South African Reserve Bank Working Paper Series WP/26/13

From climate crisis to cost crisis: inflation dynamics in a warming world

Serena Merrino and Xolani Sibande

Authorised for publication by Monique Reid

31 August 2026

SOUTH AFRICAN RESERVE BANK

South African Reserve Bank Working Papers are written by staff members of the South African Reserve Bank and, on occasion, by consultants under the auspices of the South African Reserve Bank. The papers deal with topical issues and describe preliminary research findings and develop new analytical or empirical approaches in their analyses. They are solely intended to elicit comments and stimulate debate.

South African Reserve Bank Working Papers are externally refereed.

Information on South African Reserve Bank Working Papers can be found at https://www.resbank.co.za/en/home/publications/Papers/working-papers.

Enquiries relating to the Working Paper Series can be addressed to:
Head: Economic Research Department
South African Reserve Bank
P O Box 427
Pretoria 0001

Tel. +27 12 313 3911

From climate crisis to cost crisis: inflation dynamics in a warming world

Serena Merrino* and Xolani Sibande†

Abstract

This paper investigates the inflationary effects of weather shocks using a novel panel of monthly country-sector consumer price inflation sub-indices covering 65 countries over the period 2000–2024. Leveraging disaggregated price data across five sectors and exploiting international input-output links, we identify the price effects of both temperature and precipitation extremes. The analysis is both global and South Africa-specific. Our results show that weather shocks primarily generate sector-specific, upstream inflation, concentrated in food, energy and transport, with limited and often insignificant pass-through to measured core inflation. Effects are strongly non-linear in the intensity of the shock and are largest for compound heat-and-drought episodes. Importantly, countries operating under inflation-targeting regimes exhibit significantly dampened price responses, reflecting anchored expectations rather than aggressive policy intervention. These findings carry important implications for inflation management. Climate-driven inflation differs fundamentally from demand-driven inflation, and the moderate, transitory shocks in our sample do not warrant systematic policy tightening: raising rates against weather-driven spikes deepens output losses without containing inflation, especially when shocks originate upstream. Central banks should generally 'look through' first-round climateflation and coordinate with fiscal and structural policies for adaptation and supply-side adjustment. The exception is salience: because food and energy weigh heavily in inflation perceptions, protracted or repeated shocks that keep headline inflation elevated could unanchor expectations and justify a response.

JEL classification

E31, E52, Q54, F44

Keywords

Climate risk, inflation, monetary policy, inflation targeting

* Corresponding author, Fellow, Economic Research Department (ERD), South African Reserve Bank (SARB). Email: serena.merrino@resbank.co.za.

† Senior economist, ERD, SARB. Email: xolani.sibande@resbank.co.za.

1. Introduction

The post-pandemic surge of inflation to a four-decade high in many advanced and emerging markets has renewed interest in the drivers of inflationary pressures and prompted questions on inflation management strategies, including alternatives to conventional monetary approaches. While the consensus is strong on the need to curb excess demand-pull inflation through monetary tightening, adverse supply shocks that push prices up and output down create difficult policy trade-offs (Klomp 2020). A key tenet of modern monetary policymaking under flexible inflation-targeting regimes is to ‘look through’ the first-round effects of supply shocks, tightening only when their persistence threatens the anchoring of inflation expectations — and, through second-round effects on wages and core prices, medium-term headline inflation. Along these lines, although the recent inflationary episode was mainly driven by a series of idiosyncratic developments – namely, supply-chain bottlenecks, changes in relative prices and Russia’s invasion of Ukraine, possibly exacerbated by firms’ excessive market power (Stiglitz and Regmi 2022) – central banks eventually responded by sustaining high interest rates.

In the 2024 Bank for International Settlements (BIS) Annual Economic Report, such forceful global tightening action is celebrated for sending “a strong signal to markets, firms and workers that the central bank would do what it took to restore price stability” (BIS 2024: 46). As a result, “inflation is now again returning to the price stability region while economic activity and labour markets have proved resilient” (ibid: 41). In academic circles, however, the firm adoption of a contractionary stance was generally seen as a blunt and unnecessarily costly revival of the monetarist doctrine, which overshadows alternative instruments of price stabilisation (see, for example, Stiglitz and Regmi 2022; Weber and Wasner 2023; Blyth and Fraccaroli 2025). Correctly identifying the origins of inflation is key to tailoring an appropriate policy response.

As the bout of post-COVID-19 inflation wanes, the debate on the best cure to trade-off-inducing shocks remains relevant in the context of another, increasingly concerning, source of stagflation risks. Climate change is an accelerating process that is expected to increase both the frequency and intensity of acute physical hazards (droughts, floods, wildfires, heat waves, etc.) and the progressive shift of meteorological indicators away from their historical means (rising averages in temperature, precipitation and sea levels) (IPCC 2021). The impacts stemming from these phenomena influence households and firms' preferences and endowments, with immediate implications for the price stability mandate of central banks around the world through a variety of supply- and demand-side channels. In contrast to longer-run chronic changes in climatic trends that influence the economy's steady state and the neutral interest rate (also called r-star), extreme events "are largely unpredictable and thereby bear resemblance to other shocks that unfold over the business cycle and to which monetary policymakers tend to adjust monetary policy" (NGFS 2024: 7). Hence, the monetary policy strategy to climate shocks should be informed by a deep understanding of the nature and pattern of these inflationary pressures.

This paper aims to contribute to this discussion by providing new empirical evidence on the effect of climate shocks on inflation, employing a global panel dataset of monthly country-sector inflation from 2000 to 2024. Throughout the paper, the term 'climate shocks' refers exclusively to acute physical shocks and is thus a synonym for 'weather shocks'.[1] Several authors have started exploring the subject (among others, Faccia, Parker and Stracca 2021; Kotz et al. 2024; Cevik and Tovar Jalles 2024), and we add to this growing body of empirical findings in several ways. First, we examine a global panel of disaggregated price data – specifically, five consumer price sub-indices[2] – to disentangle the idiosyncratic price impact of weather shocks on key market segments, and identify the sectoral origins of aggregate inflation dynamics. In addition, we account for the monetary policy stance as a possible moderating factor in the 'climateflation' mechanism. Our second contribution turns to South Africa, tracing how weather shocks transmit to sectoral prices both directly and through the global production network that propagates these spillovers across borders. While there is broad agreement that price transmission mechanisms operate through cross-border input-output networks, the specific intercountry channels through which climate change

---

1 Climate shocks can be broadly classified into transition shocks (arising from policy, technological or behavioural changes associated with the shift to a low-carbon economy) and physical shocks, which can be differentiated into chronic shocks (gradual changes such as rising mean temperatures or sea levels) and acute shocks (discrete extreme weather events).

2 We use the Classification of Individual Consumption According to Purpose (COICOP) price classification, a United Nations international reference framework for grouping household consumption expenditures on goods and services within homogeneous categories (United Nations 2000).

generates inflationary effects remain empirically unexamined. To fill this gap, we build on the literature on sectoral propagation of shocks (Acemoglu et al. 2012; Acemoglu, Akcigit and Kerr 2016) – recently extended by Zappalà (2024) to assess the impact of weather shocks and sectoral productivity – to quantify the indirect price spillover effects of foreign weather shocks in South Africa. In addition, throughout our econometric exercises, we test for non-linear effects and check for the presence of tipping points by simulating shocks of higher intensity.

The remainder of the paper is structured as follows. Section 2 introduces a conceptual framework for analysing how extreme weather-induced price shocks propagate across sectors. Section 3 and 4 outline the data and the econometric techniques used in the analysis. Section 5 presents and discusses the empirical findings. Finally, section 6 concludes and highlights the associated policy implications.

2. Climateflation: a literature review

In recent years, researchers have increasingly focused on assessing physical climate impacts, including on prices. For instance, Mukherjee and Ouattara (2021) and Kotz et al. (2024) document that temperature shocks generate persistent inflation, especially in lower-income countries, whereas Parker (2018) and Cevik and Tovar Jalles (2024) highlight that outcomes would also depend on the type of disaster, the country's level of development and fiscal space. This mix of possibilities means "no two physical hazard events have the same macroeconomic effects" (NGFS 2024: 9). Different weather shocks will likely hit distinct segments of the economy, often unevenly, causing volatility both in nominal and relative prices (Buelens 2024). Here, we attempt to systematically summarise the transmission mechanisms underlying climateflation, as defined by Schnabel (2022), who frames how physical climate risks can exert upward pressure on prices.

2.1 Supply-side weather shocks

Direct impacts. On the supply side, extreme weather influences some of the characteristics and effective availability of productive factors through capital, productivity and production losses, so that weather-exposed sectors are particularly sensitive to the direct effect of climate shocks. In farming, for example, extreme temperature and precipitation impact negatively on both crops and animal breeding through workers' heat stress (De Lima et al. 2021) or increased use of pesticides and overall production costs (Savage 2024). Roberts and Schlenker (2013) find that crop yields are humped-shaped, with higher temperatures increasing yields up until a threshold, before having increasingly negative effects. The obvious relation between the weather and the food system has prompted many authors to closely examine food price dynamics. Faccia, Parker and Stracca (2021) find that upward temperature anomalies have an immediate impact on food prices; Kotz et al. (2024) observe that the effects of global warming are stronger in the food component of inflation; and according to Parker (2018) storms and floods lead to a short-lived but upward effect on food price inflation.

Besides agriculture, precipitation extremes are likely to hit water-intensive sectors, such as electricity, manufacturing and waterway transport (Buelens 2024), while damage to infrastructure, natural resources and properties can undermine the provision of services (NGFS 2023; Dube 2024). Non-agricultural activity can also be undermined by reduced labour productivity, particularly outdoor work (e.g. construction and tourism) (ILO 2019). Acevedo et al. (2018) document that higher temperatures significantly lower labour productivity in heat-exposed sectors but have no significant effect in non-heat-exposed industries, including in hot climate countries. Some authors also highlight the presence of seasonally heterogenous pressures, such that heat waves in already hot months and regions cause relatively larger inflationary impacts (Colacito, Hoffmann and Phan 2019), while warmer winter temperatures are associated with lower energy prices (Kotz et al. 2024).

Indirect impacts. In all these cases, higher production costs in the affected sectors are transmitted downstream as higher end-user and wholesale prices. There is a growing body of literature that highlights the role of production networks in the shock transmission mechanism: shocks that hit sectors or firms in the early stages of the supply chain propagate to the rest of the economy through input-output links, leading to 'cascade effects' and aggregate changes. The international and intersectoral propagation of weather shocks has been assessed empirically but only in terms of output and productivity. De Winne and Peersman (2018) warn that harvest-induced spikes to agricultural commodity prices depress economic activity, including in high-income countries. Zappalà (2024) uses the input-output framework to examine the productivity shock transmission across sectors and shows that, although agriculture is harmed the most and earlier, downstream sectors – even if foreign – suffer from substantial and persistent losses because of network effects.

The price transmission mechanism occurs along similar lines, with changes in input prices, such as in food and energy, percolating downstream. In contrast to production, in the inflation diffusion network the central nodes are the upstream industries that, by supplying intermediate inputs to others, lead to pipeline pressures and cost pass-through. In the euro area, Peersman (2022) estimates that shifts in international food prices caused by harvests between 1961 and 2016 explain 30% of euro-area inflation volatility. In addition, Ciccarelli, Kuik and Martinez Hernandez (2023) document that temperature increases raise European Union inflation in food and services, possibly due to higher sensitivity of services, such as health and tourism, to food or weather. Di Giovanni et al. (2022) argue that the post-pandemic inflation in the euro area was amplified by production networks. Moreover, the transmission mechanism is asymmetric because prices increase more rapidly and sizeably than they decrease.

The price propagation will be stronger if it originates in 'salient' commodities or primary goods, whose inelastic demand and supply make their price more volatile. Depending on the inputs' elasticity of substitution, the reallocation of expenditure can mitigate the ripple effect of the production cost shock. Otherwise, input price increases are passed on to consumers as cost-push inflation.[3] Even if weather events are temporary, a sequence of severe compound shocks can generate durable implications that affect inflation expectations ('second-round effects') and the conduct of monetary policy (NGFS 2026).

This last observation connects climateflation to a distinct literature on the salience of food and fuel prices in the formation of inflation expectations. Food and energy are not only upstream in the production network; they are also the prices households observe most frequently and most precisely, and they can therefore weigh on expectations well

[3] If demand is perfectly elastic, producers will be forced to fully absorb the shock. On the contrary, if demand is perfectly inelastic, consumers will be forced to buy the good whatever the price is.

in excess of their expenditure shares. D’Acunto et al. (2021) show that US consumers form aggregate inflation expectations from the grocery prices they personally encounter, and that the frequency and size of the price changes they observe matter more than the budget share of the goods concerned. They conclude that a policy focus on core inflation, which excludes precisely these items, risks systematically understating the extent to which food price shocks shape inflation expectations. Coibion and Gorodnichenko (2015) document an analogous mechanism for fuel, finding that oil price movements account for almost all of the variation in US households’ short-run inflation expectations between 2000 and 2013, precisely because fuel prices are visible and frequently observed. Salience is therefore a channel through which weather-driven food and energy shocks may influence expectations even where their measured pass-through into core inflation is limited – a possibility that a design based on realised consumer prices, such as ours, cannot exclude. These considerations carry more force in emerging markets, where food and energy have larger consumer price index (CPI) weights, administered prices are more prevalent and inflation expectations are less firmly anchored (De Gregorio 2012). Direct evidence on food and fuel pass-through in South Africa remains thin, but what exists points to non-trivial second-round effects. Rangasamy (2011) documents a substantial role for food prices in South African headline inflation, while Simbanegavi and Palazzi (2023) find that core inflation partially reverts towards headline within 12 months.

2.2 Demand-side weather shocks

Beyond driving cost-push inflation up, physical hazards can also shift household preferences and human needs, and by extension, demand patterns. For example, the higher demand for energy for cooling and warming can increase its price, as well as the chances of power shortages (Mukherjee and Ouattara 2021). Consumption shifts towards disaster-related goods[4] can push sectoral prices up – especially in the

[4] Disaster-related goods are goods and services whose demand rises sharply in the aftermath of an extreme weather event, typically driven by reconstruction, repair and emergency response needs. Classic examples include construction materials (cement, steel, lumber), building and repair services, medical supplies and pharmaceuticals, generators and pumps, and temporary housing. This demand surge can generate localised price spikes and, through input-output links, propagate to upstream suppliers.

presence of structural rigidities in the shrinking sectors. Furthermore, Ferrante, Graves and Iacoviello (2023) note that the post-pandemic inflationary effects of the consumption reallocation from services to goods were amplified by the heterogeneous price rigidities across sectors: industries that produce goods have more flexible prices than those that produce services, so the reduction in service supply was accompanied by only modest declines in prices. Thus, another important question is whether climate change spurs demand in sectors with relatively more flexible prices than shrinking sectors.

Another way climate change affects demand is through Keynesian supply shocks: when extreme weather depresses economic activity, declining real disposable incomes, wealth and confidence might also cause a fall in demand and consequently prices for non-tradable sectors (Kamber, McDonald and Price 2013). In a cross-country analysis of 48 advanced and emerging economies, Faccia, Parker and Stracca (2021) find that upward temperature anomalies have a swift upward effect on prices that turns insignificant or even negative in the medium term, possibly due to the negative demand effect. Distinguishing by type and intensity of climate shocks, Kabundi, Mlachila and Yao (2022) find that, while droughts tend to push inflation up because of rising food prices, floods curb demand and thus inflation. The second-round deflationary effect of Keynesian-type supply shocks depends not only on the size of the initial negative impact on output but also on the income and wealth elasticity of demand. Particularly in developing countries where food constitutes the largest share of the consumer basket, higher food prices reduce the money available for other items, stifling broader consumer spending. Mukhejee and Ouattara (2021) report that in developing countries price effects persist several years after the initial shock due, for instance, to poor integration into global markets and weak import substitution effects.

2.3 A conceptual map

Figure 1 summarises the price spillovers that follow a weather shock (i.e. deviation of temperature from its historical mean). The upper diagram shows the case of a weather shock hitting the end of the supply chain (i.e. downstream). The shock can either shift consumer preferences away from the focal sector with potentially deflationary but localised effects (resulting in *Effect A*) or push sectoral inflation up through higher demand or production costs passed on to consumers (*Effect B*) – in the case of essential or substitute goods with increased post-disaster demand. Regardless of whether the shock alters demand- or supply-side forces, it will affect the price in the focal sector directly but will not propagate up the supply chain (from customers to suppliers).[5] For example, if an extreme weather event depresses tourism, lower prices in the hospitality sector will not affect the price of its suppliers (i.e. food or construction industry).

