INTERNATIONAL MONETARY FUND

When Policy Bites: State-Dependent Monetary Policy Transmission in Emerging Markets

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WP/26/96

2026
MAY

WORKING PAPER

 WP/26/96

IMF Working Paper
Monetary and Capital Markets Department

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May 2026

Authorized for distribution by David Hofman
May 2026

ABSTRACT: We document the state-dependence of monetary policy transmission to output and core consumer prices in a sample of eleven large inflation-targeting emerging markets along three cyclical dimensions: the business cycle position, the monetary policy stance, and the level of trend inflation. We show that monetary policy has strong effects on output during recessions and after a period of loose monetary policy, but little to no impact during expansions or when monetary policy has been tight. In contrast, the response of prices is muted regardless of business cycle position or monetary policy stance. Transmission also depends on trend inflation: when trend inflation is low, monetary policy has a stronger impact on output and a weaker effect on prices, whereas a high-inflation environment dampens the output response and amplifies price adjustments. These findings are broadly consistent with the presence of financial frictions in the form of occasionally binding borrowing constraints, endogenous frequency of price adjustments, loss aversion preferences, and a convex Phillips Curve.

JEL Classification Numbers:	E50, E52
Keywords:	Monetary policy transmission; state-dependence; emerging markets.

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* The authors would like to thank Salvatore Dell’Erba, Marco Errico, Adriano Fernandes, David Hofman, Kosha Modi, and Victoria Petrenko for helpful comments.

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Contents

TABLES

Acronyms

AE	Advanced Economy
CPI	Consumer Price Index
EM	Emerging Market
EMDE	Emerging Market and Developing Economy
GDP	Gross Domestic Product
NEER	Nominal Effective Exchange Rate
REER	Real Effective Exchange Rate
VAR	Vector Autoregression

Introduction

The sharp rebound in output and the global surge in inflation in the aftermath of the COVID-19 pandemic have reignited interest in how monetary policy transmits to key macroeconomic variables. In particular, the surge of inflation to levels not seen in decades, coupled with the fast rise in policy rates after a prolonged period of accommodative monetary policy have raised several important questions such as whether the effects of monetary actions in such an environment would mirror those observed in the past. Potential state -dependence and other nonlinearities in the inflation and policy transmission process would challenge traditional linear frameworks typically used in policy analysis and underscore the need for a more nuanced understanding of how monetary policy transmits under different economic conditions.

Much of the empirical literature on state-dependence in monetary policy transmission has focused on advanced economies (AEs). Empirical research on this topic in the context of emerging market economies (EMs) remains underdeveloped, with the literature so far centered around the role of structural characteristics in shaping transmission. This points to a gap and highlights the need for studies to inform policy particularly when considering the complexity of macroeconomic management in EMs, where policy makers often need to navigate a volatile environment.

Our paper fills this gap by providing a comprehensive analysis of state-dependent transmission of monetary policy to output and consumer prices in EMs, focusing on three cyclical conditions: the business cycle position, the level of trend inflation, and the monetary policy stance. This focus is largely motivated by the theoretical literature which has emphasized the role of financial frictions (Bernanke and Gertler 1989, Gilchrist and Zakrajsek 2015), nominal rigidities (Benigno and Eggertsson 2023), and endogenous frequency of price adjustments (Karadi et al. 2025) as sources of cyclical state-dependence, as well as the empirical literature on state-dependence in AEs, which we review below. We exploit a panel of eleven large EM economies with an inflation-targeting mandate and a freely floating exchange rate regime, to minimize concerns about heterogeneity in monetary policy and exchange rate frameworks and allow appropriate benchmarking against studies on AEs. To better understand the channels of state-dependent transmission, we analyze responses to monetary policy shocks of a broader set of real macroeconomic variables, namely consumption, investment, credit, real effective exchange rate (REER), and net exports.

Our identification strategy aims to strike a balance between sample size limitations and possible concerns about shock exogeneity. While high-frequency identification following Kuttner (2001) has become the method of choice in studies of major AEs (e.g. Altavilla et al. 2019, Jarociński and Karadi 2020, Bauer and Swanson 2023a, Braun et al. 2023), its use in EMs has been limited to a handful of countries because of the scarcity of reliable financial market data (Bolhuis et al. 2024, Emeksiz et al. 2026). Fortunately, an alternative approach using forecast errors for identification allows greater EM country coverage. In our empirical strategy, we therefore follow Furceri et al. (2018) and Deb et al. (2023) and exploit the availability of private sector macroeconomic forecasts compiled by Consensus Economics for a large set of economies. These monthly forecasts, provided by financial analysts at private banks, allow us to construct orthogonalized forecast errors as a source of exogenous variation in monetary policy for the eleven EMs in our sample.[1] With the monetary

[1] Checo et al. (2024) construct forecast errors based on Bloomberg survey data for 18 EMs. One advantage of their approach is that individual forecasters can update their forecast any time prior to a monetary policy meeting, making it unlikely that the policy "surprise" on the day of the policy announcement partially reflects other shocks. At the same time, because Bloomberg contributors can observe others' forecasts and revise theirs up to the time of the meeting, their forecasts may be more subject to herd behavior.

policy shocks in hand, we implement panel local projections in long differences (Jordà and Taylor 2025, Piger and Stockwell 2025a) to estimate impulse responses over a 12-quarter horizon in both a linear state-independent setting and the three state-dependent settings mentioned above.[2]

Our analysis indicates that transmission to output is strong and gradual while the statistical significance of transmission to prices is limited in the linear model. We find that the peak effect of a monetary policy shock is in fact equally strong in our EM sample as in a benchmark AE sample, and that this strength reflects transmission through consumption and investment, with little or no role for net exports.

More importantly, we uncover considerable state-dependence of monetary policy transmission in EMs along each of the three cyclical dimensions we study. First, monetary policy has strong effects on gross domestic product (GDP) during recessions but no statistically significant effects during expansions, with peak effects twice as large during recessions compared to expansions. While Wald tests indicate that the decline of core consumer prices is initially stronger during expansions following a tightening shock, neither of the two price responses is significant at the 90 percent confidence level. Second, monetary policy has a stronger impact on output during low trend inflation periods, particularly in the short term, while its impact on prices is much more pronounced during high trend inflation periods at all horizons. Finally, output reacts much more strongly to monetary policy shocks after a period of loose monetary policy in the medium term, while price responses remain largely insensitive to the stance. These findings are broadly in line with priors based on economic theory and with the most recent literature on business cycle state dependence in the United States (De Santis and Tornese 2024, Piger and Stockwell 2025b).

Regardless of the type of state dependence we analyze, the response of GDP to monetary policy shocks is echoed by the responses of consumption, investment, and credit. In addition, we observe that real exchange rate appreciation is more persistent after a tightening monetary policy shock in states associated with larger negative output responses (that is recessions, low trend inflation, and loose stance states), potentially reflecting the expectation of a positive impact of demand compression on the trade balance. The responses of net exports, however, are often muted. In the linear specification, exports decline in the short term in line with the REER appreciation, while imports fall in the medium-term alongside drops in consumption and investment, but these effects are not statistically significant. In the state-dependent models, the dynamics of net exports are often difficult to reconcile with the responses of the real exchange rate and domestic demand.

Overall, our results are broadly supportive of theories emphasizing the role of financial frictions such as occasionally binding borrowing constraints, nominal rigidities, state-dependent pricing and loss-aversion preferences in monetary policy transmission, and call for attention to state-dependence in macroeconomic modeling and monetary policymaking, also in an emerging market context.

The rest of the paper is organized as follows. Section 2 provides a literature review. Section 3 describes our dataset and construction of monetary policy shocks. We present results from linear (state-independent) panel regressions in Section 4. Our main results on state-dependent monetary policy transmission are presented in Section 5, followed by a discussion of their robustness in Section 6. Section 7 concludes, and three annexes provide additional details on data and variable definitions.

[2] While the past literature has often used local projection specifications in levels, Piger and Stockwell (2025a) show that, in small samples, local projection models estimated in long differences display less bias and are therefore preferable.

I. Literature Review

Theoretical Foundations of State-Dependent Monetary Policy Transmission

The theoretical literature suggests that financial frictions, typically modeled as net-worth- or collateral-based borrowing constraints (Bernanke and Gertler 1989; Bernanke, Gertler, and Gilchrist 1999, Kiyotaki and Moore 1997), increase monetary policy's impact on real activity. Transmission becomes state-dependent when the borrowing constraints are only occasionally binding. If constraints bind permanently, borrowers operate continuously at their credit limit and increases in interest rates produce uniformly large contractions in demand. By contrast, when these constraints are only occasionally binding, tightening has little effect when balance sheets are strong but can be very impactful during downturns when they are weaker (Bianchi 2011, Jermann and Quadrini 2012).

At the same time, the price response to monetary policy shocks can be more muted during downturns, as financially constrained firms prioritize cash flows over price cuts (Gilchrist and Zakrajsek, 2015). Additionally, convexities in the Phillips Curve play a role (Bunn et al. 2025): during recessions, a flatter curve means a larger decline in real activity is needed to achieve the same price effect, while during expansions, a steeper curve leads to bigger price changes even with a small output response. Thus, even with differing output responses, price responses may be comparable. Benigno and Eggertsson (2023), Harding, Lindé and Trabandt (2023), Ascari et al. (2025), and Schmitt-Grohé and Uribe (2025) provide various microfoundations for such convexities, including downward nominal wage and price rigidities and endogenous price adjustment frequency.[3] Models that featuring loss aversion in household preferences such as Santoro et al. (2014) also generate output responses that are amplified in downturns and no state-dependent price adjustments.[4]

Economic theory suggests that the level of trend inflation affects the transmission of monetary policy through price-setting behavior. When trend inflation is low, prices are stickier and adjustments are less frequent, making monetary policy less effective in impacting prices but more effective in affecting output (Ball and Mankiw, 1994; Alvarez et al., 2019; Karadi et al., 2025). As trend inflation rises, firms get closer to their price-increase thresholds, increasing the convexity of the Philips Curve and amplifying the inflation response to monetary policy shocks (Bunn et al. 2025). A related mechanism is rational inattention, where firms and households become more responsive to inflation only once it crosses a certain threshold, implying a Phillips Curve that is steeper during high trend inflation periods (Ball and Mankiw, 1994; Sims, 2006 and 2010).

Finally, the monetary policy stance can affect the strength of the monetary policy transmission by affecting risk-taking incentives and balance sheets. A prolonged loose stance encourages risk-taking by boosting credit access and allowing leverage buildup. Within an occasionally binding constraint framework, this buildup

[3] The flattening of the Phillips Curve in weak economic condition is driven by nonlinear nominal frictions. Downward nominal wage and price rigidity limit adjustment at high unemployment, contributing to the "missing deflation" phenomenon (Benigno and Eggertsson, 2023). Additionally, nonlinear labor supply behavior—such as the presence of discouraged workers at high unemployment levels—can further suppress inflationary pressures, as discussed by Blanchard (2016) and Gagnon & Collins (2019). Weak demand also reduces firms' incentives to cut prices, as price reductions yield limited sales gains (Harding, Lindé, and Trabandt, 2023). These constraints ease in expansions and tight labor markets, steepening the Phillips Curve as adjustments shift towards prices rather than quantities (Ascari et al., 2025; Schmitt-Grohé and Uribe, 2025).

