# Eye of the Storm: The Impact of Climate Shocks on Inflation and Growth*

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Serhan Cevik[$] João Tovar Jalles[#]

**Abstract**

What is the impact of climate change on inflation and growth dynamics? This is not a simple question to answer as climate shocks tend to be ubiquitous, but with opposing effects simultaneously on demand and supply. The extent of which climate-related shocks affect inflation and economic growth also depends on long-run scarring in the economy and the country's fiscal and institutional capacity to support recovery. In this paper, we use the local projection method to empirically investigate how climate shocks—as measured by weather-related natural disasters—influence inflation and economic growth in a large panel of countries over the period 1970–2020. The results shows that both inflation and real GDP growth respond significantly but also differently in terms of direction and magnitude to different types of disasters caused by climate change. We split the full sample of countries into income groups—advanced economies and developing countries—and find a striking contrast in the impact of climate shocks on inflation and growth according to income level, state of the economy, and fiscal space when the shock hits.

JEL Classification Numbers: E31; I10; N10

Keywords: [Type Here] Climate change; inflation; growth; local projections; panel data

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$ International Monetary Fund, 700 19th Street NW, 20431 Washington DC; USA. email: scevik@imf.org.
# University of Lisbon-Lisbon School of Economics and Management (ISEG), Rua do Quelhas 6, 1200-781 Lisboa, Portugal. Research in Economics and Mathematics (REM) and Research Unit on Complexity and Economics (UECE), Universidade de Lisboa-ISEG, Rua Miguel Lupi 20, 1249-078 Lisbon, Portugal. Economics for Policy, Universidade Nova de Lisboa-Nova School of Business and Economics, Rua da Holanda 1, 2775-405 Carcavelos, Portugal. IPAG Business School, 184 Boulevard Saint-Germain, 75006 Paris, France. Email: joaojalles@gmail.com

## I. INTRODUCTION

Climate change is the defining challenge of our time, with complex and evolving dynamics that remain a source of uncertainty for the global economy and financial markets. The global annual average surface temperature has already increased by more than 1.3 degrees Celsius (°C) compared with the preindustrial average, escalating the frequency and severity of extreme weather events. Projections show that more rapid and intense climate change will increase the risk of heat waves, wildfires, droughts, flooding, and severe storms and inflict greater harm on the environment, lives, and livelihoods, as the global mean temperature increase by as much as 4°C over the next century (Stern 2007; IPCC 2007, 2014, 2019; 2021). The economic consequences of climate change will be felt across the world, but the extent of potential vulnerability depends on the size and composition of economies, the resilience of institutions and physical infrastructure, and the capacity for mitigation and adaption to climate change.

What is the impact of climate change on inflation and growth dynamics? This is not a simple question to answer as climate shocks tend to be ubiquitous, but with opposing effects simultaneously on demand and supply. The magnitude and pattern of the impact on inflation and growth also depends on long-run scarring in the economy and the country's fiscal and institutional capacity to support recovery. In this paper, we use the local projection (LP) method proposed by Jordà (2005) to investigate how climate shocks—measured by a binary variable for the occurrence of a large-scale weather-related natural disaster or the number of deaths caused by such an event per population in a given year—influence alternative measures of inflation and economic growth in a large panel of 173 countries during the period 1970–2020. We also explore the possibility of nonlinear effects of climate shocks on inflation and real GDP growth by looking at two particular dimensions: (i) the position of a given economy in the business cycle and (ii) the level of public debt as a proxy of fiscal space when a weather-related disaster occurs.

Using data on 173 countries over the period from 1970 to 2020, the empirical analysis shows that inflation and growth respond significantly to disasters caused by climate change but the impact varies in terms of direction and magnitude. While an increase in temperature results in lower inflation, drought and storms lead to higher levels of inflation. On the other hand, we find that the initial response of economic growth is negative to all types of climate shocks, but the magnitude and pattern of response show variation over the long run. Furthermore, when we split the sample of countries by income group, we observe a striking contrast in the impact of climate shocks on inflation and growth in advanced and developing countries. We also develop a more granular analysis by focusing on alternative measures of inflation and identify that the impact of weather-related shocks on core and food inflation shows significant variation in magnitude and pattern across country groups. Finally, we find that the impact of climate disasters on inflation and growth varies in a nonlinear fashion depending on the state of the economy and the level of fiscal space when the shock hits.

Empirical findings presented in this paper have several important implications for economic policy in the wake of accelerating climate change. First, this will make inflation and growth dynamics more volatile, with potential feedback effects across all sectors of the economy. Second, the differing patterns in how inflation and growth response to climate shocks will lead to greater heterogeneity in the level of inflation and income growth experienced by different segments of the society within a country. In other words, households whose consumption basket consists of goods and services that are more likely to experience an increase in inflation and loss of income in the aftermath of natural disasters will be more adversely affected compared to households whose consumption is proportionately less dependent on such products and income is not subject to a negative shock. These results, in our view, reflect demographic and structural differences and weaker fiscal and institutional capacity in developing counties to adapt to and mitigate the consequences of climate shocks. Looking forward, it is also important for policymakers to take into account how the green transition away from fossil fuels, as an important part of climate change mitigation efforts, will affect inflation and growth dynamics.

The remainder of this paper is organized as follows. Section II provides an overview of the related literature. Section III describes the data used in the empirical analysis. Section IV introduces the salient features of our econometric strategy. Section V presents the empirical results, including a series of robustness checks. Finally, Section VI offers concluding remarks with policy implications.

## II. A Brief Overview of the Literature

This paper brings together different strands of the literature on inflation, economic growth and climate change. Inflation is show to be a function of factors including policy preferences (Rogoff, 1985) macroeconomic developments such as the level of income, trade and financial openness, and fiscal deficits (Végh, 1989; Romer, 1993; Campillo and Miron, 1997; Lane 1997; Galí and Gertler, 1999; Gruben and McLeod, 2002; Catao and Terrones, 2005; Clark and McCracken, 2006; Gupta, 2008, Badinger, 2009), flexibility of labor-market institutions (Cukierman and Lippi, 1999), type of exchange rate regimes (Levy-Yeyati and Sturzenegger, 2001; Husain et al., 2005), and political and institutional factors (Cukierman, 1992; Aisen and Veiga, 2007). There is also an extensive array of studies focusing on the relationship between central bank independence and inflation. Building on Kydland and Prescott (1977) and Barro and Gordon (1993), this strand of the literature shows that greater central bank independence contributes to low inflation, but not always in a consistent and statistically significant way (Cukierman et al., 1992; Alesina and Summers, 1993; Campillo and Miron, 1997; Lougani and Sheets, 1997; Cottarelli et al., 1998; Posen, 1998; Arnone et al., 2006; Brumm, 2006; Walsh, 2008). Cevik and Zhu (2020), for example, find that greater monetary independence, measured as a country's ability to conduct its own monetary policy for domestic purposes independent of external monetary influences, is associated with lower inflation.

Economic growth shows enormous variation across countries and over time, driven by a plethora of cultural, demographic, economic, financial, institutional, political and social factors. Neoclassical and endogenous growth theories explain these differences in growth performance mainly by the accumulation of physical and human capital and technological advancements (Solow, 1956; Romer, 1986, 1990; Lucas, 1988). Using cross-country analysis, Easterly and Wetzel (1989), Barro (1991; 2003), Barro and Sala-i-Martin (1992), Mankiw et al.(1992), Easterly and Rebelo (1993), King and Levine (1993), Islam (1995), Knack and Keefer (1995), Easterly and Levine, (1997), Sachs and Warner (1997), Burnside and Dollar (2000), Acemoglu et al.(2002), Sala-i-Martin et al.(2004), among others, show that the differences in income growth rates are systematically related to a set of quantifiable variables, including the initial level of real GDP per capita, the amount of human capital in terms of educational attainments and health conditions, public and private investment, the extent of international openness and terms-of-trade shocks, along with the influence of geography, institutions and politics. Other studies reach similar empirical results, even with different samples and methodologies (Ciccone and Jarocinski, 2010).

There is a growing literature on the economic and financial effects of climate change.[1] Starting with Nordhaus (1991; 1992) and Cline (1992), aggregate damage functions have become a mainstay of analyzing the climate-economy nexus. Although identifying the macroeconomic impact of annual variation in climatic conditions remains a challenging empirical task, Gallup et al. (1999), Nordhaus (2006), and Dell et al. (2012) find that higher temperatures result in a significant reduction in economic growth in developing countries. Burke et al. (2015) confirm this finding and conclude that an increase in temperature would have a greater damage in countries that are concentrated in geographic areas with hotter climates. Using expanded datasets, Acevedo et al. (2018), Burke and Tanutama (2019) and Kahn et al. (2019) show that the long-term macroeconomic impact of weather anomalies, such as persistent changes in the temperature above or below the historical norm, is uneven across countries and that economic growth responds nonlinearly to temperature.

