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Monetary Tightening without Disinflation? Cross-Country Evidence on Heterogeneous Transmission

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Monetary Tightening without Disinflation? Cross-Country Evidence on Heterogeneous Transmission[1]

João Tovar Jalles[2] John Beirne[3] Donghyun Park[4]

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Abstract

This paper examines how institutional, fiscal, and external conditions shape monetary transmission in 40 economies over 1991–2022. Using forecast-based policy innovations and local projections, we estimate cumulative CPI price-level and real GDP responses. On average, monetary tightening produces a positive but imprecise price response and a modest, delayed output contraction. Heterogeneity is more pronounced for activity than for prices: GDP declines most clearly in flexible-regime emerging markets, whereas regime differences in price responses are generally weak. In joint moderator models, financial openness retains the clearest association with CPI responses, while emerging-market status and public debt matter most for GDP. Controlling for global risk through a shock–VIX interaction leaves these results essentially unchanged. No principal estimate yields a sufficiently precise price decline, precluding meaningful sacrifice ratios. The findings point to overlapping institutional and external influences rather than a single dominant transmission mechanism.

Keywords: Monetary policy transmission, inflation dynamics, exchange rate regimes, central bank independence, financial openness, external buffers, global financial cycle, local projections, cross-country heterogeneity

JEL codes: E52, E58, F41, F42, C23

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1. Introduction

Monetary tightening does not always produce rapid disinflation. Although standard transmission mechanisms operate through aggregate demand, credit conditions, expectations, and exchange rates, their strength varies considerably across economies. In some cases, higher policy rates are followed by persistent inflation or even an increase in the price level. Such responses may reflect differences in monetary institutions and external adjustment, but they may also arise from forward-looking policy behaviour, central-bank information effects, or correlated country characteristics. Understanding this heterogeneity is particularly important in cross-country settings, where economies differ markedly in their policy frameworks, financial openness, fiscal positions, and exposure to global conditions.

Recent experience illustrates this challenge. The inflation surge following the COVID-19 pandemic and subsequent commodity and energy shocks prompted one of the most synchronised monetary tightening cycles in decades. Yet inflation, output, and exchange rates responded differently across countries. These differences were especially visible between advanced economies (AEs) and emerging market economies (EMEs), and between flexible and managed exchange-rate arrangements. In open economies, monetary tightening may reduce inflation through currency appreciation and lower import prices. This channel may weaken or reverse, however, when global risk, capital outflows, foreign-currency exposures, or sovereign-risk concerns dominate conventional interest-rate effects (Rey, 2015; Miranda-Agrippino and Rey, 2020).

Monetary institutions may also condition transmission. Inflation targeting and central bank independence can improve credibility and anchor expectations (Rogoff, 1985; Alesina and Summers, 1993; Jácome and Pienknagura, 2025). Greater financial openness may strengthen the exchange-rate and capital-flow channels but also increase exposure to the global financial cycle. Fiscal conditions can influence sovereign risk, financing costs, and expectations about future monetary accommodation. These characteristics are strongly correlated: inflation-targeting economies often have more independent central banks, different exchange-rate arrangements, and higher levels of financial integration. Estimates examining each characteristic separately may therefore attribute to one institution heterogeneity that reflects a broader combination of country attributes.

Identification creates an additional difficulty. Observed policy actions respond endogenously to inflation and economic activity, while central banks may act on information unavailable to private forecasters or the econometrician. A tightening innovation may consequently precede higher inflation if it contains information about future price pressures, producing an information effect or price puzzle (Romer and Romer, 2004; Coibion, 2012; Nakamura and Steinsson, 2018). Cross-country estimates must therefore distinguish, as far as possible, unexpected monetary policy innovations from systematic policy responses and assess whether the resulting shocks are predictable from prior macroeconomic conditions.

This paper examines how institutional, fiscal, and external conditions shape monetary transmission in a panel of 40 economies over 1991–2022. Monetary policy shocks are constructed from forecast errors and standardised so that the responses correspond to a one-standard-deviation contractionary innovation. We estimate cumulative CPI price-level and real GDP responses using local projections with economy and year fixed effects, predetermined macroeconomic controls, and future monetary policy shocks through each projection horizon (Jordà, 2005; Teulings and Zubanov, 2014). Predictability regressions and pre-shock placebo tests provide qualified support for interpreting the innovations as unanticipated policy disturbances, although some residual persistence warrants caution.

The empirical analysis proceeds in three stages. We first estimate the average price and output responses. We then examine heterogeneity across four combinations of AE–EME status and contemporaneous de facto exchange-rate regimes, as well as across inflation targeting, central bank independence, financial openness, and public debt. Continuous moderators are standardised and evaluated at one standard deviation below and above their estimation-sample means. Finally, we compare separate estimates, separate estimates on a common sample, and a joint moderator model. This comparison distinguishes changes arising from sample composition from those produced by conditioning on correlated country characteristics. We also test whether an interaction between the monetary policy shock and the VIX accounts for the institutional heterogeneity.

Four findings emerge. First, the average cumulative CPI response to a contractionary innovation is positive but generally imprecisely estimated, while real GDP displays a modest and delayed contraction that is not statistically significant in the full sample. The pooled estimates therefore exhibit a price puzzle rather than a conventional disinflationary response. Second, the group-specific estimates reveal greater heterogeneity in output than in prices. Real GDP contracts most clearly in flexible-regime EMEs, whereas the estimated responses for pegged economies are positive. The latter results must be treated cautiously because the EME–peg group contains only 34 observations from four economies. Formal tests provide limited evidence that the effect of the exchange-rate regime differs systematically between AEs and EMEs.

Third, the separate institutional specifications show limited and inconsistent heterogeneity in CPI responses but larger differences in real activity. Several of these differences weaken or change sign when the models are estimated on the common joint-model sample. In the joint specification, financial openness retains the clearest conditional association with the CPI response, while EME status and public debt retain the clearest associations with the GDP response. The interactions are jointly significant at the principal medium and longer horizons, but the instability of individual coefficients indicates that institutional characteristics should not be interpreted as independently identified causal channels.

Fourth, the interaction between the monetary policy shock and the annual VIX is statistically insignificant and leaves the main institutional interactions essentially unchanged. The annual VIX therefore does not explain the observed heterogeneity, although it may not capture country-specific exposure or within-year changes in global risk. Moreover, none of the full-sample or regime-specific estimates produces a negative and sufficiently precise price response from which a meaningful sacrifice ratio can be calculated. The data consequently do not identify a stable output cost of disinflation, rather than showing that disinflation can be achieved without output losses.

The paper contributes to the literature in three respects. First, it provides comparable cross-country evidence on cumulative price and output responses using forecast-based monetary policy innovations. Second, it links monetary transmission to economy-group status, contemporaneous de facto exchange-rate regimes, monetary institutions, financial openness, and public debt within a common empirical framework. Third, it evaluates these dimensions jointly and explicitly separates the influence of sample composition from that of correlated moderators. The results suggest that the counterintuitive average price response cannot be attributed to a single institutional characteristic or to the annual VIX. Monetary transmission instead reflects overlapping institutional, fiscal, and external conditions, with the strongest heterogeneity appearing in real activity rather than in prices.

The remainder of the paper is organised as follows. Section 2 reviews the related literature. Section 3 presents the conceptual framework. Section 4 describes the data and empirical methodology. Section 5 reports the empirical results and robustness exercises. Section 6 concludes.

2. Literature Review

A large literature examines the macroeconomic effects of monetary policy shocks. Foundational contributions establish that unexpected policy changes have significant effects on output and prices through interest-rate, credit, and expectations channels (Bernanke and Blinder, 1992; Christiano, Eichenbaum, and Evans, 1999; Romer and Romer, 2004). Subsequent work has strengthened identification through high-frequency surprises, external instruments, and forecast-based measures of policy innovations (Gürkaynak, Sack, and Swanson, 2005; Nakamura and Steinsson, 2018). While much of this literature emphasises average domestic effects, a growing body of evidence shows that monetary transmission varies substantially across countries and economic environments.

One source of heterogeneity is international financial integration. Global monetary and financial conditions propagate through bank lending, portfolio flows, dollar funding, and risk-taking channels, thereby affecting the ability of domestic policy rates to influence local financial conditions (Rey, 2015; Buch et al., 2019; Miranda-Agrippino and Rey, 2020). Dées and Galesi (2021) show that US monetary policy is an important driver of the global financial cycle and that its effects increase with cross-country interconnectedness. Nadal De Simone (2024) similarly documents significant real and financial effects of US monetary tightening in small open economies. These findings imply that domestic monetary transmission cannot be separated from global financial conditions and countries' exposure to international capital flows.

The exchange rate provides a second source of cross-country heterogeneity. In open economies, monetary tightening affects inflation not only through domestic demand but also through exchange-rate movements and import-price pass-through. The magnitude of pass-through varies with the inflation environment, trade openness, exchange-rate arrangements, and the credibility of monetary policy (Flamini, 2007; Choudhri and Hakura, 2006; Devereux and Yetman, 2010; Gopinath, 2015). Under conventional transmission, an increase in domestic interest rates induces currency appreciation and lowers imported inflation. This response may be weaker under managed exchange rates and may differ between advanced and emerging market economies. In EMEs, an increase in global risk aversion or country risk can offset the conventional interest-rate channel and produce depreciation following monetary tightening. Consequently, pooling economies with different exchange-rate regimes and levels of financial development may conceal economically important differences in transmission.

A third strand emphasises monetary institutions and credibility. Inflation targeting and central bank independence are generally associated with better-anchored expectations and improved inflation performance (Rogoff, 1985; Alesina and Summers, 1993; Cukierman, 1992). Subsequent research highlights the importance of transparency, communication, and operational independence in determining the credibility of monetary policy (Dincer and Eichengreen, 2014). Jácome and Pienknagura (2025), for example, find that greater central bank independence is associated with lower inflation tail risks in emerging markets. These findings suggest that institutional arrangements may affect not only average inflation but also the transmission of monetary policy shocks.

The relationship between credibility and observed transmission is nevertheless not necessarily monotonic. More credible and forward-looking central banks may respond pre-emptively to information about future inflation. If the empirical shock does not capture all information available to policymakers, tightening may appear to precede higher inflation, generating an information effect or price puzzle (Romer and Romer, 2004; Coibion, 2012; Nakamura and Steinsson, 2018). Similarly, inflation-targeting and high-CBI economies often have greater financial openness and more developed financial systems. Estimates obtained by considering each characteristic separately may therefore reflect a common set of advanced-economy attributes rather than independent institutional effects.

Recent research increasingly treats monetary transmission as state-dependent. The effects of monetary shocks can vary with financial conditions, the business cycle, institutional arrangements, and countries' positions in the international monetary system (Tenreyro and Thwaites 2016; Deb et al. 2023). This literature rejects a uniform transmission mechanism and instead emphasises the interaction between domestic policy frameworks and external financial conditions.

The present paper contributes to this literature in three ways. First, it estimates the dynamic effects of forecast-based monetary policy shocks on prices and real activity in a panel of 40 economies. Second, it examines whether transmission varies with exchange-rate regimes, inflation targeting, central bank independence, financial openness, and AE–EME status. In particular, it distinguishes flexible-regime AEs from flexible-regime EMEs, for which the exchange-rate consequences of monetary tightening may differ markedly. Third, it evaluates these dimensions jointly and investigates whether global risk conditions help account for apparently counterintuitive inflation responses. This approach connects the literatures on monetary transmission, exchange-rate adjustment, and institutional credibility while addressing the possibility that the same underlying country characteristics may explain several apparently distinct forms of heterogeneity.

3. Conceptual Motivation and Empirical Predictions

This section provides a parsimonious framework for interpreting cross-country differences in monetary policy transmission. The objective is not to develop a structural model, but to identify the main channels through which monetary tightening affects inflation and output and why these effects may vary across institutional and macro-financial environments.

In a standard open-economy framework, inflation depends on expected inflation, domestic economic activity, and exchange-rate movements:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t + \gamma \Delta e_t, \qquad (1)$$

where π_t denotes inflation, x_t is the output gap, and an increase in Δe_t denotes depreciation. Monetary tightening raises the real interest rate, weakens domestic demand, and thereby reduces inflation and output. In an open economy, it also operates through the exchange rate. A risk-adjusted uncovered interest parity condition can be represented as

$$i_t - i_t^* = E_t \Delta e_{t+1} + \rho_t, \qquad (2)$$

where $i_t - i_t^*$ is the interest-rate differential and ρ_t is a country-specific risk premium. Under conventional transmission, monetary tightening induces appreciation, lowers import prices, and reinforces the disinflationary demand effect.

The strength—and potentially the direction—of these channels can vary across economies. Under pegged exchange rates, currency adjustment is constrained, whereas flexible regimes permit a stronger exchange-rate response. Flexibility does not, however, guarantee appreciation. If tightening coincides with higher sovereign or financial risk, an increase in the risk premium may offset the interest-rate differential and produce depreciation, particularly in EMEs exposed to volatile capital flows and global financial conditions.

Institutional arrangements can also shape transmission. Inflation targeting and central bank independence may strengthen the expectations channel by increasing the credibility of the nominal anchor. At the same time, more forward-looking central banks may tighten in response to information about future inflation that is not fully captured by observed forecasts. The identified monetary policy innovation may therefore retain an information component, potentially generating a weak or even positive estimated inflation response despite an underlying contractionary policy effect.

Financial openness creates a related ambiguity. Greater capital-account openness may strengthen the response of capital flows and exchange rates to interest-rate differentials, but it also increases exposure to the global financial cycle. Similarly, fiscal conditions may affect transmission through sovereign risk. In highly indebted economies, monetary tightening raises debt-service costs and may increase concerns about fiscal sustainability, altering risk premia, exchange-rate dynamics, and ultimately the response of inflation and output.

These considerations imply that monetary transmission should be viewed as state dependent. Schematically,

$$IRF_h = \beta_h + \Gamma_h Z_{i,t-1}, \qquad (3)$$

where IRF_h denotes the response to a monetary policy shock at horizon h, and $Z_{i,t-1}$ contains predetermined institutional and structural characteristics, including exchange-rate arrangements, inflation-targeting status, central bank independence, financial openness, development status, and public debt. Equation (3) is an organising representation rather than a structural relationship; its empirical counterpart is estimated using the local projections described in Section 4.4.

The framework yields four empirical implications. First, monetary tightening should ordinarily reduce prices and real activity, although the pooled response may be weak when transmission differs substantially across economies. Second, responses may differ between AEs and EMEs and across exchange-rate regimes. Third, because monetary institutions, financial openness, development status, and fiscal conditions are correlated, their moderating roles should be evaluated jointly as well as separately. Fourth, if global risk or information effects account for non-standard inflation responses, controlling explicitly for these mechanisms should attenuate the corresponding institutional interactions.

