

# Natural disasters and inflation in Canada

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## Introduction

To understand how storms, floods and wildfires affect consumer prices, we study the impact of natural disasters on provincial inflation. We find that natural disasters can significantly increase the volatility of inflation across Canada in the short term. Over the long term, natural disasters can have a significant impact on provincial inflation due to shelter costs, with:

- an increase in consumer price index (CPI) excluding food and energy after floods, largely driven by inflation in shelter prices
- a decrease in CPI excluding food and energy after summer storms when provincial gross domestic product (GDP) is lower than its trend, driven by inflation in shelter prices
- a decrease in CPI excluding food and energy after wildfires when provincial GDP is lower than its trend, partly driven by inflation in rent prices
- a decrease in shelter price inflation for owners after winter storms when provincial GDP is lower than its trend

Because both the frequency and severity of natural disasters are expected to increase, central banks might find it increasingly difficult to target low and stable inflation. For instance, in the *2021 Monetary Policy Framework Renewal* (Bank of Canada 2021, 71), the Bank of Canada stated that to conduct monetary policy effectively, it “must understand the potential impacts of climate change on the macroeconomy, inflation and jobs.”

This note is part of a broad series of work analyzing how natural disasters in Canada affect the macroeconomy, including GDP (Dahlhaus, Duprey and Johnson, forthcoming) and employment (Duprey, Jo and Vallée 2024).

## Our framework helps assess how natural disasters affect provincial inflation

We leverage monthly records of natural disasters across provinces by using the natural disaster shocks from Duprey, Jo and Vallée (2024) that build on Public Safety Canada’s Canadian Disaster Database. The database tracks natural disasters that overwhelm a community’s ability to cope, as partly reflected by:

- the number of injuries and evacuations
- an appeal for assistance
- significant disruptions in a community’s services

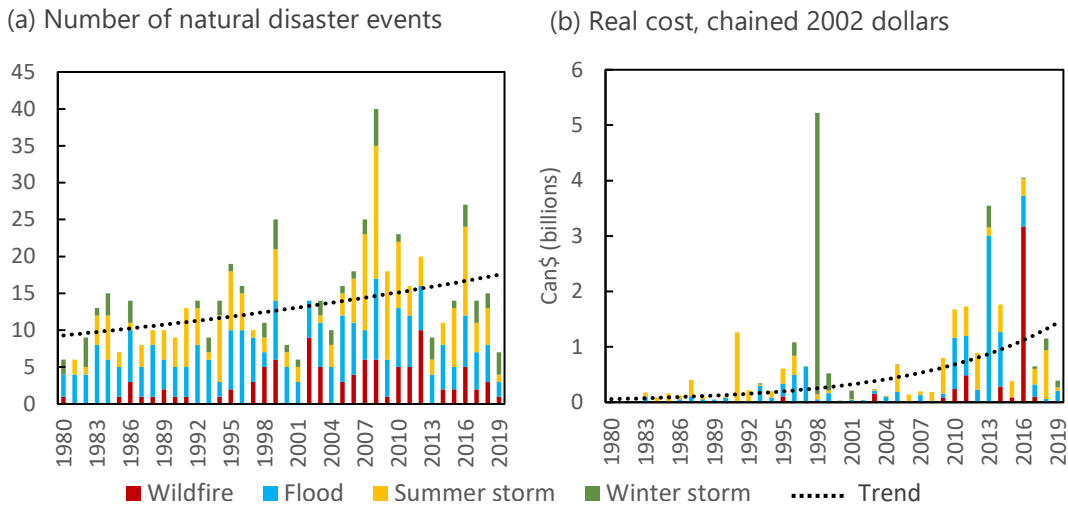
We identify wildfires, floods, summer storms and winter storms from 1980 to 2019. Disaster records suggest both an increasing frequency and rising costs (**Chart 1**). However, a natural

disaster may not affect all Canadian provinces and may be short-lived, so we first perform a monthly provincial analysis before aggregating the results at the country level.