In a related vein, it is documented that climate change by increasing the frequency and severity of natural disasters affects economic development (Loyaza et al., 2012; Noy, 2009; Raddatz, 2009; Skidmore and Toya, 2002; Rasmussen, 2004), reduces the accumulation of human capital (Cuaresma, 2010) and worsens a country´s trade balance (Gassebner et al., 2010). More recently, Cevik and Jalles (2020; 2021; 2022) show that climate change vulnerability and resilience have significant effects on government bond yields and spreads, the probability of sovereign debt default and sovereign credit ratings, especially in developing countries. In a similar vein, Bansal et al. (2016) and IMF (2020) find that the risk of climate change—as proxied by temperature rises—has a negative effect on asset valuations, while Bernstein et al. (2019) show that real estate exposed to the physical risk of sea level rise is priced at a discount relative to otherwise similar unexposed properties. Focusing on the U.S., Painter (2020) finds that counties more likely to be affected by climate change pay more in underwriting fees and initial yields to issue long-term municipal bonds compared to counties unlikely to be affected by climate change.

With regards to the impact of climate change on consumer price inflation, there is a small but growing literature. A few studies look at the impact of natural hazards on prices (Parker, 2018; Heinen et al., 2019), while there is almost no research on the effect of extreme weather events including temperature deviations, apart from studies focusing on specific sectors of activity (De Winne and Peersman, 2018; 2021). In a recent paper, Faccia et al. (2021) investigate how extreme temperatures affect various measures of inflation in 48 advanced and emerging economies during the period 1951–1980 and find that higher temperatures played a non-negligible role in driving price developments, especially for emerging market economies. Similarly, Kabundi et al. (2022) analyze how climate shocks affect consumer prices and find that the impact depends on the type and intensity of shocks, country income level, and monetary policy regime.

[1] Tol (2018) provides a recent overview of this expanding literature.

## III. DATA OVERVIEW

We construct a panel dataset of annual observations covering 173 countries over the period 1970–2020. Our dependent variables are consumer price inflation and economic growth. Inflation is computed on an annual basis as the year-on-year percentage change in the CPI as follows:

$$\pi_{c,t} = \left(\frac{CPI_{c,t}}{CPI_{c,t-12}}\right) * 100$$

where $\pi_{c,t}$ denotes inflation in country $c$ at time $t$ based on headline CPI, core CPI and food component of the CPI, drawn from the World Bank's global database of inflation (Ha *et al*., 2021). We measure economic growth using the annual rate of change in real GDP, which is obtained from the World Bank's World Development Indicators database.

The main explanatory variables of interest are climate shocks as measured by the occurrence of climate-related natural disasters from the Emergency Events Database (EM-DAT). The EM-DAT database on natural disasters—compiled by the Centre for Research on the Epidemiology of Disasters (CRED) at the Université Catholique de Louvain in Belgium—offers information on different categories from which we focus on climate-related events including droughts, extreme temperatures, and storms. [2] These shocks take the value of 1 when a climate-related disaster occurs in a country in a given year and zero otherwise. However, to develop a more granular analysis, we also use the intensity of climate-related natural disasters as measured by the number of deaths scaled by population.

Following the literature, we introduce a number of control variables, including real GDP per capita, measures of trade and financial openness, money supply growth, the terms-of-trade index, the output gap[3], and the public debt-to-GDP ratio, which are drawn from the IMF, the World Bank and the Chinn-Ito database. Appendix Table A1 reports summary statistics across all countries in the sample.

## IV. ECONOMETRIC METHODOLOGY

The empirical approach used in this paper boils down to estimating the response of inflation and economic growth to climate shocks by applying the LP method and derive impulse response functions (IRFs) in a panel setting. The LP approach is flexible enough to accommodate a panel structure and does not constrain the shape of IRFs, which makes it less sensitive to misspecification. Auerbach and Gorodnichenko (2013), Jordà and Taylor (2016), Ramey and Zubairy (2018), as well as Born et al. (2019) among others, also rely on local projections while analyzing different types of policy instruments. Moreover, Auerbach and Gorodnichenko (2013) and Romer and Romer (2019) advocate the LP method as a flexible alternative to estimating dynamic responses, such as, in our context, interactions between climate shocks and macroeconomic and developments. Accordingly, we define the baseline specification in the following form:

[2] The EM-DAT provides data on the occurrence and effects of over 22,000 large-scale natural disasters across the world from 1900 to the present day. The database is compiled from various sources, including UN agencies, non-governmental organizations, insurance companies, research institutes and press agencies.

[3] The output gap for each country is obtained by applying the Hodrick-Prescott (HP) filter.

$$y_{t+k,i} - y_{t-1,i} = \alpha_i + \tau_t + \beta_k CS_{i,t} + \theta X_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $y$ is a measure of consumer price inflation or economic growth, which are winsorized at 5th and 95th percentiles to mitigate the effects of extreme outliers; the coefficients $\alpha_i$ and $\tau_t$ are country and time fixed effects, respectively, accounting for cross-country heterogeneity and global shocks; $\beta_k$ denotes the cumulative response of inflation or growth in each $k$ year after the climate shock; and $CS_{i,t}$ denotes the climate shock variable, which is measured by either a binary variable or the number of deaths scaled by population and treated as an exogenous event that cannot be anticipated nor correlated with past changes in economic activity. Large-scale climate shocks featured in our analysis are considered to be country-wide shocks for two reasons: either because the shock itself is widespread or because economic relationships related to trade and/or market integration eventually propagate the shock throughout the country. $X_{i,t}$ is a set a of control variables including up to two lags of climate shocks, of the relevant dependent variable and two lags of the output gap obtained via the HP filter.[4]

This equation is estimated for three different measures of consumer price inflation—headline CPI, core CPI, and food prices—and real GDP growth. In terms of the main variable of interest ($CS_{i,t}$), we consider three alternative climate shocks: drought, extreme temperature, and storms. Equation (1) is estimated using Ordinary Least Squares (OLS) with Spatial Correlation Consistent (SCC) standard errors as proposed by Driscoll and Kraay (1998).[5] Impulse response functions (IRFs) are then obtained by plotting the estimated $\beta_k$ for $k = 0,1,\dots,5$ with 90 percent confidence bands computed using the standard errors associated with the estimated coefficients $\beta_k$ over a five-year period.[6]

We also explore whether initial macro-fiscal conditions at the time of the shock influence the impact of climate shocks on inflation and growth. The LP estimation of nonlinear effects is equivalent to Granger and Terasvirta's (1993) smooth transition autoregressive (STAR) model.[7] The augmented LP model takes the following form:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i + \tau_t + \beta_k^L F(z_{i,t}) CS_{i,t} + \beta_k^H (1 - F(z_{i,t})) CS_{i,t} + \theta X_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$\text{with} \quad F(z_{it}) = \frac{\exp(-\gamma z_{it})}{1+\exp(-\gamma z_{it})}, \quad \gamma > 0$$

in which $z_{it}$ the state of the economy as measured by the output gap or the public debt-to-GDP ratio that is normalized to have zero mean and unit variance.[8] The coefficients $\beta_L^k$ and $\beta_H^k$ capture

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[4] To ensure the robustness of our empirical findings, we also include additional control variables: real GDP per capita, trade openness, financial openness, the terms-of-trade index, and money supply growth.

[5] This is a nonparametric technique assuming the error structure to be heteroskedastic, autocorrelated up to some lag, and possibly correlated across countries.

[6] Another advantage of the LP method compared to vector autoregression (autoregressive distributed lag) specifications is that the computation of confidence bands does not require Monte Carlo simulations or asymptotic approximations. One limitation, however, is that confidence bands at longer horizons tend to be wider than those estimated in vector autoregression specifications.

[7] Using such a STAR function in such empirical setups is not new. Auerbach and Gorodnichenko (2012, 2013) and Abiad *et al*. (2016) employed a similar approach.

[8] The weights assigned to each regime vary between 0 and 1 according to the weighting function $F(.)$, so that $F(z_{it})$ can be interpreted as the probability of being in a given space state.

the impact of climate shocks at each horizon k in cases of recessions ($F(z_{it}) \approx 1$ when z goes to minus infinity) and expansions ($1 - F(z_{it}) \approx 1$ when z goes to plus infinity), respectively. We choose $\gamma = 1.5$.[9] This approach permits a direct test of whether the effect of climate shocks varies across different regimes such as recessions and expansions and also allows the effect of climate shocks to change smoothly between recessions and expansions by considering a continuum of states to compute IRFs, thus making the response more stable and precise. We use fiscal space as an alternative conditioning variable to assess whether a government's fiscal capacity to respond to a climate shock affects its inflationary impact.