[4] In their model, households' intertemporal elasticity of substitution between current and future consumption increases and the labor supply curve flattens during recessions. Together, those two features result in an amplified output response to monetary policy shocks when economic activity is weak.

increases the likelihood that even modest tightening can push borrowers into the constrained region. Effects are stronger when household net worth is low and occasional constraints bind (Harding and Klein, 2022). When constraints always bind, as in Alpanda and Zubairy (2019), households with high debt become less responsive to monetary policy changes. If interest rates stay low for long periods, many households refinance their mortgages at those low rates, so later monetary policy changes have less impact on consumption (Eichenbaum et al. 2022). Together, these mechanisms illustrate how the monetary policy stance can interact with financial frictions and lending market structure to modulate the effectiveness of current monetary policy.

Empirical Evidence: State-Dependent Output and Price Responses

Turning to empirical evidence, findings in the literature regarding business cycle state dependence in AEs have been mixed. Our finding of stronger output effects during recessions is in line with the most recent literature using U.S. data (De Santis and Tornese 2024, Piger and Stockwell 2025b) which has argued that an influential earlier paper with the opposite finding (Tenreyro and Thwaites 2016) used inferior identification and methodological approaches.[5] On the other hand, AEs cross-country studies have generally found that transmission to output is stronger during expansions and that transmission to prices does not depend on the state of the business cycle (Jordà et al. 2020, Alpanda et al. 2021).[6] Focusing on a large sample of 22 manufacturing industries across 102 countries (both AEs and EMs), Choi et al. (2024) find that the credit channel is stronger in bad times, which is broadly in line with our findings.

The evidence on state dependence with respect to trend inflation and monetary policy stance is even scarcer. Ascari and Haber (2022) find no significant difference in the response of U.S. industrial production to monetary shocks across high and low trend inflation regimes, but document a faster, and less persistent, reaction of inflation to a monetary disturbance in a high trend inflation regime. Jordà et al. (2020) find that the impact of monetary policy on output is significantly muted when inflation is low (below 2 percent) in a panel of AEs, and that the impact on prices does not depend on the level of inflation. Both findings are the opposite of ours in an EM context. Regarding the effect of the monetary policy stance, Alpanda et al. (2021) find that the response of output to monetary policy shocks in a sample of AEs is larger during periods of loose stance, which is similar to our finding in EMs.[7]

[5] De Santis and Tornese (2024) study state-dependence across growth regimes using high-frequency shocks from Bauer and Swanson (2023a), whereas Tenreyro and Thwaites (2016) use Taylor-rule residuals in Romer and Romer (2004), later shown to be affected by informational frictions (Miranda-Aggripino and Ricco, 2021). Using the same shocks, Piger and Stockwell (2025a) show that Tenreyro and Thwaites (2016)'s results are sensitive to the treatment of outliers in the distribution of monetary policy shocks and the sample period. At the micro level with a cross-section of U.S. banks, Sapriza and Temesvary (2019) find a stronger bank credit channel of monetary policy when economic growth is weak.

[6] As Tenreyro and Thwaites (2016), both papers use local projections in levels, which display more small sample bias than the local projections in long differences we use (Piger and Stockwell, 2025a). Alpanda et al. (2021) interpret their findings using small scale partial equilibrium model featuring loan-to-value and debt-service-ratio borrowing constraints, adjustable vs. fixed-rate mortgage types, and mortgage refinancing. The underlying assumption is that real wages and incomes are higher and debt levels lower during expansions, which relaxes debt-service limits, boosting borrowing and spending and amplifying output effects.

[7] Their interpretation is that households are less likely to refinance their mortgages in tightening cycles, especially when existing fixed-rate mortgages carry lower interest rates. As a result, the credit channel is dampened, and interest rate cuts are less effective in stimulating borrowing and spending during periods of high interest rates. Sapriza and Temesvary (2020) show that U.S. monetary policy has a larger impact on bank lending when monetary policy is expansionary, i.e. the real federal funds rate is below the natural rate of interest. Indirect evidence from related literature suggests that interest rate changes have a larger effect on bank profitability when rates are low, highlighting a more potent credit channel in loose-policy environments.

Monetary Policy Transmission in Emerging Markets

Our paper advances the literature on monetary policy transmission in emerging markets by studying EMs with similar monetary and exchange rate frameworks. Until recently, cross-country studies often argued that transmission was weaker in EMs than in AEs due to less developed financial systems, shallower financial markets, and lower institutional quality or that data limitations and methodological issues obscured the true size of the effects (Mishra et al., 2012; Mishra and Montiel, 2013). Recent studies have added more nuances to this narrative. Willems (2020) documents weaker output response but stronger price effects in a sample of 162 emerging market and developing economies (EMDEs) over the period 1970-2017, consistent with a relatively lower degree of price stickiness in these economies. Brandao-Marques et al. (2020) document large effects on industrial production in a sample of 40 EMs and find that the monetary policy framework —especially adoption of inflation targeting — matters more than other structural characteristics, including financial development. Deb et al. (2023) find equally strong GDP responses across AEs and EMs in a sample of 33 countries. Checo et al. (2024) also find strong responses of output and prices in a group of 18 EMs and provide firm-level evidence suggesting that financial frictions are important determinants of monetary policy transmission in EMs. Finally, Ha et al. (2025) find equally strong responses of industrial production in a sample of 7 AEs and a sample of 14 EMs with a flexible exchange rate regime and an inflation-targeting framework.[8] Our approach offers the clearest basis for cross-country comparisons by focusing on EMs with frameworks closely matching those of major AEs.

II. Data and Monetary Policy Shock Construction

Sample and Data Sources

Our sample is restricted to the 11 large EMs that meet two criteria. First, they have an explicit inflation target as the primary objective of their monetary policy and they have a floating exchange rate arrangement according to the 2024 vintage of the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (IMF 2024).[9] Second, they have relevant data, including private sector macro forecasts, to allow us to construct monetary policy shocks for at least 32 quarters, which limits the degree of unbalance in the sample. Our sample period spans from 1996Q1 to 2025Q1, resulting in 763 observations. To benchmark our basic results on transmission (see the next section), we also construct a separate sample of 17 inflation-targeting advanced economies. Table A1 in Annex I provides the list of countries in the two samples.

Our macroeconomic data comes from national statistical agencies or central banks, available through Haver Analytics, the IMF's International Financial Statistics database, and the BIS. Private sector forecasts data are sourced from Consensus Economics. Table A2 in Annex I lists all variables and their sources.

Consensus Economics publishes monthly forecast data on short-term interest rates, real GDP growth, and inflation. The definition of the short-term interest rate varies by country, and we inspect the country-specific

[8] Ha et al. (2025) also argue that controlling for inflation expectations resolves the price and the foreign exchange puzzles observed in some earlier empirical EM studies.

[9] These 11 emerging market economies are Brazil, Chile, Colombia, Hungary, India, Indonesia, Mexico, Peru, Poland, Russia and Thailand.

reports provided by Consensus Economics to identify the corresponding realized interest rate to use (Annex Table I.3). For short-term rates, Consensus Economics provides 3-month-ahead forecasts. In contrast, forecasts for real GDP growth and consumer price index (CPI) inflation are available for the current and next calendar years. To construct 4-quarter ahead forecasts for GDP growth and inflation each quarter, we interpolate these calendar-year forecasts (see Annex II for details).

Finally, to account for the potential impact of financial crises in our analysis, we rely on information from the Laeven and Valencia (2020) database, which provides years of banking, currency, and sovereign debt crises in our sample countries.

Construction of Monetary Policy Shocks

To robustly identify monetary policy transmission, we use orthogonalized forecast errors of private sector forecasters from Consensus Forecasts. This method isolates unanticipated changes in short-term rates relative to professional forecasters' expectations. Specifically, we collect the residuals from country-level regressions that purge short-term rate forecast errors from a rich set of macro-financial variables, including GDP growth and inflation forecasts as well as their revisions. By purging the systematic component of forecast errors, this approach helps isolate exogenous monetary policy shocks.

While high-frequency identification is widely considered state-of-the art for analyses of monetary policy transmission, the availability of truly high-frequency shocks has been limited to a handful of major central banks (Altavilla et al. (2019) for the euro area, Bauer and Swanson (2023a) for the U.S., Braun et al. (2023) for the UK).[10] The literature on EMs to date has relied on Taylor-rule-type residuals (Brandao Marques et al. 2020), orthogonalized forecast errors of financial analysts (Checo et al. 2024), and nearly-high-frequency shocks measured over one-day window (Bolhuis et al. 2024).[11] Our approach is closest in spirit to Checo et al. (2024), and to Deb et al. (2023), who also rely on forecast error regression residuals.

In our empirical analysis, for each country, we regress the interest rate forecast error in a given quarter (which we call FE) on expectations and changes in expectations of year-on-year (y-o-y) GDP growth ($\Delta \mathrm{y}$) and inflation (π), as well as on a comprehensive set of lagged macroeconomic indicators. $FE_{(j,t)}$ is the difference between country j's realized short-term rate at the end of quarter t and forecast for that short-term rate at the end of the previous quarter. To account for the systematic response of central banks to economic conditions and inflationary pressures, we include one-year-ahead forecasts of y-o-y GDP growth and inflation, along with their first differences ($\Delta_q E\Delta y$ and $\Delta_q E\pi$ respectively) and two lags.[12] Additionally, we incorporate two lags of the short-term interest rate to capture persistence in short-term rates (i). We also control for lagged quarterly changes in the nominal effective exchange rate ($\Delta_q NEER$). We include contemporaneous and lagged y-o-y changes in global commodity prices (π^C) to account for global commodity price shocks, as well as two lags of

[10] Emeksiz et al. (2026) have recently produced a dataset covering 16 countries, which should allow high-quality identification is a cross-country panel data setting. Their EM subsample, however, covers only 5 countries.

[11] Using Taylor-rule-residuals has certain limitations, including the assumption of a time-invariant policy rule. In addition, as shown by Miranda-Agrippino and Ricco (2021), forward guidance creates a wedge between Taylor rule residuals and true monetary policy shocks, and these residuals can be autocorrelated and hence forecastable.

[12] We acknowledge that controlling for contemporaneous output and inflation forecasts by private forecasters may not fully capture potential information effects related to the central bank's private information or superior ability to process publicly available information about the outlook (Romer and Romer 2000, Nakamura and Steinsson). Bauer and Swanson (2023b) provide evidence against the presence of central bank information effects in the United States.

the term spread ($spread$)—defined as the difference between the 10-year government bond yield and the short-term policy rate.[13] We account for crisis periods by including the $crisis$ dummy variable, which captures both times of financial crisis and the four quarters of 2020 (that is, the first year of the COVID-19 pandemic).[14] Our specification is therefore the following:

$$FE_{(j,t)} = \alpha_{(j)} + \gamma_{(j,1)} E_t \Delta y_{(j,\,t+4)} + \gamma_{(j,2)} \Delta_q E_t \Delta y_{(j,\,t+4)} + \gamma_{(j,3)} E_t \pi_{(j,\,t+4)} + \gamma_{(j,4)} \Delta_q E_t \pi_{(j,\,t+4)} + \sum_{k=1}^{2} \delta^{y}_{(j,k)} \Delta y_{(j,t-k)} + \sum_{k=1}^{2} \delta^{\pi}_{(j,k)} \pi_{(j,t-k)} + \sum_{k=1}^{2} \delta^{i}_{(j,k)} i_{(j,t-k)} + \sum_{k=1}^{2} \delta^{NEER}_{(j,k)} \Delta_q NEER_{(j,t-k)} + \sum_{k=1}^{2} \delta^{Spread}_{(j,k)} spread_{(j,t-k)} + \sum_{k=0}^{2} \delta^{Com}_{(j,k)} \pi^{C}_{(t-k)} + \sum_{k=0}^{1} \delta^{Crisis}_{j,k} crisis_{(j,t-k)} + \epsilon_{(j,t)} \qquad (1)$$

The residual from Equation (1), $\epsilon_{(j,t)}$, is our monetary policy shock and we will subsequently label it $shock_{(j,t)}$.[15] We run regression (1) for each economy separately. For purposes of comparison in the next section of the paper, we compute monetary policy shocks also for a sample of AEs (listed in Table A1).[16]

To verify that our shocks capture country-specific monetary policy shocks rather than global shocks, we compute pairwise cross-country correlations of the estimated shocks. The results are reported in Annex IV, where Table IV.1 presents the full correlation matrix and Figure IV.1 shows the distribution of the bilateral correlations. An average correlation very close to zero and a distribution with most of the mass between -0.2 and 0.2 supports the interpretation that our identification strategy successfully isolates idiosyncratic monetary policy shocks rather than global factors.