We examine the impact of various natural disasters on provincial inflation using a local projection framework (see the [Appendix](#)). We regress monthly provincial CPI inflation on both past inflation and on a monthly indicator for the occurrence of provincial natural disasters. Once we control for seasonality, natural disasters occurring in a given month or province can be understood as unanticipated shocks. We consider three specifications:

- First, we explore the difference between total CPI and CPI excluding food and energy, a proxy for core inflation. Central banks tend to aim for stability in a measure of core inflation that excludes the most volatile components.
- Second, we differentiate between natural disasters that occur when the provincial economy operates above or below its trend GDP. Inflationary pressures caused by natural disasters may depend on the strength of the provincial economy relative to its trend.
- Third, we break the CPI down into its subcomponents to better understand the role each channel plays.

**Chart 1: Higher annual frequency and severity of natural disasters in Canada**



Note: Only 60% of the 558 disasters shown in panel a have a reported dollar cost shown in panel b. Real cost includes insurance costs and government disaster assistance payments. Summer storms include hail, thunderstorms, high winds, hurricanes and tornadoes; floods include storm surges.

Sources: Public Safety Canada and Bank of Canada calculations

## Summer storms reduce inflation persistently

Summer storms decrease both total inflation and inflation excluding food and energy (**Chart 2**, panels a and b). The difference between total inflation and inflation excluding the most volatile components comes from lower inflation in food prices, mainly in stores.

The lasting negative effect of summer storms on inflation is largely driven by periods of economic activity with below-trend growth due to reduced inflation in shelter prices (**Chart 2**, panels c and d). Decreased shelter inflation is evident from both homeowners and renters, who

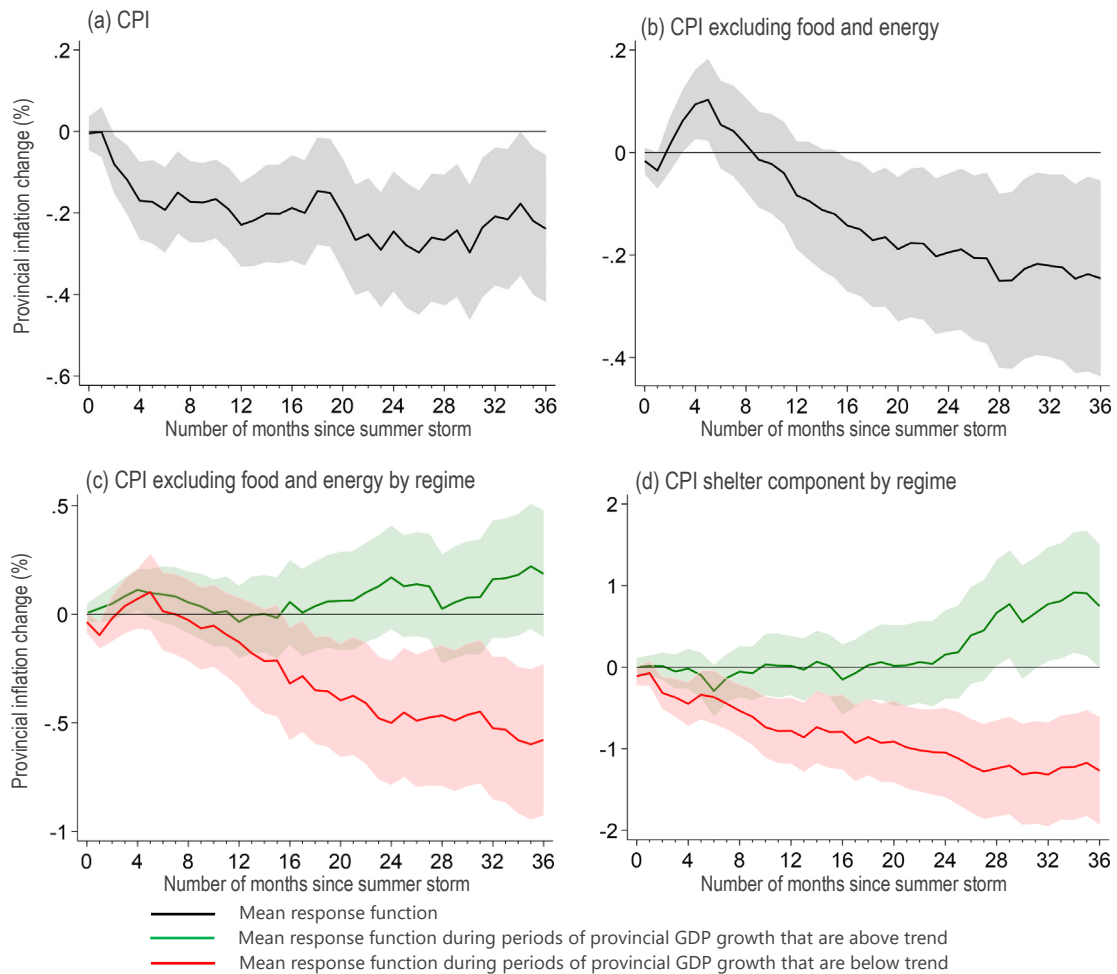
face lower replacement and rental costs, respectively. This negative effect of summer storms on shelter price inflation is possibly due to housing structures being damaged and the quality of neighbourhoods being adversely affected in the absence of strong economic conditions.