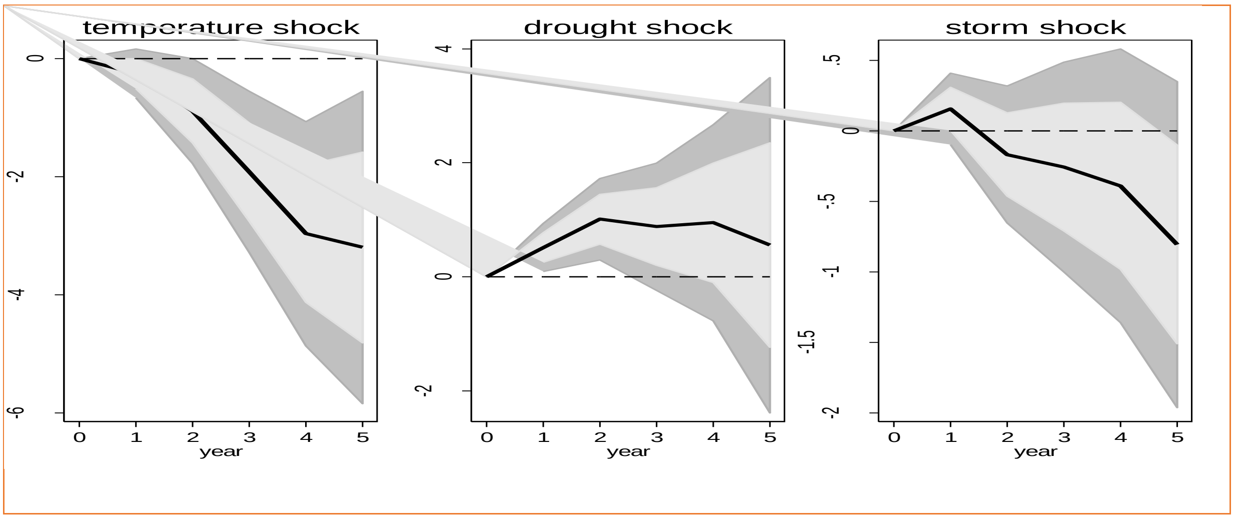
## V. EMPIRICAL RESULTS

### A. Climate Shocks and Inflation

The starting point of our empirical analysis is the estimation of the impact of climate shocks on inflation in the whole sample of 173 countries over the period 1970-2020. Figure 1 presents the IRFs of headline inflation to three types of climate-related natural disaster shocks, together with 90 percent confidence intervals. We find that headline inflation responds significantly but also differently in terms of direction and magnitude to climate shocks as measured by a binary variable for the occurrence of a large-scale weather-related natural disaster in a given year. While an increase in temperature results in lower inflation, drought and storms lead to higher inflation. In the case of a temperature shock, we find that headline inflation declines significantly below its initial level in the first year and over the long run. This fall reaches its trough after about 4 years since the shock, at which point headline inflation is 3.5 percentage points lower than if the temperature shock had not happened. A drought shock, on the other hand, results in an immediate increase in headline inflation above its initial level, which lasts over the long term and amounts to about 1.5 percentage points compared to if the shock had not occurred. The impact pattern of a storm shock, however, is different than other types of weather-related disasters. We find that headline inflation increases by about 0.2 percentage points in the first year after the storm shock, but then ends up 1 percentage points lower over the long term if the shock had not happened. These results suggest that climate shocks have an enduring effect on inflation through multiple channels, such as (i) increasing or lowering agricultural production and food prices, (ii) dampening economic activity and reducing labor productivity, and (iii) affecting transportation infrastructure and distribution costs. However, we cannot disentangle the opposing effects on headline inflation in a broad sample advanced and developing countries.

**Figure 1. Impact of Climate Shocks on Headline Inflation: Global Sample**

[9] Our results hardly change when using alternative values of the parameter $\gamma$, between 1 and 4. We also attempted using alternatively the output gap computed via the Hamilton (2018) approach. Results remain qualitatively similar.



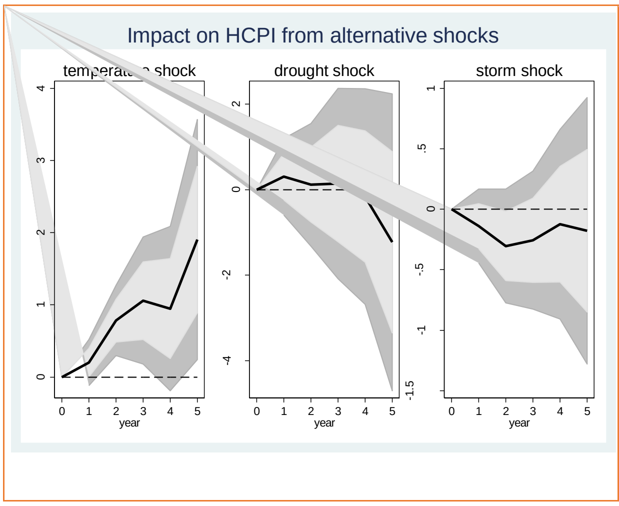
Note: The charts show IRFs using the LP method. x-axis in years; t=0 is the year preceding the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock and the dark grey area denotes 90-percent confidence bands based on standard errors clustered at the country level.

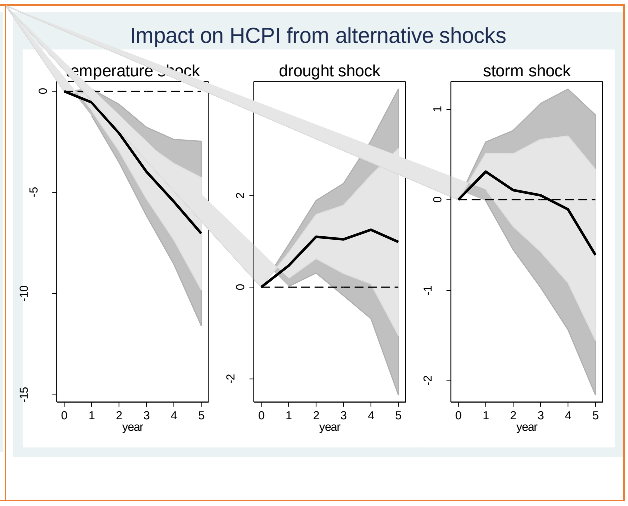
We also explore the possibility of nonlinear effects of climate shocks on inflation by looking at two particular dimensions: (i) the position of a given economy in the business cycle at the time the climate shock hits; and (ii) the level of public debt as a proxy of fiscal space to cushion the impact of climate shocks. First, as presented in Figure 4, we find that the state of the economy plays an important role in shaping the impact of weather-related disasters on core inflation, but magnitude and long-run pattern depend on the exact nature of the shock. Second, as presented in Figure 5, we find that climate shocks have a differentiated effect on core inflation depending on the level of fiscal space as measured by low levels of public debt as a ratio of GDP. The inflationary impact of weather-related disasters in lower in countries with greater fiscal space compared to countries that are fiscally constrained.

An increase in temperature leads to higher and more volatile core and food inflation in advanced economies, whereas it has the opposite and sustained impact in developing countries. A drought shock appears to be disinflationary with a volatile pattern in advanced economies, but exhibits a sustained inflationary effect in developing countries. The inflationary impact of droughts on food prices, however, is similar across all country groups, albeit significantly greater in developing countries. Finally, a storm shock leads to a small immediate increase in core inflation in advanced economies, but this effect dissipates over the long run, whereas we observe a downward adjustment in core inflation in the first year after a storm shock that remains intact over the long run in the case of developing countries. The impact of storms on food inflation, on the other hand, exhibits an opposite pattern in advanced economies (declining) and developing countries (increasing), but converges to insignificance over the long run in both country groups.

