2024 Aneel, a local power regulator in Brazil, decided to impose an additional charge due to a drop in reservoir levels at hydroelectric plants during the country's dry season (Reuters (2024)). Droughts may also impair water transportation, which is important for a broad range of raw materials and basic food items. For instance, after a long drought in 2022 the Mississippi River experienced extremely low water levels and the cost of transporting soy and other crops on the river soared by 300% before water levels normalised.

A key feature of extreme weather events is that their direct impact is localised. Risk-sharing across regions can thus alleviate their effects. Economic activity may temporarily increase in other regions to cushion the supply shock in affected ones.

Yet several potential factors may limit risk-sharing across regions. The effects of extreme events strike harder if an affected region is responsible for a large share of production or consumption of specific goods. For example, floods in Rio Grande do Sul in 2024 affected a region which accounts for 12.7% of agriculture and 8.4% of manufacturing in Brazil (Central Bank of Brazil (2024)). In October 2024, Hurricane Helene in the United States disrupted a firm responsible for a substantial share of global quartz production, which had a significant impact on global chip production (Bradshaw (2024)).

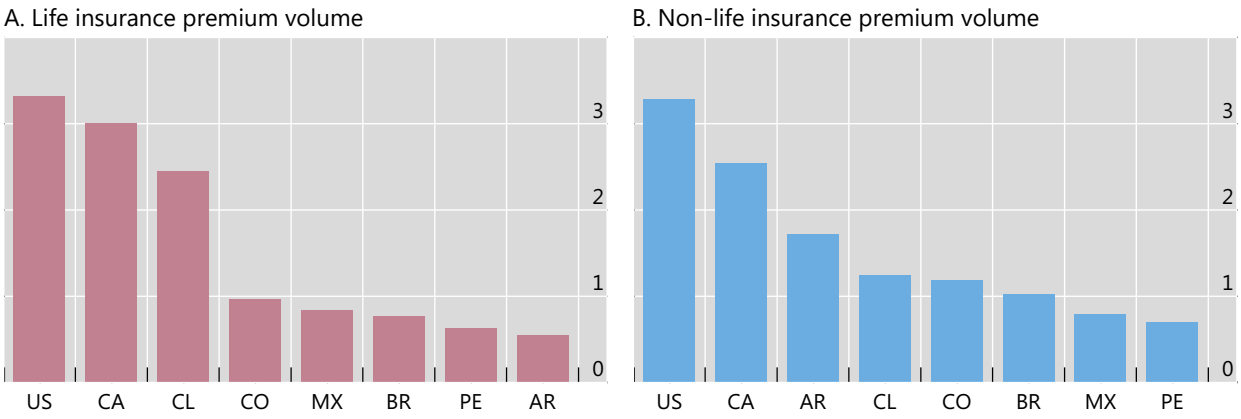
Role of insurance provision

The financial impact of disasters on those affected can be mitigated by insurance. Von Peter et al (2024) show that insurance mitigates the macroeconomic cost of disasters in affected countries by helping to finance the recovery. Graph 1 shows that insurance products in eight countries in the Americas are sizeable:

life and non-life insurance premiums represent between 0.7 and 3% of GDP. The market size for catastrophe bonds remains relatively small (USD 49.5 billion at end-2024) but grew around 10% in 2024.

Life and non-life insurance premiums in eight major countries in the Americas

As a percentage of GDP, average for 2000–23 — Graph 1



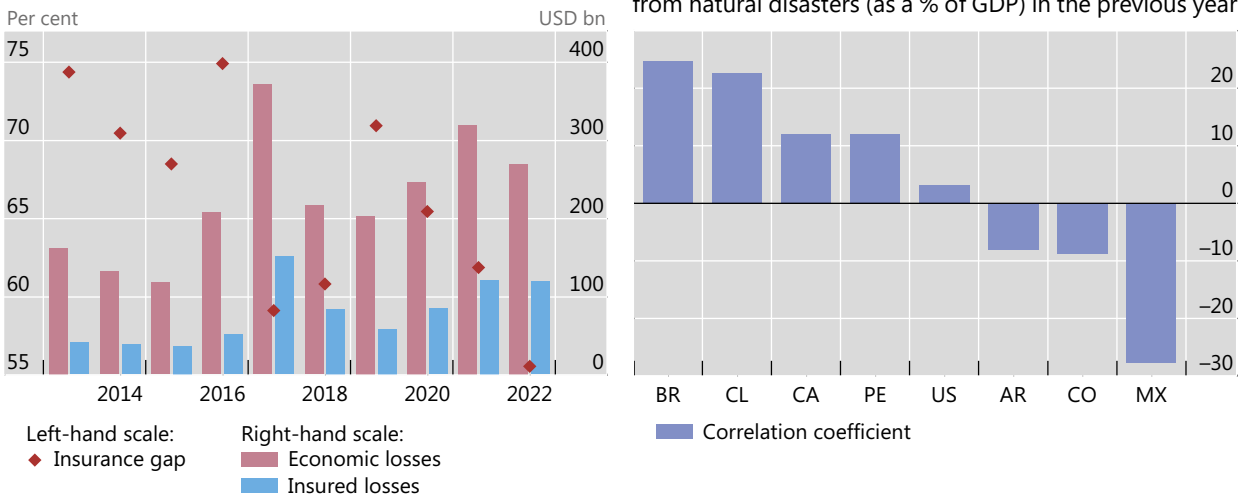
AR = Argentina; BR =Brazil; CA = Canada; CL = Chile; CO = Colombia; MX = Mexico; PE = Peru: US = United States.