We find a similar pattern of reduced prices for goods and services, such as apparel, furnishings and recreation, after summer storms during periods of weaker provincial economic growth. This suggests that households limit their spending after summer storms when economic conditions are weak.

We also observe increased out-of-province migration after summer storms, which could suggest that the impact on prices for goods and services and rent may be related to cross-provincial migration. Households that are already facing weakened provincial economic conditions may be more likely to look for better out-of-province opportunities when they experience a natural disaster.

In good economic times, the short-term increase in inflation excluding the most volatile components is led by increased rents, as well as housing repairs and household equipment to address damages, with shelter costs eventually rising as the value of repaired houses increases (**Chart 2**, panels c and d).

**Chart 2: Impact of an average summer storm on provincial CPI inflation**



Note: Impulse responses of provincial inflation (or subcomponents) are modelled as differences between the indicated horizon ( $t + h$ ) and the period before the disaster ( $t - 1$ ) when the disaster occurs at period  $t$ . We consider the average effect (black) and average effect by provincial economy regime, represented as periods of provincial GDP growth that are above (green) or below (red) trend. The shaded area represents a 90% confidence interval.

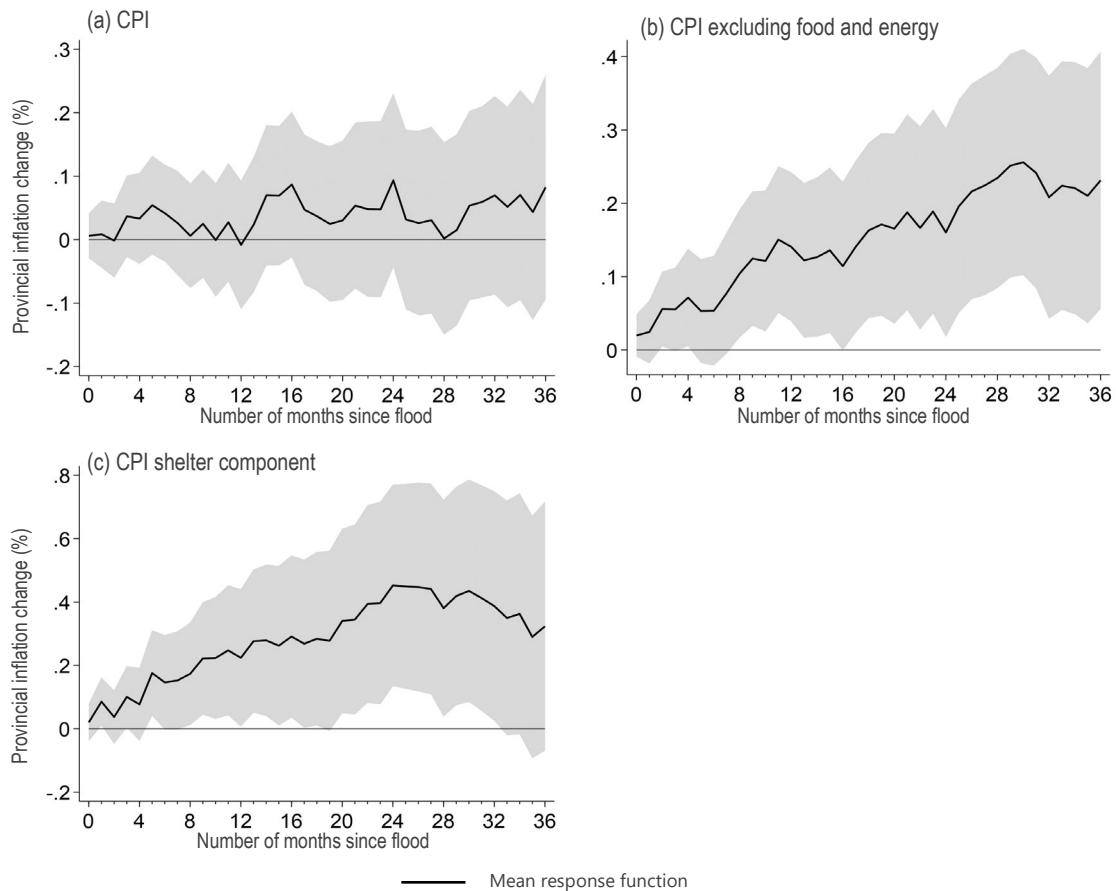
Source: Bank of Canada calculations