**Figure 2. Impact of Climate Shocks on Headline Inflation: Income Group**

| Advanced Economies | Developing Countries |
| --- | --- |

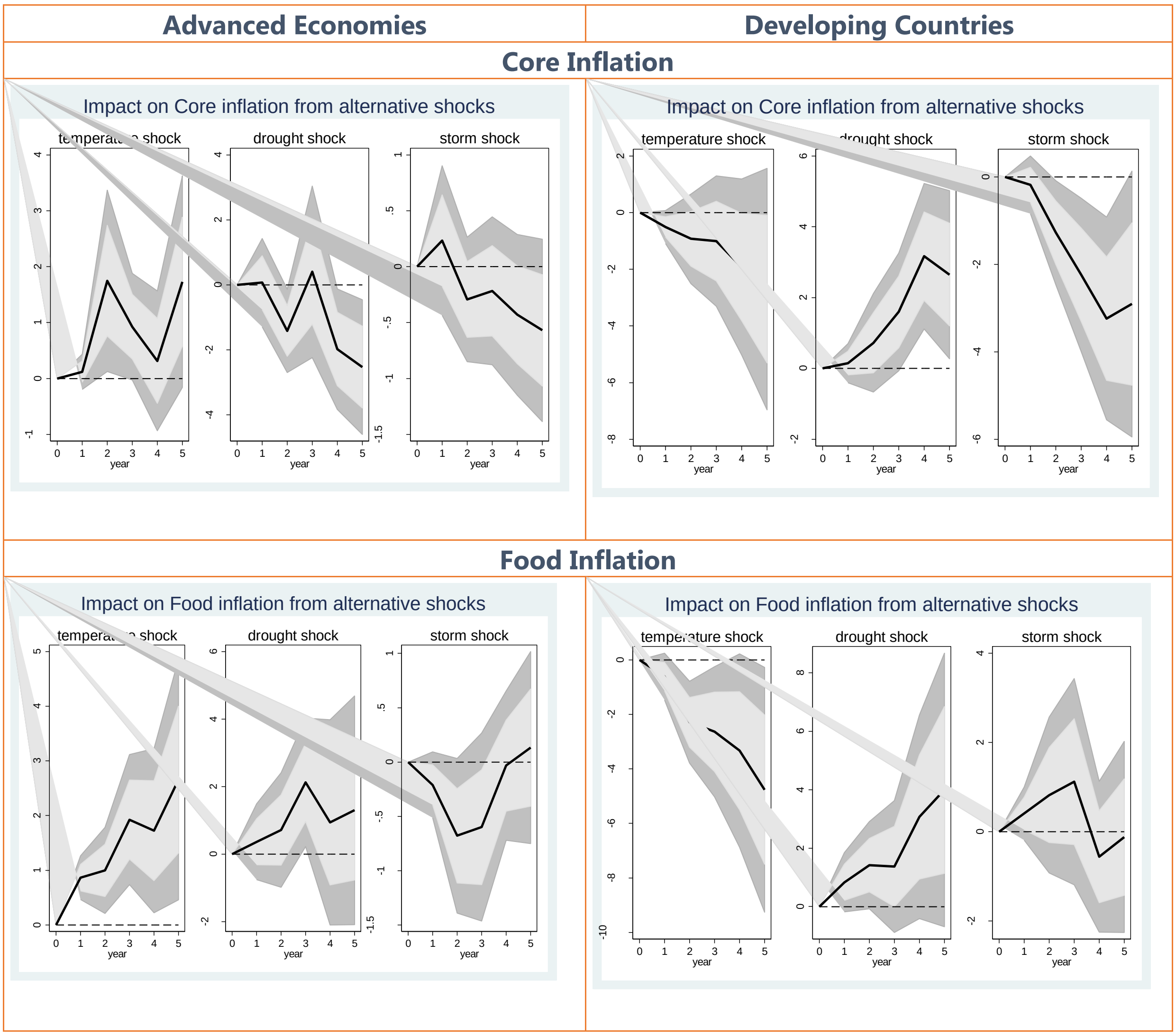



Note: The charts show IRFs using the LP method. x-axis in years; t=0 is the year preceding the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock and the dark grey area denotes 90-percent confidence bands based on standard errors clustered at the country level.

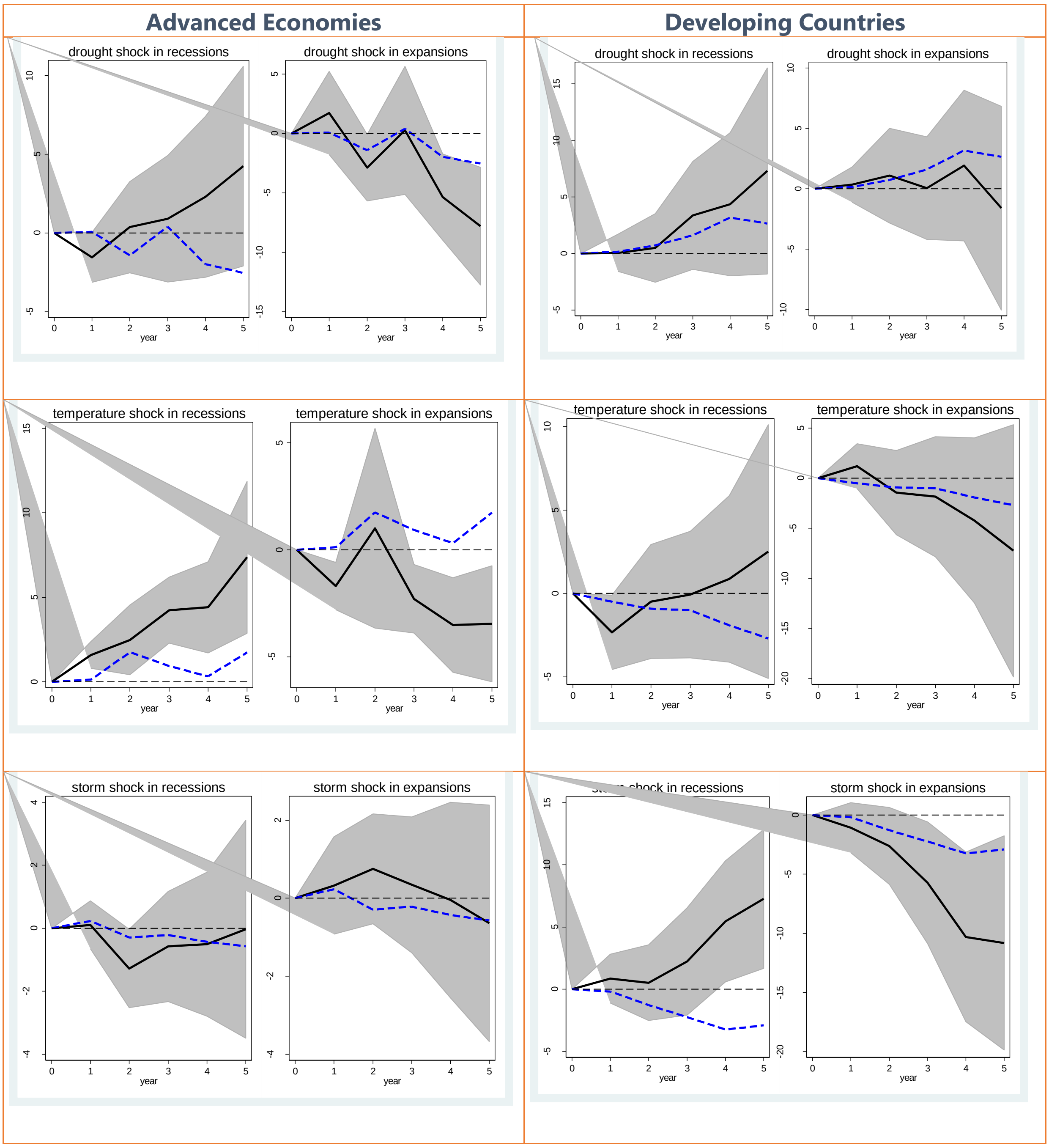
We also explore the possibility of nonlinear effects of climate shocks on inflation by looking at two particular dimensions: (i) the position of a given economy in the business cycle at the time the climate shock hits; and (ii) the level of public debt as a proxy of fiscal space to cushion the impact of climate shocks. First, as presented in Figure 4, we find that the state of the economy plays an important role in shaping the impact of weather-related disasters on core inflation, but magnitude and long-run pattern depend on the exact nature of the shock. Second, as presented in Figure 5, we find that climate shocks have a differentiated effect on core inflation depending on the level of fiscal space as measured by low levels of public debt as a ratio of GDP. The inflationary impact of weather-related disasters in lower in countries with greater fiscal space compared to countries that are fiscally constrained.