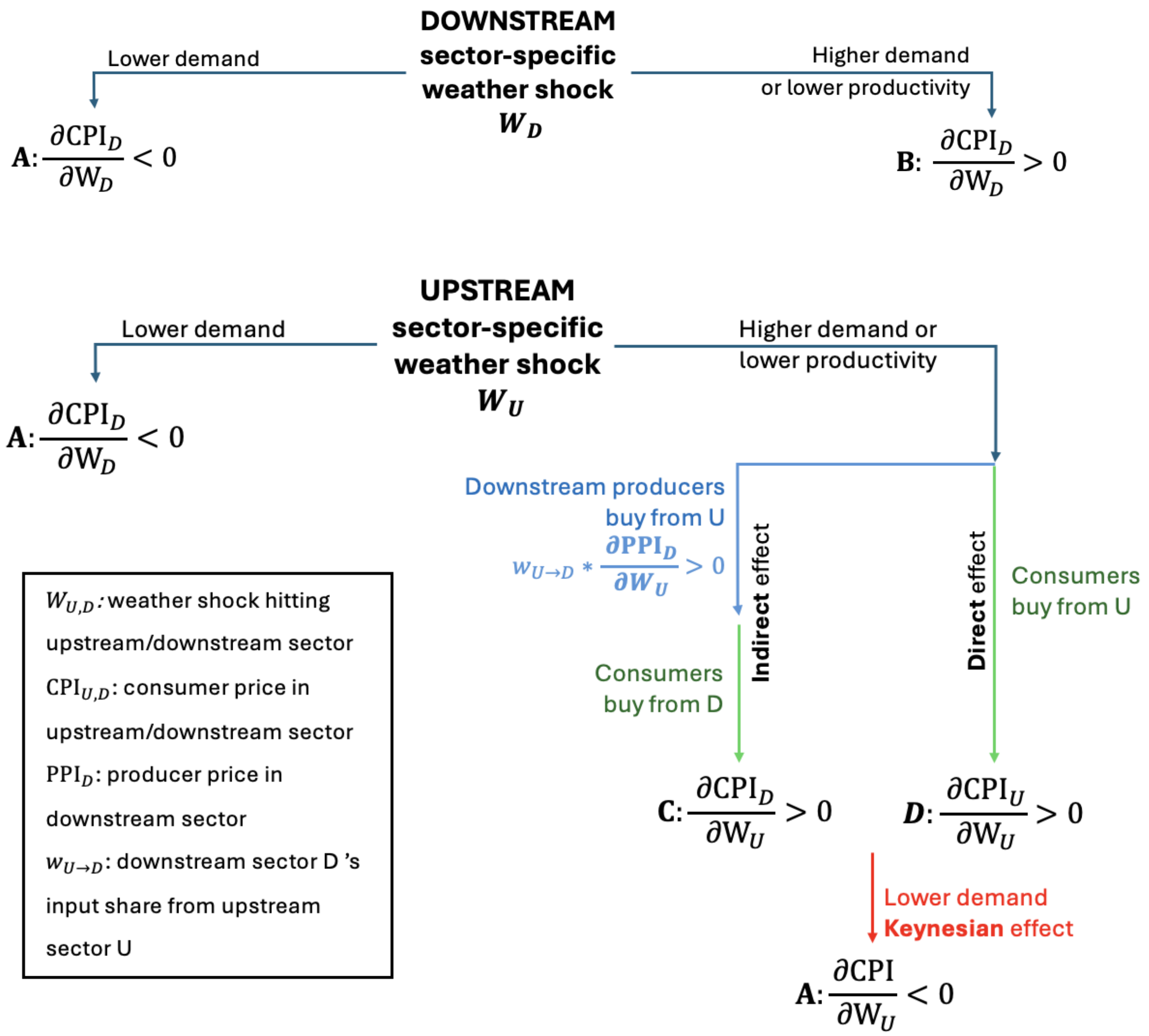
The lower diagram represents the transmission mechanism of a weather shock hitting an upstream sector (i.e. energy or agriculture). A physical hazard is not expected to decrease demand for primary goods – so the deflationary *Effect A* rarely occurs (i.e. energy demand decreasing in mild winters). Yet, an upstream weather shock can translate into sectoral inflation via either higher demand or higher production costs in the upstream sector. In both cases, the final effect might result from aggregating (i) the direct channel, whereby the weather shock changes the consumer price directly through sector-specific supply or demand forces (*Effect C*), and (ii) the indirect channel, whereby the price change travels downstream to other sectors that purchase inputs from the focal sector (*Effect D*). The cross-sector sum of these effects will result in aggregate inflation. At this point, the price shock can travel further via a Keynesian-type propagation that depresses demand, with subsequent deflationary effects on demand (again, *Effect A*).

Given the complex interplay of upward and downward forces on prices, the overall reaction of inflation to weather shocks depends on which countervailing dynamic dominates the sum of the marginal effects. If the shock hits sectors downstream only, the aggregate effect on inflation (A + B) will not be clear in advance, although it is expected to remain confined to the focal sectors. If the shock hits the upstream supply chain, then the aggregate effect (C + D) is most likely inflationary and could turn deflationary in the long run and under certain conditions. Moreover, "a negligible or null effect of local weather shocks on a given sector may be amplified or mitigated by

5 A few authors study demand shocks' transmission across sectoral production and highlight specific conditions whereby upstream propagation may arise (Acemoglu et al. 2012; Arata and Miyakawa 2024).

weather shocks hitting other sectors with strong commercial interlinkages" (Zappalà 2024: 15). Climate change is therefore highly sectoral by nature.

Figure 1: Flow chart of price propagation from weather shocks



Source: Authors' elaboration.

3. Data

3.1 Prices

We build a global dataset of selected monthly CPIs in five categories: core, food, energy, hospitality and transport. We use seasonally adjusted data for hospitality and transport CPIs sourced from Haver Analytics, while we perform a seasonal adjustment of food, energy[6] and core CPIs (World Bank Inflation Database 2025), employing the SEATS method on a country-to-country basis. Inflation is calculated as the month-on-month growth rate of price levels. After winsorising the 1% most extreme inflation values, we compute statistics of the five CPI inflation categories (see the annexures). The inflation data are rarely normally distributed; however, ordinary least squares/within-group estimators do not require the dependent variable to be normally distributed for consistency or unbiasedness if standard errors are clustered and the sample is large enough.

3.2 Weather

The analysis relies on temperature and precipitation data from the ERA-5 global reanalysis dataset, compiled by the European Centre for Medium-Range Weather Forecasts (Muñoz-Sabater 2019), which provides hourly observations on a 0.25° × 0.25° grid. To capture sector-specific exposure to weather, we weight temperature and precipitation data differently depending on the sector under consideration. For agriculture – relevant to assess impacts on food CPI inflation – we weight by the share of cropland in each country. For non-agricultural sectors – relevant for all other inflation indices – we weight the same data by night-time light intensity, which proxies for the spatial distribution of economic activity.[7] Based on these country-level monthly observations, we compute standardised temperature and precipitation indices as the difference between the observed weather metric $W_{s,c,t}$ (i.e. temperature or precipitation) minus the same-month whole-sample average $\bar{W}_{s,c,t}$, divided by its standard deviation, in sector *s*, period *t* and country c:

$$W_{s,c,t} = \frac{W_{s,c,t} - \bar{W}_{s,c,t}}{\sigma(W_{s,c,t})} \qquad (1)$$

6 Energy CPIs often include differentiated prices for fuel, gas and housing. Where available, we select electricity.

7 The use of distinct spatial weights for agricultural and non-agricultural sectors is motivated by statistical rather than purely economic considerations. Cropland share and night-time light intensity are themselves highly correlated across grid cells within most countries, since populated and economically active areas often overlap with cultivated land (see Figure A4). Applying both weighting schemes simultaneously to the same set of regressions would therefore introduce substantial multicollinearity, inflating standard errors and obscuring the identification of sector-specific weather effects. Assigning each weighting scheme to the sector for which it is the more natural proxy circumvents this problem (see Table A2 for the detailed sectoral matching).

As the historical norms are month-specific, the deviation inherently accounts for the weather's seasonality. Hence, the 5th to 95th percentiles can be interpreted as weather shocks relative to the country-specific climatic baseline in a given month. In the end, this procedure estimates four types of shocks for each country: abnormally hot or cold, or wet or dry.

3.3 Input-output data

To measure intersectoral links among countries, we employ the Organisation for Economic Co-operation and Development (OECD) Inter-Country Input-Output tables (OECD 2025). More specifically, we compute technical coefficients that measure the input from sector *i* required to produce one unit of output in the focal sector *s.* In matrix form:

$$A = T \times \text{diag}(x)^{-1} \quad (2)$$

T is the intermediate transactions matrix (in US$ million), which captures intermediate demand flows between all country-sector pairs. x is the total output of each sector (in US$ million), derived from the sum of intermediate and final demand in each sector. And $\text{diag}(x)^{-1}$ is the inverse of the x diagonal matrix. To compute the technical coefficients, we first reshape the T (intermediate transactions) matrix to align with our dataset and model specification. Specifically:

1. For each supplying country-sector pair (rows), we aggregate sectors into two broad categories: 'agri', which includes all sectors related to food and agriculture, and 'non-agri', which includes all other activities.
2. For each purchasing country-sector pair (columns), we aggregate sectors into five main categories corresponding to the CPI classification used in our analysis: food, energy, transport, hospitality and all (see Table A2 for details).

In the second step, we retain only non-negligible values within the range 0.001–0.99, which account for roughly 10% of the overall network. This filtering step focuses the analysis on economically meaningful intersectoral links and reduces noise from trivial flows.

Our final sample covers 65 countries from January 2000 to December 2024 (see Table A3). Summary statistics of inflation, climate and input-output data are in Annexure A; to illustrate some key features, South Africa's data are used.

4. Methodology

4.1 Baseline model

We quantify the relative importance of weather shocks on sectoral inflation by estimating a heterogeneous 3D fixed-effect model:

$$\pi_{s,c,t} = \propto + \sum_{L=0}^{11} \beta_{s,L}^{1} W_{s,c,t-L}^{+} + \sum_{L=0}^{11} \beta_{s,L}^{2} W_{s,c,t-L}^{-} + \Gamma_{s,c} + \eta_{month} + \gamma_{year} + \varepsilon_{s,c,t} \qquad (3)$$

The dependent variable $\pi_{s,c,t}$ is CPI inflation in sector *s* in country *c* and time *t*. The β_s coefficients are heterogeneous slopes – which are estimated jointly in a fully saturated model – representing the sector-specific *effect* of weather shocks on inflation. Weather shocks are either temperature or precipitation shocks, and they are distinguished between positive or negative deviations to capture asymmetric responses. We include country-sector fixed effects to account for the time-invariant unobserved heterogeneity of different sectors (i.e. the capacity constraints of electricity production in South Africa) that influence countries' average sectoral inflation. Month and year fixed effects remove common global shocks. Finally, $\varepsilon_{s,c,t}$ is the error term. Standard errors are clustered at the country level to account for spatial correlation of the error terms across sectors in the same country over time.

4.2 Extensions

The role of baseline climate conditions. One limitation of Equation (3) is that it abstracts from the underlying climatic context – that is, whether a shock occurs in a country-month that is already warm/cold or dry/wet.[8] To recover the effect of weather

[8] A heat wave, for example, will allegedly have a stronger economic impact if it happens when temperatures are already high and adaptive capacity is strained, than if it occurs during

shocks at a given baseline climate, we interact them with their respective country- and month-specific long-run average $\overline{W}_{s,c}$ (expressed as a deviation from the whole-sample month-specific average):

$$\pi_{s,c,t} = \propto + \sum_{L=0}^{11} \beta_{s,L}^{1} W_{s,c,t-L}^{+} + \sum_{L=0}^{11} \beta_{s,L}^{2} W_{s,c,t-L}^{-} + \sum_{L=0}^{11} \beta_{s,L}^{3} W_{s,c,t-L}^{+} \overline{W}_{s,c} + \sum_{L=0}^{11} \beta_{s,L}^{4} W_{s,c,t-L}^{-} \overline{W}_{s,c} + \beta_{s}^{5} \overline{W}_{s,c} + \Gamma_{s,c} + \eta_{month} + \gamma_{year} + \varepsilon_{s,c,t} \quad (4)$$

In particular, we evaluate the linear combinations $\beta_1 + \beta_3 W$ (for hot/dry shocks) and $\beta_2 + \beta_4 W$ (for cold/wet shocks) at two representative values of baseline temperature or precipitation. Standard errors on these combined effects are computed via the delta method using the full variance-covariance matrix of the estimated coefficients.

Quadratic terms. In another specification, we include a quadratic term in the shock to allow its marginal effect on inflation to depend on the magnitude of the shock itself. This specification is motivated by the strong non-linearities documented in the climate-economics literature: the physical and biological damages from extreme weather (crop failure, infrastructure stress, hydropower constraints) scale convexly with the size of the deviation from local norms, so a linear model would mechanically understate the response to large shocks (Burke, Hsiang and Miguel 2015; Kotz et al. 2024).

$$\pi_{s,c,t} = \propto + \sum_{L=0}^{11} \beta_{s,L}^{1} W_{s,c,t-L}^{+} + \sum_{L=0}^{11} \beta_{s,L}^{2} W_{s,c,t-L}^{-} + \sum_{L=0}^{11} \beta_{s,L}^{3} (W_{s,c,t-L}^{+})^{2} + \sum_{L=0}^{11} \beta_{s,L}^{4} (W_{s,c,t-L}^{-})^{2} + \Gamma_{s,c} + \eta_{month} + \gamma_{year} + \varepsilon_{s,c,t} \quad (5)$$

This exercise also allows us to simulate inflation responses to shocks of different intensities; for example, for a positive (hot/dry) shock at lag *L*, Equation (5) implies that the marginal contribution to inflation is $\beta_{s,L}^{1}\, k + \beta_{s,L}^{3}\, k^{2}$, where *k* is the shock size expressed in standard deviations (here *k* = 1, 2, 3). The linear coefficient β^1 captures the proportional part of the response and the quadratic coefficient β^3 captures the convex amplification of inflationary pressures at the upper tail of the shock distribution.

comparatively cooler months or in milder climates. Likewise, a cold wave is likely to be more damaging when it strikes regions or seasons that are not typically exposed to extreme cold, where infrastructure and households are less prepared to cope with such conditions.

Monetary policy rule. To assess whether monetary policy regimes condition the effects of weather shocks, we divide our sample into inflation-targeting (IT)[9] and non-inflation-targeting countries using the information from IMF monetary policy framework classification (IMF 2024) and build a dummy variable IT_c. The variable IT can be understood to encompass a wider array of institutional characteristics – income level, political stability and policy credibility, among them – rather than the monetary policy rule in isolation.

Equation (4) is then extended such that the asymmetry between positive and negative shocks is conditional on the policy regime:[10]

$$\pi_{s,c,t} = \propto + \sum_{L=0}^{11} \beta_{s,L}^{1} W_{s,c,t-L}^{+} + \sum_{L=0}^{11} \beta_{s,L}^{2} W_{s,c,t-L}^{-} + \sum_{L=0}^{11} \beta_{s,L}^{3} W_{s,c,t-L}^{+}\, IT_c + \sum_{L=0}^{11} \beta_{s,L}^{4} W_{s,c,t-L}^{-}\, IT_c + \Gamma_{s,c} + \eta_{month} + \gamma_{year} + \varepsilon_{s,c,t} \qquad (6)^{11}$$

South Africa. Finally, we adapt Equation (5) to a single-country model: South Africa. To this purpose, we estimate impulse response functions (IRFs) from local projections:[12]

$$\pi_{s,t+h} = \propto + \sum_{L=0}^{11} \beta_{s,L}^{1} W_{s,c,t-L}^{+} + \sum_{L=0}^{11} \beta_{s,L}^{2} W_{s,t-L}^{-} + \sum_{L=0}^{11} \beta_{s,L}^{3} (W_{s,t-L}^{+})^2 + \sum_{L=0}^{11} \beta_{s,L}^{4} (W_{s,t-L}^{-})^2 + \eta_{month} + \gamma_{year} + \varepsilon_{s,t+h} \qquad (7)$$

Foreign weather shocks. In the last version, we also aim to capture the indirect response of South Africa's sectoral inflation to foreign weather shocks, assuming these prices travel through the global production network, as explained in section 2. Hence,

---

9 Including fixed exchange rate regimes.

10 More advanced solutions implied singularity of the variance-covariance matrix.

11 This equation has no standalone IT dummy, because this is absorbed by the country-sector fixed effects.

12 We treat South Africa separately for two reasons. First, the heterogeneous 3D fixed-effect model identifies average sectoral responses by exploiting cross-country variation; reducing it to a single country eliminates this source of identification. Second, because the timing, persistence and shape of inflation responses are central to policy design, we adopt the local projections approach of Jordà (2005), which estimates IRFs horizon-by-horizon, accommodates non-linearities and shock interactions without imposing the iterative dynamics of a vector autoregression, and is the standard tool in the related literature (Faccia, Parker and Stracca 2021; Kabundi, Mlachila and Yao 2022).

in Equation (7) we replace domestic with foreign temperature and precipitation shocks. The latter hit a foreign sector that supplies intermediate goods or services to the focal sector – whose prices we analyse. Thus, each foreign shock can affect the focal sector indirectly, to the extent of its input purchases from the affected sector. These shocks are computed by multiplying the matrix of global weather shocks (as seen in section 3.2) by the focal sector's technical coefficient a_{i} (from section 3.3).

Robustness tests. The results presented below remain robust to a number of model specifications, such as replacing fixed effects (year-month with month and year), restricted sample period and countries, decreasing and increasing lags, joining temperature and precipitation shocks as well as isolating extremes in the 1st to 99th percentiles, estimating IRFs by local projections and adding inflation lags on the right-hand side.