III. Transmission in the Linear Model

We begin our investigation of policy transmission by considering a set of linear panel regressions without any form of state dependence. The analysis focuses on the effects of monetary policy shocks on real GDP, core CPI, and headline CPI. In our subsequent analysis of state-dependence we focus on core CPI rather than headline CPI, as the former is a more reliable indicator of underlying aggregate demand pressures.

We apply the local projections methodology to estimate the impulse responses to monetary policy shocks over horizons (h) from 1 to 12 quarters. Our specification includes current period and 3 lags of i) monetary policy shock ($shock$), ii) quarterly change in the outcome variable of interest (y), iii) crisis indicator ($crisis$), as well as time fixed effects (γ), and country fixed effects (α). As above, j denotes a country and t denotes a quarter. In line with guidance by Piger and Stockwell (2025a) and Jordà and Taylor (2025), the dependent variables are defined in terms of cumulative log-differences (as opposed to log-levels) given our

[13] These two variables have been shown to help mitigate the price puzzle in studies focused on AEs, wherein the price level initially rises following a monetary policy tightening shock (Balke and Emery, 1994).

[14] The inclusion of the crisis dummy in the equation aims to capture the fact that during crisis episodes, monetary policy may follow a different reaction function because it seeks to achieve financial stability objectives in addition to price stability.

[15] A lasso regression at the aggregate panel level confirms that 17 out of 19 coefficients in equation 1 are different from zeros.

[16] For the countries in our sample that are members of the euro area (France, Germany, Italy, The Netherlands, Slovak Republic, Spain), we use monetary policy shocks that are residuals from Equation (1) estimated at the euro-area level.

relatively small sample size. Finally, we cluster standard errors at the country level, to account for potential heteroskedasticity or within-panel serial correlation. This linear specification takes the following form:

$$y_{(j,\,t+h)} - y_{(j,\,t)} = \alpha_{(j,h)} + \gamma_{(t,h)} + \sum_{k=0}^{3} \beta_{(k,h)} shock_{(j,t-k)} + \sum_{k=0}^{3} \theta_{(k,h)} \Delta_q y_{(j,t-k)} + \sum_{k=0}^{3} \delta_{(k,h)} crisis_{(j,t-k)} + \epsilon_{(j,t,h)}, \qquad (2)$$

For each horizon h, the coefficient of interest is $\beta_{(0,h)}$.

Our results are presented in Figure 1 and are normalized to correspond to the dynamic impact of an unexpected 100-basis-point (bp) increase in the short-term rate. Because local projections estimators tend to have large variance compared to vector autoregression (VAR) models (Li et al., 2024), we report both 68 percent and 90 percent confidence intervals. We find that a 100-bp tightening shock persistently reduces real GDP, with the impact after 12 quarters reaching approximately 0.6 percent.[17] Core CPI declines by about 0.3 percent over the same horizon, although this effect is statistically significant only at the 68 percent confidence level. In contrast, the impact on headline inflation is not significant, likely reflecting the limited influence of monetary policy on the more volatile components of the CPI basket such as food and energy. These findings are broadly in line with the recent literature analyzing monetary policy transmission in EMs discussed above (Brandao-Marques et al., 2020; Deb et al., 2023; Checo et al., 2024; Ha et al., 2025).

As an aside, we also benchmark our estimated impulse response functions with those obtained in a sample of 17 AEs. The estimated magnitudes are very close to those obtained in our EM sample, suggesting that monetary policy transmission to output and prices is similar across AEs and EMs with similar inflation-targeting frameworks (Figure 1, second row).

To shed further light on the significant transmission to output, we explore transmission to major components of GDP alongside real credit to the private sector and REER (Figure 2). Like output, both consumption and investment decline almost monotonically in response to a tightening shock, with investment showing a sharper contraction despite a more delayed response.[18] Correspondingly, real credit also contracts, with a peak effect of about -1.6 percent towards the end of the projection horizon, which likely reflects the fall in credit demand from weaker consumption and investment but seems also consistent with the presence of a credit channel in the transmission of monetary policy in EMs. More specifically, while our empirical framework doesn't allow us to clearly distinguish between credit demand and supply channels, a drop in credit that is nearly three times as large as the drop in output suggests that credit supply effects are at play.[19]

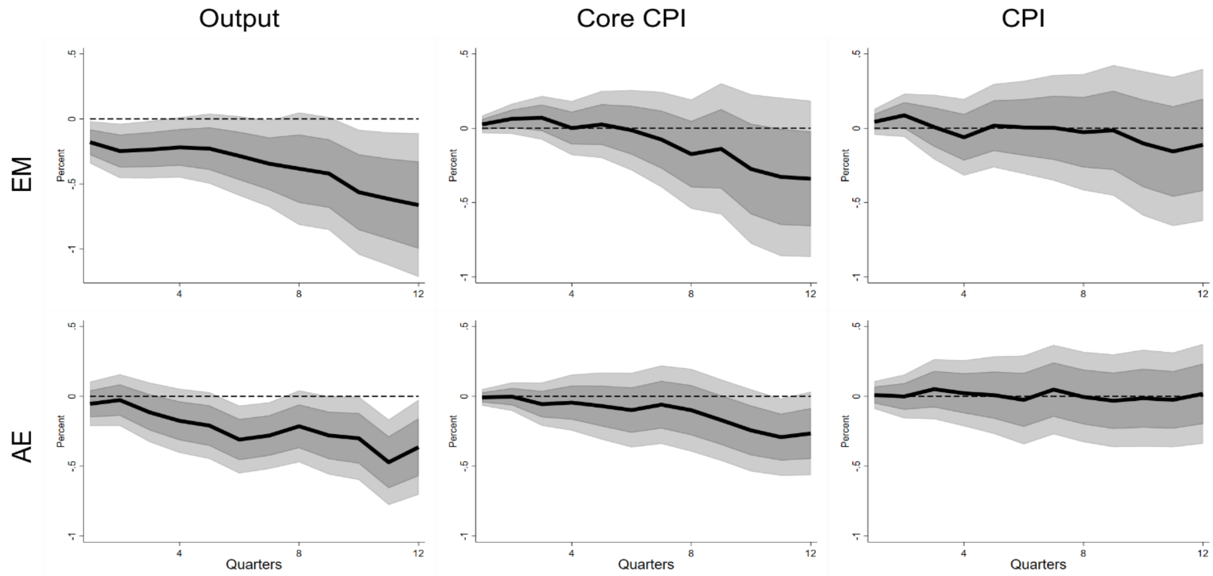
[17] Although monetary policy has no long-term effect on the level of output in standard monetary theory, many other empirical papers also find a persistent impact of monetary policy shocks on output (see e.g. Jarocinski and Karadi 2015, Willems 2018, Jorda et al. 2020). Potential explanations include hysteresis effects of temporary demand shocks (Blanchard and Summers, 1986). Caldara and Herbst (2019) argue that monetary policy shocks have more persistent real effects once the endogenous reaction of monetary policy to credit spreads is accounted for.

[18] Fernandes and Rigato (2025) provide microfoundations for the delayed response of investment to monetary policy shocks,

[19] Tighter monetary policy can reduce collateral values and increase credit risk, leading banks to raise lending spreads. Investment also responds more than consumption, as firms, which are more dependent on credit, reduce investment sharply while households on fixed-rate mortgages may adjust less.

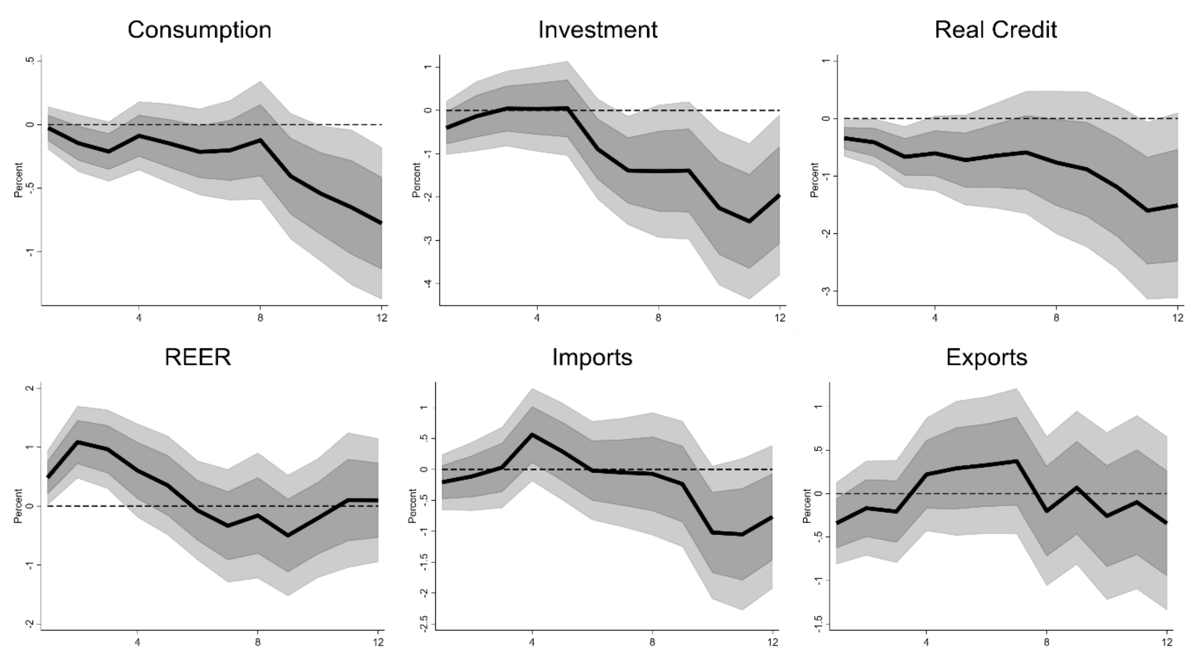
Figure 1. Impulse Responses to a 100-bp Monetary Policy Shock of Output and Prices

(Percent)



Source: Authors' calculations.
Note: The Figure shows impulse responses to a 100-bp monetary policy tightening shock over 12 quarters, together with 68 and 90 percent confidence intervals, based on estimations of Equation (2), using panel local projections with robust standard errors. The top row is based on the EM sample while the bottom row is based on a benchmark AE sample. The monetary policy shocks are the regression residuals from the estimation of Equation (1).

Figure 2. Impulse Responses to a 100-bp Monetary Policy Shock of Consumption, Investment, Real Credit, REER and Net Exports in EMs
(Percent)



Source: Authors' calculations.
Note: The Figure shows impulse responses to a 100-bp monetary policy tightening shock over 12 quarters, together with 68 and 90 percent confidence intervals, based on estimations of Equation (2), using panel local projections with robust standard errors. The monetary policy shocks are the regression residuals from the estimation of Equation (1).