**Figure 3. Impact of Climate Shocks on Inflation: Core and Food Inflation**



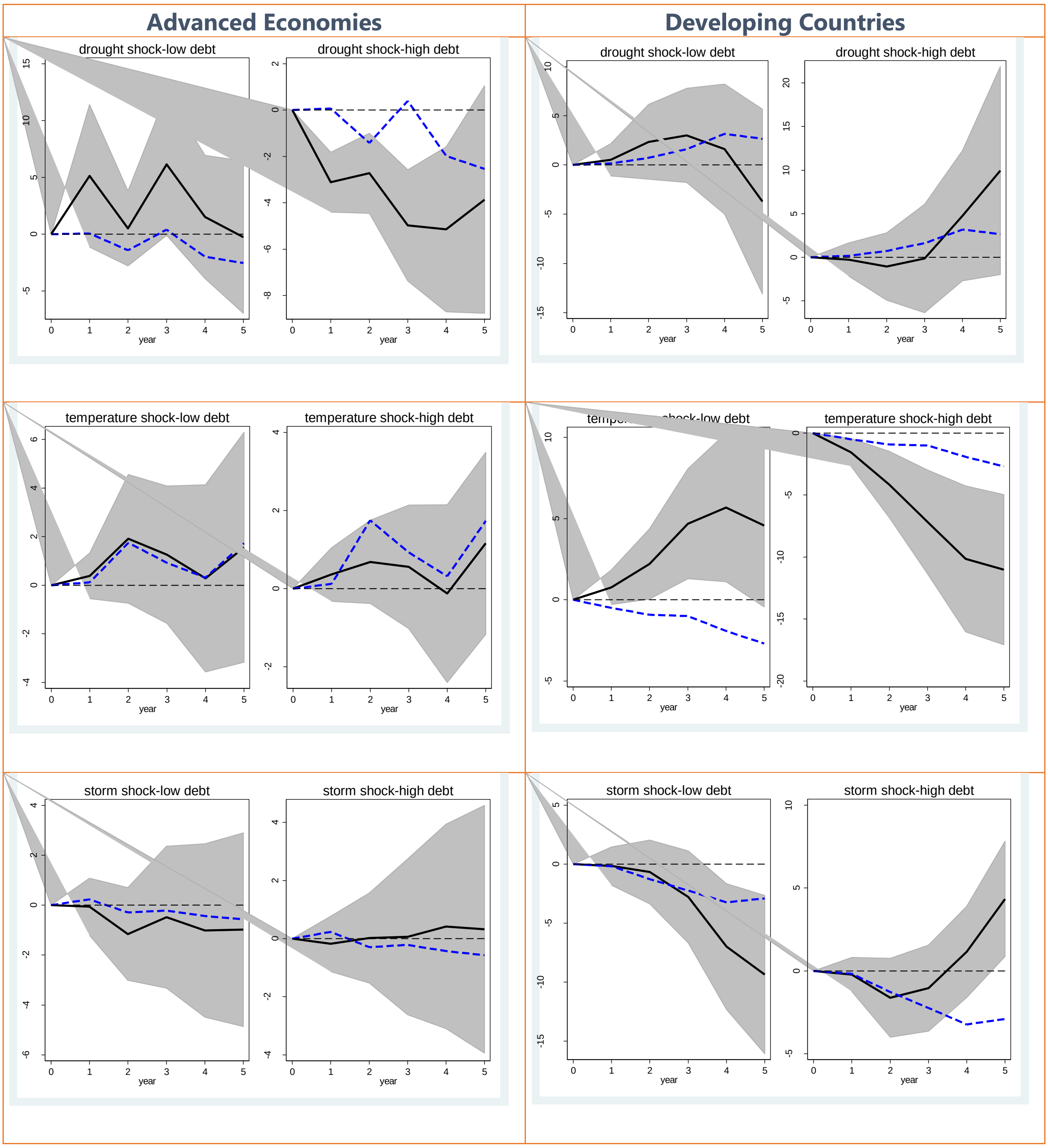

Note: The charts show IRFs using the LP method. x-axis in years; t=0 is the year preceding the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock and the dark grey area denotes 90-percent confidence bands based on standard errors clustered at the country level.

### Figure 4. Impact of Climate Shocks on Core Inflation: Role of the Business Cycle




Note: The charts present IRFs based on Equation [2]. x-axis in years; t=0 is the year of the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock; the dark grey area denotes 90-percent confidence bands based on standard errors clustered at country level; the dotted blue line denotes the unconditional baseline result obtained from Equation [1].

## Figure 5. Impact of Climate Shocks on Core Inflation: Role of the Fiscal Space



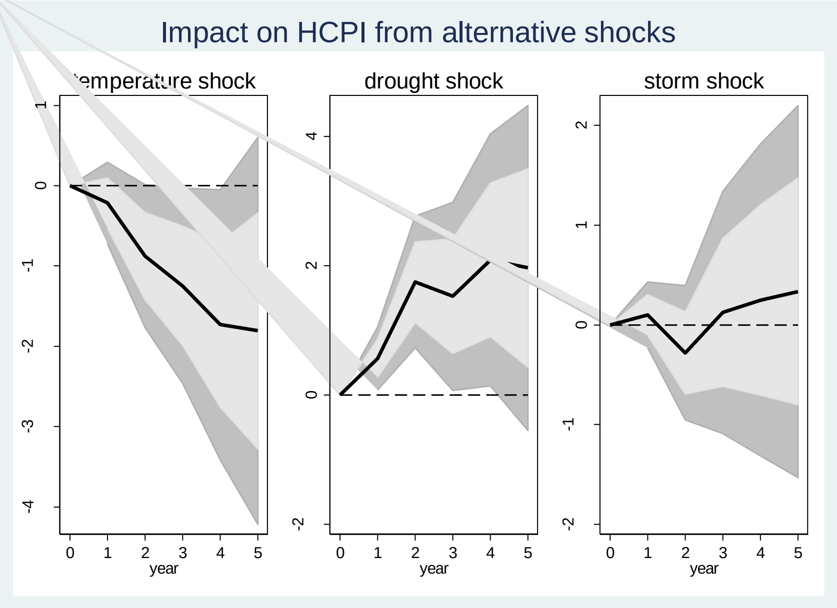

Note: The charts present IRFs based on Equation [2]. x-axis in years; t=0 is the year of the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock; the dark grey area denotes 90-percent confidence bands based on standard errors clustered at country level; the dotted blue line denotes the unconditional baseline result obtained from Equation [1].

We conduct several sensitivity checks to ensure the robustness of our baseline results. First, we control for the potential omitted variable bias by including additional variable that could contribute to inflation dynamics, such as a measure of financial openness developed by Chinn and Ito (2006)[10], the terms-of-trade index and money supply growth. Second, we estimate the

[10] The Chinn-Ito index is normalized between 0 and 1, with higher values indicating that a country is more open to cross-border capital transactions.

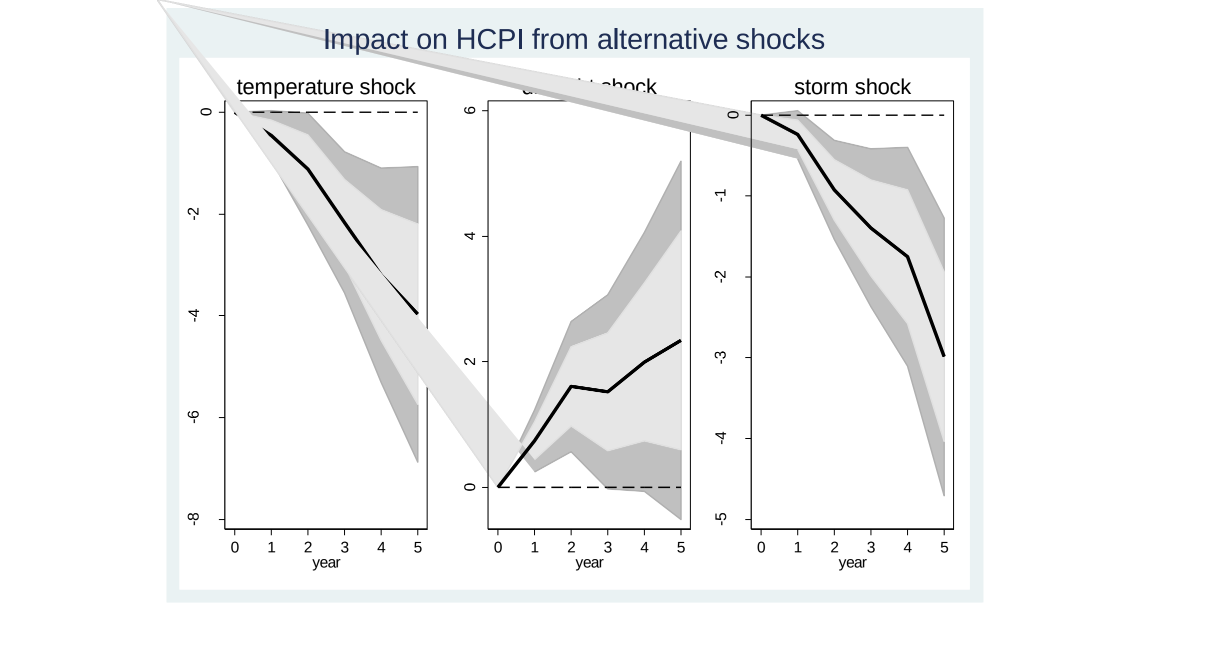
models by excluding country fixed effects, which could bias the results since the error term may have a non-zero expected value due to the interaction of fixed effects and country specific developments (Teulings and Zubanov, 2014). Third, we split the sample into two periods (1970–1995 and 1996–2020) to examine whether the inflationary impact of climate shocks has become more pronounced over time. These estimations, presented in Figure 6-8, yield similar results with no significant qualitative change. Finally, to develop a more granular analysis, we estimate a measure of disaster intensity (the number of deaths scaled by population) and find that the impact of climate shocks on inflation becomes more pronounced and turns positive even in the case of temperature deviations (Figure 9).