## Floods are inflationary, especially due to shelter costs

Floods do not have a significant average impact on total inflation (**Chart 3, panel a**). However, floods persistently increase CPI inflation excluding food and energy because of the impact of shelter price inflation (**Chart 3, panels b and c**). Indeed, residential properties can be particularly exposed to flood risk: in an average year in Canada, flooding is expected to cause about \$3 billion in structural and content damages, with 90% of the damages being concentrated in about 10% of residential properties (Johnston et al. 2023). The effect of flood damage to residential properties is immediately captured by higher inflation in rent one month after the flood, possibly from temporarily displaced households. Subsequent repairs to homes damaged by floods and the risk of future flooding for insurers is reflected in increased home and mortgage insurance.

We also find that prices for home repairs, furniture and household appliances increase during periods of strong provincial economic growth. However, during periods of weak provincial economic growth, the costs for recreation tend to decrease within a year, while the costs for health and personal care and property taxes are more likely to increase a few years after the event.

**Chart 3: Impact of an average flood on provincial CPI inflation**



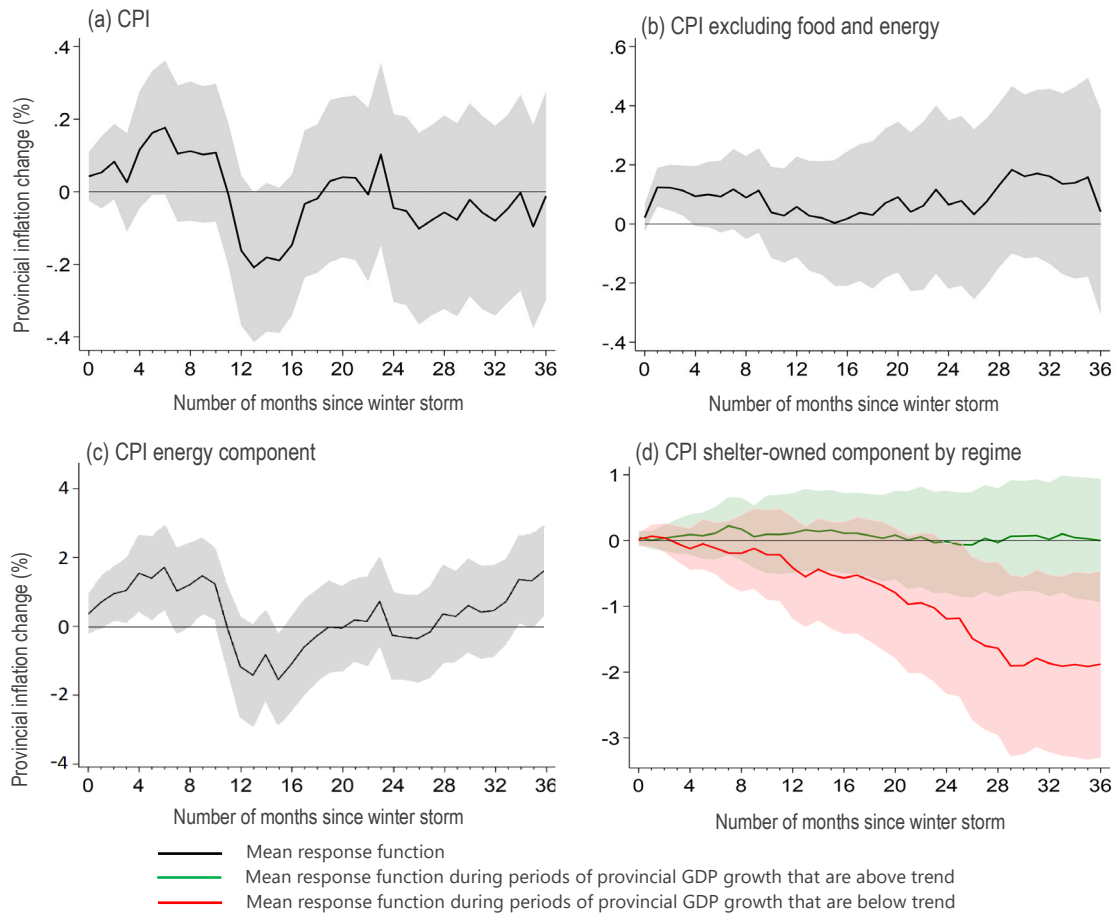
Note: Impulse responses of provincial inflation (or subcomponents) are modelled as differences between the indicated horizon ( $t + h$ ) and the period before the disaster ( $t - 7$ ) when the disaster occurs at period  $t$ . We consider the average effect (black). The shaded area represents a 90% confidence interval.