5. Results

Results from the models specified in the previous section (Equations (3) to (7)) are presented below in the form of coefficient boxplots. Each coefficient measures the marginal effect of a weather anomaly of one standard deviation (SD) above/below the long-run mean for that calendar month and location, conditional on being in the extreme tail of the distribution. The regressor is therefore not an absolute increase in temperature or precipitation, but an abnormal standardised deviation from the typical level for that month – that is, a temperature one SD hotter (colder) than the local monthly norm. Among extreme weather episodes, such a ±1 SD anomaly raises monthly inflation by β percentage points with 95% confidence. This is a tail slope, not an average effect. While coefficients might look modest in isolation, they are economically meaningful – especially when shocks are repeated over multiple months and each shock's cumulative effect should equal to the sum of the 12 monthly marginal coefficients.

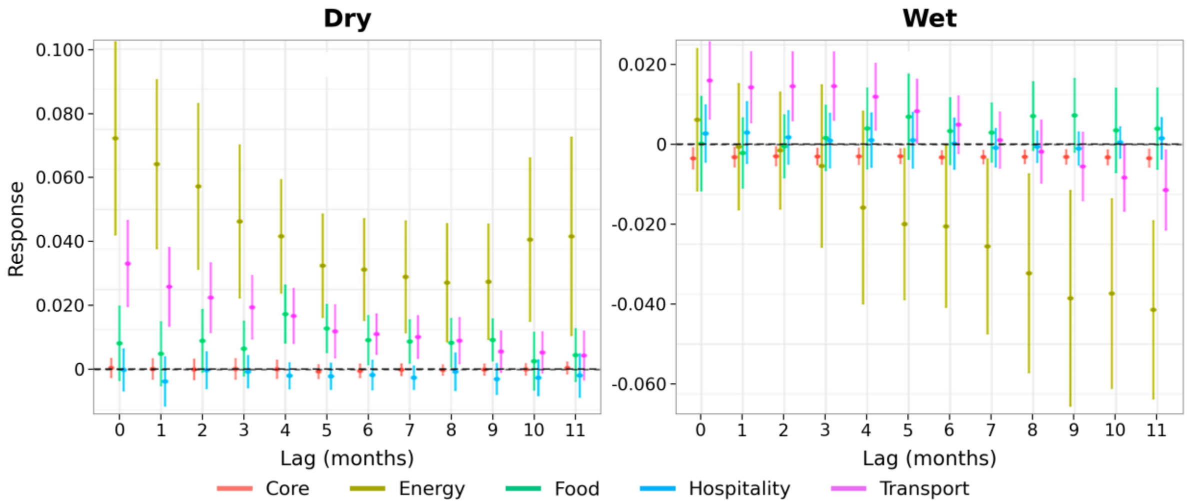
Two features of this interpretation are worth noting. First, the estimated coefficients trace the response to a weather anomaly occurring in a single calendar month and propagating over the following 12; a protracted episode is represented in the model as a sequence of such anomalies, whose price effects accumulate additively. Second, by construction, that accumulation is linear in the number of shocks: the specification allows the response to be convex in the intensity of any given shock, but holds expectations formation fixed, and so cannot capture the additional, non-linear amplification that a sustained run of shocks might set off through inflation expectations.

5.1 Precipitation shocks

In Figure 2a, precipitation mainly affects energy and transport prices, and food prices to a smaller extent. In the left quadrant, a dry anomaly immediately pushes energy and transport prices up; these effects are significant but temporary. Food prices show a moderate rise (0.01–0.02% monthly increases) after a quarter. In the right-hand-side quadrant, a wet anomaly lowers energy prices, possibly due to more efficient hydropower supply and electricity generation: these effects reach around 5 basis points on month-on-month inflation, but are delayed.[13] After an immediate small price increase, transport prices decrease too, consistent with changes in energy prices and probably higher operating costs. Core and hospitality sector prices do not respond to precipitation shocks, which confirms previous evidence that these impacts are sectoral and concentrated upstream: cost-push shocks are likely absorbed by firms (via inventory and margins) or offset by opposite effects, rather than passed through to core prices. The same effects are more pronounced in the cumulative IRFs estimated from the quadratic terms of the shock and plotted in Figure 2b.

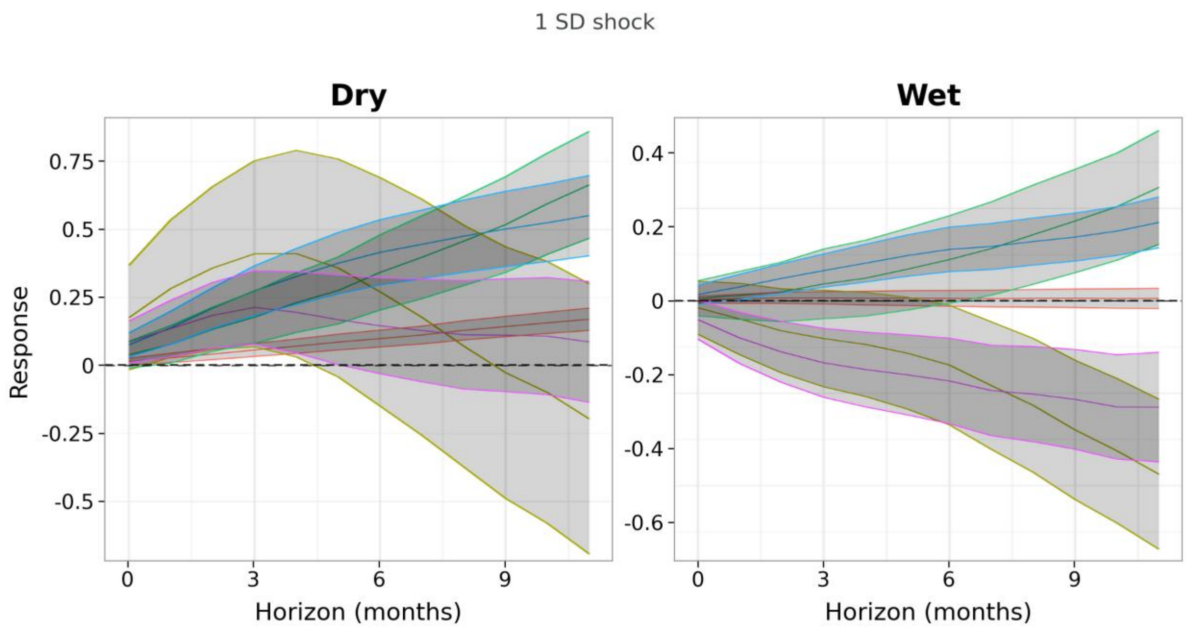
[13] Extreme precipitation increases reservoir inflows and run-of-river generation. This lowers the marginal cost of electricity, especially in hydro-intensive systems. More hydro → less gas/coal generation (more expensive) → reduced demand for fuels → price declines. This effect can spill over to neighbouring markets via interconnections. Interaction terms with hydropower (both as a share of energy mix and as dummy) by country does not change the results.

Figure 2a: Marginal effects of precipitation shocks on inflation



Note: Estimates from Equation (3) with precipitation shocks.

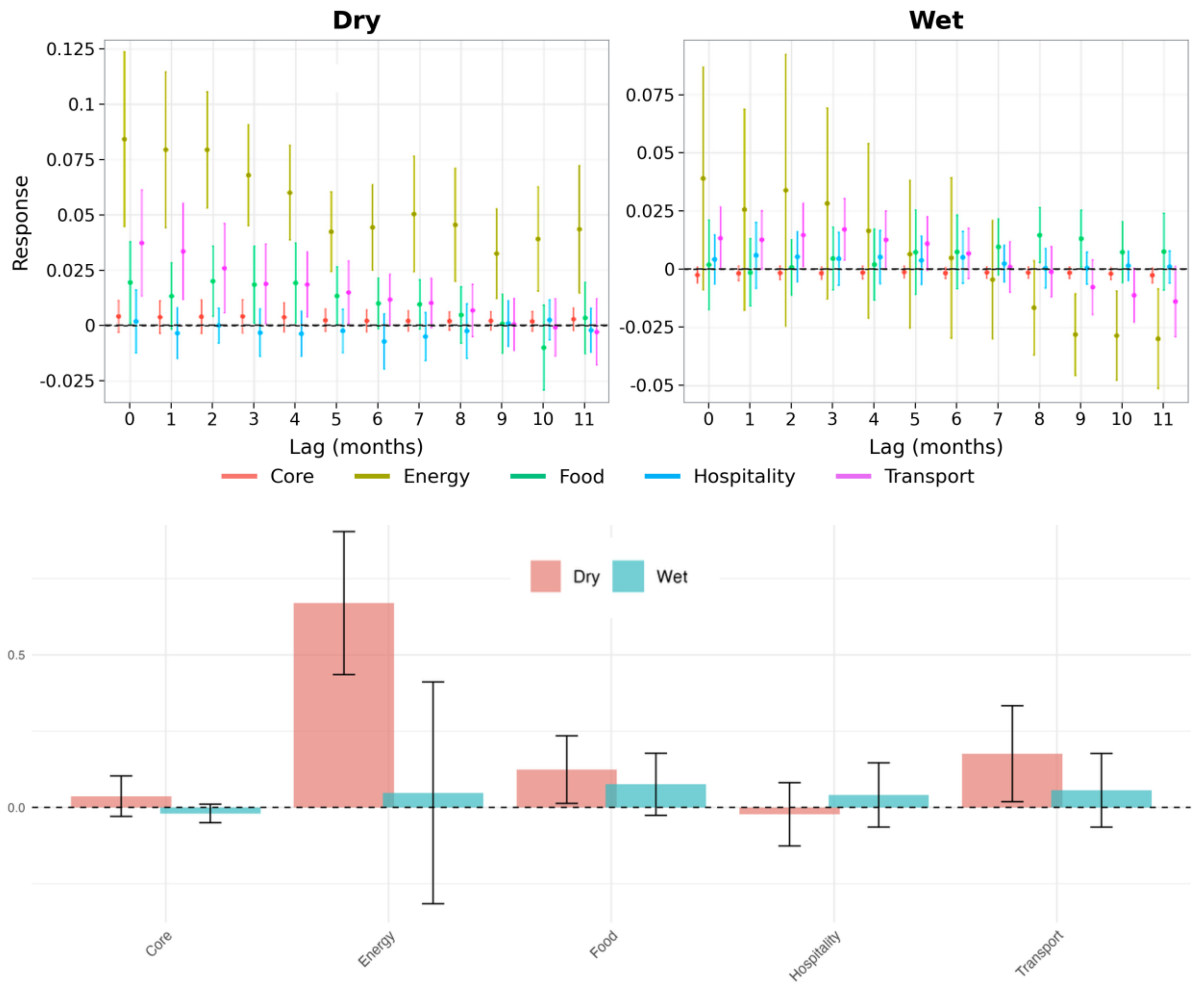
Figure 2b: Cumulative non-linear effects of precipitation shocks on inflation



Note: Estimates from Equation (5) with precipitation shocks in quadratic form.

Figure 2c evaluates the combined marginal effect of precipitation shocks at a very dry baseline climate (10th percentile), where agriculture and hydropower are already water-constrained and a further shortfall in rainfall is most likely to bind. Consistent with this, dry anomalies push food prices up earlier than in the average-climate case, as cropland under an already-arid baseline has little buffer to absorb additional moisture stress. Energy prices also rise relatively more, plausibly amplified by cooling demand – droughts often coincide with heat waves – and by hydropower constraints that are first-order in many arid economies. Wet anomalies, by contrast, have no significant effect in these dry climates: an isolated burst of rainfall from a low baseline is too small and too transient to relieve the underlying water deficit. The response therefore remains concentrated in the food and energy margins, with transport, hospitality and core prices largely unaffected.

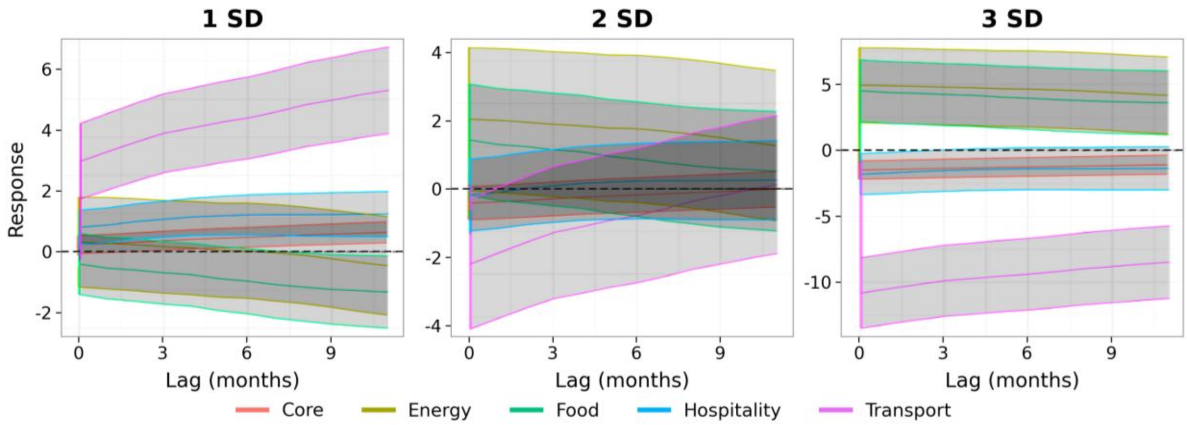
Figure 2c: Marginal (top) and cumulative (bottom) effects of precipitation shocks on inflation in dry climates



Note: Estimates from Equation (4) with precipitation shocks. The boxplots report the combined effect of dry shocks ($\beta_1 + \beta_3 P_{\text{dry}}$) and wet shocks ($\beta_2 + \beta_4 P_{\text{dry}}$) evaluated at $P_{\text{dry}} = 15.3$, corresponding to the 10th percentile of the cross-country baseline precipitation distribution. The top panel shows monthly marginal effects; the bottom panel shows cumulative effects over 12 months. Confidence intervals of 95% from delta-method standard errors.

In Figure 2d, we zoom in on the effects of dry anomalies in a restricted sample consisting of dry climates only (i.e. months and countries). Notably, with quadratic terms in the regression (see Equation (5)), inflationary pressures in food and energy prices rise by 5% when dry weather shocks are at 3 SD.

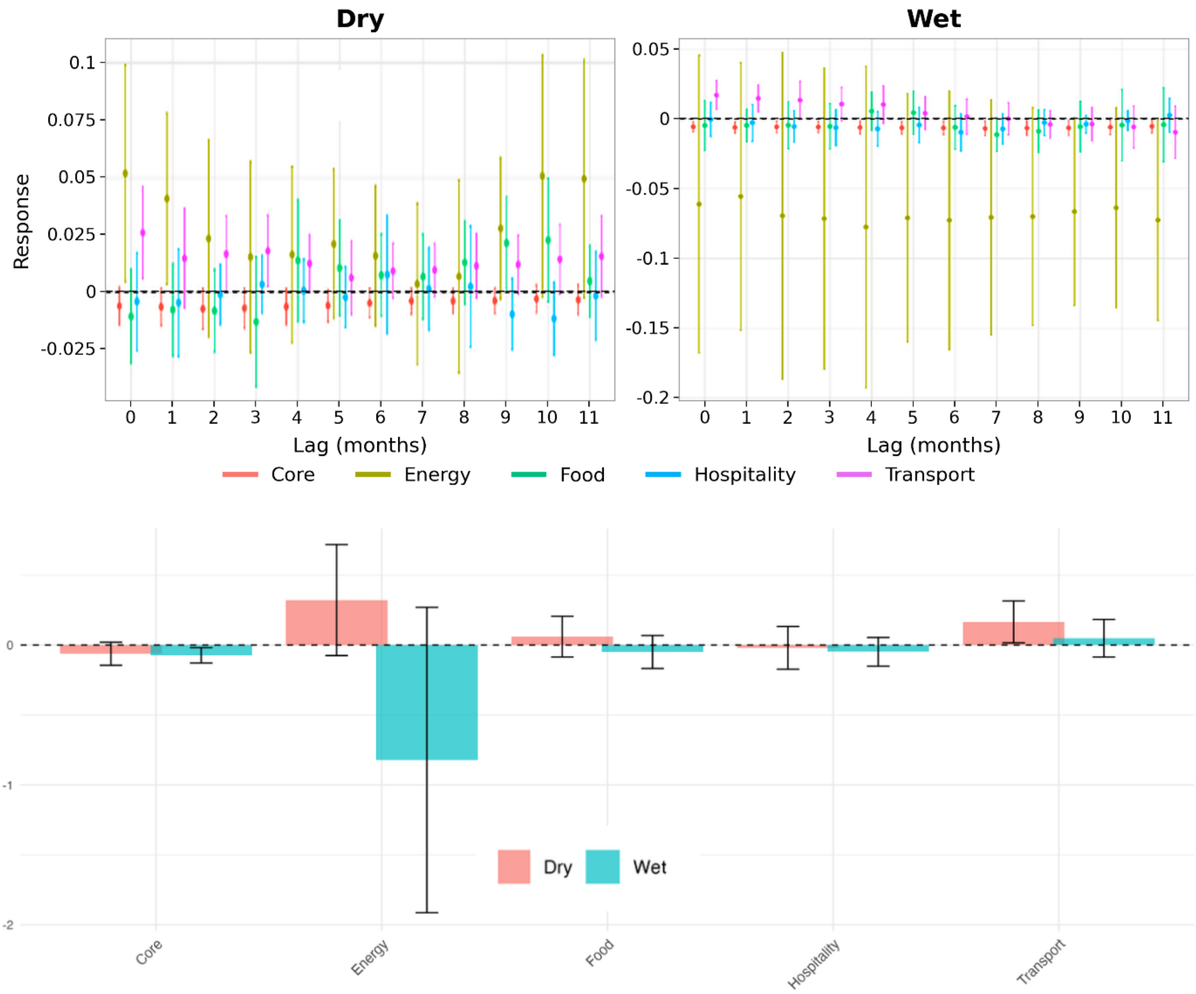
Figure 2d: Cumulative non-linear effects of dry shocks at different intensities in dry climates



Note: Estimates from Equation (5) with precipitation shocks in a restricted sample of countries with dry baseline climates ($P_c = 50$th percentile) in dry months ($P_t < 25$th percentile).