**Figure 6. Impact of Climate Shocks on Headline Inflation: Additional Controls**



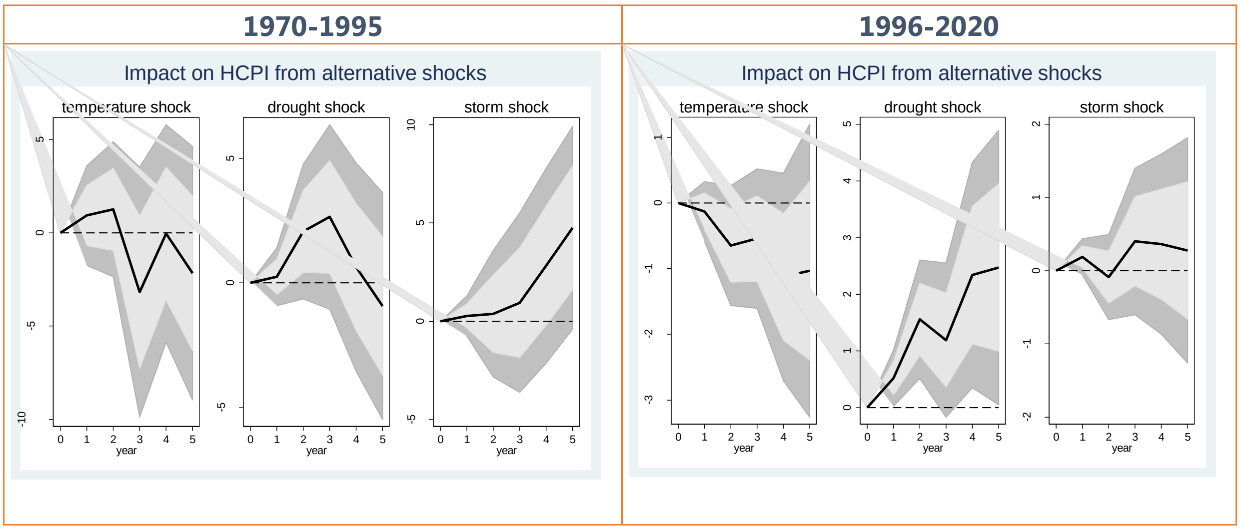

Note: The charts show IRFs using the LP method. x-axis in years; t=0 is the year preceding the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock and the dark grey area denotes 90-percent confidence bands based on standard errors clustered at the country level.

## Figure 7. Impact of Climate Shocks on Headline Inflation: Excluding Country Fixed Effects



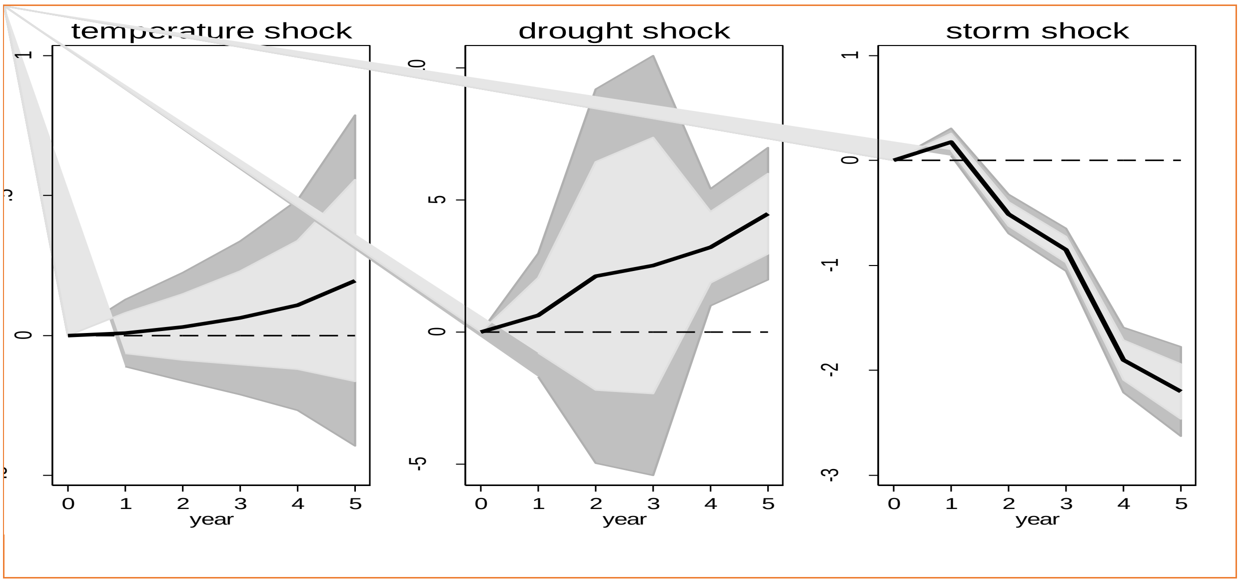

Note: The charts show IRFs using the LP method. x-axis in years; t=0 is the year preceding the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock and the dark grey area denotes 90-percent confidence bands based on standard errors clustered at the country level.

## Figure 8. Impact of Climate Shocks on Headline Inflation: Sub-Period Estimations




Note: The charts show IRFs using the LP method. x-axis in years; t=0 is the year preceding the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock and the dark grey area denotes 90-percent confidence bands based on standard errors clustered at the country level.

**Figure 9. Impact of Climate Shocks on Headline Inflation: Disaster Intensity**

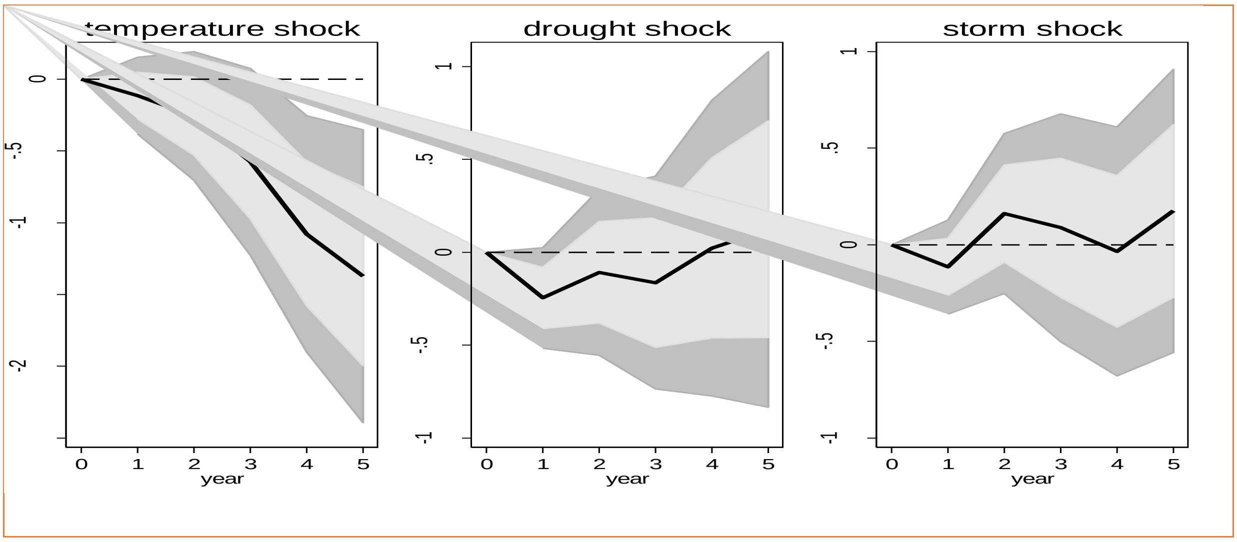



Note: The charts show IRFs using the LP method. x-axis in years; t=0 is the year preceding the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock and the dark grey area denotes 90-percent confidence bands based on standard errors clustered at the country level.

### B. Climate Shocks and Growth

Figure 10 presents the IRFs of real GDP growth to three types of weather-related natural disasters, together with 90 percent confidence intervals. We find that the initial growth response to all types of climate shocks is negative, but the magnitude and pattern of response show variation over the long run. While a temperature shock appears to lead to a lasting reduction in real GDP growth, the impact of droughts and storms is more volatile and less persistent over the long run. In the case of a temperature shock, the growth deceleration reaches at through after 5 years since the shock, at which point real GDP growth is about 1.5 percentage points lower than if the temperature shock had not happened. Both droughts and storms cause a steeper fall in growth in the first year after the shock, but the magnitude of the impact is volatile and less persistent over time.