The empirical analysis therefore proceeds from average price and output responses to exchange-rate and institutional heterogeneity, joint moderator estimates, and tests of global-risk and information channels.

4. Data and Empirical Methodology

4.1 Data and Sample

The empirical analysis uses an unbalanced annual panel of 40 economies over 1991–2022. The sample contains 941 country-year observations for which the forecast-based monetary policy shock is available. It comprises 30 advanced economies (AEs), 9 emerging market economies (EMEs), and one economy not classified in either group. These groups account for 734, 185, and 22 country-year observations, respectively.

Annual data provide substantially broader cross-country coverage than higher-frequency alternatives and permit macroeconomic variables to be combined consistently with institutional indicators, which are generally available only at annual frequency. The annual frequency also avoids introducing additional measurement error through the interpolation of slow-moving institutional characteristics.

The principal macroeconomic variables are CPI inflation, real GDP growth, nominal exchange-rate changes, private credit, government consumption, and trade openness. Inflation is measured as the annual percentage change in the CPI, while real GDP growth captures changes in aggregate economic activity. The CPI inflation series is available for all 941 observations in the monetary policy shock sample. A separately merged headline CPI index is available for 840 observations across 39 economies and is used in selected robustness exercises.

Exchange-rate changes are calculated as annual changes in the log bilateral nominal exchange rate against the US dollar and are expressed in percent. Positive values indicate depreciation. Currency-unit discontinuities associated with euro adoption are excluded because they reflect changes in the units in which national exchange rates are recorded rather than economically meaningful appreciations. After making this adjustment, the exchange-rate-change series contains 915 observations across 39 economies.

Private credit, government consumption, and trade openness are expressed as percentages of GDP. Private credit captures the importance of domestic financial intermediation, government consumption controls for the size of government demand, and trade openness measures exposure to international trade. Political stability is included as an additional institutional and political control. The timing and lag structure of these variables are described in Section 4.4.

The macroeconomic data are compiled from standard international sources, including the IMF's International Financial Statistics and World Economic Outlook databases, the World Bank's World Development Indicators, and BIS statistics. The use of harmonised international datasets promotes comparability across economies and maintains consistency with the existing cross-country literature.

The analysis also incorporates institutional and structural characteristics that may condition monetary policy transmission. Exchange-rate arrangements are measured using an annual de facto classification that distinguishes flexible or non-peg regimes from fixed or pegged regimes. Exchange-rate regime information is available for 499 observations across 29 economies. Because this coverage is more limited than that of the monetary policy shock, all regime-dependent results report the corresponding estimation sample.

Inflation-targeting status is represented by a time-varying country-year indicator constructed from central-bank and IMF-based sources. The underlying source primarily records the histories of inflation-targeting adopters. We retain all observed source values, classify years before the first recorded adoption as non-targeting, and classify subsequent years as inflation-targeting. Economies never observed adopting inflation targeting are classified as non-targeters. This procedure provides inflation-targeting status for all 941 observations.

Institutional credibility is proxied by the weighted Garriga index of central bank independence (CBI), which is available for 864 observations across 37 economies. Capital-account openness is measured using the Chinn–Ito KAOPEN index and is available for 896 observations across 38 economies. The Chinn–Ito index is a de jure measure of capital-account openness and does not capture the scale or composition of actual cross-border positions, capital flows, foreign-currency exposures, or international bank funding. These characteristics are subsequently used to assess whether monetary policy transmission depends on the prevailing institutional and external-policy environment.

Table A1 reports summary statistics for the monetary policy shock, outcome variables, controls, and institutional characteristics. The number of observations varies across variables because the institutional indicators and some macroeconomic series are not uniformly available. The construction and statistical properties of the monetary policy shock are discussed in Section 4.2.

4.2 Monetary Policy Shock Construction

We identify monetary policy shocks using the forecast-error approach proposed by Furceri et al. (2018). The objective is to isolate changes in policy interest rates that cannot be explained by the systematic response of central banks to contemporaneous macroeconomic developments. This approach shares the identification objective of narrative and high-frequency methods (Romer and Romer, 2004; Gertler and Karadi, 2015; Nakamura and

Steinsson, 2018), while offering substantially broader coverage in a cross-country panel for which consistent high-frequency financial data are not available.

The identification procedure exploits differences between realised macroeconomic outcomes and forecasts produced before those outcomes became known. For a macroeconomic variable (x), the forecast error is defined as

$$FE_{i,t}^{x} = x_{i,t} - E_{t-1}(x_{i,t}) \qquad (4)$$

where $FE_{i,t}^{x}$is the forecast error for variable $x$in economy $i$and period t, $x_{i,t}$is its realised value, and $E_{t-1}(x_{i,t})$is the forecast formed using information available before period t.

The forecasts are drawn from professional forecasting sources, including Consensus Economics and vintages of the IMF's World Economic Outlook. Using forecasts produced before the realisation of the variable ensures that the resulting forecast errors capture information that was not incorporated into the original projections.

Forecast errors are constructed for inflation and real GDP growth. These variables capture the principal macroeconomic developments to which central banks are likely to respond when setting policy rates. The change in the policy interest rate is then projected on the inflation and output-growth forecast errors:

$$\Delta r_{i,t} = \alpha_i + \lambda_t + \beta_\pi FE_{i,t}^{\pi} + \beta_y FE_{i,t}^{y} + u_{i,t} \qquad (5)$$

where $\Delta r_{i,t}$is the change in the policy interest rate, $FE_{i,t}^{\pi}$and $FE_{i,t}^{y}$are the forecast errors for inflation and real GDP growth, $\alpha_i$denotes economy fixed effects, $\lambda_t$denotes time fixed effects, and $u_{i,t}$is the residual.

The monetary policy shock is defined as the estimated residual from equation (5):

$$MPShock_{i,t} = \hat{u}_{i,t} \qquad (6)$$

A positive value of $MPShock_{i,t}$denotes an unexpected monetary tightening, while a negative value denotes an unexpected monetary easing. Conditioning on inflation and output-growth forecast errors removes the component of observed policy-rate changes associated with unexpected contemporaneous macroeconomic developments. The residual is therefore mechanically orthogonal to the variables included in the policy equation and provides a more credible measure of unexpected policy action than the observed change in the policy interest rate.

Residual-based identification does not, by itself, rule out correlation between the estimated shock and information omitted from equation (6). We therefore complement the baseline identification with predictability tests examining whether the estimated shocks are systematically related to lagged inflation, real GDP growth, and other predetermined macroeconomic conditions. These exercises provide an additional assessment of whether the shock captures policy innovations rather than predictable responses to the macroeconomic environment.

Because the outcome and institutional variables used in the empirical analysis are observed annually, the underlying monthly monetary policy innovations are aggregated within each calendar year:

$$MPShock_{i,t}^{A} = \sum_{m=1}^{12} MPShock_{i,t,m} \qquad (7)$$

where $MPShock_{i,t,m}$ is the monthly monetary policy shock in economy i, year t, and month m, and $MPShock_{i,t}^{A}$ is the corresponding annual shock. Summing the monthly innovations captures the cumulative unexpected change in the monetary policy stance during the year and aligns the shock measure with the frequency of the macroeconomic and institutional dataset. Although annual aggregation necessarily removes some within-year variation, it preserves the cumulative direction and magnitude of unexpected policy actions relevant to annual macroeconomic outcomes. The robustness analysis instead considers an alternative shock measure, winsorisation of extreme innovations, alternative lag structures, and the exclusion of crisis periods.

Appendix Figure A1 presents the distribution of the annual monetary policy shocks used in the analysis. Across the 941 country-year observations, the shock has a mean of −0.007, a median of 0.014, and a standard deviation of 0.956. The distribution is strongly concentrated around zero but exhibits relatively long tails. Its 1st and 99th percentiles are −3.92 and 2.34, respectively, and 21 observations have an absolute shock greater than three units. The baseline analysis retains the complete shock distribution, while the robustness exercises examine whether extreme innovations exert disproportionate influence on the estimated responses.

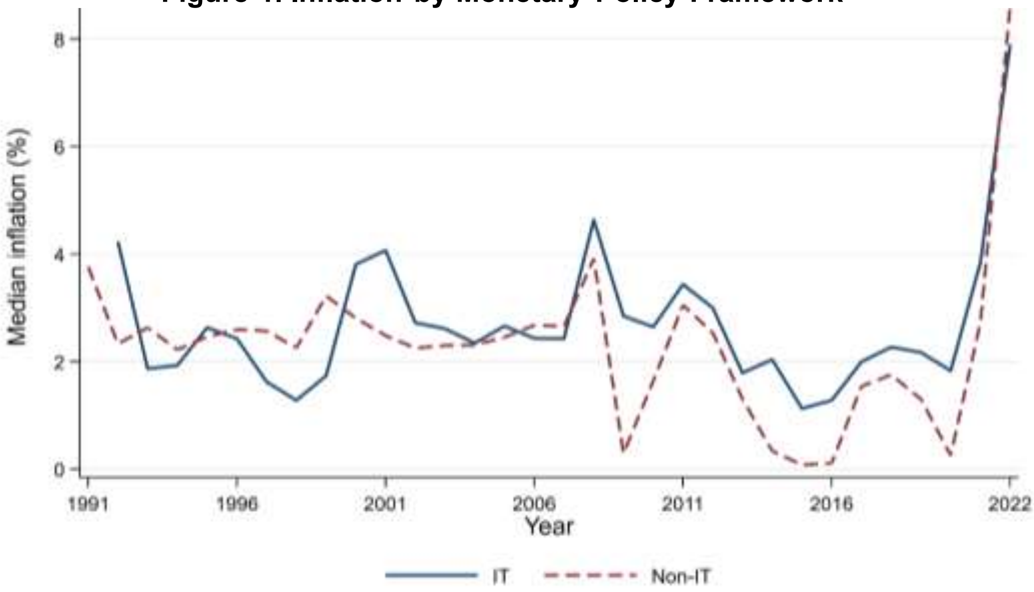
Having defined the monetary policy shock and documented its distribution, we next present descriptive evidence on inflation dynamics and exchange-rate movements in the estimation sample.

4.3 Stylised Facts

Before presenting the local-projection estimates, we document two descriptive features of the sample: inflation dynamics across monetary policy frameworks and exchange-rate movements during identified monetary tightening episodes.

Figure 1 plots median CPI inflation for inflation-targeting and non-targeting observations. There is no stable ranking between the two groups, with their inflation paths crossing repeatedly over the sample and both experiencing a pronounced increase in 2022. These unconditional patterns suggest that differences in inflation performance cannot be attributed to monetary policy frameworks alone and motivate the state-dependent analysis below.

Figure 1. Inflation by Monetary Policy Framework

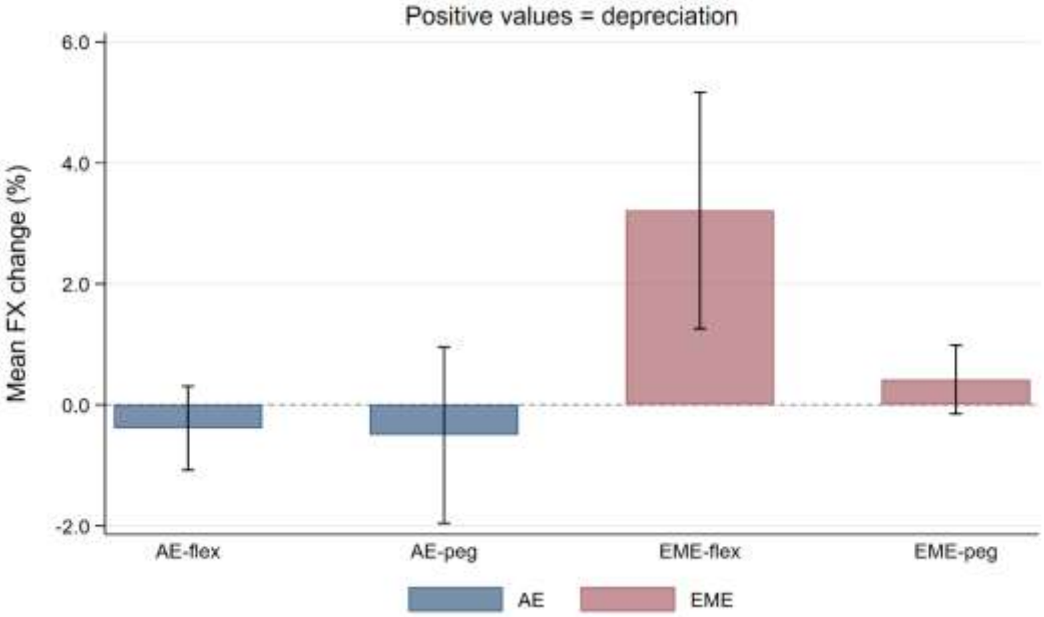


Note: The figure plots median annual CPI inflation for inflation-targeting (solid blue line) and non-inflation-targeting (dashed red line) country-years over 1991–2022. The sample is restricted to observations for which the forecast-based monetary policy shock is available. Inflation is measured as the annual percentage change in the CPI. Inflation-targeting status is represented by a time-varying country-year indicator constructed from central-bank and IMF-based sources. Differences between the two series are descriptive and may partly reflect changes in group composition over time.

Figure 2 reports average contemporaneous exchange-rate changes in country-years with positive monetary policy shocks, distinguishing AEs from EMEs and flexible from pegged exchange-rate regimes. In AEs, tightening episodes are associated with small and statistically insignificant appreciations under both regimes. In EMEs, by contrast, flexible regimes experience an average depreciation of approximately 3.2%, with the 90% confidence interval excluding zero, while the corresponding change under pegs is smaller and insignificant.

This contrast suggests that exchange-rate adjustment following monetary tightening may depend jointly on development status and the exchange-rate regime, potentially reflecting differences in exposure to global financial conditions, risk premia, and capital flows. These are descriptive conditional means rather than causal responses, but they motivate the regime- and economy-specific local projections presented below.

Figure 2. Exchange-rate Changes in Years of Identified Monetary Tightening



Note: The figure reports average annual changes in the bilateral nominal exchange rate against the US dollar in country-years with positive forecast-based monetary policy shocks. Positive values indicate depreciation. Economies are divided into advanced economies (AEs) and emerging market economies (EMEs) and classified according to their contemporaneous de facto exchange-rate regime as flexible or pegged. Currency-unit discontinuities associated with euro adoption are excluded. Capped lines report 90% confidence intervals based on standard errors clustered by economy. The bars represent descriptive conditional means and should not be interpreted as dynamic impulse responses.