Figure 2e evaluates the combined marginal effect of precipitation shocks at a very wet baseline climate (90th percentile), where additional rainfall is least likely to relieve a binding water constraint. Consistent with this, dry anomalies have no meaningful inflationary effect in these already-wet climates, since a precipitation shortfall from a high baseline rarely pushes agriculture or hydropower into scarcity. Wet anomalies point in the expected direction for energy prices – negative, consistent with abundant reservoir inflows and run-of-river generation displacing costlier thermal sources – but the effect is not statistically significant, so it should be read as suggestive rather than conclusive. Across the remaining sectors – food, transport, hospitality and core – precipitation shocks of either sign leave prices essentially unresponsive.

Figure 2e: Marginal (top) and cumulative (bottom) effects of precipitation shocks on inflation in wet climates

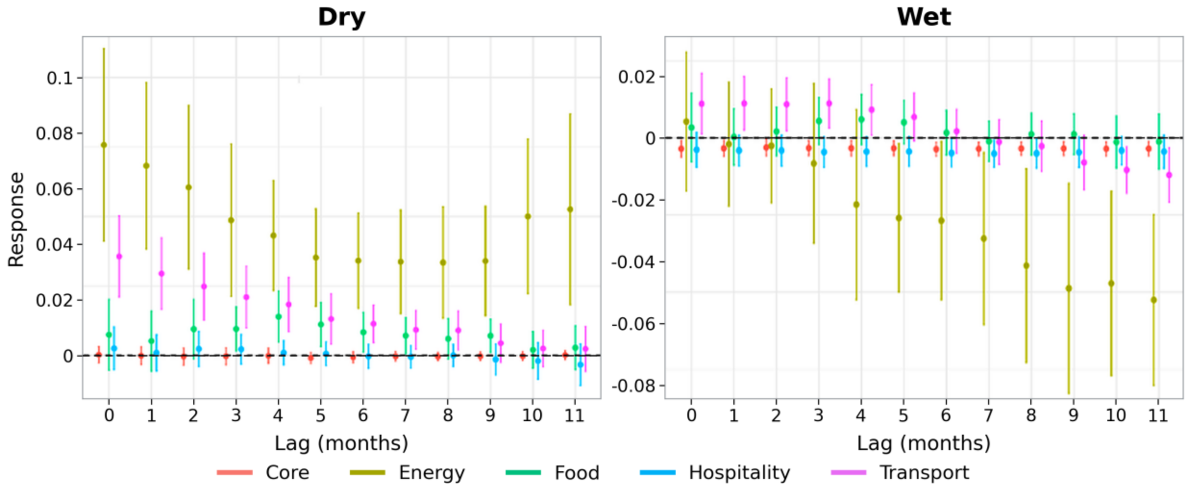


Note: Estimates from Equation (4) with precipitation shocks. The boxplots report the combined effect of dry shocks ($\beta_1 + \beta_3 P_{\text{wet}}$) and wet shocks ($\beta_2 + \beta_4 P_{\text{wet}}$), evaluated at P_{wet} =185.1, corresponding to the 90th percentile of the cross-country baseline precipitation distribution. The top panel shows monthly marginal effects; the bottom panel shows cumulative effects over 12 months. Confidence intervals of 95% from delta-method standard errors.

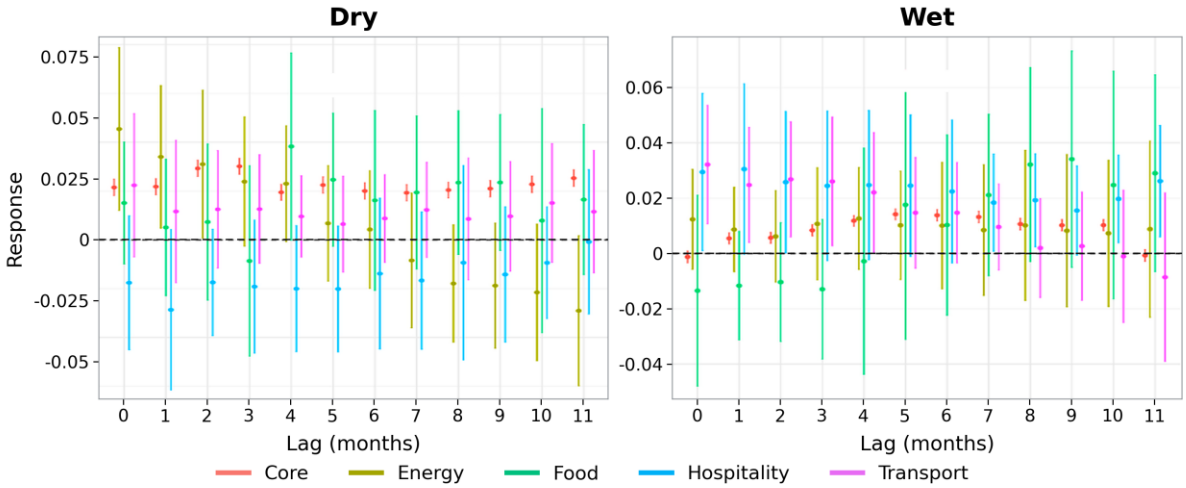
One of the most important findings concerns the monetary policy regime (see Figure 2f). In IT countries (n = 44), precipitation shocks have largely insignificant effects, and core inflation remains stable. Even the sizeable inflationary impacts observed for 3 SD shocks are substantially weaker when the sample is restricted to IT countries – though they do not disappear entirely. This suggests that credible monetary policy helps dampen, but not fully eliminate, climate-driven inflationary pressures. In addition, intense precipitation shocks in IT countries may also generate negative marginal effects on core inflation, reflecting anchored expectations, competitive pass-through and the absence of accommodative monetary responses.

Figure 2f: Effects of precipitation shocks on inflation in IT vs non-IT countries

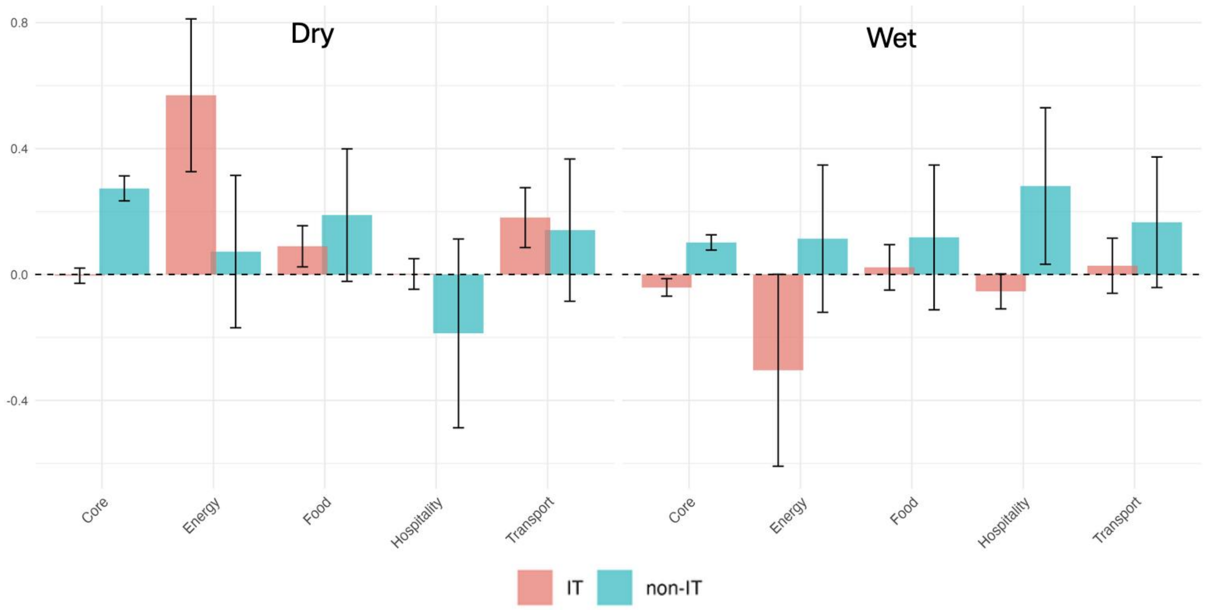
(i) IT countries



(ii) Non-IT countries



(iii) IT vs non-IT countries



Note: Estimates from Equation (6) with precipitation shocks. The top panel shows monthly marginal effects in IT countries; the middle panel shows monthly marginal effects in non-IT countries; the bottom panel shows cumulative effects over 12 months. Confidence intervals of 95% from delta-method standard errors.

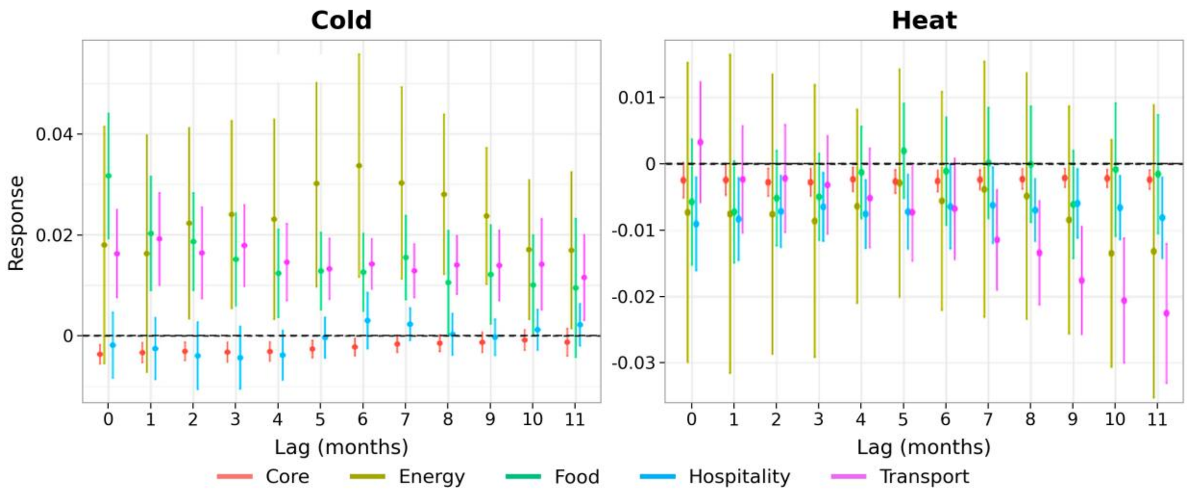
Table 1: Summary of findings: precipitation shocks

Type of shock	Effect on inflation
Global panel – baseline (Equation 3)	
Dry anomaly	Energy and transport ↑ (immediate but temporary); food ↑ moderately (0.01–0.02%/month) after about a quarter; core and hospitality show no response (Figure 2a)
Wet anomaly	Energy ↓ (~5 basis points, delayed; hydropower effect); transport small initial ↑ then ↓; food, core and hospitality show no response (Figure 2a)
Conditioned on baseline climate (Equation 4)	
Dry × dry climate	Food ↑ earlier (agriculture already water-constrained); energy ↑ more (cooling demand + hydropower constraint) (Figure 2c)
Wet × dry climate	No significant effect (Figure 2c)
Dry × wet climate	No significant effect (Figure 2e)
Wet × wet climate	Energy and core ↓ (Figure 2e)
Non-linear/intensity (1, 2, 3 SD; Equation 5)	
Dry × dry climate, by intensity	Food and energy ↑ ~5% at 3 SD; effect grows convexly with shock intensity (Figure 2d)
Mediating role of monetary policy regime (Equation 6)	
IT countries (n = 44)	Food and energy ↑ (Figure 2f)
Non-IT countries (n = 21)	Core ↑ (Figure 2f)

5.2 Temperature shocks

By using extremely abnormal deviations from monthly temperature averages, we are able to capture persistent, broad heat or cold. Our baseline estimates are plotted in Figure 3a. Cold waves can have short-run inflationary effects on energy and transport prices, probably caused by a surge in the demand for heating: energy demand is highly inelastic in the short run, so prices respond quickly, but while spot and wholesale energy prices rise almost immediately, retail energy prices rise with a lag depending on regulation and contracts. Extreme cold also has a positive and almost contemporaneous impact on food inflation (up to 0.03% in the same month) that fades within 3–4 months.

Figure 3a: Marginal effects of temperature shocks on inflation



Note: Estimates from Equation (3) with temperature shocks. The vertical axis shows coefficient estimates of marginal effects.

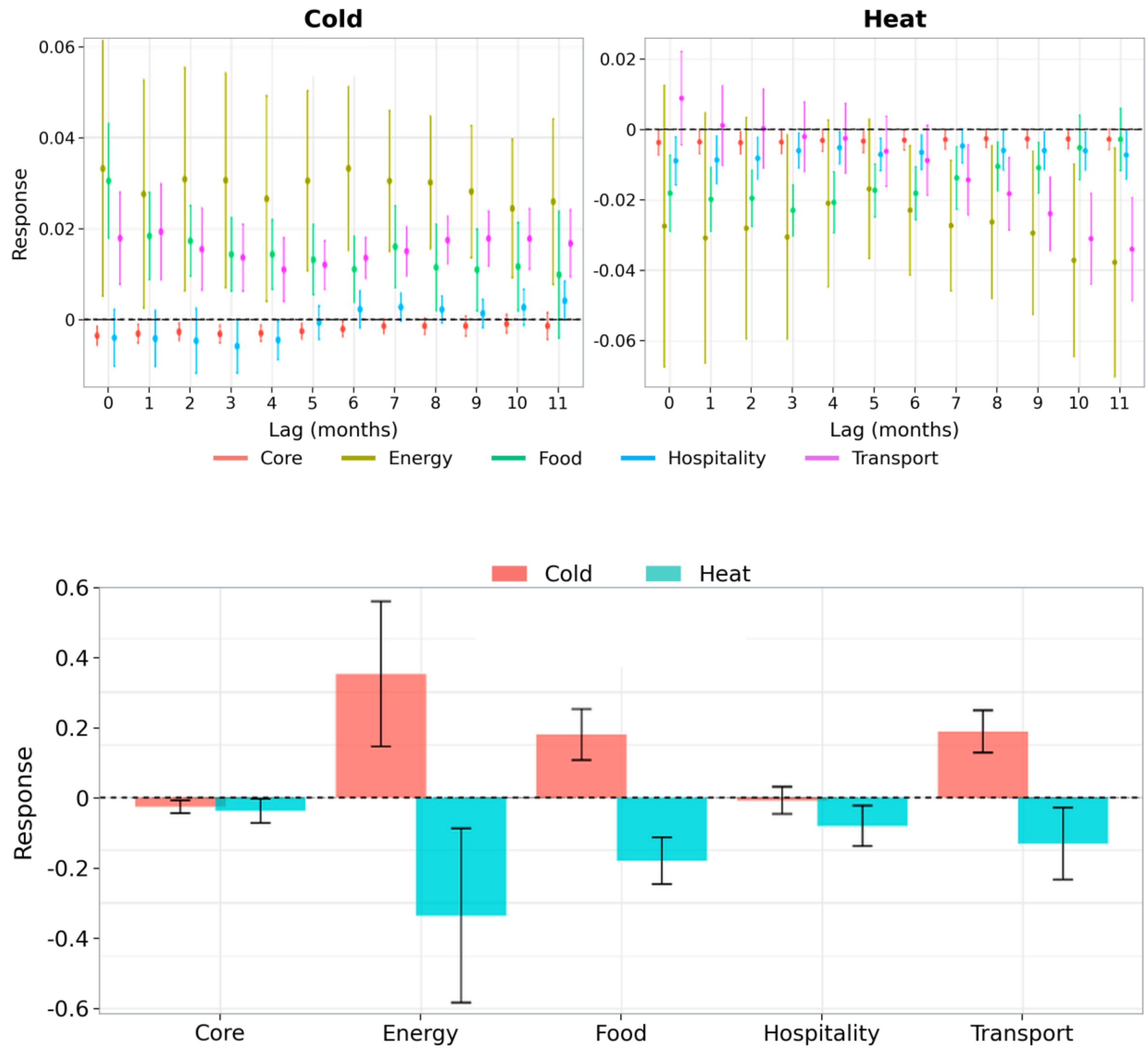
Both the magnitude and timing of these results are plausible with known economic and supply-chain mechanisms: extreme cold affects unprocessed food supply within days and, because food supply chains have low inventories and food demand is highly price-inelastic, even short disruptions push prices up quickly.[14] A 0.03% monthly impact on food inflation is plausible because the cold events we identify here are severe (e.g. bottom 5% of temperature distribution). At the same time, our results are related to the broad food category and might mask larger impacts concentrated in food commodity

14 To validate the last result, we should look at whether the sample countries' diet is particularly dependent on unprocessed food and whether they do not substitute so quickly.

prices (Falck and Schulte 2025). In the case of heat waves, the effect on core and hospitality prices is tiny and deflationary, indicating a small but consistently negative demand effect. Transport prices decrease, too, with a delay.