**Figure 10. Impact of Climate Shocks on Growth: Global Sample**

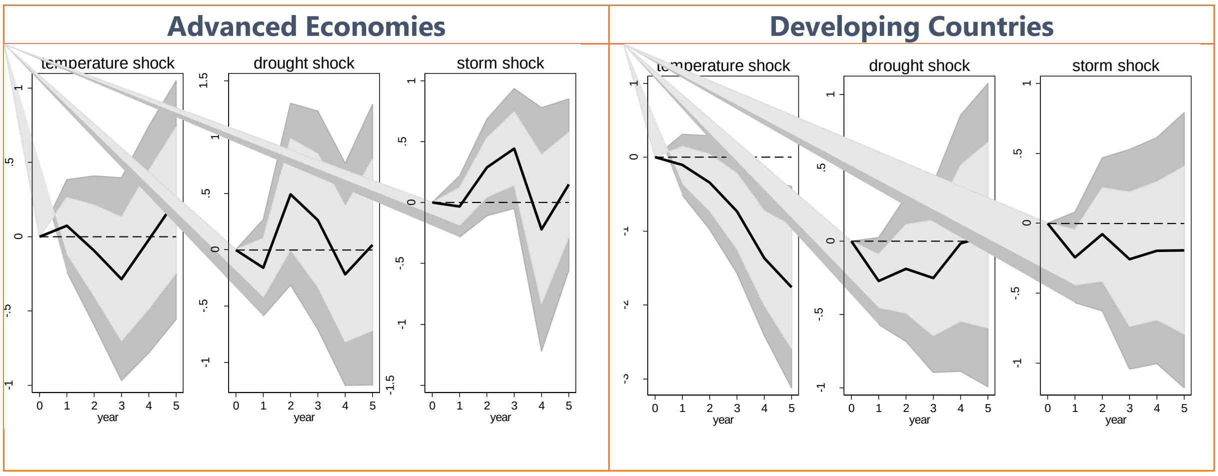



Note: The charts show IRFs using the LP method. x-axis in years; t=0 is the year preceding the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock and the dark grey area denotes 90-percent confidence bands based on standard errors clustered at the country level.

To better discern the growth impact of climate shocks, we split the full sample of countries into income groups—advanced economies and developing countries—and present these IRFs in Figure 11. This disaggregation confirms reveals a striking contrast in the impact of climate shocks on real GDP growth in countries at different levels of development. While weather-related natural disasters lead to a significant and persistent decline in economic growth in developing countries, there is no such impact in advanced economies. Nevertheless, when we use the intensity of climate shocks (measured by the number of deaths scaled by population) instead of a dummy variable for disasters, the growth impact is significantly negative for all types of climate shocks across all countries in our sample (Figure 12).

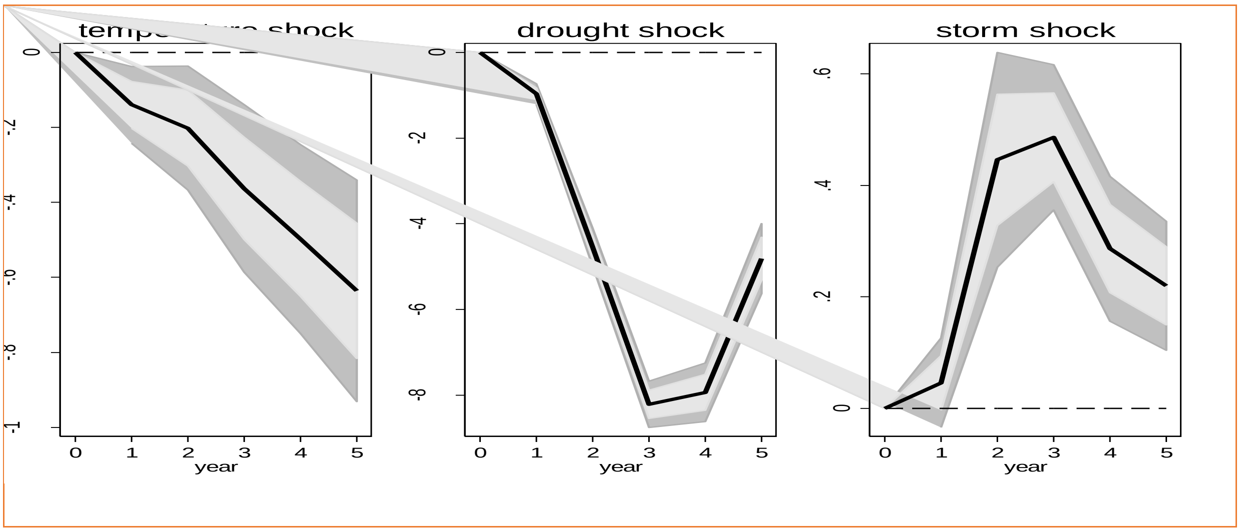
We also explore the nonlinear effects of weather-related natural disasters on economic growth by taking into account the state of the economy and the level of public debt as a proxy of fiscal space at the time the climate shock hits. These results, presented in Figure 13-14, show that both the state of the economy and available fiscal space play critical roles in determining how climate shocks affect economic growth in terms of magnitude and persistence over the long run, which also varies with the level of income across countries. These results, in our view, reflect demographic and structural differences and weaker fiscal and institutional capacity in developing counties to adapt to and mitigate the consequences of climate shocks. In particular, we should also note that the overall impact of weather-related natural disasters on real GDP growth is likely to conceal significant differences across sectors, as shown by the varying growth response in advanced and developing economies.

**Figure 11. Impact of Climate Shocks on Growth: Income Group**



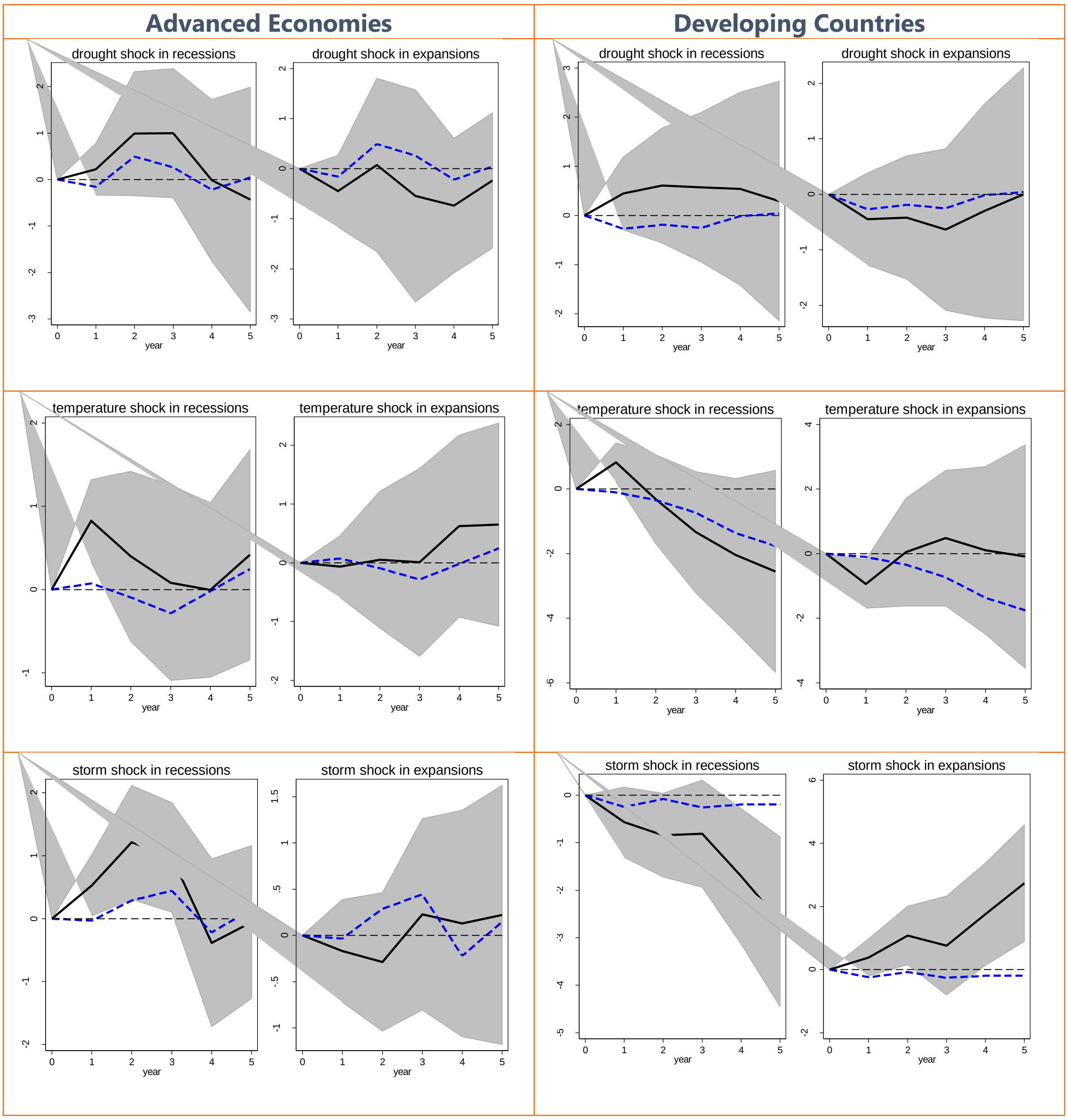

Note: The charts show IRFs using the LP method. x-axis in years; t=0 is the year preceding the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock and the dark grey area denotes 90-percent confidence bands based on standard errors clustered at the country level.