Sources: World Bank, annual frequency data for the period 2000–23; authors' calculations.

As the frequency and intensity of extreme weather events rise, so do insurance premiums. Some insurers may also withdraw from the market, leading to a widening insurance gap. The global insurance gap fluctuated substantially over time (Graph 2.A). Also, losses from natural disasters are associated with subsequently higher insurance premiums in Brazil, Canada, Chile, Peru and the United States (Graph 2.B). Given the large insurance gap and the need for fiscal relief measures, disasters can increase fiscal deficits and sovereign debt yields, affecting the fiscal space to react to future shocks.

Insurance gap for natural disasters and rising insurance premiums

Graph 2



[1] Correlation between non-life insurance premiums and losses from natural disasters is based on annual data.

Sources: MunichRe; World Bank; authors' calculations.

An empirical analysis of macroeconomic effects in the Americas

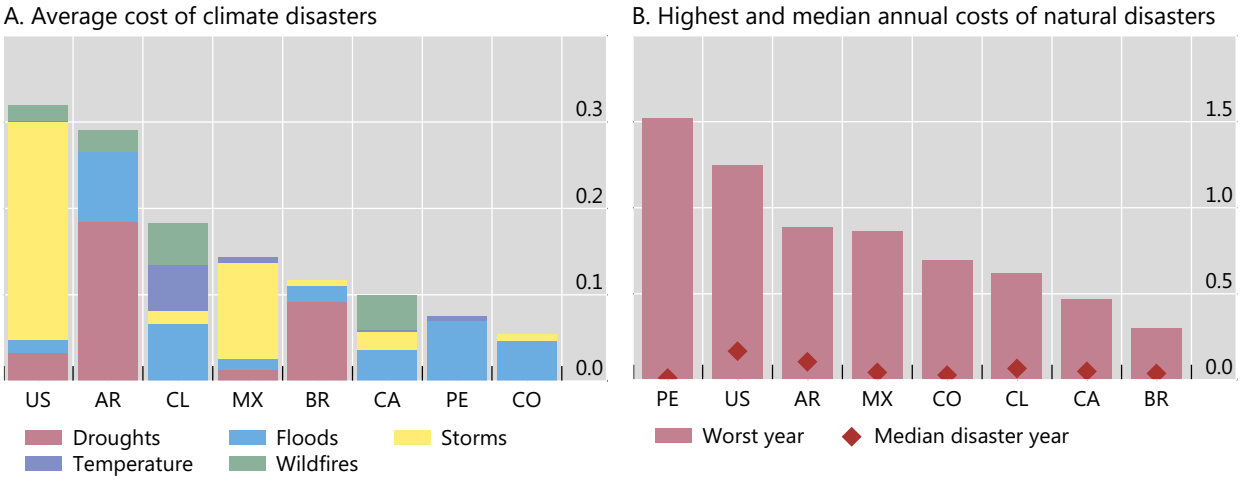
Empirical evidence points to a significantly negative effect of extreme weather events on output *in the short term*, but their effects on long-term GDP growth are mixed (Botzen et al (2019)). The effects on

inflation vary in both magnitude and direction, depending on the type and magnitude of the shock. Cevik and Jalles (2024), for instance, find that inflation fell after extreme temperature shocks. Overall, the literature points to a short-lived effect on inflation (Beirne et al (2024)). Yet the effect on inflation also varies with the intensity of the shock. Recent studies point to a more pronounced and persistent effect on inflation for more extreme temperature or precipitation shocks (eg Kotz et al (2023); Moessner (2022)).