In cold climates, one would expect heat waves to be relatively mild and thus less disruptive than cold waves. The boxplots in Figure 3b show that in cool climates heat waves decrease the price of food and energy, while every month cold waves increase the price of energy by around 0.05% and of food by 0.025%. Interestingly, cold extremes lower prices slightly in the hospitality sector. The bottom chart aggregates the monthly coefficients shown below, and indicates that in already cold climates, cold waves drive up energy, food and transport prices. In contrast, heat waves (shown in light blue) tend to lower these prices – likely because they moderate an otherwise cold baseline climate.

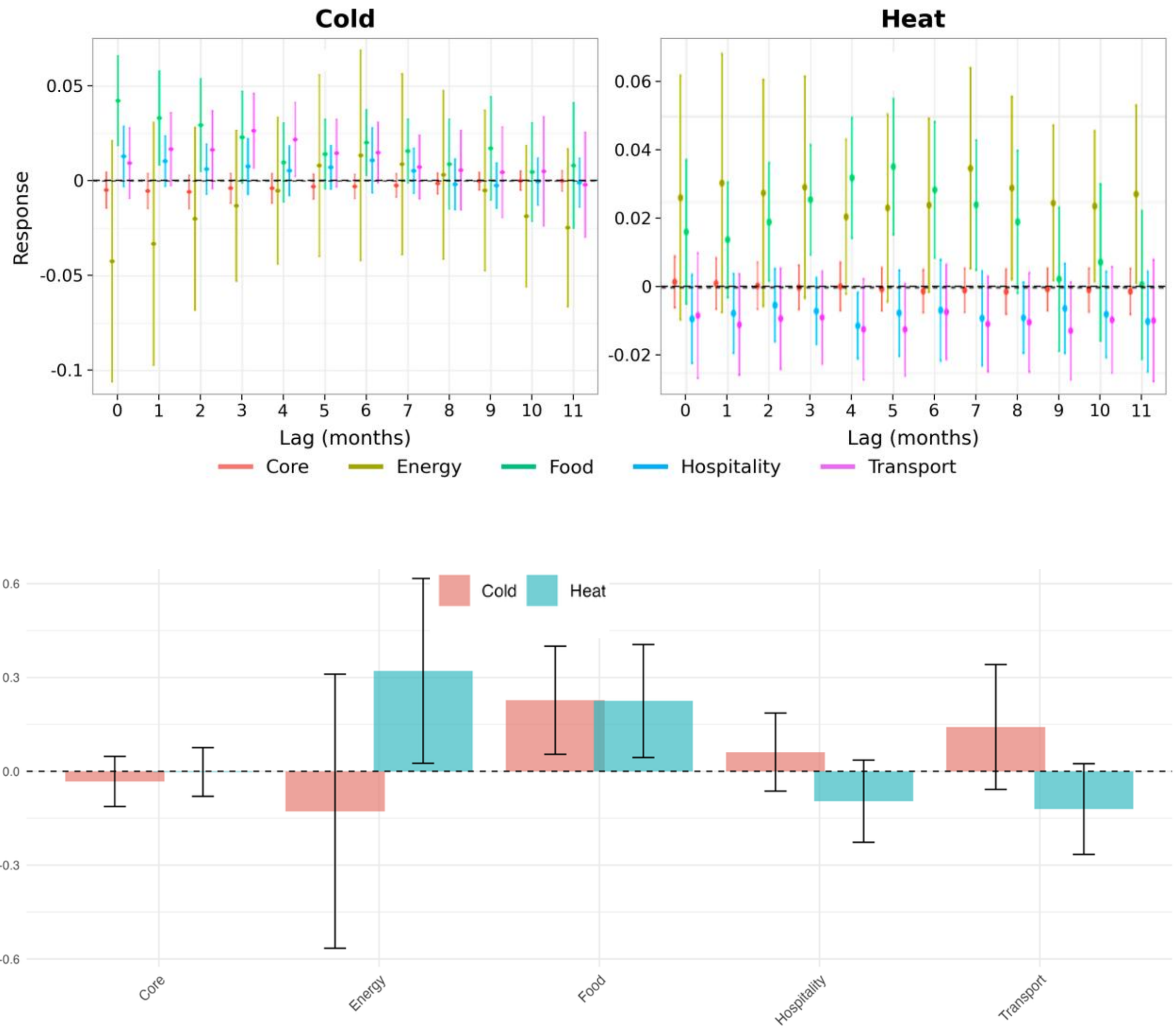
Figure 3b: Marginal (top) and cumulative (bottom) effects of temperature shocks on inflation in cold climate



Note: Estimates from Equation (4) with temperature shocks. The boxplots report the combined effect of cold ($\beta_1 + \beta_3 T_{\text{cold}}$) and heat waves ($\beta_2 + \beta_4 T_{\text{cold}}$) evaluated at T_{cold}= 8.6°C, corresponding to the 25th percentile of the cross-country baseline temperature distribution. The top panel shows monthly marginal effects; the bottom panel shows cumulative effects over 12 months. Confidence intervals of 95% from delta-method standard errors.

Figure 3c evaluates temperature shocks at a very warm baseline climate (90th percentile, 27.3°C). Heat waves raise energy and food inflation – cumulative effects of about 0.3 and 0.2 percentage points, respectively, both significant – building gradually across horizons rather than spiking on impact. Cold waves in these hot climates raise food prices by a comparable magnitude (~0.2 percentage points, significant), but their effect on energy is negative and statistically indistinguishable from zero – its confidence band is very wide, spanning roughly −0.55 to +0.30 – consistent with the idea that in a hot climate a mild cold spell reduces cooling demand as often as it raises heating demand, leaving the net energy response imprecise.

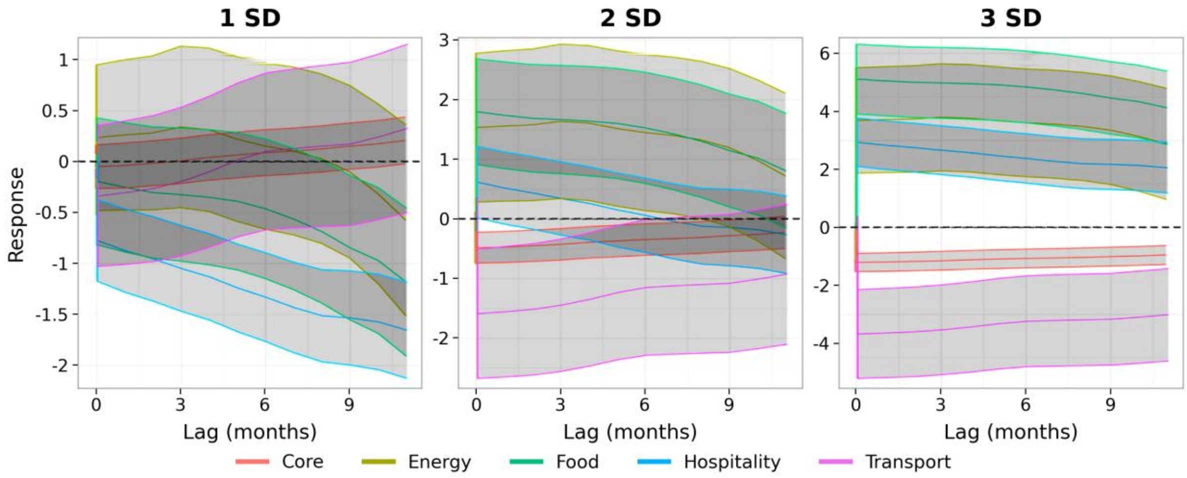
Figure 3c: Marginal (top) and cumulative (bottom) effects of temperature shocks on inflation in warm climates



Note: Estimates from Equation (4) with temperature shocks. The boxplots report the effect of cold ($\beta_1 + \beta_3 T_{\text{warm}}$) and heat waves ($\beta_2 + \beta_4 T_{\text{warm}}$) evaluated at T_{warm}= 27°C. The top panel shows monthly marginal effects; the bottom panel shows cumulative effects over 12 months. Confidence intervals of 95% from delta-method standard errors.

Figure 3d simulates heat-wave shocks at different intensity levels (1, 2 and 3 SDs), allowing for non-linear effects and restricting the sample to economically meaningful hot-month episodes. At low intensity (1 SD), cumulative price responses are generally small and often close to zero, with somewhat ambiguous patterns, particularly for food and energy. As intensity increases, however, inflationary effects become clearer and stronger: food and energy prices exhibit the largest positive spikes, especially at 3 SD. Hospitality, which at lower intensities appears driven mainly by weaker demand, increasingly reflects adverse supply pressures as heat waves intensify. The larger effect sizes at higher intensities arise because the total impact combines both the linear and quadratic terms in the estimates (total effect = linear coefficient + quadratic coefficient × intensity²), so stronger shocks generate disproportionately larger inflationary responses.

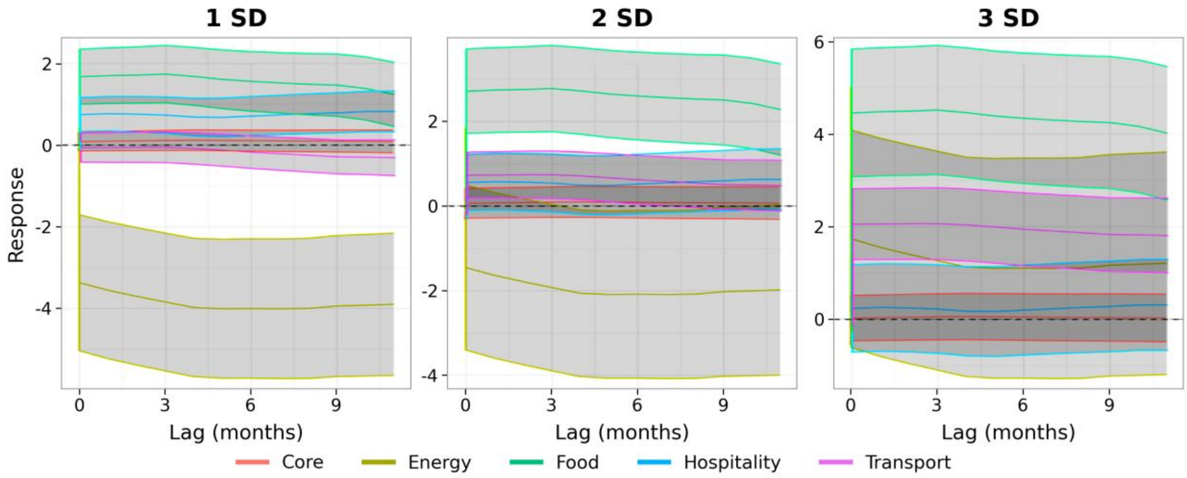
Figure 3d: Cumulative non-linear effects of heat waves at different intensities in warm climates



Note: Estimates from Equation (5) with positive temperature shocks in a restricted sample with country-months whose long-run climatic baseline is at least 25°C.

In addition, Figure 3e reports simulated cold-wave shocks at different intensity levels (1, 2 and 3 SDs), focusing only on warm countries, where cold weather is relatively unusual and therefore potentially more economically disruptive. Consistent with this idea, the inflationary impact becomes stronger as intensity increases. Food prices rise substantially, reaching cumulative increases of up to 5% at higher intensities, making food the most affected component. Energy prices, by contrast, show deflationary effects only at low intensity – consistent with earlier results – likely because in warm countries a mild cold spell reduces cooling demand rather than triggering large heating needs. As the shock becomes more severe, however, this energy deflation fades and effects move closer to zero or turn positive. Overall, the non-linear specification (combining linear and quadratic terms) implies that stronger cold shocks generate disproportionately larger effects, particularly for food inflation.

Figure 3e: Cumulative non-linear effects of cold waves at different intensities in warm climates

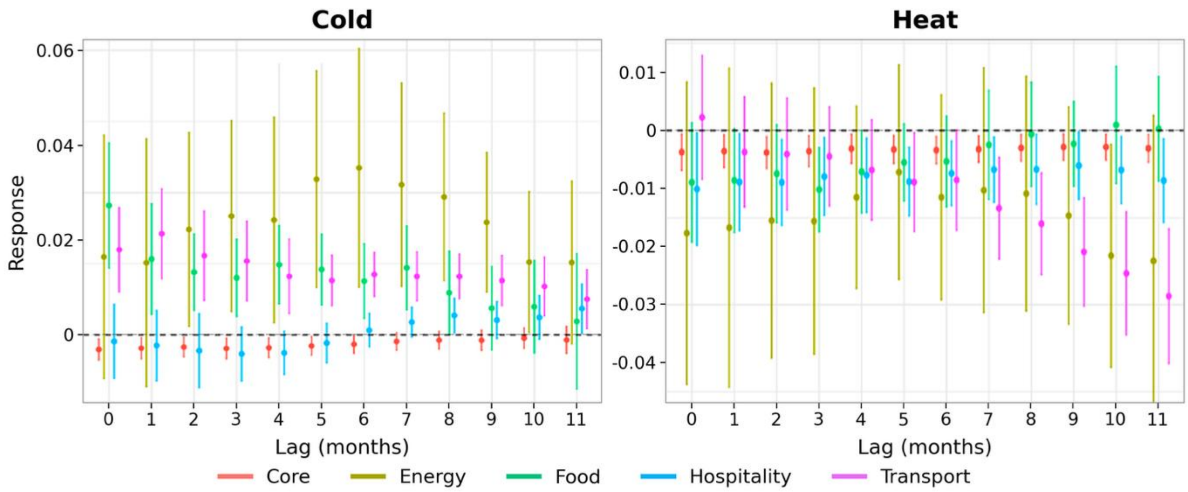


Note: Estimates from Equation (5) with negative temperature shocks in a restricted sample with country-months whose long-run climatic baseline is at least 25°C.

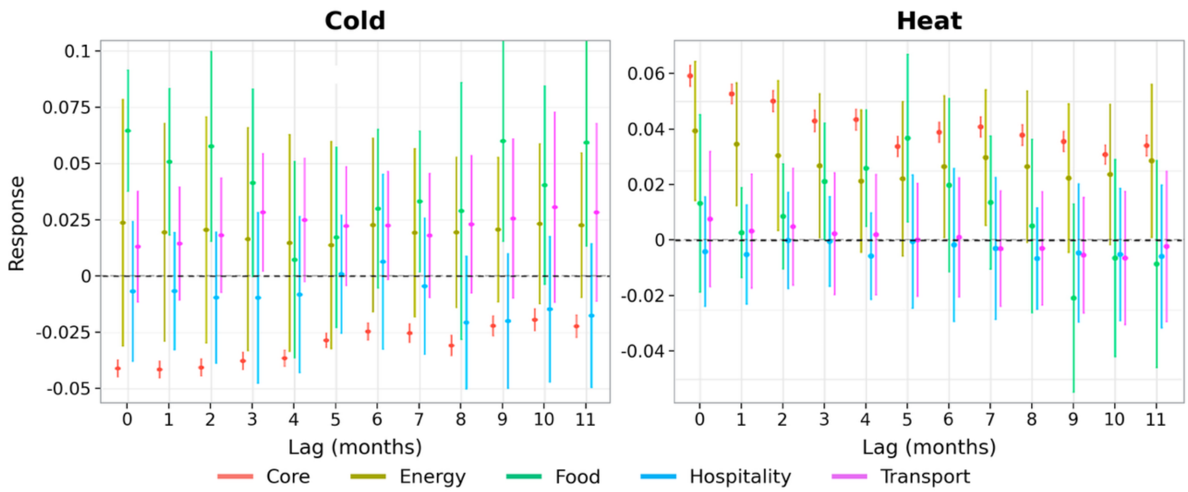
Figure 3f compares the cumulative effect of temperature extremes across monetary policy regimes. The contrast is sharp and consistent with anchored expectations. In non-IT countries, temperature shocks pass through forcefully: cold waves raise cumulative food inflation by roughly 0.5 percentage points and energy by about 0.25 percentage points, while heat waves push core inflation up by around 0.5 percentage points and energy by 0.3 percentage points – core, the cleanest gauge of broad-based pressure, moves significantly, signalling that climate shocks become generalised inflation where policy is less credible. In IT countries, these responses are heavily dampened: core inflation is essentially flat under both heat and cold, and the food and energy effects, while still positive, are smaller and more precisely bounded. The per-lag panels reinforce this: non-IT core inflation drifts significantly negative after cold waves and strongly positive after heat waves across most horizons, whereas IT core hugs the zero line throughout. The one notable exception is non-IT energy, whose wide bands leave it imprecisely estimated. Overall, IT does not eliminate the first-round, sector-specific cost-push effects of weather – food and energy still respond – but it appears to sever their transmission into core inflation, which is exactly the second-round containment a credible regime is designed to deliver.