Source: Bank of Canada calculations

## Winter storms are inflationary in the short term

Winter storms appear to have limited inflationary effects on provincial CPI inflation (**Chart 4**, panel a). These effects are visible only once the food and energy components are excluded (**Chart 4**, panel b). This is partly because the most volatile components of the CPI move in opposite directions. On the one hand, food prices—especially in restaurants—decline when winter storms occur because households are more likely than usual to stay home. On the other hand, energy-related costs—including shelter utility bills due to increased demand for electricity—and transportation costs tend to increase (**Chart 4**, panel c).

**Chart 4: Impact of an average winter storm on provincial CPI inflation**



Note: Impulse responses of provincial inflation (or subcomponents) are modelled as differences between the indicated horizon ( $t + h$ ) and the period before the disaster ( $t - 1$ ) when the disaster occurs at period  $t$ . We consider the average effect (black) and average effect by provincial economy regime, represented as periods of provincial GDP growth that are above (green) or below (red) trend. The shaded area represents a 90% confidence interval.

Source: Bank of Canada calculations

In the short term, CPI inflation excluding food and energy increases due household equipment—possibly to clear the snow and repair damages—and household appliances that may freeze or be damaged by power surges (**Chart 4, panel b**).<sup>1</sup> Over time, shelter costs for homeowners decrease when the provincial economy is weak because of a decrease in homeowners’ replacement costs, possibly from lower prices of new builds (**Chart 4, panel d**).<sup>2</sup>

<sup>1</sup> One of the eight major components of the Canadian CPI is “Household operations, furnishings and equipment.” “Household equipment” includes appliances and other tools, such as snow removal equipment.

<sup>2</sup> One of the eight major components of the Canadian CPI is “Shelter.” The “owned accommodation” subcomponent is an intermediate-level aggregate that includes homeowners’ replacement cost, which represents the hypothetical amount to replace the loss of value to a dwelling from normal depreciation and is linked to prices of new homes.