The REER appreciates for about one year following the shock before normalizing. The initial appreciation peaks at 100 bp in the second quarter and is broadly consistent with uncovered interest parity and portfolio rebalancing channels as domestic prices barely move. This appreciation during the first year is reflected in a small but temporary drop in exports, while the pronounced decline in domestic demand later in the horizon is reflected in a fall in imports in year 3. These effects, however, are not highly significant, and overall net exports barely respond to the shock, suggesting a limited role for the trade channel in monetary policy transmission on average in EMs.[20]

IV. State-Dependent Transmission

We now turn to the main question of our analysis, that is the state-dependence of monetary policy transmission. As explained in the introduction, we focus on three types of binary states: i) position of an economy in the business cycle (recession or expansion), ii) level of trend inflation (high or low), and iii) monetary policy stance (loose or tight). Before estimating state-dependent versions of Equation (2), we first explain how we define these states and discuss the correlations between the three types of states as well as the distribution of monetary policy shocks across states.

Definitions of States and Distribution of Monetary Policy Shocks across States

We follow a standard approach in most of the literature and construct binary indicators to define the states of interest:[21]

Business cycle. Like many other papers (e.g. Jordà et al. 2020, Alpanda et al. 2021) studying how transmission depends on the state of the business cycle, we use output gap estimates to identify periods of economic overheating (positive output gap) and periods of slack (negative output gap). We compute country-level output gap series using the one-sided standard HP filter with 4-quarter-ahead forecasts to capture real-time information, and, to reduce the impact of short-term output volatility, we use the 5-quarter moving average after applying the filter.[22] Thus, for each country, we define an expansion as a period with a strictly positive value of the 5-quarter moving average of the output gap, and a recession as a period with a negative value of that variable.

Level of trend inflation. We compute trend inflation using a two-sided Hodrick-Prescott filter and define a high trend inflation (low trend inflation) state as a period when trend inflation exceeds (is below) the median trend inflation value in the whole EM sample (that is, 4.8 percent). [23] This approach is intended to capture the inflation level above which firms and households become more attentive to inflation dynamics. For AEs, the

[20] Alexander and Reza (2024) also report insignificant responses of exports and imports to monetary policy shocks in Canada. One factor likely contributing to the low responsiveness of exports to exchange rate movements is foreign currency invoicing (Boz et al 2025).

[21] In the robustness analysis in Section 6 below, we consider alternative definitions of the states, based on continuous state transition functions as in Auerbach and Gorodnichenko (2011) and Tenreyro and Thwaites (2016).

[22] Since the length of the business cycle is typically found to be 6–32 quarters (Stock and Watson, 1999; Christiano & Fitzgerald, 2003), smoothing over 5 quarters removes noise below that range but keeps the relevant frequencies intact.

[23] The practical motivation for using the full sample in the HP filter is to reduce volatility in trend inflation. Because year-on-year inflation is sensitive to small movements in the filtered log CPI trend, truncation can generate excessive volatility in estimated trend inflation.

literature commonly identifies inflation rate thresholds in the 2–4 percent range (e.g., Korenok et al., 2023; Bracha and Tang, 2025). The relevant threshold is likely higher for EMs.[24]

Monetary policy stance. We first compute an interest rate gap for each country-quarter, where the interest rate gap is defined as the difference between the ex-ante real short-term rate—equal to the nominal short-term rate minus one-year-ahead inflation expectations —and its long-term (20-quarter) moving average, serving as a proxy for the neutral interest rate. We then define the monetary policy stance as tight (loose) if the interest rate gap is positive (negative).

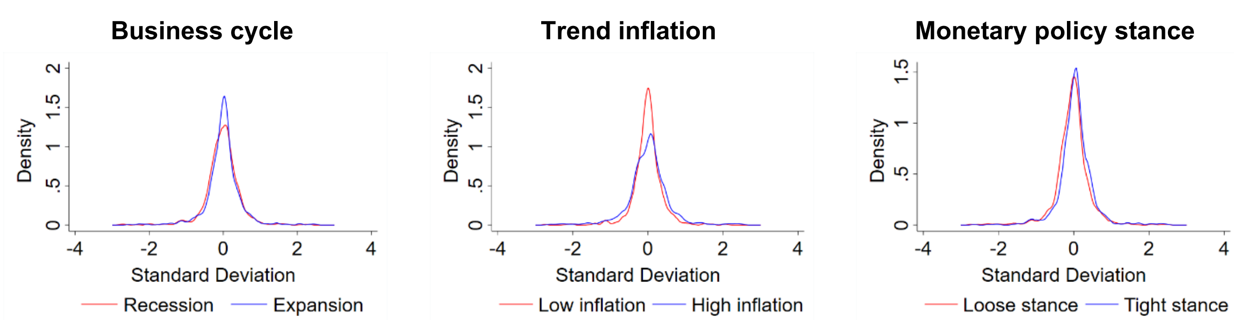
Overall, the correlations between the types of states are low (Table 1). This suggests that they capture different dimensions of macroeconomic conditions and that their effects on monetary policy transmission are largely independent from each other.

Table 1. Correlations between Types of States (High vs. Low)

	Business cycle	Trend inflation	Monetary policy stance
Business cycle (H=expansion)	1		
Trend inflation (H=high trend inflation)	-0.004	1	
Monetary policy stance (H=tight stance)	0.12	0.02	1

In addition, the distributions of the monetary policy shocks across the different states are very similar across recession versus expansion, high versus low trend inflation, and loose versus tight monetary stance states (Figure 3). This mitigates potential concerns that any observed state dependence in the transmission of monetary policy could be driven by significant differences in the distribution of size or sign of the shocks across the states.

Figure 3. Distribution of Monetary Policy Shocks across States



Source: Authors' calculations

Estimation of State-dependence in Transmission

To analyze differences in monetary policy transmission across the two states of the same type, we estimate the following state-dependent version of Equation (2):

[24] Robustness checks using country-specific median trend inflation yield identical conclusions. Importantly, inflation need not exceed a country's median (e.g., 7.7 percent for Indonesia) to be cognitively salient for firms and households.

$$y_{(j,\,t+h)} - y_{(j,\,t)} = \gamma_{(t,h)} + \alpha_{(j,h)} + \sum_{k=0}^{3} \mathrm{I}_{(j,t-k)}\left[\alpha_{(h)}^{1} + \beta_{(k,h)}^{1} shock_{(j,t-k)} + \theta_{(k,h)}^{1} \Delta_q y_{(j,t-k)}\right] +$$
$$+ \sum_{k=0}^{3}\left(1 - \mathrm{I}_{(j,t-k)}\right)\left[\alpha_{(h)}^{2} + \beta_{(k,h)}^{2} shock_{(j,t-k)} + \theta_{(k,h)}^{2} \Delta_q y_{(j,t-k)}\right] + \sum_{k=0}^{3} \delta_{(k.h)} crisis_{(j,t-k)} + \varepsilon_{(j,t,h)}, \quad (3)$$

where the notation is the same as above and $\mathrm{I}_{(j,t)}$ is a dummy variable indicating which of the two states country *j* is in during quarter *t*. We allow state-dependence in the effect of the monetary policy shocks and of the lagged quarterly differences in the outcome variable of interest. We also include state-dependent constant terms, $\alpha_{(h)}^{1}$ and $\alpha_{(h)}^{2}$, as well as time and country fixed effects. Superscripts 1 and 2 indicate the two states and the coefficients of interest are $\beta_{(0,h)}^{1}$ and $\beta_{(0,h)}^{2}$.

Recession versus Expansion

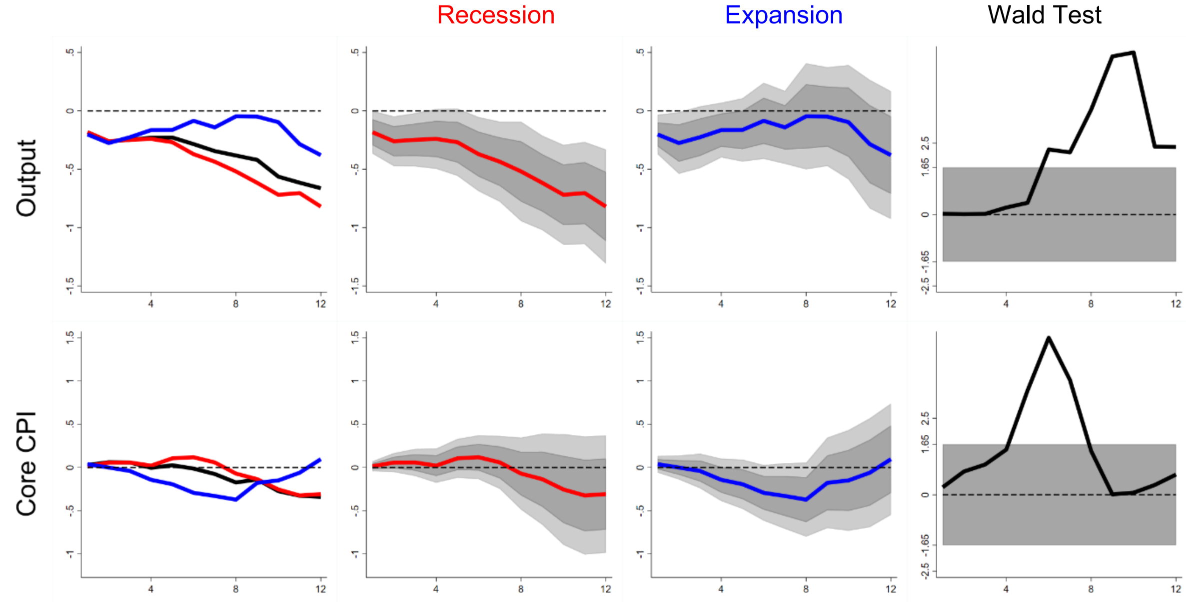
Figure 4 summarizes the results when we consider the dependence of transmission on the state of the business cycle. Each of the two rows corresponds to a different outcome variable (output in the first row and core CPI in the second row) and is made of four charts. The first chart shows the non-state-dependent impulse response (black line), the impulse response in a recession (red line), and the impulse response in an expansion (blue line). The second chart shows the impulse response of a given outcome variable in the recession state and provides the 68- and 90-percent confidence bands (in dark grey and light grey colors respectively). The third chart does the same for the expansion state. Finally, the fourth chart provides the Wald statistics of tests of equality of impulse responses across the two states at each horizon as well as the threshold of significance at the 90-percent confidence level (dark grey rectangles).

The evidence indicates that monetary policy shocks have a stronger impact on output during recessions, with the difference between the two states becoming statistically significant from the sixth quarter. While transmission to output appears largely muted during expansions, it is always significant and gets gradually stronger over time during recessions, reaching a peak impact of about -0.8 percent after 12 quarters.

Turning to core consumer prices, the evidence of state-dependent effects of monetary policy is mixed. The effects are stronger during expansions in the second year (the difference in responses across the two states is statistically significant between quarters 5 and 8), which is somewhat puzzling given the weaker response of output in that state. However, they are not significantly different from zero in any of the two states of the business cycle. More specifically, there is no significant evidence of transmission during recessions, and only mild evidence of transmission (at the 68-percent confidence level) during expansions.

Impulse responses shown in Figure 4 are consistent with the presence of (occasionally binding) financial constraints in the economy. On the real side, when financial constraints are binding (as is more likely to be the case during recessions), monetary policy, whether easing or tightening, tends to have a larger impact on firms' investment, households' consumption and therefore total output. On the price side, the relatively muted reaction of core CPI across the two states despite a much stronger output response in the recession state could reflect convexities in the Phillips curve. In particular, financially constrained firms may optimally keep prices elevated in bad times due to liquidity pressures (Gilchrist et al. 2017), which could potentially balance out the downward pressures on prices from weaker aggregate demand. Stronger real effects of monetary policy during recessions and no clear-cut evidence of asymmetric impact on prices also align well with the theory of loss-averse preferences (Santoro et al., 2014).