4.4 Empirical Methodology

We estimate the dynamic effects of monetary policy shocks using the local-projection method of Jordà (2005). Local projections are well suited to the present application because they impose relatively few restrictions on the shape of the impulse responses and can be extended directly to accommodate nonlinearities and interactions with institutional and structural characteristics.

Let p_{it} denote the logarithm of the CPI and y_{it} the logarithm of real GDP in economy i and year t. For each horizon h, we define the cumulative outcomes as

$$\Delta_h p_{i,t+h} = 100(p_{i,t+h} - p_{it}), \qquad (8)$$

and

$$\Delta_h y_{i,t+h} = 100(y_{i,t+h} - y_{it}). \qquad (9)$$

These variables measure the cumulative percentage change in the price level and real GDP between years t and $t + h$, respectively. Responses are normalised to zero at $h = 0$. This construction avoids summing CPI index levels and allows the estimated coefficients to be interpreted directly as cumulative changes relative to the year of the monetary policy shock.

The monetary policy shock is standardised using its standard deviation in the estimation sample:

$$MP_{it}^{s} = \frac{MP_{it}}{\sigma_{MP}}, \qquad (10)$$

where σ_{MP} denotes the sample standard deviation of the identified shock. The impulse responses therefore measure the effect of a one-standard-deviation unexpected monetary policy tightening.

For each outcome $z \in \{p, y\}$ and projection horizon h, we estimate the baseline specification

$$\Delta_h z_{i,t+h} = \alpha_i^h + \lambda_t^h + \beta_h MP_{it}^{s} + \Gamma_h^{'} X_{i,t-1} + \sum_{j=1}^{L} \rho_{h,j}\, \Delta z_{i,t-j} + \sum_{k=1}^{h} \theta_{h,k}\, MP_{i,t+k}^{s} + \varepsilon_{i,t+h}^{h}, \qquad (11)$$

where α_i^h and λ_t^h denote economy and year fixed effects. The coefficient β_h traces the cumulative response of the outcome at horizon h to a one-standard-deviation contractionary monetary policy innovation.

The vector $X_{i,t-1}$ contains predetermined macroeconomic controls, including inflation, real GDP growth, private credit, government consumption, trade openness, and political stability, with the precise composition adjusted to the outcome being estimated. Lagged dependent variables are also included to capture persistence in macroeconomic dynamics. Using predetermined rather than contemporaneous controls reduces the risk of conditioning on variables that themselves respond to the monetary policy shock.

For horizons greater than zero, equation (11) additionally controls for monetary policy shocks occurring between $t + 1$ and $t + h$. Following Teulings and Zubanov (2014), this prevents the response attributed to the innovation in year t from incorporating the effects of subsequent monetary policy interventions. Because future outcomes, subsequent shocks, and lagged controls are required, the effective estimation sample declines with the projection horizon. We therefore report the number of observations and economies underlying the estimates at each horizon.

Economy fixed effects absorb persistent cross-country differences in economic structures, policy frameworks, and average macroeconomic performance. Year fixed effects capture shocks common to all economies, including global commodity-price movements, changes in international financial conditions, and synchronised business-cycle fluctuations. Inference is based on Driscoll–Kraay standard errors, which are robust to heteroskedasticity, serial correlation, and general forms of cross-sectional dependence. The baseline figures report both 90 and 95% confidence intervals.

State-dependent transmission

We next examine whether monetary policy transmission varies systematically with institutional and structural characteristics. For a moderator $M_{i,t-1}$, we estimate

$$\Delta_h z_{i,t+h} = \alpha_i^h + \lambda_t^h + \beta_h MP_{it}^s + \delta_h \left(MP_{it}^s \times M_{i,t-1}\right) + \phi_h M_{i,t-1} \\ +\Gamma_h^{'} X_{i,t-1} + \sum_{j=1}^{L} \rho_{h,j}\, \Delta z_{i,t-j} + \sum_{k=1}^{h} \theta_{h,k}\, MP_{i,t+k}^s + \varepsilon_{i,t+h}^h. \quad (12)$$

The moderator is predetermined whenever appropriate so that the conditioning variable is measured before the monetary policy innovation. The coefficient δ_h captures differences in the transmission of the shock associated with the moderator. These interaction estimates are interpreted as conditional differences in monetary transmission rather than as causal effects of the institutional characteristic itself.

For binary moderators, such as inflation-targeting status or the de facto exchange-rate regime, β_h gives the response for the reference group, while

$$IRF_h^1 = \beta_h + \delta_h \quad (13)$$

gives the response for the alternative group. We report the implied group-specific responses together with formal tests of their equality.

For continuous moderators, including central bank independence (CBI), capital-account openness (KAOPEN), and public debt, the variables are centred at their estimation-sample means and standardised by their estimation-sample standard deviations:

$$M_{i,t-1}^s = \frac{M_{i,t-1} - \bar{M}}{\sigma_M}. \quad (14)$$

Under this normalisation, β_h represents the response at the sample-average value of the moderator, while δ_h measures the change in the response associated with a one-standard-deviation increase in that characteristic. For ease of interpretation, we evaluate the implied responses at one standard deviation below and above the mean:

$$IRF_h^{Low} = \beta_h - \delta_h,\ IRF_h^{High} = \beta_h + \delta_h. \quad (15)$$

CBI, financial openness, and some other institutional characteristics are highly persistent. Their direct effects may therefore be absorbed partly or entirely by economy fixed effects. This does not prevent identification of their interactions with the monetary policy shock, because the shock varies over time. The resulting coefficients should nevertheless be interpreted as differences in shock transmission associated with institutional environments rather than as causal estimates of the direct effects of those institutions.

Exchange-rate regimes and development status

Because the exchange-rate consequences of monetary tightening may differ systematically between advanced and emerging market economies, we estimate a joint specification that interacts the monetary policy shock with both development status and the de facto exchange-rate regime:

$$\begin{aligned}\Delta_h z_{i,t+h} = {} & \alpha_i^h + \lambda_t^h + \beta_h MP_{it}^s + \delta_{1h}(MP_{it}^s \times EME_i) \\ & + \delta_{2h}(MP_{it}^s \times Peg_{it}) + \delta_{3h}(MP_{it}^s \times EME_i \times Peg_{it}) \\ & + \phi_h Peg_{it} + \psi_h(EME_i \times Peg_{it}) + \Gamma_h' X_{i,t-1} + \sum_{j=1}^{L} \rho_{h,j}\, \Delta z_{i,t-j} \\ & + \sum_{k=1}^{h} \theta_{h,k}\, MP_{i,t+k}^s + \varepsilon_{i,t+h}^h.\end{aligned} \tag{16}$$

Because EME status is time invariant, its level is absorbed by economy fixed effects. The specification yields four implied responses:

$$\begin{aligned} IRF_h^{AE,Flex} &= \beta_h, \\ IRF_h^{AE,Peg} &= \beta_h + \delta_{2h}, \\ IRF_h^{EME,Flex} &= \beta_h + \delta_{1h}, \\ IRF_h^{EME,Peg} &= \beta_h + \delta_{1h} + \delta_{2h} + \delta_{3h}. \end{aligned} \tag{17}$$

We formally test the within-AE regime difference, $\delta_{2h} = 0$; the within-EME regime difference, $\delta_{2h} + \delta_{3h} = 0$; and whether the effect of the exchange-rate regime differs between AEs and EMEs, $\delta_{3h} = 0$. This joint classification is preferable to interpreting exchange-rate-regime differences in isolation, since the role of exchange-rate flexibility may depend importantly on financial development, external vulnerabilities, and exposure to global capital flows.

Joint moderator specification

Institutional and structural characteristics are correlated across countries. Inflation-targeting economies, for example, tend also to have more independent central banks, greater financial openness, and different exchange-rate arrangements, while many of these characteristics are themselves associated with AE–EME status. Separate interaction regressions may therefore attribute to one moderator heterogeneity that is actually associated with another.

We consequently complement the individual specifications with a joint moderator model:

$$
\begin{aligned}
\Delta_h z_{i,t+h} = \alpha_i^h + \lambda_t^h + \beta_h MP_{it}^s + \sum_{m=1}^{M} \delta_{mh} \left(MP_{it}^s \times M_{m,i,t-1} \right) \\
+ \sum_{m=1}^{M} \phi_{mh}\, M_{m,i,t-1} + \Gamma_h^{'} X_{i,t-1} + \sum_{j=1}^{L} \rho_{h,j}\, \Delta z_{i,t-j} + \sum_{k=1}^{h} \theta_{h,k}\, MP_{i,t+k}^s + \varepsilon_{i,t+h}^h,
\end{aligned}
\tag{18}
$$

where the set of moderators includes AE–EME status, the de facto exchange-rate regime, inflation-targeting status, CBI, KAOPEN, and, where applicable, public debt. Time-invariant constituent terms are absorbed by economy fixed effects. The joint specification provides a horse race among the principal institutional and structural moderators and indicates whether each characteristic retains explanatory power conditional on the others.

We report individual tests of the interaction coefficients together with Wald tests of their joint significance. Because the joint model requires observations for which all moderators are simultaneously available—and exchange-rate-regime coverage is particularly restrictive—the joint estimation sample is smaller than the samples used in several individual specifications. To distinguish changes caused by sample composition from those caused by conditioning on correlated moderators, we compare three sets of estimates: the original separate specification, the same separate specification estimated on the common joint-model sample, and the full joint specification.

Finally, we examine potential mechanisms underlying the heterogeneous responses. In particular, we assess whether global financial conditions account for part of the institutional heterogeneity by interacting monetary policy shocks with global risk conditions. Because common global conditions are absorbed by year fixed effects, their interaction with the country-specific monetary policy shock remains identifiable. We also use shock-predictability and pre-trend tests to assess whether information effects or residual anticipation may contribute to non-standard inflation responses. Contemporaneous exchange-rate movements are not included as controls in the inflation projections because the exchange rate is itself a potential transmission mechanism; instead, exchange-rate responses are estimated directly as an outcome.

The baseline local projections are estimated for the full sample and subsequently subjected to a range of robustness exercises, including alternative lag structures, alternative monetary policy shock measures, trimming of extreme innovations, exclusion of crisis periods, alternative sample definitions, and leave-one-out estimates. Taken together, these exercises assess both the robustness of the average responses and the extent to which monetary policy transmission varies systematically across institutional, fiscal, and external environments.

5. Empirical Results

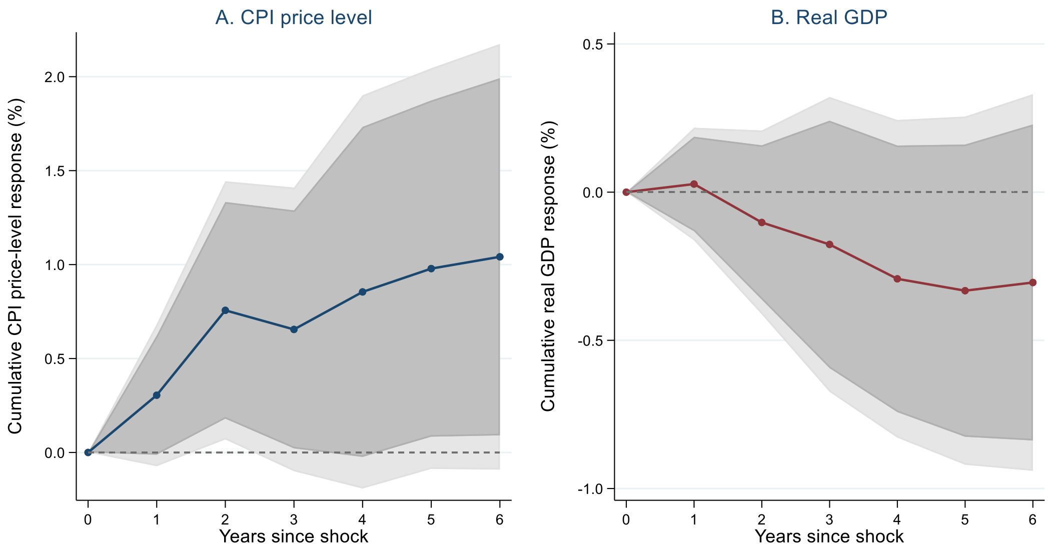
5.1 Baseline Effects and Identification Checks

We first assess whether the identified monetary policy innovations are predictable using information available before the policy decision. Appendix Table A2 regresses the standardised shock on lagged macroeconomic variables, economy and year fixed effects, and shock lags. Predictability is generally limited, although the first lag of the shock is positive and significant and the broader predetermined information set becomes jointly significant when shock lags are included. Appendix Figure A2 reports complementary placebo tests using shocks dated one and two years ahead. Pre-shock estimates are generally small and insignificant, although the CPI estimate one year before the shock is marginally significant. Taken together, these diagnostics provide qualified support for interpreting the forecast-based innovations as unanticipated monetary policy shocks, while warranting some caution in interpreting the pooled estimates.

Figure 3 reports the average cumulative responses of the CPI price level and real GDP to a one-standard-deviation contractionary monetary policy shock. The CPI response is positive but generally imprecise, rising by approximately 0.31% after one year, 0.66% after three years, and 0.98% after five years. It is statistically significant in year 2 and only marginally significant at some longer horizons.

The positive price response is consistent with the well-known price puzzle (Sims, 1992; Christiano, Eichenbaum, and Evans, 1999). Potential explanations include residual information about future inflationary pressures (Romer and Romer, 2004; Coibion, 2012), central-bank information effects (Nakamura and Steinsson, 2018), and cost or risk-premium channels (Barth and Ramey, 2001). In our setting, annual aggregation and pooling economies with substantially different institutional and external characteristics may further obscure the underlying transmission mechanism.

Figure 3. Baseline Effects of Monetary Policy Shocks



Note: The figure reports cumulative responses of the CPI price level and real GDP to a one-standard-deviation contractionary monetary policy innovation. Panel A shows $100\left[\ln\left(CPI_{i,t+h}\right) - \ln\left(CPI_{i,t}\right)\right]$, while Panel B shows $100\left[\ln\left(Y_{i,t+h}\right) - \ln\left(Y_{i,t}\right)\right]$. Responses at $h = 0$are normalised to zero. Each horizon is estimated separately using local projections with economy and year fixed effects, outcome-specific macroeconomic controls, and future monetary policy shocks through horizon h. Solid lines report point estimates; dark and light shaded areas denote 90 and 95% confidence intervals, respectively, based on Driscoll–Kraay standard errors. Appendix Table A3 reports the underlying estimates.