Figure 3f: Effects of temperature shocks on inflation in IT vs non-IT countries

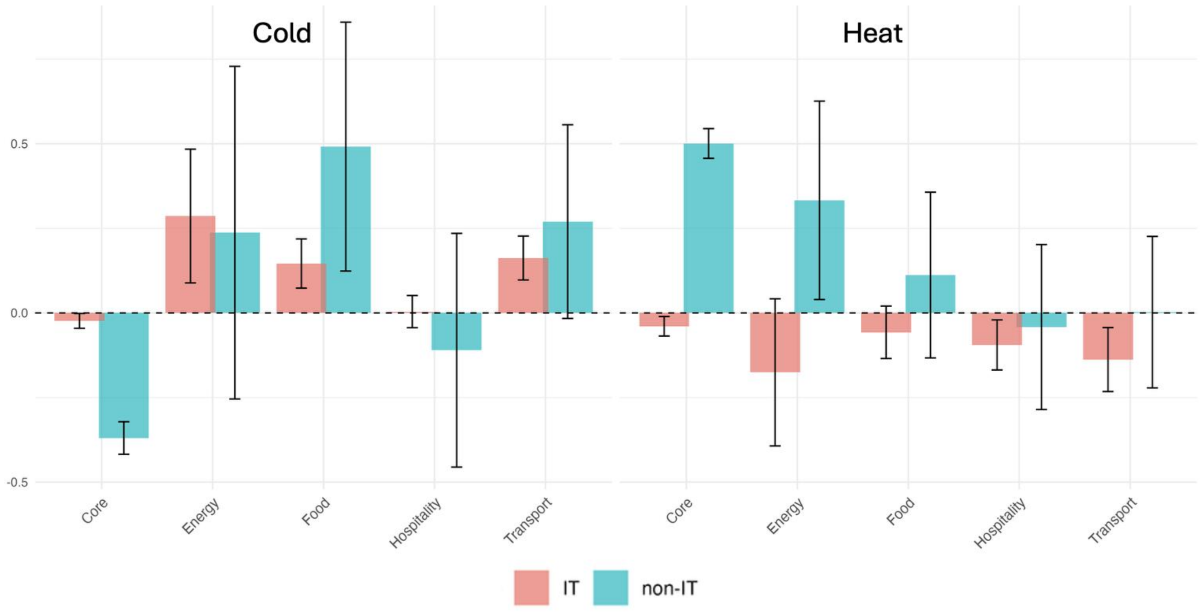
(i) IT countries



(ii) Non-IT countries



(iii) IT vs non-IT countries



Note: Estimates from Equation (6) with temperature shocks. The top panel shows monthly marginal effects; the bottom panel shows cumulative effects over 12 months. Confidence intervals of 95% from delta-method standard errors.

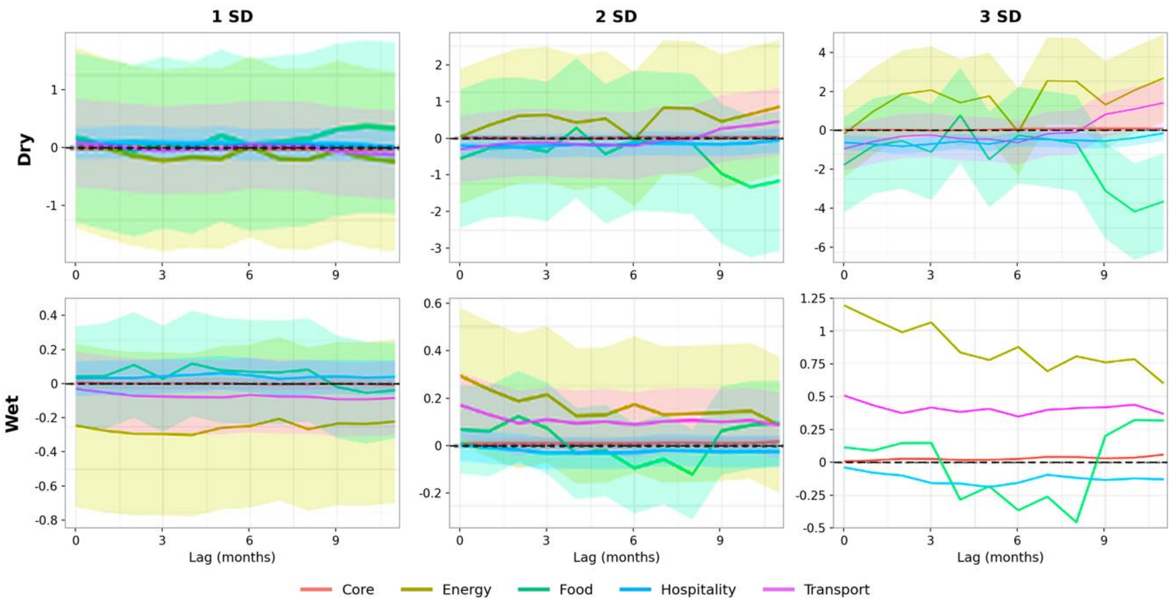
Table 2: Summary of findings: temperature shocks

Type of shock	Effect on inflation
Global panel – baseline (Equation 3)	
Cold wave	Energy ↑ and transport ↑ in the short run (heating demand); food ↑ (up to 0.03%/month, fading within 3–4 months) (Figure 3a)
Heat wave	Core and hospitality tiny ↓ (small negative demand effect); transport ↓ with a lag (Figure 3a)
Conditioned on baseline climate (Equation 4)	
Cold wave × cold climate	Energy ↑ (~0.05%/month), food ↑ (~0.025%/month), transport ↑; hospitality slight ↓ (Figure 3b)
Heat wave × cold climate	Food ↓ and energy ↓ (heat moderates an otherwise cold baseline) (Figure 3b)
Heat wave × warm climate	Energy ↑ (~1%) and food ↑ (~0.5%); other indices unaffected (Figure 3c)
Cold wave × warm climate	No effect except food ↑ (Figure 3c)
Non-linear/intensity (1, 2, 3 SD; Equation 5)	
Heat wave × warm climate, by intensity	Small/ambiguous at 1 SD; food and energy ↑ strongly at 3 SD; hospitality shifts from demand-driven to supply-driven ↑ (Figure 3d)
Cold wave × warm countries, by intensity	Food ↑ substantially (up to ~5% at high intensity); energy ↓ only at low intensity, fading or turning positive as the shock intensifies (Figure 3e)
Mediating role of monetary policy regime (Equation 7)	
IT countries (n = 44)	Cold waves: energy and food ↑ (Figure 3f)
Non-IT countries (n = 21)	Heat waves exert more pronounced inflationary pressures, including on core indices (Figure 3f)

5.3 South Africa

Figure 4a presents IRFs of South African inflation components to precipitation extremes at 1, 2 and 3 SD shocks, estimated from Equation (7). At mild (1 SD) levels, both dry and wet anomalies have relatively small and mostly insignificant effects across sectors. As intensity increases to 2 SD, sectoral responses become more pronounced, particularly for food and energy, though effects remain moderate. At extreme (3 SD) levels, non-linearities become clear: severe dry anomalies (i.e. droughts) generate noticeable increases in energy and transport inflation, while food inflation shows substantial volatility and delayed negative responses. Conversely, heavy rainfall leads to strong short-run increases in energy inflation and moderate transport pressures, but food prices initially decline sharply before recovering, suggesting demand or distribution effects rather than pure supply shortages. Core inflation remains comparatively muted throughout, indicating that precipitation extremes primarily transmit through food, energy and transport channels rather than broad-based price pressures.

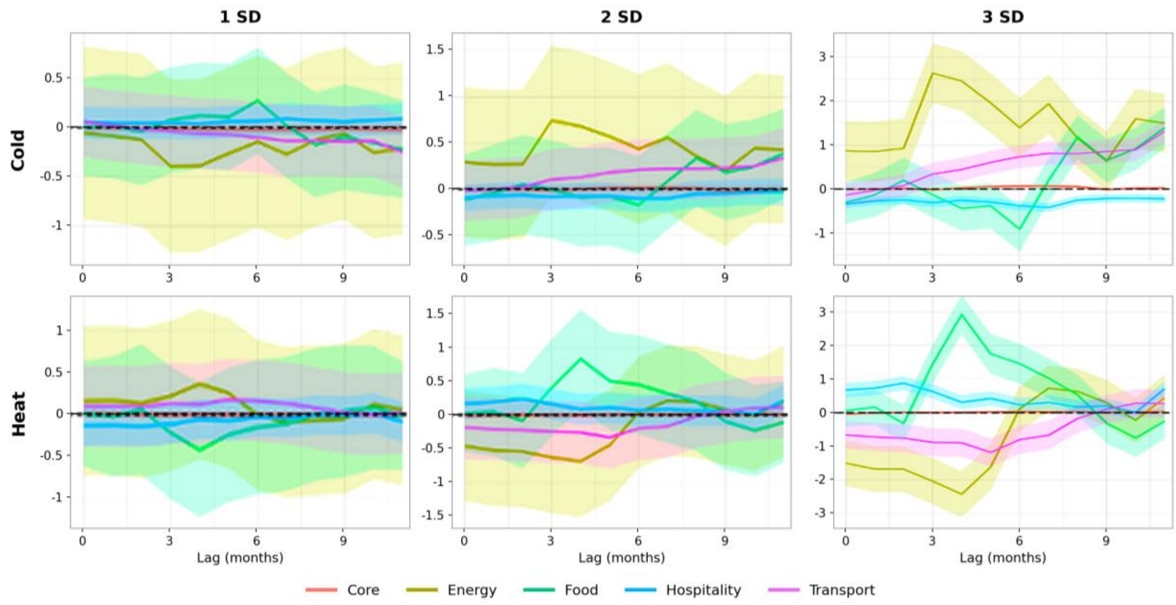
Figure 4a: IRFs to precipitation shocks in South Africa: marginal effects at different intensities



Note: IRFs estimated from Equation (7) with precipitation shocks.

Turning to South Africa's temperature anomalies (see Figure 4b), stronger shocks – around three SDs – produce much larger and more volatile effects than mild shocks. Energy and food inflation are the most responsive, particularly under severe shocks. Cold waves generally push energy inflation upward, with effects peaking a few months after the shock, while heat waves cause sharper short-run spikes in food inflation, typically around 3–5 months. Core inflation remains relatively stable across all scenarios, and most effects peak within 3–6 months before gradually fading. Focusing on the 3 SD cold wave scenario, energy inflation rises strongly due to increased heating demand, which also drives up transport inflation. Food inflation initially becomes volatile and then exhibits a notable but short-lived negative response at around 4–6 months. These cold deviations in South Africa typically reflect a winter intensification rather than Arctic-style freezes, suggesting that the observed decline in food prices is driven by demand factors – reduced mobility, lower informal sector activity and slower turnover of fresh produce – rather than a supply collapse. By contrast, heat waves produce more conventional effects: food prices rise, hospitality prices increase slightly and core inflation remains roughly flat. Energy prices decrease briefly, a pattern consistent with limited demand responsiveness in a heavily regulated electricity market.

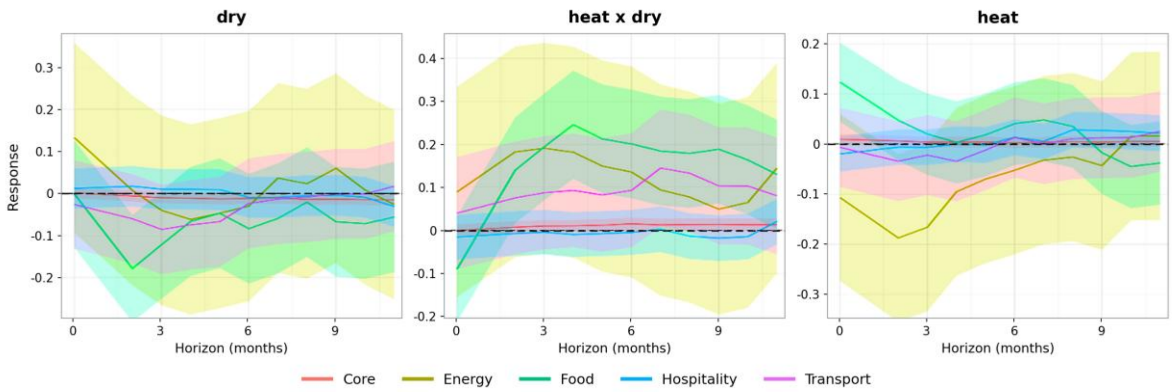
Figure 4b: IRFs to temperature shocks in South Africa: marginal effects at different intensities



Note: IRFs estimated from Equation (7) with temperature shocks.

Figure 4c shows IRFs of South African inflation components to dry anomalies and heat waves, and their interaction over a 12-month horizon. Dry weather alone has relatively modest and mixed effects: energy prices increase slightly, food prices initially fall before recovering, and core and hospitality inflation remain close to zero. Heat waves on their own also generate limited inflationary pressure, with small, short-lived movements across sectors and no strong core response. In contrast, the interaction between heat and dry weather produces the clearest and most persistent inflationary effects, particularly for food and energy, which rise noticeably in the months following the shock. Transport inflation also increases under the combined shock, while core inflation remains muted. Overall, IRFs in Figure 4c highlight the importance of compound shocks: it is the interaction of extreme events, rather than isolated weather disturbances, that generates the most significant inflationary pressures, especially through food and energy channels.

Figure 4c: Interaction effects of heat waves and dry anomalies in South Africa



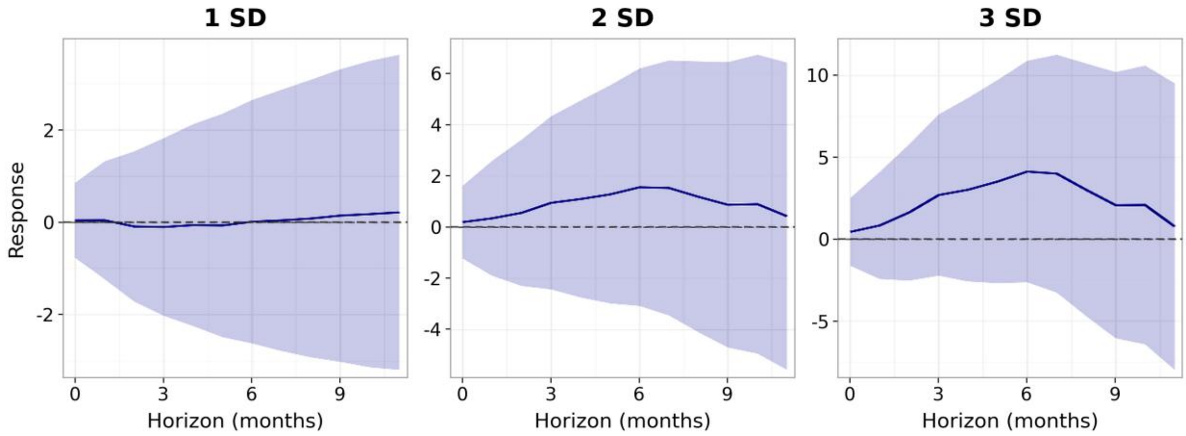
Note: IRFs estimated from an alternative version of Equation (7):

$$\pi_{s,t+h} = \propto + \sum_{L=0}^{11} \beta_{s,L}^{1} T_{s,c,t-L}^{+} + \sum_{L=0}^{11} \beta_{s,L}^{2} P_{s,t-L}^{-} + \sum_{L=0}^{11} \beta_{s,L}^{3} T_{s,t-L}^{+} P_{s,t-L}^{-} + +\eta_{month} + \gamma_{year} + \varepsilon_{s,t+h}$$

where $\beta_{s,L}^{3}$ represents the interaction effects of heat waves and dry anomalies on sectoral inflation rates in South Africa.

Finally, the point estimates in Figure 4d suggest foreign agricultural heat shocks transmit to South African food inflation with the expected positive sign and a multi-month lag, and the response is larger at higher shock intensities. However, the wide confidence bands – reflecting the rarity of severe foreign supply shocks binding on South African food inputs – mean we cannot rule out a null effect, so we read this as suggestive corroboration of the cross-border channel rather than independent confirmation that climateflation propagates through global production and trade networks, transmitting weather-related disruptions across borders.

Figure 4d: Cumulative effects of foreign heat waves on food prices in South Africa



Note: IRFs estimated by restricting Equation (7) to regress food inflation in South Africa on foreign heat waves occurring in Brazil, the United States, Argentina and Thailand.

Table 3: Summary of findings: South Africa

Type of shock	Effect on inflation
Precipitation shocks (local projections, Equation 8)	
Dry anomaly/drought	At 3 SD: energy ↑ and transport ↑; food volatile, with delayed negative response; core muted (Figure 5a)
Wet anomaly/heavy rainfall	Energy ↑ short run, transport moderate ↑; food ↓ sharply then recovers; core muted (Figure 5a)
Temperature shocks (local projections, Equation 8)	
Cold wave	Energy ↑ (peaks a few months later), transport ↑; food volatile then short-lived ↓ at 4–6 months; core flat (Figure 5b)
Heat wave	Food ↑, hospitality slight ↑; energy brief ↓; core flat (Figure 5b)
Compound and foreign shocks	
Heat × dry interaction	Clearest and most persistent inflationary effect: food ↑, energy ↑, transport ↑; core muted. Compound shocks matter most (Figure 5c)
Foreign heat waves (e.g. Brazil, United States)	South African food inflation ↑ after a few months; non-linear, with sizeable cumulative increases at 3 SD (cross-border transmission) (Figure 5d)

5.4 Comparison with existing literature

Our results both corroborate and qualify the emerging evidence on climateflation. Like Faccia, Parker and Stracca (2021), we find that extreme temperatures exert an economically meaningful, largely contemporaneous effect on prices, particularly food, and that these effects are markedly non-linear, scaling disproportionately with the size of the shock. Our intensity simulations, in which food and energy inflation rise by up to 5% only at the 3 SD tail, sharpen this point by showing that the convexity of physical damage functions translates directly into a convex price response.