Figure 4. Impact of Monetary Policy Shocks on Output and Core CPI depending on the State of the Business Cycle
(Percent)



Source: Authors' calculations
Note: The charts show impulse responses of key variables in the baseline (black line) and across different states (red and blue lines) over 12 quarters with the 68 percent (dark grey areas) 90 percent (light grey areas) confidence intervals. The fourth column shows Wald test statistics testing the hypothesis that the impulse responses at a given horizon are equal across the two states. The dark shaded area denotes the 90 percent confidence interval.

To further understand what is driving these differences, we explore the responses of five additional variables: consumption, investment, real domestic credit, REER, and net exports.[25] As the first two rows of Figure 5 show, both components of domestic demand (consumption and investment) decline strongly during recessions in response to a tightening shock, with the peak effect observed in or close to quarter 12. A tightening of monetary policy is much less potent in cooling down domestic demand during expansions, with consumption not responding significatively and investment initially increasing following the shock. The responses of real credit (shown in the third row) broadly mirror those of aggregate demand. Credit declines somewhat faster and stronger during recessions than in expansions. However, the difference between the two is not statistically significant.

The REER appreciates on impact to a similar extent (by about 1 percent) during both expansions and recessions, in line with the financial channel operating through changes in interest rate differentials described above. This initial appreciation is temporary in both cases: during recessions, the REER gradually returns to its initial level, while during expansions, it eventually reverses into a depreciation of a slightly greater magnitude during the second year. Overall, the initial responses are comparable across states while the medium-term depreciation during expansions is slightly surprising.

Net exports follow broadly similar long-term patterns across states. While they decline more during recessions for the first 7 quarters after a tightening shock, this early difference is not statistically significant.

[25] When estimating Equation (3), to deal with the fact that net exports can be negative, we define net exports as a share of GDP period *t-1* so that the dependent variable is percentage change in the share of net exports in *t-1* GDP. All other variables are defined in log levels.

Given strong domestic demand during expansions and similar REER appreciation in both states, net exports would be expected to weaken more in expansions, yet the data show otherwise.[26] By quarter 12, however, the difference between the two states becomes significant and is consistent with the strong differentiated response of the REER, confirming the consistent longer-term relationship between the REER and net exports despite some short-term variation.

Overall, our empirical results demonstrate that monetary policy exhibits stronger transmission to output during recessions than in expansions.

Low versus High Trend Inflation

We now turn to the next potential source of monetary policy state-dependence, that is the level of trend inflation. It is an important consideration for EMs which have historically been relatively more prone to high-inflation episodes than AEs.

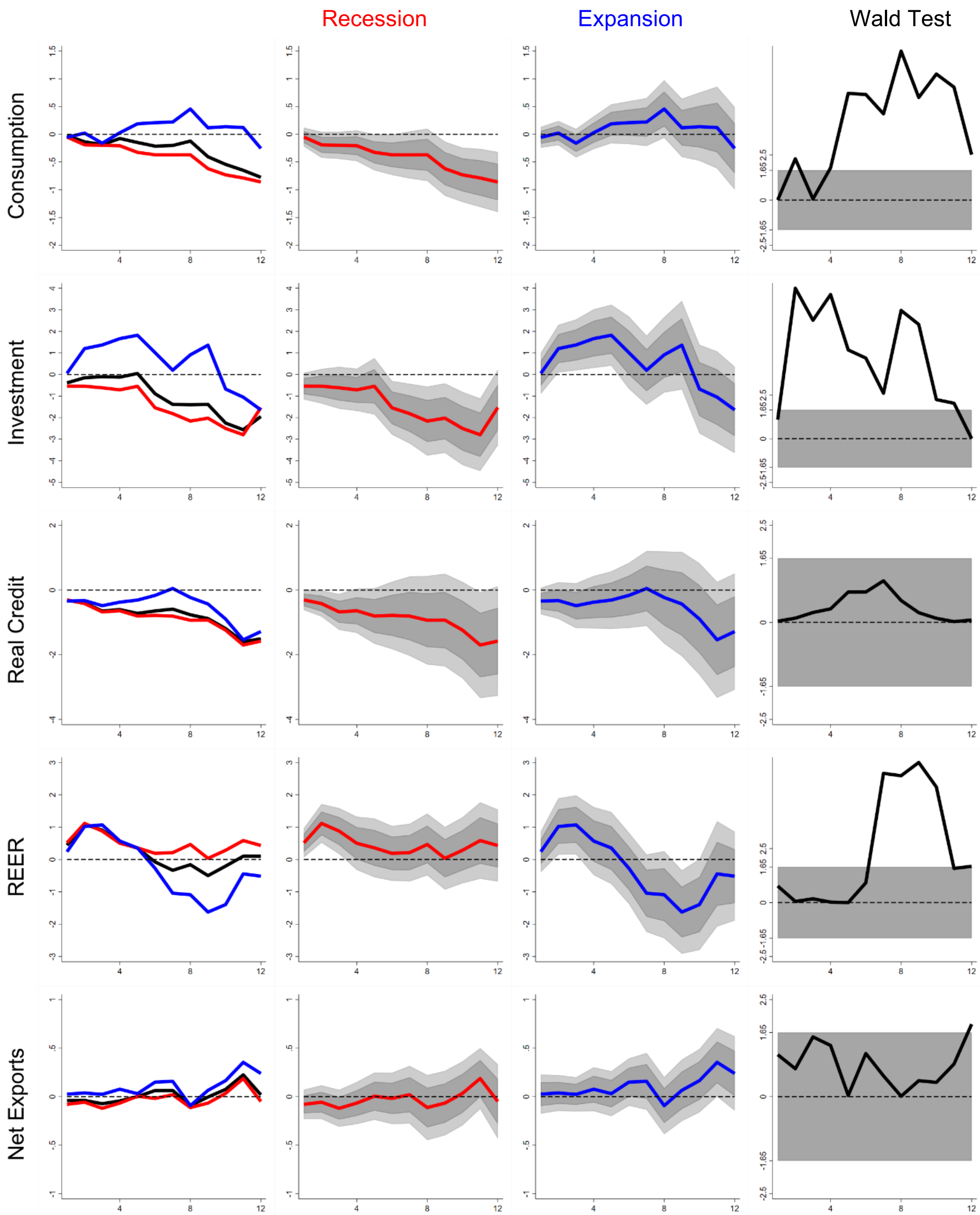
Figure 6 presents the impulse responses of output and core CPI to a tightening monetary policy shock in the two states. The red color now indicates a low trend inflation state, and the blue color indicates a high trend inflation state. In response to the shock, output declines in both states, but relatively more in the low-inflation state, reaching a peak decline of -1 percent (almost twice as large as in the non-state-dependent model) in quarter 12 (first row). The difference across the two states is largest and statistically significant during the first 4 quarters after the shock.

The contrast between the two states is starker when analyzing the core CPI response. The fall in prices is gradual and strong during periods of high trend inflation, with the peak impact reaching about -1.2 percent in quarter 11. By contrast, there is a small price puzzle lasting 6 quarters — that is, the price level increases significantly in response to the tightening shock — in the low-inflation state.

The findings of more forceful price adjustments and weaker output responses when inflation is high are consistent with theories of state-dependent pricing (Ball and Mankiw, 1994; Alvarez et al., 2019; Karadi et al., 2025) and those of rational inattention (Mackowiak and Wiederholt 2009).

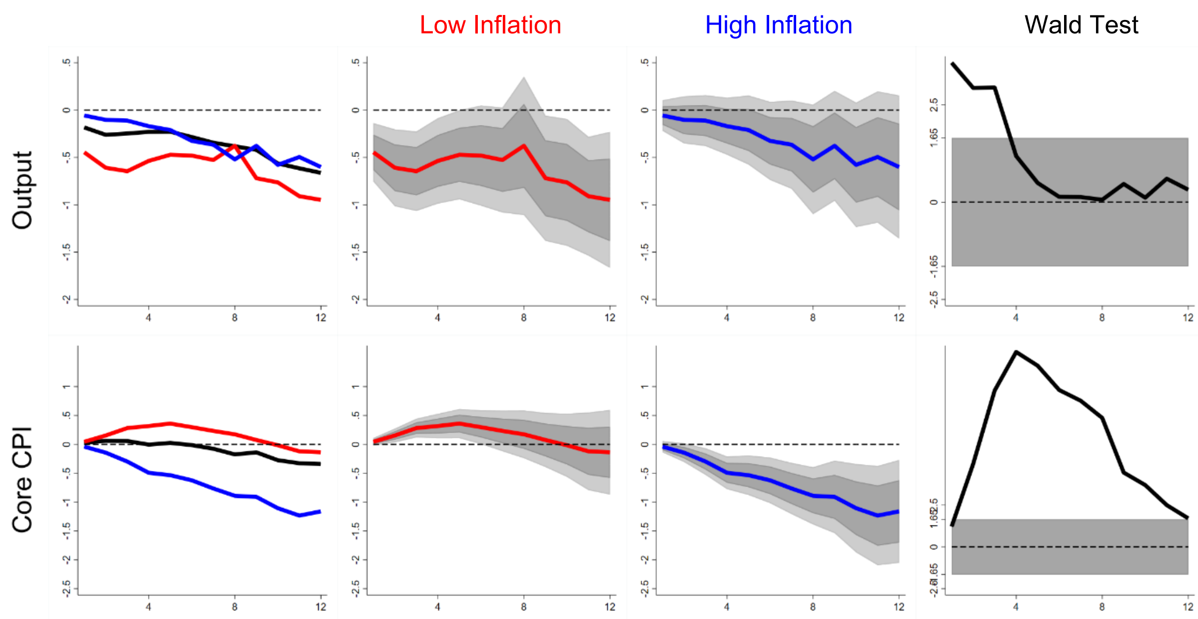
[26] Following Adler and Osorio-Buitron (2020), one possible interpretation is the relative strength between the demand-augmenting and demand-diverting effects. Specifically, after a tightening monetary policy shock, a bigger drop in domestic demand during recessions would improve net exports by more if demand-augmenting effects dominate. Vice versa, if demand-diverting effects dominate during expansions, a shift from non-tradable to tradable goods that are now relatively cheaper with appreciating REER would worsen net exports.

Figure 5. Impact of Monetary Policy Shocks on Consumption, Investment, Real Credit, REER, and Net Exports depending on the State of the Business Cycle
(Top four rows: Percent; Last row: Percent of Period t-1 GDP)



Source: Authors' calculations
Note: The charts show impulse responses of key variables in the baseline (black line) and across different states (red and blue lines) over 12 quarters with the 68 percent (dark grey areas) 90 percent (light grey areas) confidence intervals. The fourth column shows Wald test statistics testing the hypothesis that the coefficients (impulse responses) at a given horizon are equal across the two states. The shaded area denotes the 90 percent confidence interval.