## **Wildfires reduce inflation mostly when the provincial economy is weak**

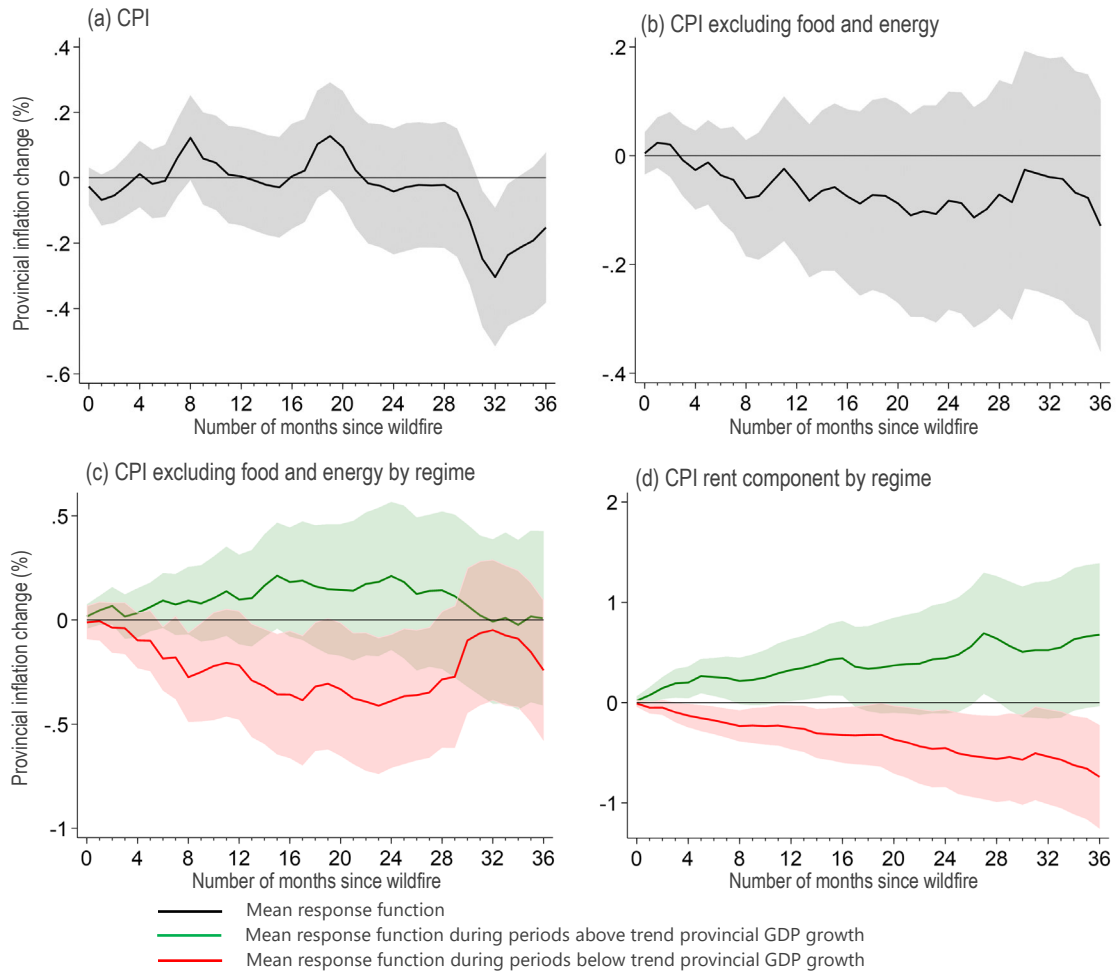
On average, wildfires do not affect CPI inflation, even when inflation excludes food and energy (**Chart 5**, panels a and b). However, this conceals some variability over the provincial economic cycle (**Chart 5**, panel c).

## **Shelter inflation decreases for homeowners and renters when wildfires occur in periods of weak economic growth**

Homeowners face decreased costs for maintenance and repairs and household appliances in the short term. This happens when houses have burned down or were severely damaged by the wildfires and homeowners have limited options for immediate repair because they are likely waiting for an insurance payout. Even if their houses were not directly affected by the wildfires, homeowners may postpone spending on home improvements in the short term. Around a year after the wildfire, homeowners' replacement costs increase, which is possibly explained by higher prices of newly built homes. Prices for household appliances also increase a few years out. Over time, home and mortgage insurance costs steadily rise.