**Figure 12. Impact of Climate Shocks on Growth: Disaster Intensity**



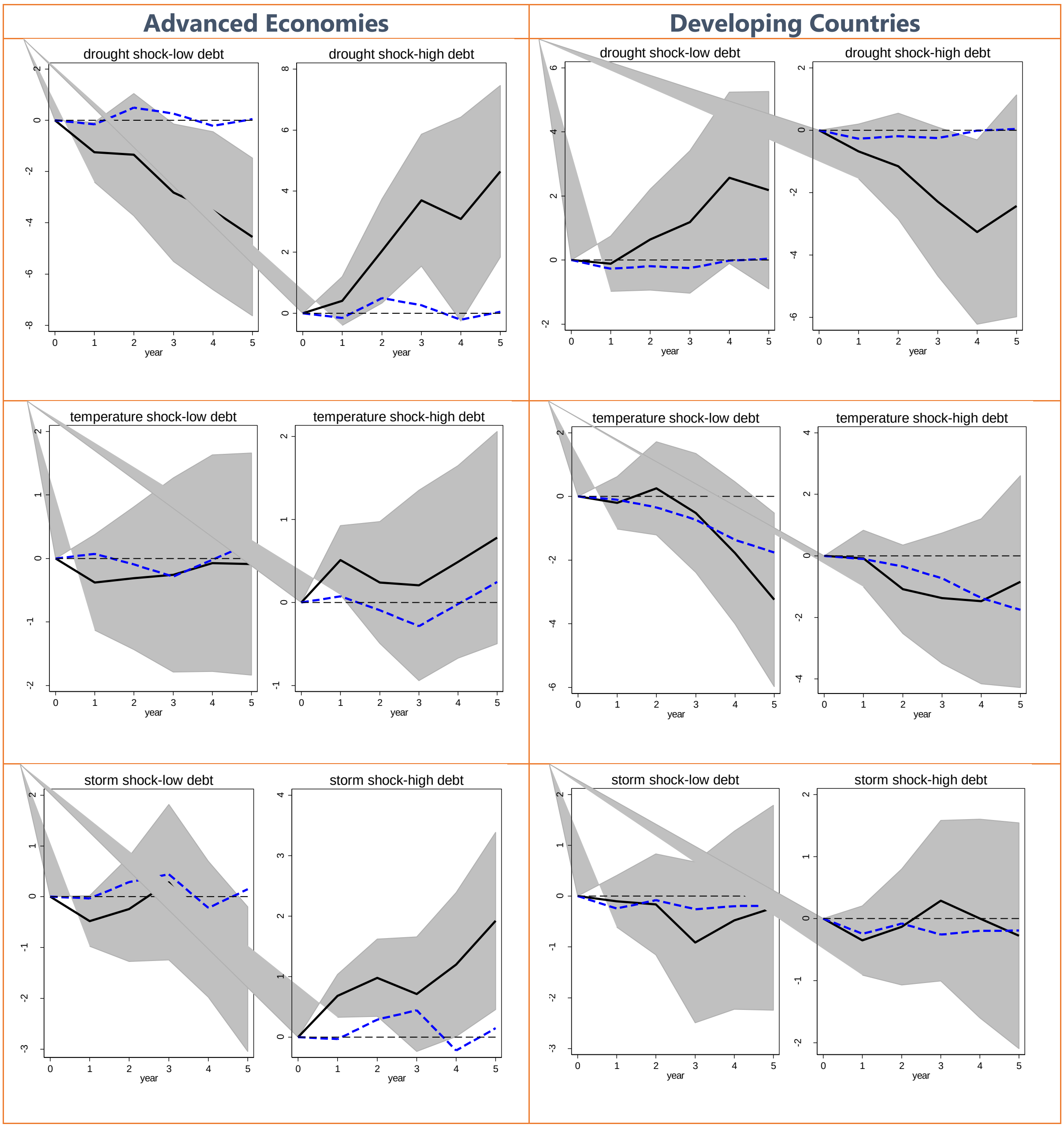

Note: The charts show IRFs using the LP method. x-axis in years; t=0 is the year preceding the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock and the dark grey area denotes 90-percent confidence bands based on standard errors clustered at the country level.

## Figure 13. Impact of Climate Shocks on Growth: Role of the Business Cycle




Note: The charts present IRFs based on Equation [2]. x-axis in years; t=0 is the year of the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock; the dark grey area denotes 90-percent confidence bands based on standard errors clustered at country level; the dotted blue line denotes the unconditional baseline result obtained from Equation [1].

## Figure 14. Impact of Climate Shocks on Growth: Role of Fiscal Space




Note: The charts present IRFs based on Equation [2]. x-axis in years; t=0 is the year of the climate shock; t=1 is the first year of impact. The solid black line denotes the response to a climate shock; the dark grey area denotes 90-percent confidence bands based on standard errors clustered at country level; the dotted blue line denotes the unconditional baseline result obtained from Equation [1].

## VI. Conclusion

Climate change is the defining challenge of our time. In this paper, we empirically investigate the impact of weather-related natural disasters on consumer price inflation and economic growth, using a large panel of 173 countries during the period 1970–2020. The analysis based on the LP method shows that headline inflation and growth respond significantly but also differently in terms of direction and magnitude to climate shocks.

- Temperature shocks result in lower inflation, but droughts and storms lead to higher inflation. We split the full sample of countries into income groups—advanced economies and developing countries—and find a striking contrast in the impact of climate shocks on headline inflation according to the level of economic development. We also develop a more granular analysis by focusing on alternative measures of inflation and identify that the impact of weather-related shocks on core and food inflation shows significant variation in magnitude and pattern across country groups. Finally, we find that the inflationary impact of climate disasters varies in a nonlinear fashion depending on the state of the economy and the level of fiscal space when the shock hits. These results suggest that climate shocks have an enduring effect on inflation through multiple channels, such as (i) increasing or lowering agricultural production and food prices, (ii) dampening economic activity and reducing labor productivity, and (iii) affecting transportation infrastructure and distribution costs.

- All types of climate shocks have a negative impact on economic growth, but the magnitude and pattern of response show variation over the long run. While a temperature shock appears to lead to a lasting reduction in real GDP growth, the impact of droughts and storms is more volatile and less persistent. To better discern the growth impact of climate shocks, we split the full sample of countries into income groups and find a striking contrast in the impact of climate shocks on real GDP growth in countries at different levels of development. While weather-related natural disasters lead to a significant and persistent decline in economic growth in developing countries, there is no such impact in advanced economies. We also explore the nonlinear effects of weather-related natural disasters on economic growth and observe that both the state of the economy and available fiscal space play critical roles in determining how climate shocks affect economic growth in terms of magnitude and persistence over the long run, which also varies with the level of income across countries.

These results, in our view, reflect demographic and structural differences and weaker fiscal and institutional capacity in developing counties to adapt to and mitigate the consequences of climate shocks. Accordingly, there are several important implications for economic policy in the wake of accelerating climate change. First, this will make inflation and growth dynamics more volatile, with potential feedback effects across all sectors of the economy. Second, the differing patterns of inflation and growth response to climate shocks will lead to greater heterogeneity in the level of inflation and income growth experienced by different segments of the society within a country. In other words, households whose consumption basket consists of goods and services that are more likely to experience an increase in inflation and loss of income in the aftermath of natural disasters will be more adversely affected compared to households whose consumption is proportionately less dependent on such products and income is not subject to a negative shock. Looking forward, it is also important for policymakers to take into account how the green transition away from fossil fuels, as an important part of climate change mitigation efforts, will affect inflation and growth dynamics.

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