Figure 6. Impact of Monetary Policy Shocks on Output and Core CPI depending on the State of Trend Inflation
(Percent)



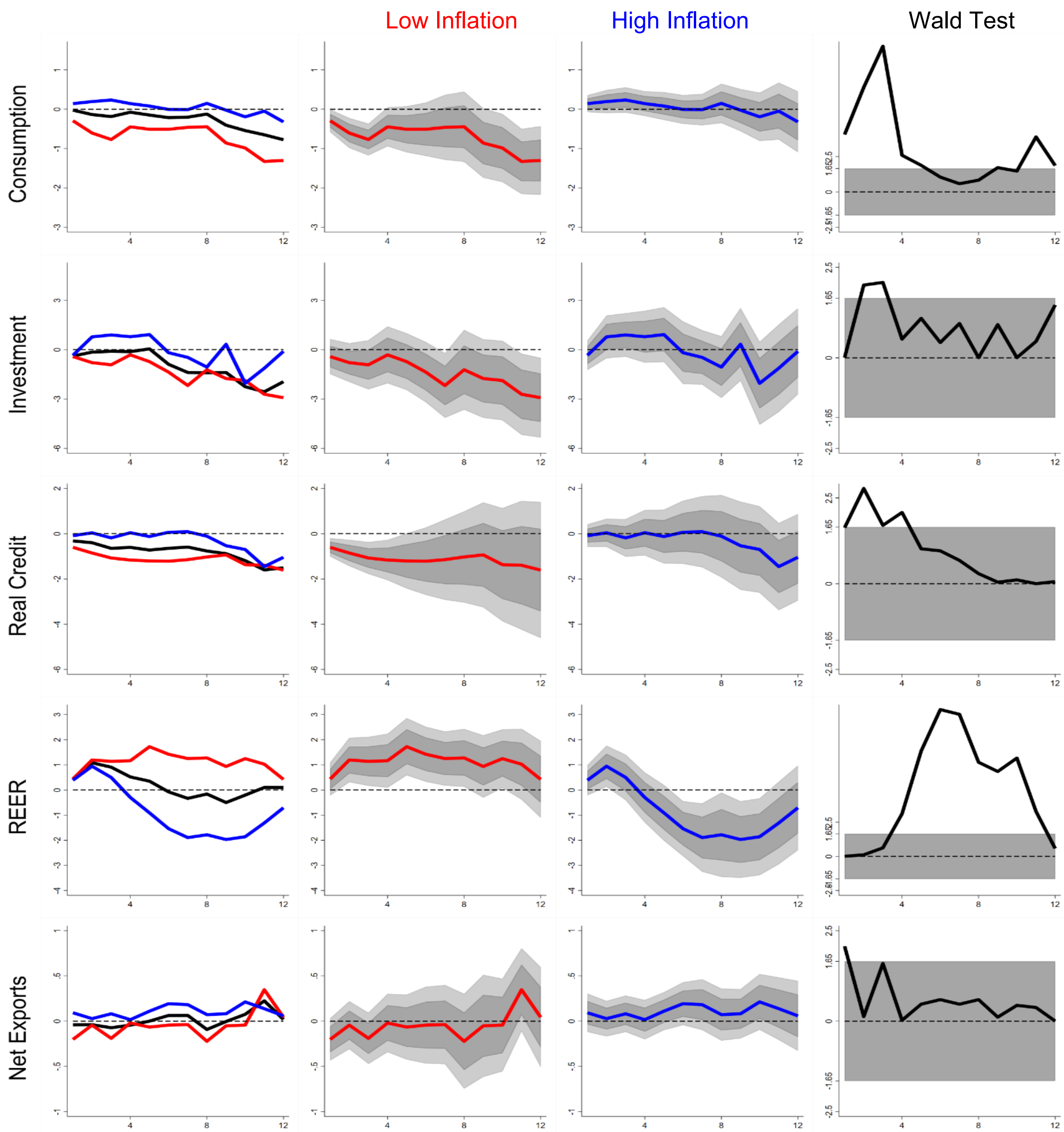
Source: Authors' calculations
Note: The charts show impulse responses of key variables in the baseline (black line) and across different states (red and blue lines) over 12 quarters with the 68 percent (dark grey areas) 90 percent (light grey areas) confidence intervals. The fourth column shows Wald test statistics testing the hypothesis that the coefficients (impulse responses) at a given horizon are equal across the two states. The shaded area denotes the 90 percent confidence interval.

The state-dependent response of output is mirrored by similar differentiated responses across states for both components of domestic demand (Figure 7, top two rows). There is no significant response of either consumption or investment in the high-inflation state. In the low-inflation state, both investment and consumption drop after the shock, with consumption falling faster and investment eventually falling twice as much as consumption. The response difference is particularly statistically significant for consumption. The initial divergence in the responses of output across the two states is also mirrored by the differential responses of real credit, which remains initially muted in the high-inflation state but falls in the low-inflation state during the first year.

While the initial appreciation of the REER is equally observed in the first 2 quarters following the shock in both states, the responses of the REER after that initial period diverge very significantly (row 4). Real appreciation persists in the low-inflation state but reverses quickly in the high-inflation state where it is followed by a real depreciation reaching -2 percent until quarter 10. As the response of net exports is very similar across the two states (Figure 7, fifth row), it is likely that the effect of this divergence in REER behavior is offset by the sharper drop in domestic demand in the low-inflation state.

Overall, we find that the asymmetric responses of output, its components, and prices are consistent with theories of state-dependent pricing and rational inattention, which predict relatively larger nominal adjustments to monetary policy shocks when inflation is high, and relatively larger real adjustments when inflation is low. The lack of state-dependence in the response in net exports for most of the post-shock horizon could be a result of different forces balancing each other out as also explained above in the case of business cycles: weaker consumption putting downward pressure on imports (and thus upward pressure on net exports) and a more appreciated REER putting downward pressure on exports when trend inflation is low, and vice versa when trend inflation is high. As in the case of business cycle dependence, the significant medium-term real exchange rate depreciation is somewhat puzzling.

Figure 7. Impact of Monetary Policy Shocks on Consumption, Investment, Real Credit, REER, and Net Exports depending on the State of Trend Inflation
(Top four rows: percent; Last row: Percent of period t-1 GDP)



Source: Authors' calculations
Note: The charts show impulse responses of key variables in the baseline (black line) and across different states (red and blue lines) over 12 quarters with the 68 percent (dark grey areas) 90 percent (light grey areas) confidence intervals. The fourth column shows Wald test statistics testing the hypothesis that the coefficients (impulse responses) at a given horizon are equal across the two states. The shaded area denotes the 90 percent confidence interval.

Loose versus Tight Monetary Policy Stance

To study the dependence of transmission on the monetary policy stance, we modify slightly Equation (3) by lagging the indicators of the state by one period (that is, the stance dummy indicator reads $\mathrm{I}_{(j,t-1-k)}$ instead of $\mathrm{I}_{(j,t-k)}$). This modification allows the policy stance indicators not to be affected by the monetary policy shock in the same quarter.

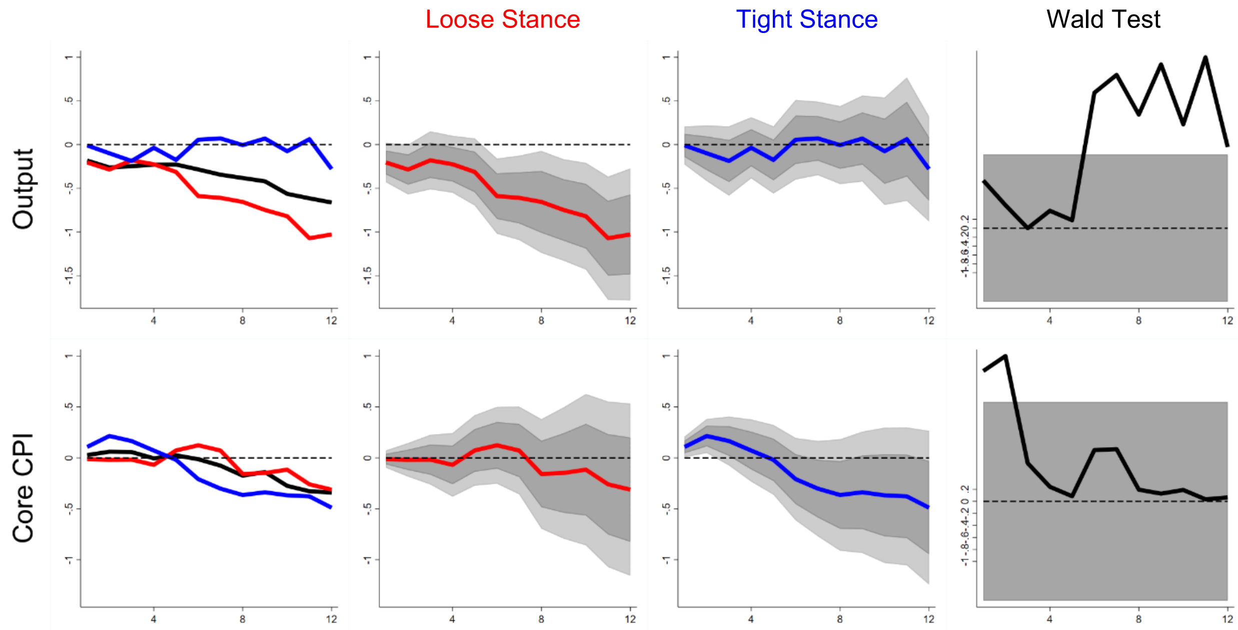
Our results are presented in Figure 8, where the red color now indicates a loose stance and the blue color indicates a tight stance. Following a tightening shock, output contracts when the shock follows a period of loose monetary policy but barely reacts when the shock follows a period of tight policy stance (Figure 8, first row). This difference in responses is statistically significant from the sixth quarter onward. Quantitatively, the peak impact on output is about twice as strong in the loose-stance state than in the linear model with no state dependence presented in Section 4. Turning to core CPI, we observe no significant response in the loose-stance state, a small initial price puzzle in the tight-stance state, and generally no evidence of asymmetric response beyond the second quarter (Figure 8, second row).

Our finding that output is more responsive to monetary policy shocks following a loose stance is consistent with the view that a loose stance incentivizes financial risk-taking and leverage buildup, resulting in tighter borrowing constraints amplifying transmission. Conversely, following tight stance periods, the economy's weak response to monetary policy shocks is likely to reflect lower financial imbalances and less binding borrowing constraints, which limit the potential for shock amplification.

Looking at the components of domestic demand, the response of consumption is broadly similar in the two states as in the state-independent model (Figure 9, first row). The fall in consumption is initially somewhat faster following a tight stance, but overall, there is little evidence of state-dependence, which suggests that financial constraints bind equally on households across monetary policy stance states. One possible explanation is that households are partially insulated in the short run from a rate change thanks to fixed-rate mortgages locked in during the preceding loose-stance period. This allows households to smooth consumption, whereas business cycle downturns immediately raise unemployment risk, prompting an adjustment in consumption.

By contrast, investment plays a key role in explaining the differential responses of output across the two states (Figure 9, second row). These responses are muted until the fifth quarter before diverging sharply as investment falls in the loose-stance state but increases in the other state. A similar divergence is also observed in the responses of real credit, as the decline of this variable reaches 3 percent at the end of the projection horizon in the loose-stance state while its response is insignificant throughout in the tight-stance state. This finding is consistent with a loose stance incentivizing higher borrowing and leverage in the corporate sector, making firms' investment more sensitive to future interest rate changes.

Figure 8. Impact of Monetary Policy Shocks on Output and Core CPI depending on the Initial Monetary Policy Stance
(Percent)



Source: Authors' calculations.
Note: The charts show impulse responses of key variables in the baseline (black line) and across different states (red and blue lines) over 12 quarters with the 68 percent (dark grey areas) 90 percent (light grey areas) confidence intervals. The fourth column shows Wald test statistics testing the hypothesis that the coefficients (impulse responses) at a given horizon are equal across the two states. The shaded area denotes the 90 percent confidence interval.