For renters, inflation in rent persistently declines during periods of weak economic growth (**Chart 5**, panel d). This is possibly because people may choose to move to another province hoping for better economic opportunities elsewhere after living through a natural disaster. Indeed, Duprey, Jo and Vallée (2024) find that wildfires during provincial economic slowdowns are associated with job loss and fewer hours worked. We also find some evidence of reduced cross-provincial inflows after wildfires, especially when provincial GDP growth is below trend. This suggests that households may consider both the recent episode of wildfires and provincial economic conditions when choosing to move to another province.

**Chart 5: Impact of an average wildfire on provincial CPI inflation**



Note: Impulse responses of provincial inflation (or subcomponents) are modelled as differences between the indicated horizon ( $t + h$ ) and the period before the disaster ( $t - 1$ ) when the disaster occurs at period  $t$ . We consider the average effect (black) and average effect by provincial economy regime, represented as periods of provincial GDP growth that are above (green) or below (red) trend. The shaded area represents a 90% confidence interval.

Source: Bank of Canada calculations

## Natural disasters increase Canada-wide inflation volatility

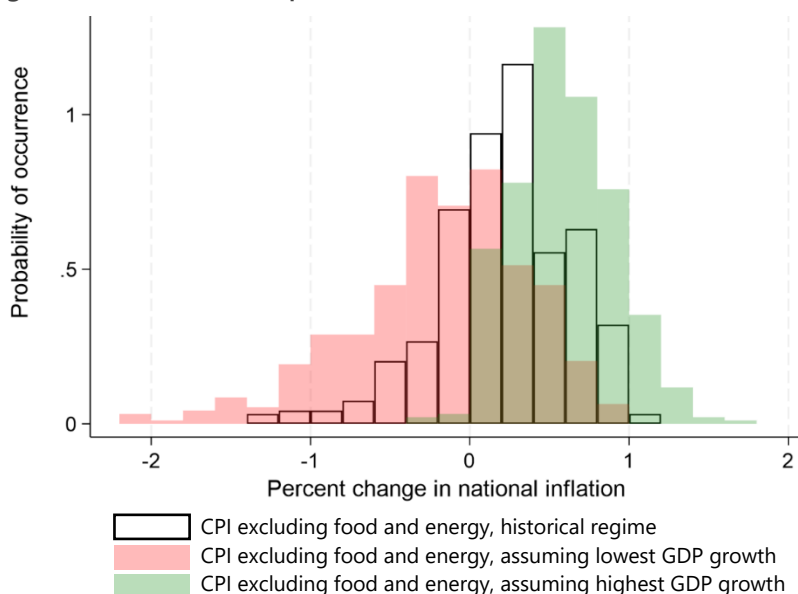
So far, we have focused on the effects of natural disasters on provincial inflation, but provinces can experience several disasters each year, and collectively the effects of these disasters can affect the entire Canadian economy. Using the same provincial model, we aggregate the effects of disasters over the past 40 years and across provinces, weighted by each province's contribution to Canada-wide CPI inflation. **Chart 6** shows the distribution of possible monthly changes in the level of Canada-wide inflation excluding food and energy caused by natural disasters.

Overall, inflation tends to go up, but with a significant likelihood of lower-than-expected inflation (**Chart 6**, black bars). During periods of strong GDP growth, natural disasters are almost always inflationary (**Chart 6**, green bars). However, when GDP growth is weak, natural disasters are more likely to be deflationary due to depressed shelter costs (**Chart 6**, red bars).

The amplified impact during economic downturns may occur if natural disasters interact with vulnerabilities and productivity. For example, natural disasters tend to affect vulnerable households (Duprey et al. 2021), sometimes:

- decreasing job and wage growth when there is already slack in the labour market (Duprey, Jo and Vallée 2024)
- generating migration away from areas with higher exposure to disasters (Leduc and Wilson 2024)

**Chart 6: Average national inflation impact from disasters in Canada, 1980–2019**



Note: A reading of 1 means that, on average, national CPI excluding food and energy is 1% higher than usual due to natural disasters. For simplicity, each natural disaster is assumed to have an impact over a maximum of 36 months, the horizon of the impulse responses. The black bars correspond to the effect when using historical provincial GDP growth. The green (red) bars are counterfactual effects if we instead assume that all provincial economies always experienced their strongest (weakest) GDP growth above (below) trend.