The real GDP response is more conventional but imprecisely estimated. Output is essentially unchanged after one year, turns negative thereafter, and reaches approximately −0.33% in year 5 before remaining negative in year 6. None of the estimates is statistically significant at conventional levels. The baseline evidence therefore points to a modest and delayed output contraction alongside a non-standard positive average price response.

These pooled estimates may mask substantial cross-country heterogeneity. The following sections examine whether transmission varies systematically with exchange-rate arrangements and institutional and macro-financial characteristics, and whether this heterogeneity helps account for the positive average price response.

5.2 Heterogeneity in Monetary Transmission

Exchange-rate regimes and AE–EME differences

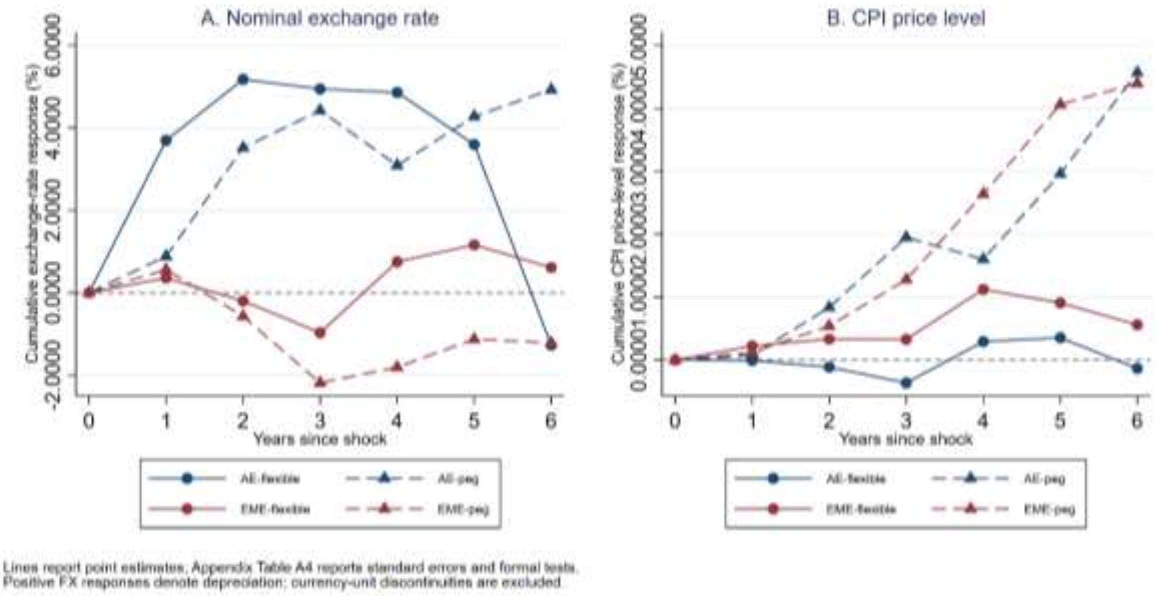
The exchange-rate regime is a natural starting point because it determines the extent to which the nominal exchange rate can adjust following a monetary policy disturbance. Greater exchange-rate flexibility should facilitate external adjustment and monetary-policy autonomy, although this insulation may be weakened by capital mobility, foreign-currency liabilities, and global financial conditions (Mundell, 1963; Obstfeld, Shambaugh, and Taylor, 2005; Rey, 2015). These considerations may be particularly important for EMEs, where exchange-rate movements affect inflation, balance sheets, capital flows, and risk premia.

We estimate the joint interaction specification in equation (17), distinguishing flexible and pegged AEs and EMEs. The corresponding group responses are defined in equation (18).

Formal tests compare pegged and flexible economies within each economy group and assess whether the effect of the exchange-rate regime differs between AEs and EMEs.

Figure 4 presents the exchange-rate and CPI price-level responses. The conditional exchange-rate estimates differ from the descriptive pattern in Figure 2. Flexible AEs experience cumulative depreciations of approximately 3.7% after one year and 4.9% after three years, compared with approximately 0.9 and 4.4% for pegged AEs. Responses among both EME groups remain closer to zero. Despite these differences in point estimates, the formal tests provide little evidence of systematic regime heterogeneity: neither the within-EME regime comparison nor the difference between the AE and EME regime effects is statistically significant over the main horizons.

Figure 4. Monetary Transmission Across Exchange-rate Regimes and Economy Groups



Note: Panel A reports cumulative changes in the bilateral nominal exchange rate against the US dollar; positive values denote depreciation. Panel B reports cumulative CPI price-level responses. The four response functions correspond to flexible-regime AEs, pegged AEs, flexible-regime EMEs, and pegged EMEs. Responses are normalised to a one-standard-deviation contractionary forecast-based monetary policy shock. Exchange-rate regimes are contemporaneous de facto classifications. Currency-unit discontinuities, including those associated with euro adoption, are excluded from the exchange-rate outcome. All specifications include economy and year fixed effects, outcome-specific controls, lagged dependent variables, and future monetary policy shocks through the relevant projection horizon. Lines report point estimates only to preserve readability. Appendix Table A4 reports standard errors, formal cross-group tests, observations, economies, and group support.

The distinction between Figures 2 and 4 is informative. Figure 2 reports unconditional exchange-rate changes during positive monetary policy innovations, whereas Figure 4 isolates conditional dynamic responses after controlling for fixed effects, macroeconomic conditions, and subsequent policy shocks. The descriptive depreciation observed for flexible-regime EMEs therefore does not translate into a precisely estimated dynamic response. More generally, exchange-rate flexibility need not provide complete insulation from global financial forces when international credit conditions and intermediary balance sheets transmit shocks across borders (Miranda-Agrippino and Rey, 2020).

The CPI responses similarly provide limited evidence of systematic regime heterogeneity. Although some within-group differences emerge at individual horizons, particularly at longer horizons, the triple-interaction tests do not indicate that the regime differential varies systematically between AEs and EMEs. The de facto exchange-rate regime alone therefore does not appear to explain the positive pooled price response documented in Figure 3.

The corresponding GDP responses are reported in Appendix Figure A3. Output remains approximately unchanged in flexible AEs but contracts progressively in flexible EMEs, by about 1.1% after three years and 1.5% after five years. Estimated responses are positive for pegged economies, particularly pegged EMEs, and the within-EME difference between pegged and flexible regimes is statistically significant. This result should be interpreted cautiously however, because the EME–peg cell contains only 34 observations from four economies. The subsequent joint-moderator analysis examines whether these patterns survive conditioning on correlated institutional and structural characteristics.

Institutional, financial, and fiscal heterogeneity

Figure 5 examines four additional dimensions of heterogeneity. Inflation targeting is represented by a binary country-year indicator, while central bank independence, financial openness, and public debt enter as lagged standardised continuous moderators. Following equations (13)–(16), responses for the continuous moderators are evaluated at one standard deviation below and above their estimation-sample means. This preserves the information in the underlying indicators without imposing arbitrary sample splits.

The CPI results reveal little systematic heterogeneity. Under inflation targeting, the cumulative responses at horizons one, three, and five are approximately 0.25, 0.38, and 0.93%, compared with 0.33, 0.78, and 1.00% for non-targeting observations. The differences are not statistically significant. Inflation-targeting status therefore does not appear to account for the positive pooled price response.

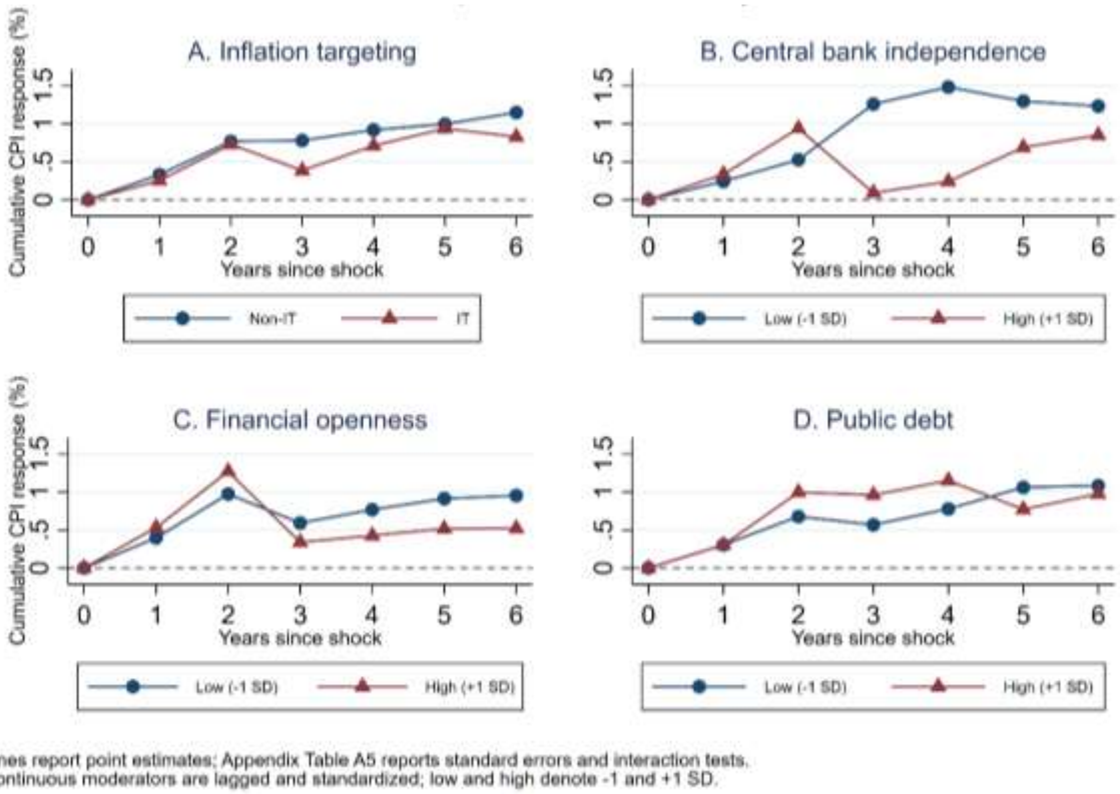
Central bank independence produces a larger difference around the third year, when the estimated CPI response is approximately 1.26% at low independence and 0.09% at high independence, but this separation is not persistent across horizons. Financial openness likewise generates no statistically robust difference: at the five-year horizon, the responses are approximately 0.91% at low openness and 0.52% at high openness. The corresponding low- and high-debt responses are approximately 1.06 and 0.77%. Overall, none of the four moderators emerges as a consistently important determinant of the price response.

Heterogeneity is more pronounced for real activity. Appendix Figure A4 shows that inflation-targeting observations experience cumulative GDP contractions of approximately 0.29% after one year, 1.06% after three years, and 1.64% after five years, while responses among non-targeting observations remain small and positive. This pattern is consistent with stronger demand-side transmission under inflation targeting, although it should not be interpreted as a causal effect of adopting the framework.

GDP responses also differ with central bank independence, financial openness, and public debt. At low central bank independence, output declines by approximately 0.98% after three years and 1.81% after five years, whereas the corresponding responses at high independence are positive. Responses are likewise more positive at high financial openness than at low openness from the third year onward. Greater financial openness may therefore capture exposure to external financing conditions and the global financial cycle as well as greater monetary-policy autonomy (Rey, 2015; Miranda-Agrippino and Rey, 2020).

Public debt displays a similar asymmetry. At low debt, output declines by approximately 0.49% after three years and 0.66% after five years, whereas the corresponding estimates at high debt are positive. Fiscal conditions may alter monetary transmission through sovereign risk, debt-service costs, private balance sheets, and expectations about future fiscal adjustment (Leeper, 1991). The positive responses at high debt, however, should not be given a structural interpretation on the basis of the separate interaction model alone.

Figure 5. Institutional and Structural Heterogeneity in Monetary Transmission



Note*:* The figure reports cumulative CPI price-level responses to a one-standard-deviation contractionary forecast-based monetary policy shock. Panel A compares inflation-targeting and non-inflation-targeting observations. Panels B–D evaluate central bank independence, financial openness, and lagged public debt at one standard deviation below and above their respective estimation-sample means. Continuous moderators are standardised and lagged. All specifications include economy and year fixed effects, CPI controls, lagged inflation, and future monetary policy shocks through the relevant projection horizon. Lines report point estimates only to preserve readability. Appendix Table A5 reports standard errors, interaction tests, observations, and economies.

Taken together, the separate specifications reveal substantially more heterogeneity in real activity than in prices. Some of the output differences are economically large, but the positive responses associated with high central bank independence, financial openness, and public debt do not map straightforwardly into conventional contractionary transmission. Moreover, these characteristics are strongly correlated across economies. The separate estimates should therefore be interpreted as conditional associations rather than independent institutional effects. The joint-moderator analysis in the next section examines which dimensions of heterogeneity survive once these overlapping characteristics and differences in sample composition are considered jointly.

5.3 Independent Moderators and Transmission Mechanisms

The heterogeneity documented above may reflect distinct transmission channels, but it may also arise because monetary frameworks and institutional characteristics are correlated across economies. We therefore conduct two complementary exercises. First, we estimate the principal moderator interactions jointly and distinguish changes caused by sample composition from those produced by conditioning on the other moderators. Second, we examine whether exposure to global risk, measured by the VIX, accounts for the main differences in inflation transmission.

Joint moderator estimates

Table 1 compares three estimates of each shock–moderator interaction at horizons 1, 3, and 5. The first comes from the original separate model using the maximum sample available for the relevant moderator. The second re-estimates the same separate specification on the smaller sample available for the joint model. The third includes interactions of the monetary policy shock with EME status, the contemporaneous de facto exchange-rate regime, inflation-targeting status, central bank independence, financial openness, and public debt simultaneously. Comparing the first two estimates isolates the effect of changes in sample composition, while comparing the second and third shows how the coefficient changes after conditioning on the other moderators.

For the CPI price level, none of the interactions in the joint model is individually significant at horizon 1, although the joint Wald test rejects homogeneity at the 10% level. More pronounced differences emerge at horizons 3 and 5. Conditional on the other moderators, the interaction with financial openness is negative and statistically significant, indicating a smaller cumulative price increase in more financially open economies. The interactions with a de facto peg and inflation targeting become positive and large, particularly at horizon 5. The joint Wald test strongly rejects the hypothesis that all CPI interactions are zero at both medium and longer horizons.

These conditional estimates should be interpreted cautiously. The peg and inflation-targeting coefficients increase sharply when the moderators enter simultaneously, suggesting limited common support and suppression among correlated institutional characteristics. Moreover, the EME–peg category contains only 34 observations from four economies in the broader regime analysis and may be even more weakly represented after imposing the common-sample requirements. The coefficients therefore describe conditional heterogeneity within the observed sample and should not be interpreted as causal effects of adopting particular policy frameworks.