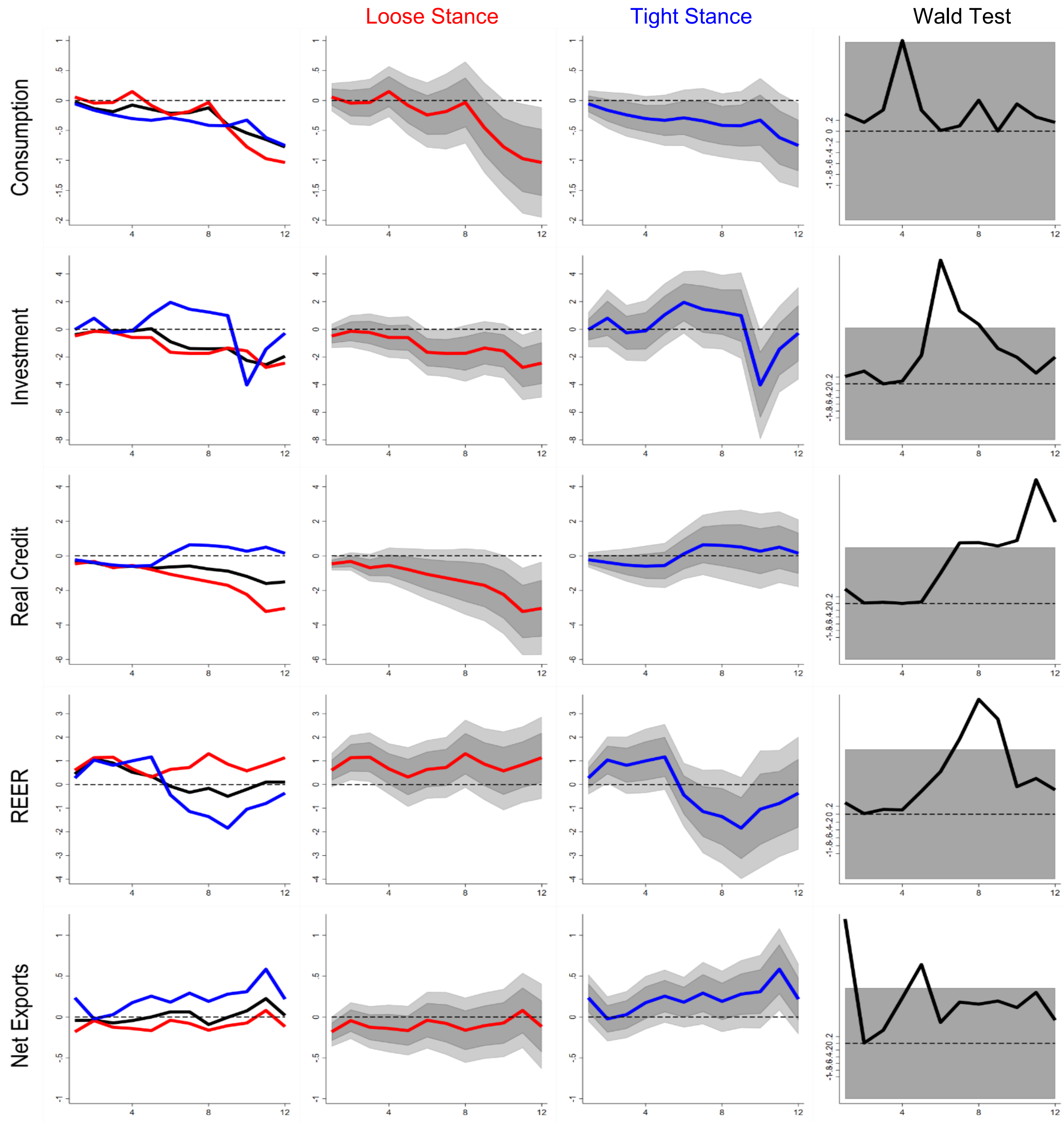
In this analysis again, the REER appreciates on impact regardless of the state (Figure 9, fourth row). However, in the second year following the tightening shock, the REER weakens in the tight-stance state. This exchange rate weakness may help explain why net exports tend to be stronger toward the end of the horizon in the tight-stance state, while their relative strength in this state during the first year and a half appears to partially reflect the contemporaneous weakness in consumption.

To sum up, these findings align with the interpretation that following periods of looser monetary policy stance, higher leverage and more binding borrowing constraints among the private sector — especially firms — amplify the effects of monetary policy shocks. In such states, it is likely that monetary policy shocks have larger impacts on investment due to the greater interest rate sensitivity of highly leveraged agents. Conversely, following periods of tight stance, lower leverage and less binding constraints limit the marginal impact of policy changes, resulting in more muted effects. This analysis highlights the importance of financial vulnerabilities in shaping the state-dependent transmission of monetary policy to the economy. [27]

[27] This state-dependent response also appears broadly consistent with Eichenbaum et al. (2025)'s model with inattentive households and state dependence in deposit interest rates, although this model would imply state-dependence of both consumption and investment.

Figure 9. Impact of Monetary Policy Shocks on Consumption, Investment, Real Credit, REER, and Net Exports depending on the Initial Monetary Policy Stance

(Top four rows: percent; Last row: Percent of Period t-1 GDP)



Source: Authors' calculations.
Note: The charts show impulse responses of key variables in the baseline (black line) and across different states (red and blue lines) over 12 quarters with the 68 percent (dark grey areas) 90 percent (light grey areas) confidence intervals. The fourth column shows Wald test statistics testing the hypothesis that the coefficients (impulse responses) at a given horizon are equal across the two states. The shaded area denotes the 90 percent confidence interval.

V. Robustness

We now explore whether our results are robust to an alternative strategy of identifying states. To do so, we allow the economy to be in one of the two states with a certain probability, which in turn is a function of an observable indicator $z_{(j,t)} \in \mathbb{R}$. Following Granger and Terasvirta (1993), we construct these probabilities by applying the following logistic transformation:

$$F\left(z_{(j,t)}\right) = \frac{\exp\left(-\kappa z_{(j,t)}\right)}{1+\exp\left(-\kappa z_{(j,t)}\right)} \qquad (4)$$

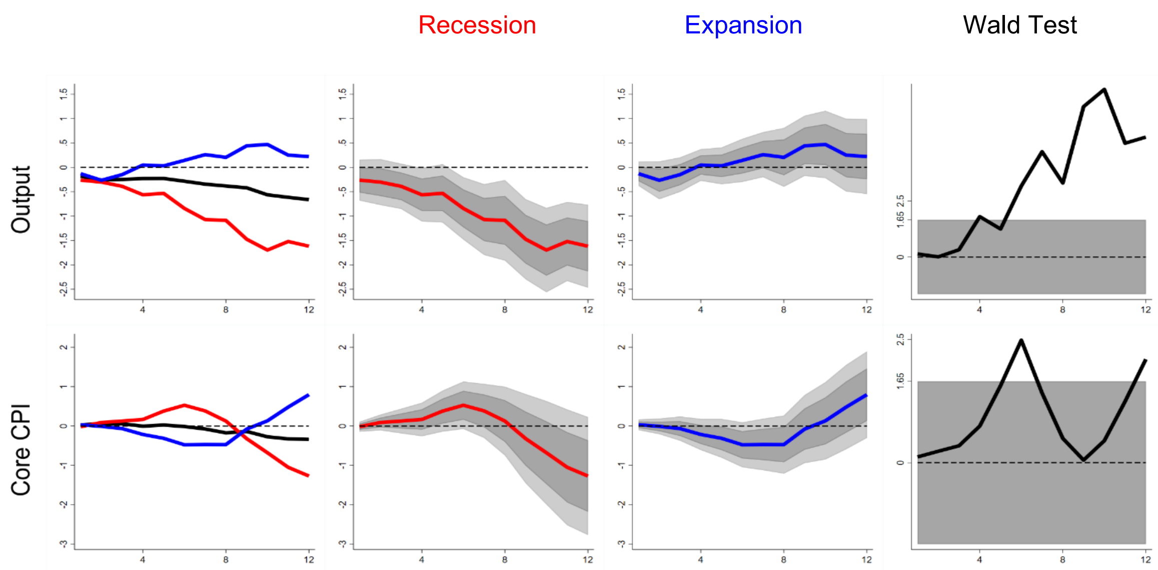
$F\left(z_{(j,t)}\right)$ is a smooth increasing function of the indicator $z_{(j,t)}$, with parameter κ capturing how quickly the economy switches from one state to the other. The higher κ is, the closer the value of the function F can approach 0 or 1 for a given change in $z_{(j,t)}$. Our earlier analysis based on dummy variables $\mathrm{I}_{(j,t)}$ corresponded to $\kappa = \infty$. To proceed, we replace the dummy indicator $\mathrm{I}_{(j,t)}$ with $F\left(z_{(j,t)}\right)$ in Equation (4) and re-estimate it.

We use the same indicators of the state of the economy $z_{(j,t)}$ as in Section 5. More specifically, for the *business cycle* analysis, we use the 5-quarter moving average of the output gap and set $\kappa = 3$ following Auerbach and Gorodnichenko (2011) and Tenreyro and Thwaites (2016). For the *trend inflation* analysis, we take $z_{(j,t)}$ to be equal to the difference between the country-specific trend inflation and the median value across the EM sample, and we set $\kappa = 5$ following Ascari and Haber (2022). Finally, for the *monetary policy stance* analysis, we define $z_{(j,t)}$ as the interest rate gap, that is the difference between the real short-term rate (policy rate minus the one-year ahead inflation expectations from Consensus Forecasts) and its 5-year moving average. We set $\kappa = 2$ to ensure that known period of monetary policy tightening such as the post-Covid period would translate into a tight stance. Changing the value of parameter κ to 1 or 3 does not materially affect our results.

Figures 10, 11 and 12 show the impulse responses of output and core inflation when using the continuous state transition probability functions. The alternative measures of the states confirm our previous findings that monetary policy transmission in EMs is state-dependent along the three dimensions we focus on.

Interestingly, the contrast in the output response between recessions and expansions is starker with this approach, and the peak effect in a recession is particularly large at -1.7 percent (Figure 10, top row). The only material difference with the baseline analysis presented in Section 5 is that the core CPI response shows strong signs of state-dependence over the medium-term between the two monetary policy stances (Figure 12, bottom row). The relatively weaker inflation developments in the tight stance state from quarter 6 onward are puzzling given the relatively stronger output performance.