In the eight countries, the average annual cost of natural disasters was sizeable over 2000–23 (Graph 3.A). In addition, the distribution of losses are skewed to the left. The worst events in these countries caused damages over 10 times larger than the median (Graph 3.B). Damages across countries also vary widely across the five categories of natural disasters (droughts, floods, storms, extreme temperatures and wildfires). The major economic disasters were droughts in Argentina and Brazil; floods in Chile, Colombia and Peru; storms in Mexico and the United States; and wildfires in Canada and the United States. Furthermore, there is evidence that temperature fluctuations have affected regional GDP growth in Chile and the United States (Colacito et al (2019); Hernández and Madeira (2022)).

Average and worst annual impact of climate disasters in the Americas over 2000–23

As a percentage of GDP — Graph 3



Sources: EM-DAT International Disaster Database; authors' calculations.

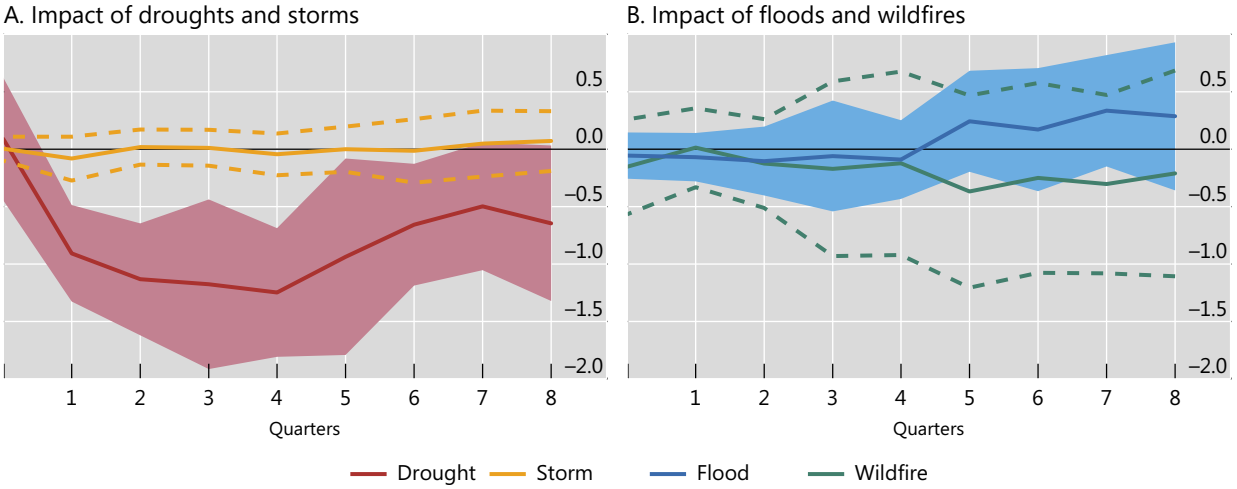
As rising temperatures increase natural disasters' intensity and frequency and a greater stock of physical capital is built in vulnerable areas, the future impact of natural disasters can become larger. In particular, in recent decades more housing has been built in areas closer to natural parks and forests, which are more susceptible to wildfires. Moreover, rising sea levels expose several major cities to floods, storms and coastal deterioration.

Natural disasters can potentially have persistent negative effects on output, as the recovery from a significant loss of agricultural land, physical capital, housing and labour supply takes time (eg Aguirre et al (2024); Kabundi et al (2022)). An analysis of the dynamic impact of natural disasters on GDP in the eight countries shows that droughts have a strong negative effect on GDP growth over the following six quarters (Graph 4.A), while storms, floods and wildfires do not (Graphs 4.A and 4.B). This prolonged effect of droughts may be due to their lasting effects on agriculture, forestry and electricity production.

An analysis of the dynamic impact of natural disasters on inflation in the eight countries indicates that inflation tends to increase only temporarily over the three-month period after most types of disaster. In particular, droughts increase both energy and food inflation in the same month, but their impact lasts only for that month (Graphs 5.A and 5.C). Storms push up energy inflation only one month after the initial shock (Graph 5.B). Wildfires result in a strong increase in food prices only two to three months after the shock (Graph 5.D). The four types of natural disaster do not have significant effects on core inflation. Overall, we do not find a persistent impact of extreme weather events on inflation.