Table 1. Separate and Joint Moderator Estimates
Panel A. Cumulative CPI Price-level Response

Horizon	Moderator	Separate model	Separate model, common sample	Joint model	Joint Wald p-value
1	EME status	−0.253 (0.372)	−0.073 (0.250)	−0.155 (0.231)	
1	De facto peg	−0.087 (0.209)	−0.063 (0.186)	1.024 (1.054)	
1	Inflation targeting	−0.078 (0.115)	0.100 (0.214)	1.229 (1.126)	
1	Central bank independence	0.047 (0.219)	0.016 (0.233)	0.139 (0.281)	
1	Financial openness	0.068 (0.102)	−0.032 (0.038)	−0.025 (0.074)	
1	Public debt	−0.001 (0.163)	0.005 (0.190)	0.014 (0.279)	0.091
3	EME status	0.305 (0.563)	−0.723 (0.757)	−1.085 (0.845)	
3	De facto peg	1.128** (0.484)	1.176** (0.491)	5.907* (2.991)	
3	Inflation targeting	−0.395 (0.305)	−0.819 (0.517)	4.795* (2.773)	
3	Central bank independence	−0.583** (0.240)	0.146 (0.620)	1.019 (0.877)	
3	Financial openness	−0.126 (0.130)	−0.202 (0.128)	−0.556** (0.227)	
3	Public debt	0.195 (0.435)	0.068 (0.657)	0.238 (0.709)	0.001
5	EME status	0.885 (0.942)	−1.163 (1.507)	−1.876 (1.333)	
5	De facto peg	2.871*** (0.688)	2.952*** (0.701)	13.500*** (4.328)	
5	Inflation targeting	−0.060 (0.447)	−1.894* (0.930)	10.473** (3.855)	
5	Central bank independence	−0.304 (0.294)	0.610 (0.795)	1.781 (1.050)	
5	Financial openness	−0.197 (0.224)	−0.387 (0.224)	−1.010*** (0.241)	
5	Public debt	−0.145 (0.584)	−0.851 (1.134)	−0.365 (0.830)	<0.001
	Observations	—	—	366 at $h = 1,3$; 328 at $h = 5$	
	Economies	—	—	24	

Panel B. Cumulative Real GDP Response

Horizon	Moderator	Separate model	Separate model, common sample	Joint model	Joint Wald p-value
1	EME status	−0.162 (0.206)	−1.049* (0.569)	−1.297 (0.904)	
1	De facto peg	1.288*** (0.354)	1.240*** (0.374)	0.437 (0.915)	
1	Inflation targeting	−0.472*** (0.123)	−1.169*** (0.372)	−0.308 (0.985)	
1	Central bank independence	0.114 (0.109)	0.089 (0.326)	0.305 (0.288)	
1	Financial openness	0.049 (0.041)	0.107 (0.095)	0.059 (0.157)	
1	Public debt	0.241* (0.128)	−0.409 (0.412)	−0.880* (0.425)	0.020
3	EME status	−1.423** (0.670)	−2.457** (0.892)	−2.570** (1.099)	
3	De facto peg	3.458*** (0.697)	3.328*** (0.730)	4.168* (2.101)	
3	Inflation targeting	−1.348** (0.575)	−2.983*** (0.686)	1.882 (2.670)	
3	Central bank independence	0.797*** (0.240)	−0.180 (0.963)	−0.059 (0.754)	
3	Financial openness	0.375*** (0.111)	0.216 (0.253)	0.078 (0.350)	
3	Public debt	0.674** (0.275)	−0.820 (0.748)	−1.960*** (0.540)	<0.001
5	EME status	−1.296 (0.956)	−1.101 (1.311)	−1.919* (1.104)	
5	De facto peg	4.423*** (0.918)	4.359*** (0.992)	3.828 (3.032)	
5	Inflation targeting	−2.005** (0.934)	−4.017*** (0.909)	0.763 (4.211)	
5	Central bank independence	1.472*** (0.523)	1.480 (1.544)	1.395 (1.186)	
5	Financial openness	0.474*** (0.123)	0.164 (0.391)	−0.053 (0.407)	
5	Public debt	0.703** (0.260)	−1.647** (0.701)	−2.632*** (0.791)	<0.001
	Observations	—	—	372 at $h = 1{,}3$; 334 at $h = 5$	
	Economies	—	—	25	

Note: The table reports coefficients on the interaction between a one-standard-deviation contractionary monetary policy shock and the indicated moderator. Driscoll–Kraay standard errors are reported in parentheses. The separate model uses the maximum sample available for each moderator. The common-sample model estimates the same separate specification on the sample used by the joint model. The joint model includes shock interactions with EME status, the contemporaneous de facto peg indicator, inflation-targeting status, central bank independence, financial openness, and lagged public debt. Continuous moderators are standardised and lagged by one year. The Wald p-value tests the joint null that all shock–moderator interactions in the joint specification equal zero. All regressions include the relevant constituent terms, economy and year fixed effects, outcome-specific controls, lagged dependent variables, and future monetary policy shocks through the relevant horizon. $*$, $**$, and $***$denote significance at the 10, 5, and 1% levels.

The results for real GDP similarly demonstrate the importance of separating sample-composition effects from conditional relationships. In the original separate specifications, central bank independence, financial openness, inflation targeting, and public debt are associated with significant differences at some horizons. Several of these relationships weaken or change sign when the separate models are estimated on the joint-model sample. Once all moderators are included simultaneously, EME status is associated with a larger output contraction at horizon 3 and, more weakly, at horizon 5. Higher public debt is associated with a more negative GDP response, particularly at horizons 3 and 5. By contrast, the separate associations of central bank independence, financial openness, and inflation targeting with the output response do not survive in the joint specification.

The shock–moderator interactions are jointly significant for GDP at all three reported horizons. Taken together, the CPI and GDP results reject the hypothesis that monetary transmission is homogeneous across all the characteristics considered. They do not, however, support treating every moderator as a separate and independently identified channel. Financial openness retains the clearest conditional relationship with the price response, whereas EME status and public debt retain the clearest conditional relationships with the output response. The instability of several other coefficients across samples and specifications indicates that part of the separate heterogeneity reflects overlapping institutional characteristics and differences in country composition.

Transmission mechanisms

We next examine whether the heterogeneity in inflation transmission is explained by global financial conditions. This possibility is especially relevant for financially open economies and EMEs, where shifts in global risk appetite can affect capital flows, financing conditions, and exchange rates. The VIX is frequently used as an indicator of the global financial cycle and global risk-bearing conditions (Rey, 2015; Miranda-Agrippino and Rey, 2020). We standardise the annual VIX and interact it with the country-specific monetary policy shock. Because the VIX level is common to all economies in a given year, it is absorbed by the year fixed effects, whereas its interaction with the country-specific shock remains identifiable.

Appendix Table A6 presents three specifications. The first includes the principal exchange-rate-regime and institutional interactions without the shock–VIX interaction. The second adds the shock–VIX interaction. The third includes the VIX interaction together with the complete set of institutional interactions. The shock–VIX coefficient is small and statistically insignificant at horizons 1, 3, and 5. Adding it also has almost no effect on the interactions with the de facto exchange-rate regime, inflation targeting, or financial openness. At horizons 3 and 5, the financial-openness interaction remains negative and significant, while the conditional peg and inflation-targeting interactions remain positive and large.

The annual VIX interaction therefore does not account for the principal institutional differences in the CPI response. This does not imply that global financial conditions are unimportant for monetary transmission. A common annual measure may not capture differences in country-level exposure, the timing of financial stress within the year, or other dimensions of the global financial cycle. Within the present specification, however, controlling for the VIX leaves the key institutional interactions essentially unchanged.

The exchange-rate evidence provides a more direct, although still qualified, mechanism test. Figure 4 shows substantial differences in nominal exchange-rate responses across economy and regime groups. Nevertheless, the formal difference-in-differences tests provide limited evidence that the effect of a de facto peg differs systematically between AEs and EMEs. Inference for pegged EMEs is also constrained by the small number of observations and economies. The exchange-rate channel is therefore consistent with some of the observed heterogeneity, but the results do not establish that it is the sole or dominant mechanism.

Finally, the shock-predictability and placebo tests in Section 5.1 provide only limited support for an information-effect explanation. Monetary policy decisions may convey central-bank information about future economic conditions, potentially producing price and output responses that differ from those associated with a pure policy disturbance (Nakamura and Steinsson, 2018; Jarociński and Karadi, 2020). In our data, however, lagged inflation and GDP growth do not consistently predict the identified shock, and the pre-shock projections do not reveal systematic anticipation. Some predictability appears when shock lags and the broader set of predetermined variables are included. An information component therefore cannot be excluded entirely, but the evidence is not sufficiently strong to explain the principal heterogeneity results.

We deliberately do not include contemporaneous exchange-rate changes as controls in the inflation projections. Because the exchange rate is a potential transmission mechanism, conditioning on its contemporaneous response would block part of the effect under investigation and could introduce post-treatment bias. Its role is instead evaluated by treating the nominal exchange rate as an outcome in Figure 4.

Table 2 summarises the evidence across the four potential mechanisms. Overall, the results point to overlapping sources of heterogeneity rather than to a single dominant transmission channel.

Table 2. Evidence on Potential Transmission Mechanisms

Mechanism	Empirical test	Main finding	Interpretation
Exchange-rate channel	Exchange-rate responses by AE/EME status and contemporaneous de facto regime	Response paths differ across groups, but the regime difference-in-differences estimates are imprecise. The EME–peg group has limited support.	Suggestive evidence of heterogeneous currency adjustment, but no robust AE–EME difference in the regime effect.
Global risk	Monetary policy shock × standardised annual VIX	The VIX interaction is insignificant and leaves the principal institutional interactions essentially unchanged.	The annual VIX does not explain the observed institutional heterogeneity.
Information effect	Shock-predictability regressions and pre-shock placebo tests	Predetermined macroeconomic variables have limited predictive power, and there are no systematic pre-shock responses.	Limited evidence of an information component and no indication that it drives the main results.
Institutional overlap	Separate, common-sample, and joint moderator models	Several interactions weaken or change sign. Financial openness remains relevant for CPI, while EME status and public debt remain relevant for GDP.	Some separate heterogeneity reflects correlated institutions and differences in sample composition.

Note: The table summarises the mechanism tests reported in Sections 5.1–5.3, Figure 4, Table 1, and Appendix Table A6. The entries synthesise the direction and robustness of the evidence rather than reporting additional estimates. The tests identify patterns consistent with particular transmission mechanisms but do not separately identify structural causal channels.

5.4 Inflation–Output Trade-offs

We conclude with a policy-oriented assessment of the inflation–output trade-off associated with monetary tightening. To ensure comparability, we estimate the cumulative CPI price-level and real GDP responses using identical specifications and horizon-specific samples. Table 3 reports the results for the full sample and for flexible-regime AEs, pegged AEs, flexible-regime EMEs, and pegged EMEs at horizons 1, 3, and 5.

A sacrifice ratio is economically meaningful only when monetary tightening produces an identifiable decline in the price level. We therefore calculate it only when the estimated price response is negative, statistically significant at the 10% level, and at least 0.10 percentage point in absolute magnitude. When these conditions are satisfied, the ratio is defined as the cumulative real GDP response divided by the cumulative CPI price-level response. A positive ratio would then measure the cumulative output loss associated with a one-percentage-point reduction in the price level. Uncertainty would be assessed using a paired country-clustered bootstrap that preserves the covariance between the price and output responses.

None of the estimates meets the conditions required to report a sacrifice ratio. In the full sample, the cumulative price-level response is positive at all three horizons, while the GDP response becomes negative but remains statistically insignificant at horizons 3 and 5. Among flexible-regime EMEs, GDP declines significantly at horizon 3 and remains negative at horizon 5, but the price response is positive. The estimates for the other groups likewise provide no combination of a significant price decline and an output contraction. The only negative price response occurs for pegged AEs at horizon 1, but it is small and statistically indistinguishable from zero.

Table 3 therefore reports the price and output responses while marking the sacrifice ratios as not estimable. This result should not be interpreted as evidence that disinflation carries no output cost. Rather, the estimated responses do not identify the disinflation required to construct a stable measure of that cost. The exercise reinforces the deliberately qualified interpretation of the results: output contractions are apparent in some groups, particularly flexible-regime EMEs, but the average price response remains weak, imprecise, or of the opposite sign.

Table 3. Inflation–Output Trade-offs

Sample or regime	Horizon	CPI price response	Real GDP response	Sacrifice ratio	90% bootstrap interval
Full sample	1	0.342* (0.181)	0.006 (0.108)	Not estimable	Not applicable
	3	0.593* (0.338)	−0.347 (0.242)	Not estimable	Not applicable
	5	0.935** (0.423)	−0.415 (0.307)	Not estimable	Not applicable
AE–flexible	1	0.018 (0.487)	0.179 (0.365)	Not estimable	Not applicable
	3	0.525 (0.780)	0.217 (1.250)	Not estimable	Not applicable
	5	0.412 (1.206)	0.282 (1.668)	Not estimable	Not applicable
AE–peg	1	−0.123 (0.200)	1.120 (0.751)	Not estimable	Not applicable
	3	1.054 (0.755)	2.590 (1.653)	Not estimable	Not applicable
	5	2.544 (1.723)	0.307 (1.357)	Not estimable	Not applicable
EME–flexible	1	0.175 (0.113)	−0.304 (0.200)	Not estimable	Not applicable
	3	0.618** (0.222)	−1.116** (0.448)	Not estimable	Not applicable
	5	0.595 (0.406)	−1.531* (0.776)	Not estimable	Not applicable
EME–peg	1	0.019 (0.267)	0.732** (0.306)	Not estimable	Not applicable
	3	1.169** (0.450)	1.689*** (0.570)	Not estimable	Not applicable
	5	3.547*** (0.593)	2.553* (1.388)	Not estimable	Not applicable

Note: The table reports cumulative CPI price-level and real GDP responses at horizons 1, 3, and 5 following a one-standard-deviation contractionary forecast-based monetary policy shock. Price and GDP responses are estimated using identical specifications and horizon-specific samples. Driscoll–Kraay standard errors are reported in parentheses. The sacrifice ratio is defined as the cumulative real GDP response divided by the cumulative CPI price-level response and is reported only when the price response is negative, statistically significant at the 10% level, and at least 0.10 percentage point in absolute magnitude. No estimate satisfies all three conditions; sacrifice ratios are therefore not estimable and bootstrap intervals are not applicable. Had the conditions been satisfied, the intervals would have been calculated as 90% percentile intervals from a paired country-clustered bootstrap. The full-sample regressions contain 767, 693, and 619 observations at horizons 1, 3, and 5, respectively, from 39 economies. The corresponding regime regressions contain 414, 393, and 351 observations from 27 economies. All specifications include economy and year fixed effects, common macroeconomic controls, price and output histories, and future monetary policy shocks through the relevant horizon. The regime responses are obtained from a joint model interacting the shock with EME status, the contemporaneous de facto peg indicator, and their interaction. Estimates for pegged EMEs should be interpreted cautiously because that category contains relatively few observations and economies. $*$, $**$, and $***$denote statistical significance at the 10, 5, and 1% levels.