Where we depart from Faccia, Parker and Stracca is in scope: their significant pass-through to a broad range of indices, including producer prices and the gross domestic product deflator, contrasts with our finding that the response remains concentrated upstream and rarely propagates to core inflation, consistent with a cost-push rather than demand-pull interpretation.

The asymmetry across shock types echoes Kabundi, Mlachila and Yao (2022): we likewise find that dry anomalies are reliably inflationary through the food channel, whereas wet anomalies are weaker and, in the case of energy, even deflationary – mirroring their result that floods tend to dampen inflation. Our evidence that precipitation matters at both tails is broadly compatible with Moessner (2022), though our data locate the strongest food-price pressure at the dry rather than the wet extreme.

Crucially, our sectoral and regime-dependent results speak directly to the policy debate opened by Mukherjee and Ouattara (2021): whereas they document persistent effects on headline inflation that would justify a monetary response, we find responses that peak within months and fade thereafter, and that are further attenuated – though not eliminated – under credible inflation-targeting regimes, reinforcing Kabundi et al.'s observation that both the income level and the monetary framework condition the outcome.

Finally, the importance of baseline climate and seasonality in our estimates aligns closely with Ciccarelli, Kuik and Martinez Hernandez (2023): the inflationary force of heat is amplified in already-warm climates and hot seasons while turning deflationary in cooler baselines, consistent with their finding of stronger price responses in southern euro-area economies such as Spain, Italy and France.

Taken together, our contribution is to reconcile these strands by showing that the apparent disagreement over whether climate shocks are inflationary, deflationary or persistent largely dissolves once one zooms in on the affected sector, the baseline climate, the shock's intensity and the prevailing monetary regime.

One apparent tension deserves comment. Simbanegavi and Palazzi (2023) find that core inflation reverts towards headline in South Africa following shocks to the non-core basket, which they interpret as evidence of second-round effects, whereas our South African estimates show muted core responses to weather anomalies. The two findings are reconcilable. Their shocks are unconditional movements in food and energy inflation, dominated by global commodity and exchange rate developments and typically larger and more persistent than the weather anomalies we isolate. Read together, the two sets of estimates suggest that the transitory, weather-driven component of non-core inflation is the part of the basket least likely to generate second-round effects, and that measured pass-through in South Africa is driven by the larger and more durable shocks with which weather anomalies frequently coincide.

6. Conclusions and policy implications

Our sectoral approach emphasises that the macroeconomic relevance of climate risk should not be underestimated. By tracing how climate shocks propagate across specific sectors, we can better understand their broader economic consequences and design tailored policy interventions. Relative price changes are central to assessing welfare costs, as households with different incomes, wealth and consumption patterns experience inflation differently. Aggregate inflation indices, while useful for broad price stability assessments, can mask important distributional effects of climateflation. Our findings indicate that climate shocks generate sectorally heterogeneous price responses, concentrated in weather-exposed sectors (food, energy, transport), with non-linear effects that are large in magnitude but typically short-lived. While these shocks generate substantial volatility in energy and food inflation, they rarely translate into persistent movements in the other price indices analysed, including core inflation.

Although our reduced-form framework cannot formally separate supply from demand, several features of the results are consistent with a predominantly cost-push interpretation. Price responses are concentrated in food, energy and transport – the sectors most directly exposed to weather through their production functions – while core inflation, the cleanest indicator of broad-based demand pressure, remains small and often insignificant. The asymmetry of responses across shock types (e.g. droughts raising food prices, cold spells raising energy prices) reflects distinct physical mechanisms by which weather impairs supply, rather than a common demand impulse. Responses peak within a few months and fade thereafter – a profile typical of transitory supply disruptions rather than self-reinforcing demand cycles – and the non-linear amplification at extreme shock magnitudes mirrors the convexity of physical damage functions.

Finally, the dampening but not elimination of responses under inflation-targeting regimes is consistent with anchored expectations limiting second-round effects without neutralising mechanical first-round cost pass-through. These insights align with recent empirical work showing that the impact of climate anomalies on headline inflation often dissipates over time and has limited long-run effects on core measures (Qi et al. 2025). They also align with work on the euro area that highlights how temperature anomalies can have asymmetric and non-linear effects on energy and food prices relative to other components, reinforcing the value of a disaggregated, sectoral perspective (Ciccarelli, Kuik and Martinez Hernandez 2023).

Nevertheless, there are limitations to our analysis. Country-level data may veil some local heterogeneity in weather impacts, and collinearity among climatic and economic factors complicates precise estimation of causal effects. Moreover, this study focuses on the concept of 'climateflation', while other important aspects of climate change – such as chronic temperature increases, long-term adaptation measures and mitigation policies – also influence the interplay between weather and price movements but are beyond the scope of this analysis. A further limitation concerns the persistence of the shocks themselves. Our identification exploits monthly deviations from local climatological norms, so the estimated responses describe the propagation of a discrete anomaly rather than a sustained shift in climatic conditions. A protracted episode enters our framework only as a repeated sequence of such anomalies, whose effects accumulate additively. Because expectations formation is held fixed, the framework cannot speak to the possibility, emphasised by the attention-threshold literature discussed in section 2, that a long run of shocks provokes a qualitatively different response from inflation expectations than a short one. Establishing whether climateflation exhibits this form of state dependence – for instance, by interacting weather shocks with the prevailing level of inflation, with the duration of the anomaly, or with survey measures of expectations – is a natural extension of the present analysis.

The evidence of sectoral heterogeneity in inflation responses to climate shocks across the world economy and South Africa highlights a clear policy dilemma. Systematic monetary tightening in response to climate-driven inflation, often termed ‘climateflation’, risks amplifying output losses without materially containing supply-driven shocks, potentially worsening long-term inflationary pressures. Such a trade-off between price and output stability in the face of supply shocks has been noted in temperature-inflation research, which underscores the challenges central banks face when weather shocks push up prices while simultaneously dampening economic activity (Mukherjee and Ouattara 2021).

Instead, central banks would benefit from a more nuanced approach. First, and as a general rule, they should ‘look through’ the first-round effects of climate shocks and focus on core inflation and inflation expectations to preserve credibility (Dikau et al. 2024). This prescription is a default rather than an absolute rule. It rests on two features of the shocks we identify: they are moderate in size and they fade within months. Neither feature can be taken for granted. Food and energy are salient prices, and the evidence that households form expectations disproportionately from them (Coibion and Gorodnichenko 2015; D’Acunto et al. 2021) implies that expectations may move even where measured pass-through to core inflation is small.

The attention-threshold literature also suggests that any such response is non-linear: negligible while inflation is low and the shock short-lived, but rising sharply once headline inflation has been elevated for long enough to command attention (Pfäuti 2025; Foresto, Reid and Rakgalakane 2025). Where a shock is protracted, where anomalies recur or compound (as our heat-and-drought interaction results suggest they may), or where second-round effects begin to appear in wage settlements and mark-ups, a monetary response is justified and looking through would be the greater error. That risk is not hypothetical in the South African case, where Simbanegavi and Palazzi (2023) document partial reversion of core to headline inflation following non-core shocks over 2003–2022. The practical implication is therefore one of surveillance rather than passivity: central banks should look through first-round climateflation while monitoring the duration and recurrence of weather shocks and the behaviour of inflation expectations, and should stand ready to act if either change.

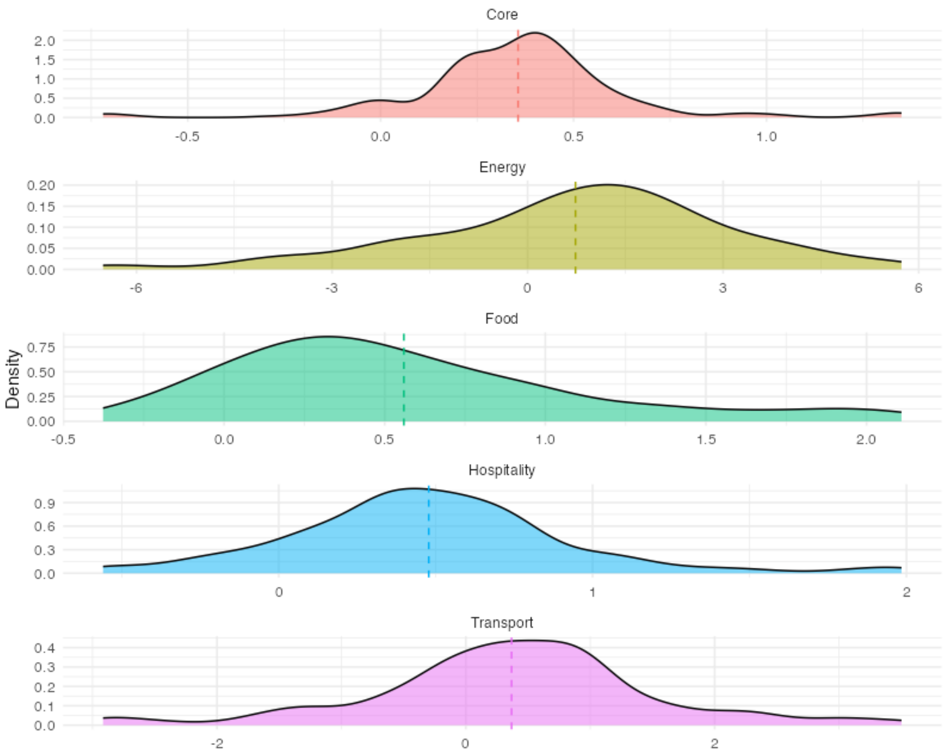
However, it also follows that more effective responses to climateflation require coordination with fiscal and structural measures, rather than monetary tightening. Climate adaptation policies are macroeconomic policy tools in their own right, particularly when shocks affect upstream sectors such as energy or transport. In sum, our findings underscore that understanding the sectoral channels and temporal dynamics of climate shocks is crucial for designing policy responses that preserve both macroeconomic stability and social welfare. Policymakers must navigate the delicate balance of maintaining monetary credibility while mitigating climate-related economic risks – without inadvertently deepening output losses or exacerbating inequality.

Annexures

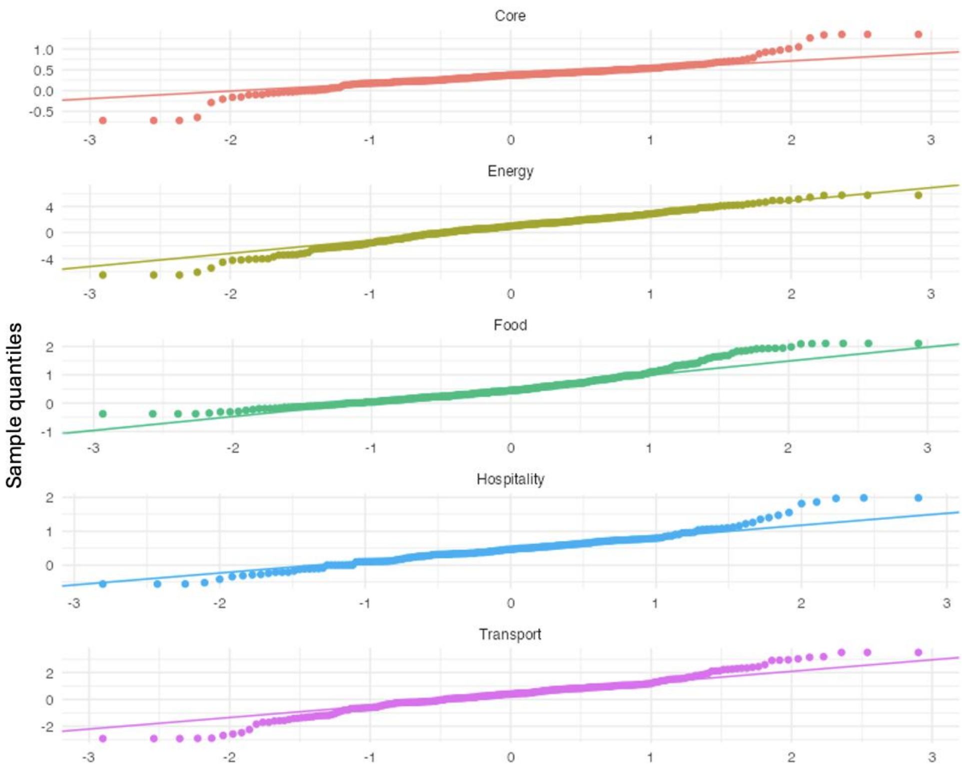
Annexure A: Summary statistics

Figure A1: South Africa's inflation distribution analysis (2000–2024)

(i) Density plots



(ii) Q-Q plots



Inflation Type	Mean	SD	Skewness	Kurtosis	N
Core	0.3561	0.2754	-0.0063	7.3721	275
Energy	0.7345	2.3339	-0.5207	3.4724	275
Food	0.5598	0.5595	0.9120	3.4626	299
Hospitality	0.4780	0.4509	0.6323	4.6163	198
Transport	0.3676	1.1472	-0.1796	4.1055	270

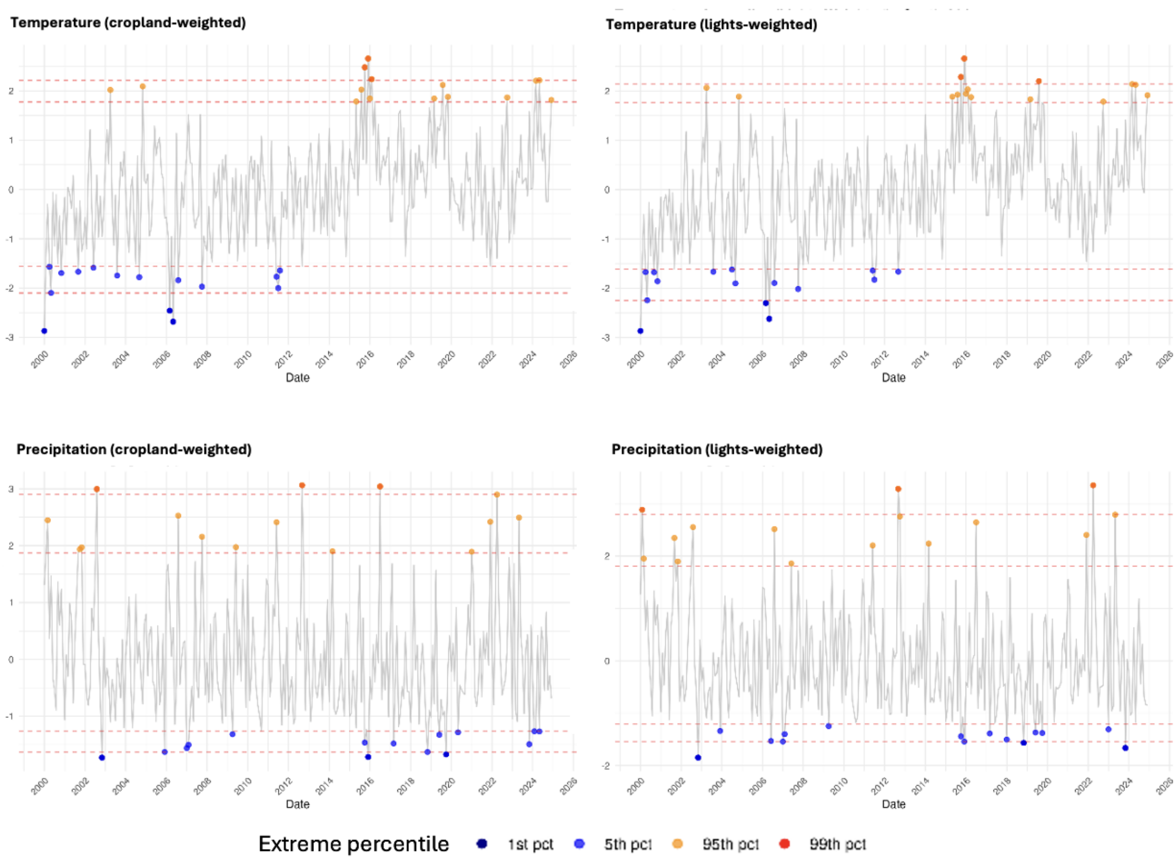
Source: Haver Analytics and World Bank; author's elaboration.

Table A1: Weather shocks: standardised deviations and extreme values

Variable	Weight	Analysis	Mean	SD	Min	Max	N
Temperature	Cropland	Deviations	0.05	1.53	-3.59	3.56	11 641
		Low 5%	-1.91	0.34	-3.59	-1.34	2 670
		High 95%	2.06	0.36	1.44	3.56	2 670
	Night lights	Deviations	0.05	1.53	-3.60	3.54	11 641
		Low 5%	-1.92	0.33	-3.60	-1.31	2 670
		High 95%	2.05	0.36	1.43	3.54	2 670
Precipitation	Cropland	Deviations	0.17	1.56	-3.63	4.8	11 637
		Low 5%	-1.58	0.34	-3.63	-0.28	2 678
		High 95%	2.40	0.60	1.39	4.8	2 669
	Night lights	Deviations	0.18	1.57	-3.73	4.8	11 637
		Low 5%	-1.56	0.34	-3.73	-0.28	2 678
		High 95%	2.43	0.61	1.55	4.8	2 669

Source: ERA5; author's elaboration.