Source: Bank of Canada calculations

## Are natural disasters a possible source of concern for central banks?

First, central banks tend to look through the short-term volatility of inflation by using measures of core inflation. Although central banks use more advanced methods to calculate core inflation, in this note we proxy for core inflation by relying on inflation excluding the most volatile components of food and energy. Even after excluding those volatile components, we find natural disasters can have lasting effects on the shelter component of inflation.

Second, given the expected increase in frequency and intensity of natural disasters associated with climate change in the coming decades, it is important for central banks to monitor how natural disasters contribute to inflation volatility. For instance, in Canada the flexible inflation-targeting framework aims to maintain total CPI at the 2% midpoint of an inflation-control range of 1% to 3%. Historically, the year-over-year inflation caused by natural disasters has remained mostly around plus or minus one-half of a percentage point, but natural disaster outliers can trigger larger swings.

Finally, the tendency of natural disasters to be inflationary during periods of strong economic growth and deflationary in periods of weak economic growth relative to trend (**Chart 6** green and red bars) might introduce a bias toward more (less) aggressive monetary policy. Specifically, a central bank may set the policy interest rate slightly higher (lower) during a period of relatively strong (weak) GDP growth when a natural disaster occurs than it would otherwise because such disasters tend to be inflationary (deflationary).

## Conclusion

Geographically localized and temporary events like natural disasters can have significant and lasting effects on inflation. With natural disasters increasing in both intensity and frequency, these events may require policy-makers' attention.

- First, although natural disasters are inflationary on average, they tend to be deflationary during periods of weak economic growth, when monetary policy easing may be needed to stabilize the economy.
- Second, natural disasters contribute to Canada-wide volatility in inflation. Despite their unequivocal destructive nature, natural disasters may not have a one-sided impact on inflation. A natural disaster may increase the range of possible risks to inflation, making it harder for central banks to maintain inflation within the target range and separate out volatility related specifically to climate change.
- Third, natural disasters contribute to inflation through channels that may already be challenging for a central bank to stabilize, such as shelter inflation and energy costs. Although central bankers often rely on inflation measures excluding energy, looking through the effect of natural disasters on shelter may be difficult.

In this note, we abstract from other channels where climate change influences inflation. For instance, a growing literature examines the inflationary impacts of extreme temperature anomalies (heat waves, droughts) on food prices (e.g., Faccia, Parker and Stracca 2021; Kotz et al. 2023). Due to our focus on domestic natural disasters, we do not capture climate-related supply shocks on imported inflation from our trade partners. Finally, natural disasters can increase uncertainty around measuring inflation when using statistical tools such as seasonal adjustments (Amano, Gosselin and McDonald-Guimond 2021).

## Appendix: Econometric model

Using Jordà's (2005) local projection model, we seek to explain fluctuations in provincial inflation ( $\Pi$ ) after a disaster starts (in period  $t$ ), up to a horizon of  $h$  months, as a function of lagged provincial inflation.

$$\Pi_{i,t+h:t-1} = c + \sum_{\tau=1}^3 \psi_h^\tau \Pi_{i,t-\tau} + \sum_{d=1}^4 \alpha_h^d \mathbb{I}(\text{disaster})_{i,t}^d + \text{controls} + \varepsilon_{i,t+h}$$

We simultaneously incorporate four types of natural disasters—wildfires, floods, summer storms and winter storms—using the dummy variable  $\mathbb{I}(\text{disaster})_{i,t}^d$  for disaster type  $d$ , in province  $i$ , at time  $t$ . The coefficient  $\alpha_h^d$  represents the average effect of disaster  $d$  on annualized provincial inflation over horizon  $h$ .

We control for before and after the adoption of the inflation-targeting framework, disasters occurring around the same time but in different provinces, seasonal patterns that are possibly specific to a given province, slow annual changes over time, and any effect specific to a province. Controlling for a measure of the provincial output gap yields similar results but doing so requires us to assume that natural disasters do not affect the output gap.

To test if inflationary pressures differ with the strength of the provincial economy, we extend the baseline equation with a state-dependence specification. We relate the natural disaster dummy variable with the probability of being in a provincial economic slowdown approximated by a logistic transformation of the provincial output gap. See Duprey and Fernandes (forthcoming) for more details.

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