5.5 Robustness and Sensitivity

We assess the robustness of the baseline results to alternative price measures, monetary policy shocks, model specifications, and sample composition. Appendix Figure A5 presents the response paths, while Appendix Table A7 reports estimates at horizons 1, 3, and 5. The shock-predictability and pre-shock placebo tests are discussed separately in Section 5.1 and reported in Appendix Table A2 and Appendix Figure A2.

First, we consider whether the estimated price response depends on the price index. The core CPI response closely tracks the headline CPI response: both are positive and largest at medium horizons. By contrast, the GDP-deflator response is smaller and becomes negative at horizons 3 and 5, although it remains statistically insignificant. Thus, the positive response is evident in consumer-price measures but not in the broader economy-wide price index. This difference suggests that the baseline CPI response may partly reflect relative-price movements or components of consumer prices that are not captured in the GDP deflator.

Second, we replace the baseline forecast-based innovation with the alternative monetary policy shock measure based on Deb et al. (2023). Because this series has more limited coverage, we estimate it using both its maximum available sample and a common sample on which it can be compared directly with the baseline shock. In the common sample, the alternative shock produces a near-zero CPI response initially and a small, statistically insignificant decline by horizon 5. Its output effects are more pronounced: real GDP falls significantly at horizons 1 and 5. In the maximum available sample, the alternative shock generates statistically significant declines in the price level at horizons 3 and 5 and a significant output contraction at horizon 5. These findings provide stronger evidence of conventional monetary transmission, although the comparison also demonstrates that the estimated price response is sensitive to the shock measure and estimation sample.

Third, we vary the local-projection specification by including lagged monetary policy shocks, adopting shorter and longer lag structures, winsorising extreme shocks, and excluding the global financial crisis and COVID-19 periods. The delayed decline in real GDP is generally preserved, with the largest and most precisely estimated contractions appearing under the longer-lag specification and when crisis years are excluded. The CPI response remains positive in most specifications, but its magnitude and statistical precision vary. In particular, including lagged shocks or using shorter lags substantially attenuates the medium-horizon price response.

Finally, the leave-one-economy-out exercise indicates that the baseline results are not driven by a single economy. Across these exclusions, the cumulative CPI response remains positive at horizons 1, 3, and 5. The GDP-response range includes zero at horizon 1 but is entirely negative at horizons 3 and 5. Although these ranges do not represent confidence intervals, they show that the principal response patterns are stable to the sequential removal of individual economies.

Overall, the robustness exercises support a deliberately qualified interpretation of the findings. The delayed output contraction is comparatively stable across model specifications, samples, and country exclusions. The price response is less robust: it varies with the price index, shock measure, lag structure, and estimation sample. The results therefore support the conclusion that contractionary monetary innovations weaken real activity, while their average price effects are more difficult to estimate precisely and depend importantly on measurement and identification choices.

6. Conclusion and Policy Implications

This paper examines how institutional, fiscal, and external conditions shape monetary policy transmission across 40 economies over 1991–2022. Using forecast-based monetary policy innovations and local projections, we find that tightening produces a modest, delayed contraction in real activity, whereas the average CPI price-level response is positive and imprecisely estimated. Heterogeneity is more pronounced for output than for prices: the clearest contraction occurs in flexible-regime emerging markets. In joint models, financial openness retains the strongest association with price responses, while emerging-market status and public debt are more closely associated with output responses. These patterns remain broadly unchanged after controlling for global risk through the VIX. The robustness exercises further show that the output contraction is more stable than the estimated price response.

The central policy implication is that monetary transmission cannot be inferred reliably from an average cross-country response. Assessments of the timing and real costs of tightening should account for the economy's exchange-rate arrangement, exposure to international financial conditions, and fiscal position. The relatively pronounced output contraction in flexible-regime emerging markets points to the importance of monitoring capital flows, financing conditions, currency mismatches, and exchange-rate pass-through when policy is tightened. Strong macroprudential frameworks, adequate foreign-currency liquidity, and credible policy communication may help contain financial amplification, although the results do not establish the causal effectiveness of these complementary instruments.

The absence of a sufficiently precise decline in the price level should not be interpreted as evidence that monetary policy is ineffective. Rather, it indicates that a stable short-run inflation–output trade-off cannot be recovered from the average cross-country response. Price dynamics may reflect central-bank information, relative-price and cost channels, exchange-rate movements, and substantial heterogeneity across economies. Policymakers should therefore avoid applying a common sacrifice ratio across countries or treating the expected inflation response to tightening as invariant to the prevailing institutional and external environment.

Several limitations qualify these conclusions. Annual data cannot capture high-frequency policy and financial-market adjustments; institutional indicators are necessarily imperfect; and some regime groups, particularly pegged emerging markets, contain relatively few observations. The forecast-based innovations may retain an information component, while the annual VIX provides only a broad measure of global risk and may not capture country-specific exposure. Future research could combine higher-frequency monetary shocks with granular measures of capital flows, financial conditions, currency mismatches, exchange-rate pass-through, and inflation expectations. Larger samples would also permit more precise analysis of interactions among development status, exchange-rate arrangements, fiscal conditions, and monetary institutions. Such extensions would help explain why monetary tightening generates comparatively robust real adjustment without producing an equally consistent average decline in the price level.

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Appendix

Table A1. Summary Statistics

Variable	Obs.	Economies	Mean	SD	P25	Median	P75	Min.	Max.
MP shock	941	40	−0.007	0.956	−0.170	0.014	0.279	−7.926	9.374
CPI inflation (%)	941	40	2.928	3.178	1.275	2.271	3.484	−1.676	28.303
Headline CPI inflation (%)	840	39	2.519	3.489	1.117	2.118	3.318	−26.580	35.583
Real GDP growth (%)	941	40	2.471	3.446	1.175	2.620	4.132	−14.839	24.475
FX change (%)	915	39	0.697	6.405	−2.826	−0.012	3.428	−17.598	33.737
Private credit (% of GDP)	851	39	84.433	41.380	51.783	78.280	110.166	0.188	304.575
Government consumption (% of GDP)	919	39	19.082	3.626	17.029	19.368	21.414	10.297	28.071
Trade openness (% of GDP)	919	39	90.102	55.151	56.588	74.313	115.110	19.786	393.141
Political stability	833	39	0.605	0.702	0.380	0.775	1.052	−2.376	1.759
Inflation targeting (IT)	941	40	0.394	0.489	0	0	1	0	1
Flexible FX regime	499	29	0.754	0.431	1	1	1	0	1
CBI	864	37	0.719	0.209	0.625	0.844	0.857	0.138	0.924
KAOPEN	896	38	1.739	0.978	1.274	2.281	2.281	−1.939	2.281

Note: The sample covers 40 economies over 1991–2022 and includes country-year observations for which the forecast-based monetary policy shock is available. Statistics use the maximum number of available observations for each variable. FX changes are annual percentage changes in the bilateral nominal exchange rate against the US dollar, with positive values indicating depreciation. Currency-unit discontinuities associated with euro adoption are excluded. IT denotes inflation targeting, CBI denotes central bank independence, and KAOPEN is the Chinn–Ito capital-account openness index.

Table A2. Predictability Tests for the Monetary Policy Shock

	(1) Inflation	(2) + GDP	(3) + Macro controls	(4) + Shock lags
Inflation $(t-1)$	−0.049	−0.040	−0.059	−0.018
	(0.036)	(0.039)	(0.043)	(0.029)
Inflation $(t-2)$	0.050	0.041	0.102**	0.043**
	(0.053)	(0.060)	(0.050)	(0.019)
GDP growth $(t-1)$	—	0.018	0.019	−0.022
		(0.020)	(0.022)	(0.019)
GDP growth $(t-2)$	—	−0.042**	−0.007	0.005
		(0.018)	(0.011)	(0.014)
Exchange-rate change $(t-1)$	—	—	−0.000	−0.001
			(0.000)	(0.001)
Trade openness $(t-1)$	—	—	0.009**	0.003
			(0.004)	(0.002)
Credit $(t-1)$	—	—	0.001	0.001
			(0.003)	(0.002)
Government consumption $(t-1)$	—	—	0.029	0.001
			(0.044)	(0.025)
MP shock $(t-1)$	—	—	—	0.300***
				(0.103)
MP shock $(t-2)$	—	—	—	−0.016
				(0.095)
Observations	936	936	831	792
Economies	40	40	39	39
Economy fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Macroeconomic variables: joint-test p-value	0.406	0.088	0.130	<0.001
Shock lags: joint-test p-value	—	—	—	0.017
All predictors: joint-test p-value	0.406	0.088	0.130	<0.001

Note: The dependent variable is the standardised forecast-based monetary policy shock, with positive values denoting contractionary innovations. Each column reports an economy-year panel regression with economy and year fixed effects. Column (1) includes two lags of inflation; column (2) adds two lags of real GDP growth; column (3) adds lagged exchange-rate changes, trade openness, credit, and government consumption; and column (4) additionally includes two lags of the monetary policy shock. Standard errors clustered by economy are reported in parentheses. The macroeconomic joint test evaluates the coefficients on all predetermined macroeconomic variables included in the corresponding column. The shock-lag test evaluates the two lagged shock coefficients, and the final test covers all reported predictors. The number of observations varies because of data availability and lag construction. ***, **, and * denote statistical significance at the 1, 5, and 10% levels, respectively.

Table A3. Baseline Local-Projection Estimates

Panel A. Cumulative CPI Price-Level Response

	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$
MP shock (one SD)	0.305	0.757**	0.655	0.855	0.979*	1.041*
	(0.193)	(0.351)	(0.385)	(0.534)	(0.544)	(0.578)
Observations	784	747	710	673	636	599
Economies	39	39	39	39	39	39
Economy fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Future MP shocks	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Cumulative Real GDP Response

	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$
MP shock (one SD)	0.027	−0.102	−0.176	−0.292	−0.332	−0.305
	(0.097)	(0.158)	(0.254)	(0.273)	(0.300)	(0.324)
Observations	809	772	735	698	661	624
Economies	39	39	39	39	39	39
Economy fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Future MP shocks	Yes	Yes	Yes	Yes	Yes	Yes

Note: The table reports local-projection estimates of the cumulative response to a one-standard-deviation contractionary monetary policy innovation. In Panel A, the dependent variable is $100[\ln(CPI_{i,t+h}) - \ln(CPI_{i,t})]$. In Panel B, it is $100[\ln(Y_{i,t+h}) - \ln(Y_{i,t})]$. Each horizon is estimated separately with economy and year fixed effects. The CPI specifications control for contemporaneous and lagged real GDP growth, credit, government consumption, and the log CPI. The GDP specifications control for contemporaneous and lagged inflation, trade openness, credit, government consumption, and log real GDP. Future monetary policy shocks through horizon $h$are included to hold subsequent policy innovations constant. Driscoll–Kraay standard errors are reported in parentheses. The declining number of observations at longer horizons reflects the construction of forward cumulative outcomes. ***, **, and * denote statistical significance at the 1, 5, and 10% levels, respectively.

Table A4. Monetary Transmission Across De Facto Exchange-rate Regimes and Economy Groups

Panel A. Nominal exchange-rate response

Horizon	AE–flexible	AE–peg	EME–flexible	EME–peg	AE regime test	EME regime test	Regime-gap test	Obs.	Economies
1	3.70**	0.88	0.36	0.56	0.063	0.792	0.110	410	26
	(1.58)	(1.76)	(0.57)	(0.44)					
2	5.17**	3.52	−0.20	−0.57	0.525	0.779	0.592	407	25
	(2.48)	(2.36)	(1.05)	(1.17)					
3	4.94*	4.42	−0.97	−2.19	0.899	0.520	0.864	404	24
	(2.67)	(3.23)	(1.31)	(2.12)					
4	4.86	3.09	0.75	−1.81	0.623	0.300	0.851	382	24
	(3.30)	(2.78)	(1.38)	(2.75)					
5	3.60	4.28	1.16	−1.13	0.881	0.258	0.544	360	23
	(3.27)	(5.20)	(1.18)	(2.47)					
6	−1.27	4.93	0.61	−1.22	0.391	0.480	0.270	339	23
	(2.55)	(7.69)	(1.59)	(2.50)					

Panel B. CPI price-level response

Horizon	AE–flexible	AE–peg	EME–flexible	EME–peg	AE regime test	EME regime test	Regime-gap test	Obs.	Economies
1	−0.01	0.08	0.22**	0.12	0.860	0.728	0.761	408	26
	(0.26)	(0.34)	(0.11)	(0.27)					
2	−0.11	0.84	0.33	0.54	0.210	0.689	0.448	408	26
	(0.49)	(0.68)	(0.27)	(0.53)					
3	−0.36	1.95*	0.33	1.28	0.015	0.140	0.160	408	26
	(0.77)	(1.06)	(0.37)	(0.79)					
4	0.29	1.60	1.12***	2.64**	0.414	0.137	0.886	387	26
	(0.71)	(1.42)	(0.24)	(1.02)					
5	0.35	2.96	0.91**	4.06***	0.196	<0.001	0.751	366	26
	(0.98)	(1.80)	(0.37)	(0.87)					
6	−0.13	4.57**	0.56	4.40***	0.093	<0.001	0.663	345	26
	(1.23)	(2.11)	(0.51)	(1.12)					

Horizon	AE–flexible	AE–peg	EME–flexible	EME–peg	AE regime test	EME regime test	Regime-gap test	Obs.	Economies
1	0.02	1.48	−0.24	0.94***	0.208	<0.001	0.803	414	27
	(0.44)	(0.97)	(0.18)	(0.32)					
2	0.30	3.04*	−0.79**	1.76***	0.189	<0.001	0.929	414	27
	(0.90)	(1.67)	(0.29)	(0.43)					
3	0.15	3.52*	−1.07***	2.17***	0.198	<0.001	0.959	414	27
	(1.14)	(1.90)	(0.36)	(0.67)					
4	−0.04	2.81	−1.33**	2.86***	0.254	<0.001	0.576	393	27
	(1.41)	(1.73)	(0.49)	(0.96)					
5	−0.05	1.23	−1.53**	3.77***	0.595	<0.001	0.086	372	27
	(1.71)	(1.31)	(0.67)	(1.17)					
6	−0.02	0.90	−1.43**	5.01***	0.662	<0.001	0.008	351	27
	(1.81)	(0.89)	(0.59)	(1.58)					

Panel C. Real GDP response

Panel D. Estimation-sample support by group

Economy group and regime	Country-year observations	Economies
AE–flexible	237	13
AE–peg	89	11
EME–flexible	119	7
EME–peg	34	4

Note: Panels A–C report responses to a one-standard-deviation contractionary forecast-based monetary policy shock. Panel A reports cumulative changes in the bilateral nominal exchange rate against the US dollar; positive values denote depreciation. Panels B and C report cumulative CPI price-level and real GDP responses, respectively. Driscoll–Kraay standard errors are reported in parentheses. The three test columns report p-values for: (i) equality of the pegged and flexible responses among AEs; (ii) equality of the pegged and flexible responses among EMEs; and (iii) equality of the regime differential between AEs and EMEs. All specifications include economy and year fixed effects, outcome-specific controls, lagged dependent variables, and future monetary policy shocks through the relevant horizon. Exchange-rate regimes are contemporaneous de facto classifications. Currency-unit discontinuities associated with euro adoption are excluded from the exchange-rate outcome. Panel D reports the underlying group support before horizon-specific attrition. The EME–peg results are based on only 34 observations from four economies and should be interpreted cautiously. ∗, ∗∗, and ∗∗∗denote statistical significance at the 10, 5, and 1% levels.