Figure A2: Weather anomalies and extremes in South Africa (2000–24)

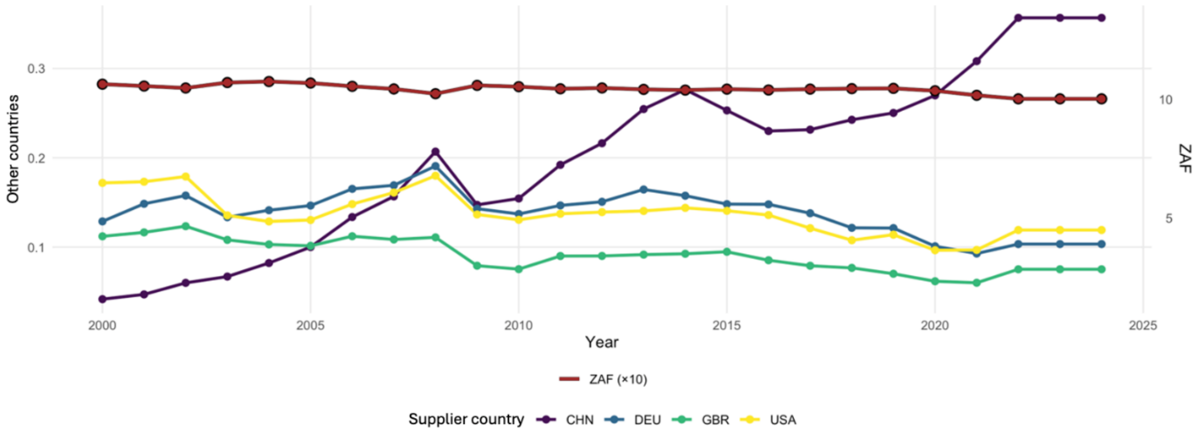


Source: ERA5; author's elaboration.

Figure A3: Weather shocks: number of events by month (2000–24)

Source: ERA5; author’s elaboration.

Figure A4: South Africa's top intermediate suppliers based on technical coefficients (2000–2024)



Source: OECD; author's elaboration.

Table A2: Sector-level data matching: CPI, weather, input-output data

CPI	Weather shock weights	OECD input-output classification
Food	Cropland	Agriculture (A01) + processed food (C10T12)
Energy	Night lights	D
Transport	Night lights	H49, H50, H51, H52
Hospitality	Night lights	I
Core	Night lights	All country's imported inputs

Source: Haver Analytics, World Bank, ERA5, OECD; author's elaboration.

Table A3: List of inflation data available by country

Country	Core	Food	Energy	Transport	Hospitality
Belarus	2003-01 – 2024-12	2005-02 – 2024-12	2005-02 – 2024-12	No data	No data
Belgium	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	No data
Brazil	No data	2006-07 – 2024-12	2000-02 – 2024-12	2006-07 – 2024-07	No data
Bulgaria	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Cambodia	No data	2001-02 – 2024-07	2001-02 – 2024-07	2004-01 – 2024-07	2004-01 – 2024-07
Cameroon	No data	2012-02 – 2024-09	2012-02 – 2024-12	No data	2012-02 – 2024-07
Canada	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	No data	No data
Chile	2009-02 – 2024-12	2000-02 – 2023-12	2000-02 – 2023-12	2000-02 – 2024-07	2000-02 – 2024-07
China	No data	No data	No data	2001-01 – 2024-07	No data
Colombia	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	No data
Costa Rica	No data	No data	No data	2000-02 – 2024-07	No data
Côte d'Ivoire	No data	2000-02 – 2024-12	2000-02 – 2024-12	No data	No data
Croatia	2000-02 – 2024-12	2005-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Cyprus	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2006-02 – 2024-07	2006-02 – 2024-07
Czech Rep.	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
DRC	No data	No data	2012-02 – 2017-02	No data	No data
Egypt	2005-01 – 2024-12	2010-02 – 2024-09	2019-10 – 2024-12	2007-10 – 2024-07	2007-10 – 2024-07
Estonia	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Finland	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	No data	No data
France	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Germany	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Greece	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	No data	No data
Hong Kong	No data	2004-11 – 2023-03	2004-11 – 2023-03	2000-02 – 2024-07	No data

Hungary	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	No data	No data
Iceland	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2002-02 – 2024-07	2002-02 – 2024-07
India	2011-02 – 2024-12	2011-02 – 2024-12	2000-02 – 2022-11	No data	No data
Ireland	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Israel	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	No data
Italy	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Japan	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2021-06	2000-02 – 2024-07	No data
Jordan	2006-02 – 2024-12	2006-02 – 2024-11	2000-02 – 2024-12	2006-02 – 2024-07	2006-02 – 2024-07
Kazakhstan	No data	No data	No data	2003-02 – 2024-07	2003-02 – 2024-07
Laos	No data	2005-02 – 2024-12	2005-02 – 2024-12	No data	No data
Latvia	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Lithuania	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Luxembourg	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Malaysia	No data	No data	No data	2015-05 – 2024-07	2005-02 – 2024-07
Mexico	2000-02 – 2024-12	2002-08 – 2024-12	2000-02 – 2024-07	2002-08 – 2024-07	2002-08 – 2024-07
Morocco	No data	2007-02 – 2024-12	2007-02 – 2024-12	2009-02 – 2024-07	2009-02 – 2024-07
Myanmar	No data	2013-02 – 2022-07	2013-02 – 2020-11	No data	No data
Netherlands	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	No data	No data
Nigeria	No data	2005-02 – 2024-12	2005-02 – 2024-12	2000-02 – 2024-07	2001-11 – 2024-07
Norway	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Pakistan	No data	2008-08 – 2024-12	2008-08 – 2024-12	2008-08 – 2024-07	2008-08 – 2024-07
Philippines	No data	No data	No data	2000-02 – 2024-07	2018-02 – 2024-07
Poland	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2002-01 – 2024-07	2002-01 – 2024-07
Portugal	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Romania	2001-01 – 2024-12	2000-02 – 2024-12	No data	2000-02 – 2024-07	2000-02 – 2024-07

Saudi Arabia	No data	2011-02 – 2024-12	No data	2011-02 – 2024-07	2011-02 – 2024-07
Singapore	No data	No data	No data	2000-02 – 2024-07	No data
Slovakia	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Slovenia	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
South Africa	2002-02 – 2024-12	2000-02 – 2024-12	2002-02 – 2024-12	2002-02 – 2024-07	2008-02 – 2024-07
South Korea	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Spain	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
Sweden	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	No data
Switzerland	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	No data	No data
Taiwan	No data	2000-02 – 2024-12	2000-02 – 2024-12	No data	No data
Thailand	No data	No data	No data	2000-02 – 2024-07	No data
Tunisia	No data	2005-02 – 2024-12	No data	2005-02 – 2024-07	2005-02 – 2024-07
Turkey	No data	No data	No data	2003-02 – 2024-07	2003-02 – 2024-07
UAE	No data	2008-02 – 2024-12	2008-02 – 2024-12	2008-02 – 2022-12	2008-02 – 2022-12
United Kingdom	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-07	2000-02 – 2024-07
United States	2000-02 – 2024-12	2000-02 – 2024-12	2000-02 – 2024-12	No data	No data
Vietnam	No data	2002-02 – 2024-12	2002-02 – 2024-12	No data	No data

Table A4: Im-Pesaran-Shin unit-root test for main variables

	Statistic	p-value
Inflation rate	-148.23	0.00
Abnormally cold temperature shock (1st percentile)	-94.17	0.00
Abnormally hot temperature shock (99th percentile)	-36.49	0.00
Abnormally cold temperature shock (5th percentile)	-94.17	0.00
Abnormally hot temperature shock (95th percentile)	-36.49	0.00
Abnormally cold temperature shock (10th percentile)	-91.95	0.00
Abnormally hot temperature shock (90th percentile)	-69.64	0.00
Abnormally dry precipitation shock (1st percentile)	-173.14	0.00
Abnormally wet precipitation shock (99th percentile)	-61.01	0.00
Abnormally dry precipitation shock (5th percentile)	-173.14	0.00
Abnormally wet precipitation shock (95th percentile)	-61.01	0.00
Abnormally dry precipitation shock (10th percentile)	-174.51	0.00
Abnormally wet precipitation shock (90th percentile)	-87.69	0.00

References

Acemoglu, D, Akcigit, U and Kerr, W. 2016. 'Networks and the macroeconomy: an empirical exploration'. *NBER Macroeconomics Annual* 30(1): 273–335.

Acemoglu, D, Carvalho, V M, Ozdaglar, A E and Tahbaz-Salehi, A. 2012. 'The network origins of aggregate fluctuations'. *Econometrica* 80(5): 1 977–2 016.

Acevedo, S, Mrkaic, M, Novta, N, Pugacheva, E and Topalova, P. 2018. 'The effects of weather shocks on economic activity: what are the channels of impact?' IMF Working Papers, WP/18/144.

Arata, Y and Miyakawa, D. 2024. 'Demand shock propagation through input-output linkages in Japan'. *Journal of Economic Behavior & Organization* 219: 262–283.

BIS (Bank for International Settlements). 2024. *Annual economic report 2022*. https://www.bis.org/annualeconomicreports/index.htm

Blyth, M and Fraccaroli, N. 2025. *Inflation: a guide for users and losers*. New York: W. W. Norton & Company.

Buelens, C. 2024. 'Climate change and its implications for prices and inflation'. *Quarterly Report on the Euro Area* 23(1): 7–20.

Burke, M, Hsiang, S M and Miguel, E. 2015. 'Global non-linear effect of temperature on economic production'. *Nature* 527(7577): 235–239.

Cevik, S and Tovar Jalles, J. 2024. 'Eye of the storm: the impact of climate shocks on inflation and growth'. *Review of Economics* 75(2): 109–138.

Ciccarelli, M, Kuik, F and Martinez Hernandez, C. 2023. 'The asymmetric effects of weather shocks on euro area prices'. ECB Working Paper Series, No. 2798.

Coibion, O. and Gorodnichenko, Y. 2015. 'Is the Phillips curve alive and well after all? Inflation expectations and the missing disinflation'. *American Economic Journal: Macroeconomics* 7(1): 197–232.

Colacito, R, Hoffmann, B and Phan, T. 2019. 'Temperature and growth: a panel analysis of the United States'. *Journal of Money, Banking and Finance* 51(2–3): 313–368.

D'Acunto, F, Malmendier, U, Ospina, J and Weber, M. 2021. 'Exposure to grocery prices and inflation expectations'. *Journal of Political Economy* 129(5): 1 615–1 639.

De Gregorio, J. 2012. 'Commodity prices, monetary policy, and inflation'. *IMF Economic Review* 60(4): 600–633.

De Lima, C, Buzan, J R, Moore, F C, Baldos, U, Huber, M and Hertel, T W. 2021. 'Heat stress on agricultural workers exacerbates crop impacts of climate change'. *Environmental Research Letter* 16(4).

De Winne, J and Peersman, G. 2018. 'Agricultural price shocks and business cycles: a global warning for advanced economies'. Ghent University Working Paper No. 18/945.

Di Giovanni, J, Kalemli-Özcan, Ş, Silva, A and Yildirim, M A. 2022. 'Global supply chain pressures, international trade, and inflation'. NBER Working Paper No. 30240. Cambridge, MA: National Bureau of Economic Research.

Dikau, S, Barmes, D, Claeys, I and Pereira da Silva, L A. 2024. *The case for adaptive inflation targeting: monetary policy in a hot and volatile world.* London: Centre for Economic Transition Expertise (CETEx), London School of Economics and Political Science.

Dube, K. 2024. 'Extreme weather in South Africa is disrupting tourism – research tracks the impact on coastal areas'. *The Conversation*. 8 July.

Faccia, D, Parker, M and Stracca, L. 2021. 'Feeling the heat: extreme temperatures and price stability'. ECB Working Paper Series, No. 2626.

Falck, E. and Schulte, P. 2025. 'From weather to wallet: evidence on seasonal temperature shocks and global food prices'. Deutsche Bundesbank Discussion Paper No. 27/2025.

Ferrante, F, Graves, S and Iacoviello, M. 2023. 'The inflationary effects of sectoral reallocation'. *Journal of Monetary Economics* 140(Supplement): S64–S81.

Foresto, A, Reid, M and Rakgalakane, J. 2025. 'State dependence of the Phillips curve: what does this mean for monetary policy?' SARB Working Paper Series, WP/25/06.

ILO (International Labour Organization). 2019. 'Working on a warmer planet: the impact of heat stress on labour productivity and decent work'. Geneva: ILO.

IMF (International Monetary Fund). 2024 *AREAER Database: Exchange arrangements and monetary policy frameworks*. Washington, DC: IMF. Available at: https://www.elibrary-areaer.imf.org

IPCC (Intergovernmental Panel on Climate Change). 2021. 'Summary for policymakers'. In *AR6 climate change 2021: the physical science basis*. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf

Jordà, Ò. 2005. 'Estimation and inference of impulse responses by local projections'. *American Economic Review* 95(1): 161–182.

Kabundi, A, Mlachila, M and Yao, J. 2022. 'How persistent are climate-related price shocks? Implications for monetary policy'. IMF Working Paper 22/207.

Kamber, G, McDonald, C and Price, G. 2013. 'Drying out: investigating the economic effects of drought in New Zealand'. Reserve Bank of New Zealand Analytical Note Series, no. AN2013/02.

Klomp, J. 2020. 'Do natural disasters affect monetary policy? A quasi-experiment of earthquakes'. *Journal of Macroeconomics* 64: 103164.

Kotz, M, Kuik, F, Lis, E and Nickel, C. 2024. 'Global warming and heat extremes to enhance inflationary pressures'. *Communications Earth & Environment* 5, article 116.

Moessner, R. 2022. 'Effects of precipitation on food consumer price inflation'. CESifo Working Paper No. 9961.

Mukherjee, K and Ouattara, B. 2021. 'Climate and monetary policy: do temperature shocks lead to inflationary pressures?' *Climate Change* 167: 1–21.

Muñoz-Sabater, J. 2019. 'ERA5-Land monthly averaged data from 1981 to present'. Copernicus Climate Change Service Climate Data Store. https://doi.org/10.24381/cds.68d2bb30

NGFS (Network for Greening the Financial System). 2023. 'Nature-related financial risks: a conceptual framework to guide action by central banks and supervisors'.

NGFS. 2024. 'Acute physical impacts from climate change and monetary policy'.

NGFS. 2026. 'Climate change and monetary policy strategy: a guide for central banks'.

OECD (Organisation for Economic Co-operation and Development). 2025. 'OECD inter-country input-output (ICIO) tables'. https://stats.oecd.org/Index.aspx?DataSetCode=ICIO

Parker, M. 2018. 'The impact of disasters on inflation'. *Economics of Disasters and Climate Change* 2(1): 21–48.

Peersman, G. 2022. 'International food commodity prices and missing (dis)inflation in the euro area'. *The Review of Economics and Statistics* 104(1): 85–100.

Pfäuti, O. 2025. 'Inflation – who cares? Monetary policy in times of low attention'. *Journal of Money, Credit and Banking* 57(5): 1211–1239.

Qi, C, Ma, Y, Du, M, Ma, X, Xu, Y and Zhou, X. 2025. 'Impacts of climate change on inflation: an analysis based on long and short term effects and pass-through mechanisms'. *International Review of Economics & Finance* 98: 103846.

Rangasamy, L. 2011. 'Food inflation in South Africa: some implications for economic policy'. *South African Journal of Economics* 79(2): 184–201.

Roberts, M J and Schlenker, W. 2013. 'Identifying supply and demand elasticities of agricultural commodities: implications for the US ethanol mandate'. *American Economic Review* 103(6): 2 265–2 295.

Savage, S. 2024. 'Climate change is pushing up food prices – and worrying central banks'. *Financial Times*, 3 July. https://www.ft.com/content/125e89c0-308a-492f-ae8e-6834847d1186

Schnabel, I. 2022. 'A new age of energy inflation: climateflation, fossilflation and greenflation'. Speech at The ECB and Its Watchers XXII conference, panel on Monetary Policy and Climate Change, Frankfurt am Main: European Central Bank, 17 March.

Simbanegavi, W and Palazzi, A L. 2023. 'Mind second round effects! The effects of food and energy inflation on core inflation in South Africa'. SARB Occasional Bulletin of Economic Notes, OBEN/23/01. Pretoria: SARB.

Stiglitz, J and Regmi, I. 2022. 'The causes of and responses to today's inflation'. Roosevelt Institute.

United Nations. 2000. *Classifications of expenditure according to purpose: COFOG, COICOP, COPNI, COPP*. Statistical Papers Series M, No. 84. New York: United Nations Department of Economic and Social Affairs, Statistics Division.

Weber, I and Wasner, E. 2023. ‘Sellers’ inflation, profits and conflict: why can large firms hike prices in an emergency?’ *Review of Keynesian Economics* 11(2): 183–213.

Zappalà, G. 2024. ‘Propagation of extreme heat in agriculture across sectors and space’. Paris School of Economics.