Dynamic impact of natural disasters on GDP in eight major countries in the Americas[1, 2]

Impact of a one standard deviation shock on cumulative real GDP growth, in per cent — Graph 4

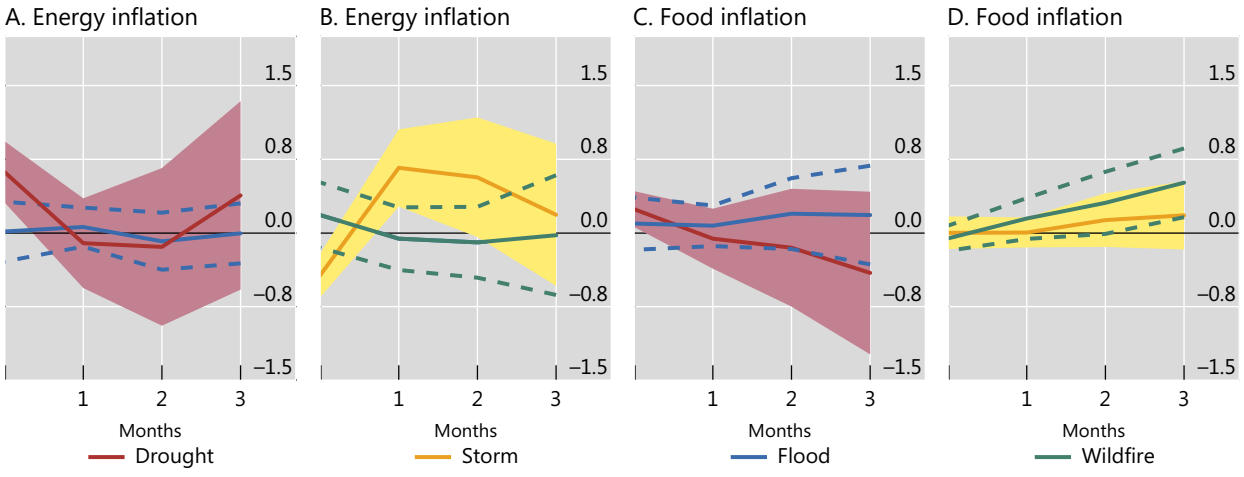


[1] The local projections consider the difference between the quarterly level of log GDP at time $t+h$ and the quarterly GDP level at time $t-1$. Time zero is when a natural disaster occurs. The local projections include the lagged quarterly GDP growth before the natural disaster (one quarter before time zero), fixed effects for country-quarter pairs, time fixed effects at the global level and the natural disaster dummies. [2] Impulse response with +/− two standard deviation intervals.

Source: Authors' calculations based on IMF quarterly macro data and disasters from the EM-DAT International Disaster Database.

Dynamic impact of natural disasters on energy and food inflation in eight major countries in the Americas[1, 2]

Impact of a one standard deviation shock on cumulative inflation after a disaster, in percentage points — Graph 5



[1] Time zero is when a natural disaster occurs. The local projections include lagged inflation rate before the natural disaster (one month before time zero), fixed effects for country-month pairs, time fixed effects at the global level and natural disaster dummies. [2] Impulse response with +/− two standard deviation intervals.

Source: Authors' calculations based on the World Bank price database and disasters from the EM-DAT International Disaster Database.

Policy implications

Fiscal support can manage the direct economic fallout from extreme weather events. Whether and how monetary policy responds depend on: (i) how a specific event affects physical capital; (ii) the relative effect on supply and demand; and (iii) the risks of second-round effects on inflation and inflation expectations.

Tightening monetary policy can be appropriate if the impact of an extreme weather event on inflation is expected to be more persistent. This is more likely to be the case if demand remains resilient, eg due to fiscal support or insurance payouts. By contrast, provided that fiscal space is limited and the insurance gap is large and inflation expectations remain anchored, "looking through" inflation may be an appropriate response. For example, central banks may want to look through inflation when commodity prices increase due to extreme weather events. If a localised weather event does not lead to supply chain disruptions, the monetary policy response may remain muted. Yet in the current juncture, policymakers may need to take into account an increased sensitivity to inflation after the recent bouts of higher inflation and the resulting high price levels in many countries. Here, even small and short-lived shocks to inflation could lead to a more persistent increase in inflation expectations.

When we consider the monetary policy response to the effects of an extreme weather event on output, a key aspect is the destruction of physical capital by floods and storms, the most common extreme weather events in the Americas. In the case of a significant loss of physical capital or housing, the economic costs of an increase in policy rates (ie high rates slowing the rebuilding of the capital stock and thus leading to longer periods of lower productivity growth) may outweigh the costs of short-term increases in inflation.

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