Table A5. Institutional and Structural Heterogeneity in Monetary Transmission

Panel A. CPI price-level responses

Moderator	Horizon	Non-IT/Low	IT/High	Interaction-test p-value	Obs.	Economies
Inflation targeting	1	0.33 (0.22)	0.25 (0.17)	0.504	784	39
	3	0.78* (0.41)	0.38 (0.41)	0.207	710	39
	5	1.00 (0.60)	0.93 (0.55)	0.894	636	39
Central bank independence	1	0.24 (0.28)	0.34 (0.29)	0.832	731	37
	3	1.26** (0.50)	0.09 (0.35)	0.022	661	37
	5	1.30** (0.57)	0.69 (0.66)	0.311	591	37
Financial openness	1	0.40 (0.24)	0.53 (0.42)	0.514	765	38
	3	0.59* (0.35)	0.34 (0.42)	0.340	693	38
	5	0.91* (0.48)	0.52 (0.67)	0.387	621	38
Public debt	1	0.30 (0.21)	0.30 (0.31)	0.996	784	39
	3	0.57* (0.28)	0.96 (0.95)	0.657	710	39
	5	1.06* (0.58)	0.77 (1.14)	0.806	636	39

Panel B. Real GDP responses

Moderator	Horizon	Non-IT/Low	IT/High	Interaction-test p-value	Obs.	Economies
Inflation targeting	1	0.19* (0.11)	−0.29*** (0.09)	<0.001	809	39
	3	0.29 (0.50)	−1.06*** (0.22)	0.026	735	39
	5	0.36 (0.67)	−1.64*** (0.47)	0.041	661	39
Central bank independence	1	−0.10 (0.12)	0.13 (0.17)	0.303	755	37
	3	−0.98*** (0.36)	0.61** (0.28)	0.002	685	37
	5	−1.81*** (0.66)	1.13** (0.52)	0.009	615	37
Financial openness	1	0.11 (0.11)	0.21 (0.17)	0.242	789	38
	3	0.43* (0.23)	1.18** (0.44)	0.002	717	38
	5	0.51 (0.31)	1.46*** (0.52)	<0.001	645	38
Public debt	1	−0.09 (0.12)	0.39** (0.17)	0.069	809	39
	3	−0.49* (0.25)	0.86* (0.44)	0.021	735	39
	5	−0.66* (0.32)	0.75** (0.36)	0.012	661	39

Note: The table reports cumulative CPI price-level and real GDP responses at horizons 1, 3, and 5 following a one-standard-deviation contractionary forecast-based monetary policy shock. For inflation targeting, the two response columns represent non-inflation-targeting and inflation-targeting observations. For central bank independence, financial openness, and public debt, “Low” and “High” represent evaluations at one standard deviation below and above the corresponding estimation-sample mean. These continuous moderators are standardised and lagged by one year. Driscoll–Kraay standard errors are reported in parentheses. The interaction-test column reports the p-value for equality of the two responses. All specifications include economy and year fixed effects, outcome-specific controls, lagged dependent variables, and future monetary policy shocks through the relevant horizon. Differences across moderators partly reflect differences in variable coverage and estimation samples. $*$, $**$, and $**$ $*$denote statistical significance at the 10, 5, and 1% levels.

Table A6. Global Risk and Institutional Heterogeneity in Inflation Transmission

Panel A. Horizon 1

Shock interaction or contrast	Without shock–VIX	With shock–VIX	VIX and institutions jointly
Peg versus flexible: AEs	1.012 (0.843)	1.121 (0.789)	1.131 (0.820)
EME difference under flexible regimes	−0.070 (0.407)	−0.097 (0.377)	−0.157 (0.213)
Peg versus flexible: EMEs	1.073 (0.941)	1.245 (0.779)	1.227 (1.043)
Regime difference-in-differences	0.060 (0.794)	0.124 (0.751)	0.095 (0.839)
Inflation targeting	1.270 (0.970)	1.407 (0.846)	1.373 (0.986)
Financial openness	−0.008 (0.070)	−0.005 (0.069)	−0.028 (0.079)
Global risk: VIX	—	0.114 (0.111)	0.116 (0.097)
Central bank independence	—	—	0.118 (0.317)
Public debt	—	—	0.057 (0.283)
Observations	366	366	366
Economies	24	24	24

Panel B. Horizon 3

Shock interaction or contrast	Without shock–VIX	With shock–VIX	VIX and institutions jointly
Peg versus flexible: AEs	6.598** (2.521)	6.626** (2.459)	6.501** (2.660)
EME difference under flexible regimes	−0.570 (0.887)	−0.577 (0.900)	−1.180 (0.962)
Peg versus flexible: EMEs	7.056*** (2.386)	7.100*** (2.404)	6.628** (2.818)
Regime difference-in-differences	0.457 (1.376)	0.474 (1.453)	0.127 (1.696)
Inflation targeting	5.964*** (2.093)	5.999*** (2.073)	5.520** (2.350)
Financial openness	−0.388** (0.166)	−0.387** (0.165)	−0.537** (0.239)
Global risk: VIX	—	0.029 (0.331)	0.017 (0.350)
Central bank independence	—	—	1.060 (0.902)
Public debt	—	—	0.207 (0.737)
Observations	366	366	366
Economies	24	24	24

Panel C. Horizon 5

Shock interaction or contrast	Without shock–VIX	With shock–VIX	VIX and institutions jointly
Peg versus flexible: AEs	13.613*** (3.438)	13.790*** (3.058)	13.468*** (3.482)
EME difference under flexible regimes	−2.252 (2.293)	−2.290 (2.290)	−3.474 (2.131)
Peg versus flexible: EMEs	19.035*** (3.062)	19.264*** (2.437)	18.179*** (2.579)
Regime difference-in-differences	5.422* (2.921)	5.475* (2.912)	4.711 (3.030)
Inflation targeting	14.785*** (2.570)	14.963*** (2.033)	14.195*** (2.134)
Financial openness	−0.944*** (0.236)	−0.938*** (0.232)	−1.055*** (0.302)
Global risk: VIX	—	0.161 (0.606)	0.075 (0.655)
Central bank independence	—	—	1.761 (1.031)
Public debt	—	—	−0.329 (0.800)
Observations	328	328	328
Economies	24	24	24

Note: The table reports cumulative CPI price-level responses at horizons 1, 3, and 5. Column 1 includes the principal exchange-rate-regime, inflation-targeting, and financial-openness interactions without the shock–VIX interaction. Column 2 adds the interaction between the monetary policy shock and the standardised annual VIX. Column 3 also includes interactions with central bank independence and lagged public debt. The level of the VIX is absorbed by year fixed effects. Driscoll–Kraay standard errors are reported in parentheses. All specifications include the relevant constituent terms, economy and year fixed effects, CPI controls, lagged inflation, and future monetary policy shocks through the relevant horizon. ∗, ∗∗, and ∗∗∗denote significance at the 10, 5, and 1% levels.

Table A7. Selected-Horizon Robustness and Sensitivity Results

Panel A. Alternative Price Measures

Price measure	Specification	Horizon 1	Horizon 3	Horizon 5	Observations (1/3/5)	Economies (1/3/5)
Headline CPI	Baseline shock	0.347(0.230)	0.765*(0.408)	1.046*(0.549)	747 / 673 / 599	39 / 39 / 39
Core CPI	Baseline shock	0.306(0.188)	0.783**(0.362)	0.841(0.526)	653 / 581 / 509	38 / 38 / 37
GDP deflator	Baseline shock	0.187(0.265)	−0.157(0.412)	−0.405(0.443)	661 / 587 / 513	39 / 39 / 38

Panel B. Alternative Monetary-Policy Shock

Outcome	Shock and sample	Horizon 1	Horizon 3	Horizon 5	Observations (1/3/5)	Economies
CPI price level	Baseline shock, common sample	0.006(0.080)	0.154(0.199)	0.290(0.188)	456 / 410 / 364	25
CPI price level	Alternative shock, common sample	0.065(0.069)	0.095(0.132)	−0.081(0.120)	456 / 410 / 364	25
CPI price level	Alternative shock, maximum sample	0.060(0.090)	−0.215*(0.122)	−0.282*(0.149)	612 / 550 / 488	33
Real GDP	Baseline shock, common sample	0.043(0.144)	−0.245(0.301)	−0.299(0.524)	469 / 423 / 377	25
Real GDP	Alternative shock, common sample	−0.101**(0.048)	−0.261(0.157)	−0.590***(0.141)	469 / 423 / 377	25
Real GDP	Alternative shock, maximum sample	−0.214(0.170)	−0.156(0.190)	−0.450**(0.169)	628 / 566 / 504	33

Panel C. Modelling and Sample Sensitivity

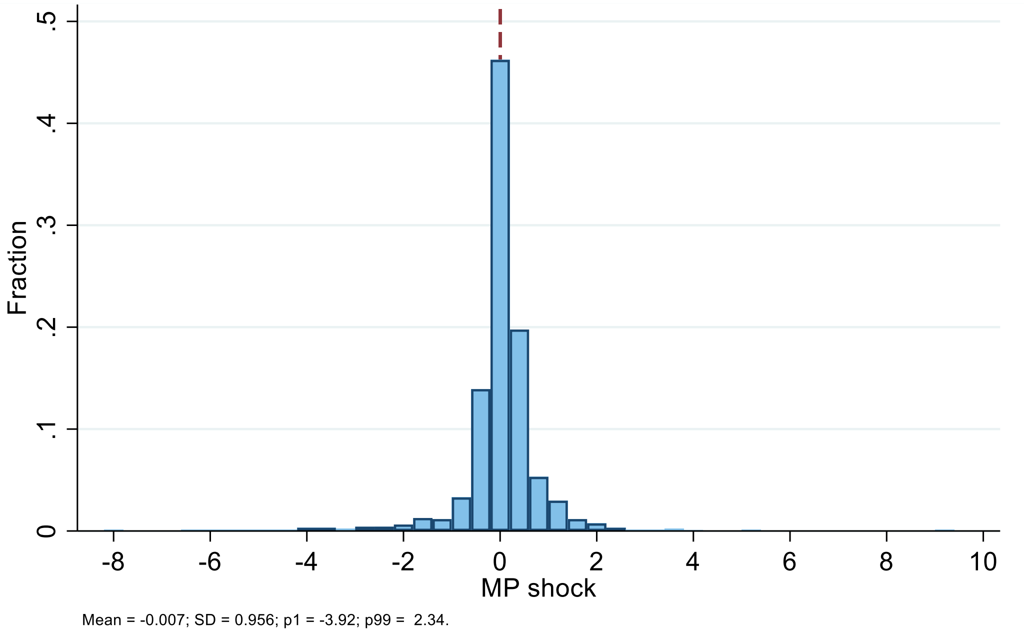
Outcome	Specification	Horizon 1	Horizon 3	Horizon 5	Observations (1/3/5)	Economies (1/3/5)
CPI price level	Baseline shock	0.347(0.230)	0.765*(0.408)	1.046*(0.549)	747 / 673 / 599	39 / 39 / 39
	Baseline plus two lagged shocks	0.402(0.278)	0.593(0.443)	0.548(0.576)	716 / 642 / 569	39 / 39 / 38
	Short lag structure	0.205(0.180)	0.120(0.386)	−0.093(0.543)	792 / 718 / 644	39 / 39 / 39
	Long lag structure	0.242(0.243)	0.291(0.174)	0.533*(0.276)	695 / 621 / 547	39 / 39 / 39
	Winsorised shock	0.318(0.254)	0.533(0.410)	0.746(0.552)	747 / 673 / 599	39 / 39 / 39
	Excluding GFC and COVID-19	0.179(0.184)	0.821*(0.443)	1.146*(0.582)	606 / 606 / 532	39 / 39 / 39
Real GDP	Baseline shock	−0.006(0.108)	−0.250(0.224)	−0.325(0.312)	772 / 698 / 624	39 / 39 / 39
	Baseline plus two lagged shocks	−0.043(0.120)	−0.144(0.233)	−0.056(0.403)	734 / 660 / 587	39 / 39 / 38
	Short lag structure	0.004(0.093)	−0.196(0.164)	−0.234(0.232)	792 / 718 / 644	39 / 39 / 39
	Long lag structure	−0.058(0.090)	−0.423**(0.179)	−0.523**(0.243)	715 / 641 / 567	39 / 39 / 39
	Winsorised shock	−0.027(0.112)	−0.142(0.230)	−0.213(0.322)	772 / 698 / 624	39 / 39 / 39
	Excluding GFC and COVID-19	−0.073(0.137)	−0.370*(0.215)	−0.453(0.290)	631 / 631 / 557	39 / 39 / 39

Panel D. Leave-One-Economy-Out Ranges

Outcome	Horizon 1	Horizon 3	Horizon 5	Minimum observations (1/3/5)	Economies
CPI price level	[0.317, 0.513]	[0.692, 0.884]	[0.935, 1.356]	718 / 646 / 574	38
Real GDP	[−0.063, 0.055]	[−0.334, −0.074]	[−0.486, −0.026]	742 / 670 / 598	38

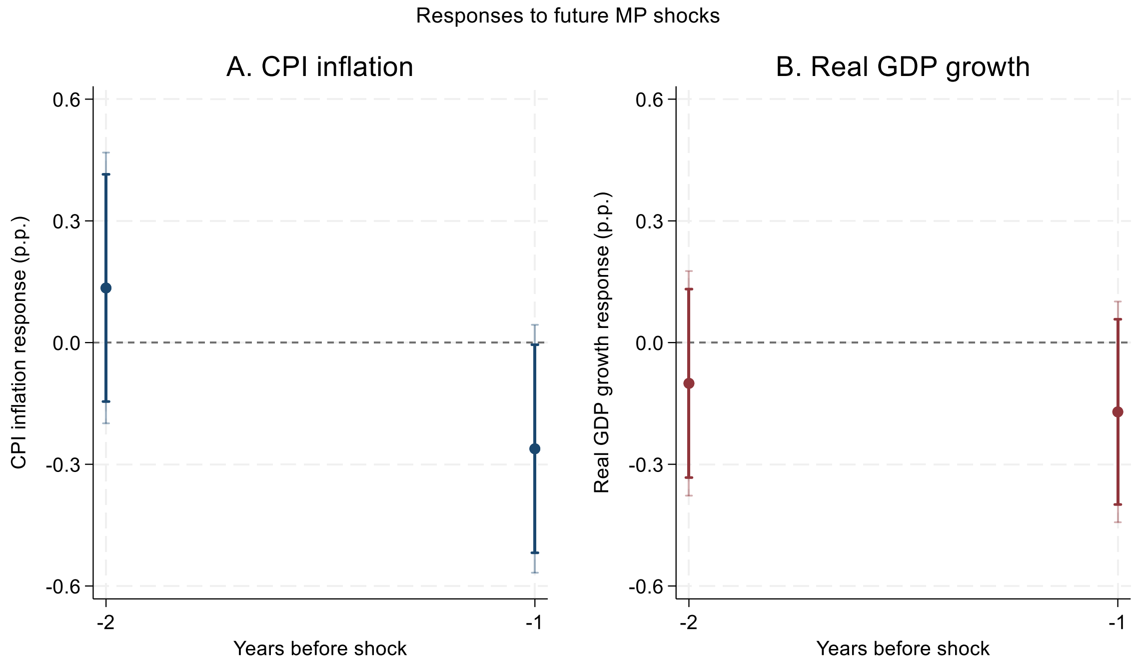
Note: Panels A–C report cumulative responses to a one-standard-deviation contractionary monetary-policy shock at horizons 1, 3, and 5. Driscoll–Kraay standard errors are reported in parentheses. Panel A compares headline CPI, core CPI, and the GDP deflator. Core CPI and the GDP deflator are index levels converted into cumulative log changes; annual changes outside the range of −50 to 100% are treated as index discontinuities. Panel B compares the forecast-based baseline shock with the alternative shock measure. Common-sample estimates standardise both shocks within their shared sample. Panel C reports alternative lag structures, the inclusion of two lagged monetary policy shocks, winsorisation of the shock, and the exclusion of 2008–2009 and 2020–2021. All specifications include economy and year fixed effects, outcome-specific controls, and future monetary policy shocks through the relevant projection horizon. Panel D reports the minimum and maximum point estimates obtained by sequentially excluding one economy. These ranges are not confidence intervals. ***, **, and * denote statistical significance at the 1, 5, and 10% levels, respectively.

Figure A1. Distribution of the Monetary Policy Shocks



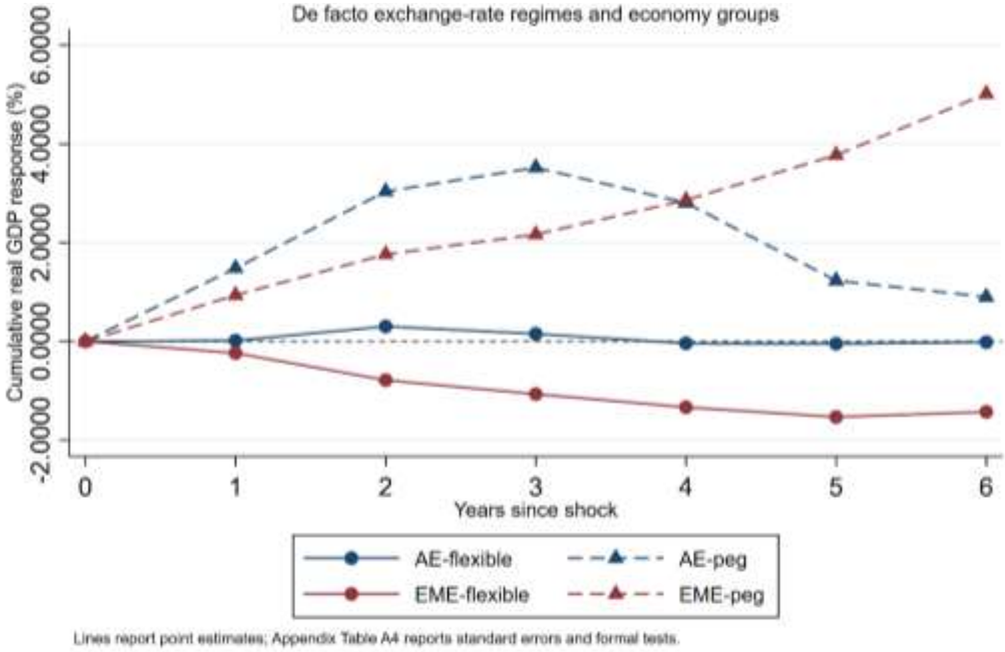
Note: The figure presents the distribution of the annual forecast-based monetary policy shocks used in the empirical analysis. The sample contains 941 country-year observations across 40 economies over 1991–2022. Positive values denote unexpected monetary tightening, while negative values denote unexpected monetary easing. The vertical dashed line denotes zero. The shock has a mean of −0.007 and a standard deviation of 0.956; its 1st and 99th percentiles are −3.92 and 2.34, respectively.

Figure A2. Pre-shock Placebo Estimates



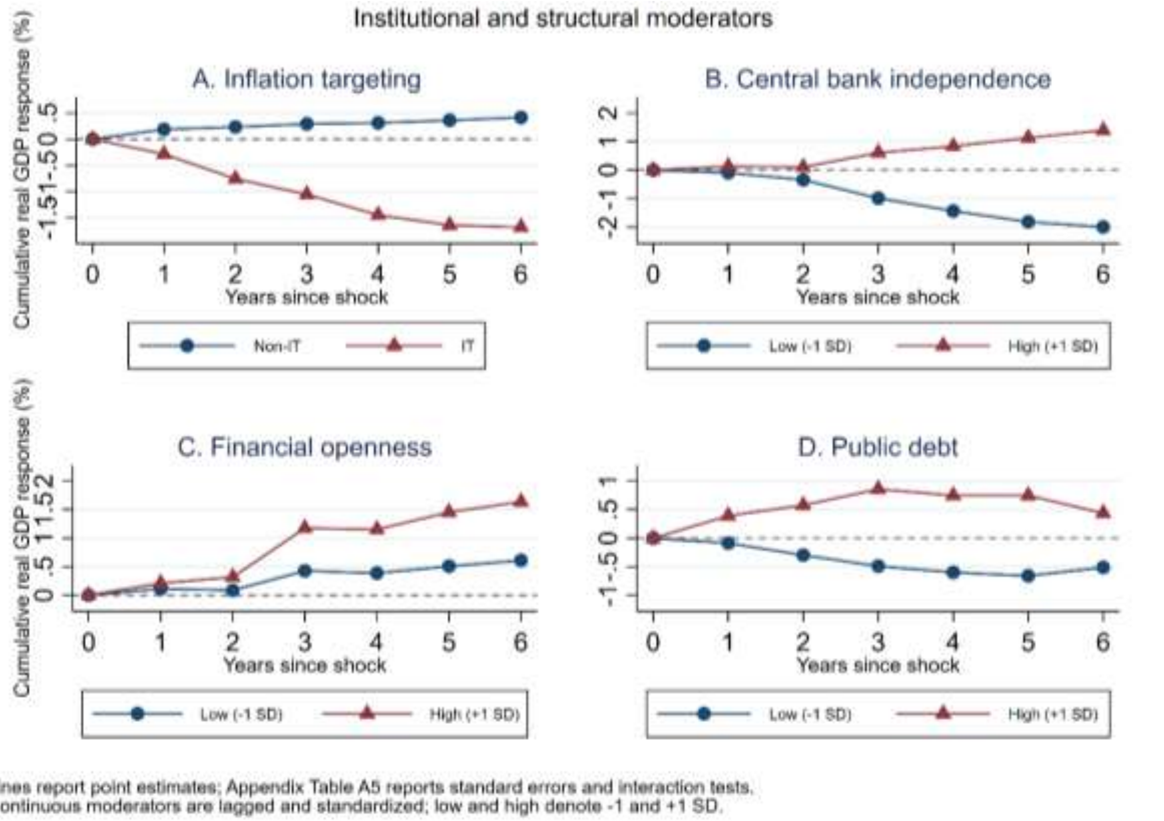
Note: The figure reports coefficients from regressions of current CPI inflation and real GDP growth on monetary policy shocks dated one and two years ahead. The shocks are standardised so that one unit corresponds to a one-standard-deviation contractionary innovation. All specifications include two lags of inflation, GDP growth, and the monetary policy shock; lagged trade openness, credit, and government consumption; and economy and year fixed effects. Inner and outer capped lines denote 90 and 95% confidence intervals, respectively, based on Driscoll–Kraay standard errors with three lags.

Figure A3. Real GDP Responses Across De Facto Exchange-rate Regimes and Economy Groups



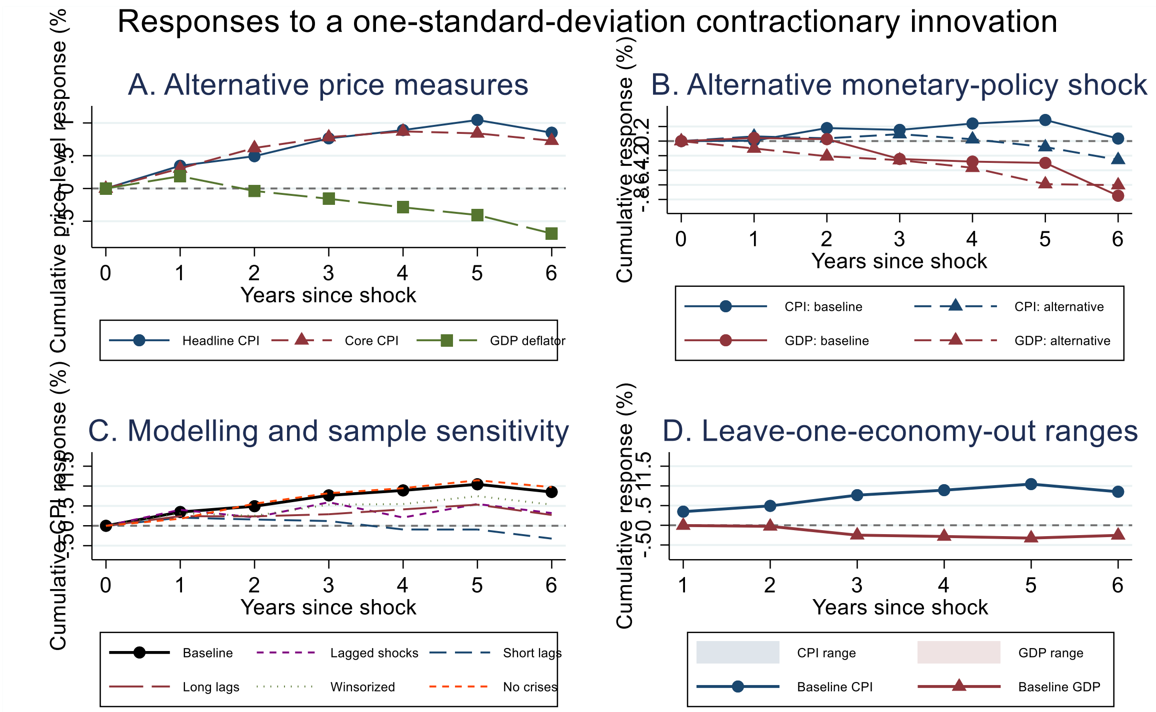
Note: The figure reports cumulative real GDP responses for flexible-regime AEs, pegged AEs, flexible-regime EMEs, and pegged EMEs following a one-standard-deviation contractionary forecast-based monetary policy shock. Exchange-rate regimes are contemporaneous de facto classifications. Specifications include economy and year fixed effects, GDP controls, lagged real GDP growth, and future monetary policy shocks through the relevant horizon. Lines report point estimates only; Appendix Table A4 provides the corresponding standard errors, significance levels, formal cross-group tests, and sample sizes. The EME–peg estimates should be interpreted cautiously because this group contains only four economies.

Figure A4. Real GDP Responses Across Institutional and Structural Characteristics



Note: The figure reports cumulative real GDP responses to a one-standard-deviation contractionary forecast-based monetary policy shock. Panel A compares inflation-targeting and non-inflation-targeting observations. Panels B–D evaluate central bank independence, financial openness, and lagged public debt at one standard deviation below and above their respective estimation-sample means. Continuous moderators are standardised and lagged by one year. All specifications include economy and year fixed effects, GDP controls, lagged real GDP growth, and future monetary policy shocks through the relevant projection horizon. Lines report point estimates only; Appendix Table A5 reports the corresponding standard errors, significance levels, interaction tests, and sample sizes.

Figure A5. Robustness of Baseline Monetary-Policy Responses



Note: Panel A compares cumulative headline CPI, core CPI, and GDP-deflator responses to the baseline monetary policy shock. Panel B compares the baseline and alternative monetary policy shocks using their common estimation sample. Panel C reports sensitivity to the inclusion of lagged shocks, shorter and longer lag structures, winsorisation of the monetary policy shock, and exclusion of the global financial crisis and COVID-19 periods. Panel D reports the minimum and maximum coefficients obtained by sequentially excluding each economy from the full sample; the shaded areas are coefficient ranges rather than confidence intervals. Responses are normalised to a one-standard-deviation contractionary monetary policy innovation. All specifications include economy and year fixed effects, outcome-specific controls, lagged dependent variables, and future monetary policy shocks through the relevant projection horizon. Lines report point estimates; statistical uncertainty and sample sizes are reported in Appendix Table A7.