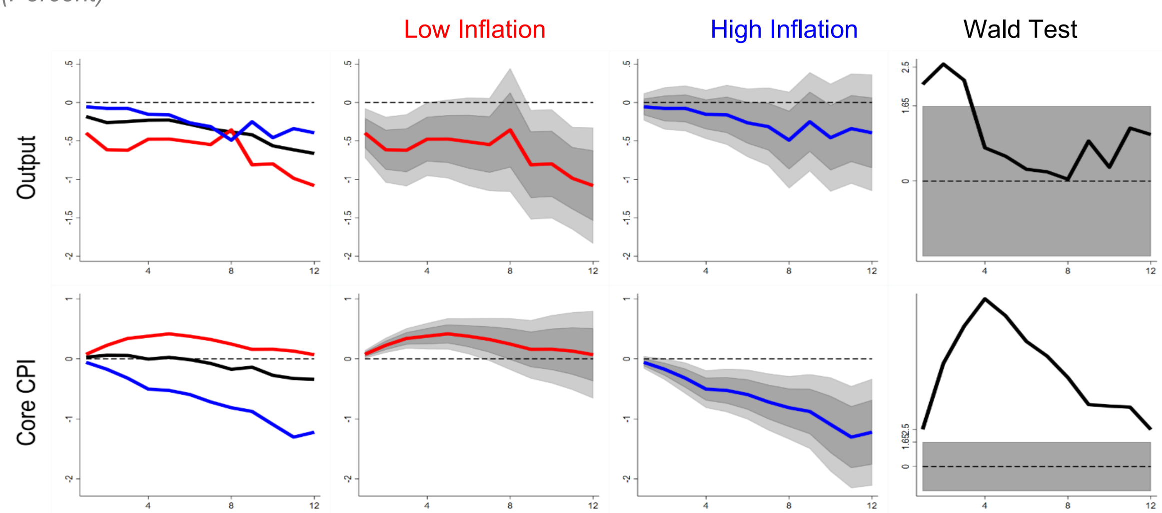
Figure 10. Impact of Monetary Policy Shocks on Output and Core CPI depending on the State of the Business Cycle based on a Smooth Transition Function
(Percent)



Source: Authors' calculations
Note: The first column shows impulse responses of key variables in the non-state-dependent baseline (black line) and across the two states (red and blue lines) over 12 quarters. The second (third) column shows the impulse responses in the recession (expansion) state together with the 68 percent (dark grey areas) 90 percent (light grey areas) confidence intervals. The fourth column shows Wald test statistics testing the hypothesis that the coefficients (impulse responses) at a given horizon are equal across the two states. The shaded area denotes the 90 percent confidence interval.

Figure 11. Impact of Monetary Policy Shocks on Output and Core CPI depending on the State of Trend Inflation based on a Smooth Transition Function

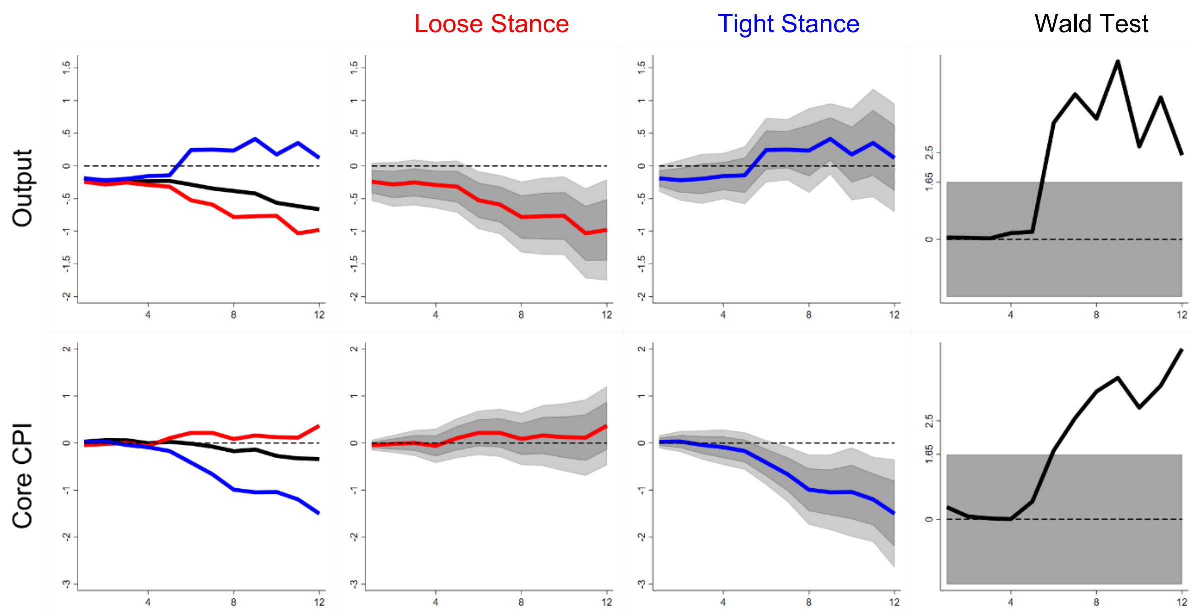
(Percent)



Source: Authors' calculations
Note: The first column shows impulse responses of key variables in the non-state-dependent baseline (black line) and across the two states (red and blue lines) over 12 quarters. The second (third) column shows the impulse responses in the low inflation (high inflation) state together with the 68 percent (dark grey areas) 90 percent (light grey areas) confidence intervals. The fourth column shows Wald test statistics testing the hypothesis that the coefficients (impulse responses) at a given horizon are equal across the two states. The shaded area denotes the 90 percent confidence interval.

Figure 12. Impact of Monetary Policy Shocks on Output and Core CPI depending on the Initial Monetary Policy Stance based on a Smooth Transition Function

(Percent)



Source: Authors' calculations
Note: The first column shows impulse responses of key variables in the non-state-dependent baseline (black line) and across the two states (red and blue lines) over 12 quarters. The second (third) column shows the impulse responses in the loose stance (tight stance) state together with the 68 percent (dark grey areas) 90 percent (light grey areas) confidence intervals. The fourth column shows Wald test statistics testing the hypothesis that the coefficients (impulse responses) at a given horizon are equal across the two states. The shaded area denotes the 90 percent confidence interval.

VI. Conclusion

Most of the literature on the state-dependence of monetary policy transmission has concentrated on AEs, likely because of better data availability. In this paper, we extend this line of research by focusing on a sample of eleven EMs with similar inflation-targeting and floating exchange rate policy frameworks. Using monetary policy shocks constructed from forecast errors made by professional forecasters, we find that transmission to output and prices varies systematically with indicators of the business cycle, trend inflation, and policy stance and that this state-dependence is economically significant. Following a tightening monetary policy shock, output declines are significantly amplified during recessions and low-inflation regimes, while falls in prices are more pronounced in high-inflation environments—consistent with models of financial frictions, state-dependent pricing, and loss aversion. Moreover, output contractions are sharper following a period of accommodative monetary policy stance, possibly reflecting greater leverage and financial imbalances built when monetary conditions are loose.

Across different types of state dependence, the response of output to monetary policy shocks is generally accompanied by a similar pattern in consumption, investment, and real credit dynamics, pointing to state-dependent transmission operating through multiple channels. While the real exchange rate appreciates upon impact, in line with standard economic theory, it depreciates over the medium-term in states associated with relative output resilience. These results underscore the importance of accounting for state-dependent dynamics in calibrating monetary policy, assessing its effectiveness, and modeling its transmission. Future research could usefully explore other dimensions of cyclical state dependence in EMs, in particular in relation to the global business cycle and the global financial cycle.

Annex I. Data Sources and Transformations

Annex Table I.1. Availability of Monetary Policy Shocks by Country in the Sample

Country	Classification	Start Date	End Date
Brazil	EM	2001q3	2024q1
Chile	EM	2005q1	2024q1
Colombia	EM	2016q2	2024q1
Hungary	EM	1999q3	2024q1
India	EM	2002q3	2024q1
Indonesia	EM	2014q1	2024q1
Mexico	EM	2002q1	2024q1
Peru	EM	2016q2	2024q1
Poland	EM	1999q4	2024q1
Russia	EM	2016q3	2024q1
Thailand	EM	2002q4	2024q1
Australia	AE	1996q1	2024q1
Canada	AE	1996q1	2024q1
Czech Republic	AE	2001q1	2024q1
France	AE	2000q1	2024q1
Germany	AE	2000q1	2024q1
Italy	AE	2000q1	2024q1
Japan	AE	1996q1	2024q1
Korea	AE	2001q2	2024q1
Netherlands	AE	2000q1	2024q1
New Zealand	AE	1996q1	2024q1
Norway	AE	1998q3	2024q1
Slovak Republic	AE	2009q1	2024q1
Spain	AE	2000q1	2024q1
Sweden	AE	1996q1	2024q1
Switzerland	AE	2000q1	2024q1
United Kingdom	AE	1997q3	2024q1
United States	AE	1996q1	2024q1

Note: AE and EM stand for Advanced Economy and Emerging Market, respectively.

Annex Table I.2. Data Sources

Variable	Description	Source
GDP	Real gross domestic product	Haver Analytics; national statistical agencies
CPI	Consumer price index	Haver Analytics; national statistical agencies
Core CPI	Consumer price index excluding food and energy	Haver Analytics; national statistical agencies
Short-term rate	Short-term interest rate corresponding to definitions of consensus forecasts (Annex Table I.3)	Haver Analytics, LSEG Datastream, Bloomberg; national central banks
10-year government bond yield	10-year government bond yield	LSEG Datastream; national central banks
Term spread	10-year government bond yield minus short-term rate	Haver Analytics, LSEG Datastream, Bloomberg; national central banks
NEER	Nominal effective exchange rate	Haver Analytics; IMF International Financial Statistics Database, BIS
REER	Real effective exchange rate	Haver Analytics; IMF International Financial Statistics Database, BIS
Commodity prices	S&P GSCI commodity index	Haver Analytics; S&P
Bilateral exchange rate	Local currency per USD	Haver Analytics; BIS
Crisis dummy	Dummy variable indicating a systemic banking, currency or sovereign debt crisis or the year 2020 (first year of the COVID-19 pandemic)	Laeven and Valencia (2020) database
Consumption	Real domestic consumption	Haver Analytics; IMF International Financial Statistics Database and national statistical agencies
Investment	Real investment	Haver Analytics; IMF International Financial Statistics Database and national statistical agencies
Net exports	Real net exports	Haver Analytics; IMF International Financial Statistics Database and national statistical agencies
Real credit	Credit to private non-financial sector from all sectors deflated by CPI	Haver Analytics; BIS

Annex Table I.3. Definition of Short-term Rates by Country in the Sample

Country	Series Description
Brazil	Overnight Interbank Interest Rate, SELIC (%)
Chile	Central Bank Monetary Policy Rate (%)
Colombia	Central Bank Policy Rate (%)
Hungary	3-month Treasury Bill Rate (%)
India	91-day Treasury Bill Rate
Indonesia	3-month Deposit Rate (%)
Mexico	28-day CETES Rate (%)
Peru	Monetary Policy Interest Rate (%)
Poland	3-month Interbank Deposit Rate (%)
Russia	Central Bank Monetary Policy Rate (%)
Thailand	3-month Interbank Rate (%)
Australia	90-day Dealer Bill Rate (%)
Canada	3-month Treasury Bill Rate (%)
Czech Republic	3-month PRIBOR Interbank Deposit Rate (%)
Euro Area 1/	3-month Euro Rate (%)
France	3-month Euro Rate (%)
Germany	3-month Euro Rate (%)
Italy	3-month Euro Rate (%)
Japan	3-month Yen Certificate of Deposit
Korea	91-day Certificate of Deposit (%)
Netherlands	3-month Euro Rate (%)
New Zealand	90-day Bank Bill Rate (%)
Norway	3-month Interbank Rate (%)
Slovak Republic	3-month Euro Rate (%)
Spain	3-month Euro Rate (%)
Sweden	3-month Interbank Rate (%)
Switzerland	3-month Swiss Av. Rate (SAR3M) (%)
United Kingdom	3-month Interbank Rate (%)
United States	3-month Treasury Bill Rate (%)

1/ We use euro-area short-term rates to compute monetary policy shocks for the countries in the euro area (France, Germany, Italy, The Netherlands, Slovak Republic, Spain).

Annex II. Computation of 1-year ahead forecasts

Each month, Consensus Economics releases forecasts for the current (calendar) year and following (calendar) year for real GDP growth and inflation. Using the current calendar year (y) and following calendar year $(y+1)$ forecasts in each calendar month m, we compute the 1-year-ahead forecast for cumulative real GDP over the previous 12 months $E_{y,m}(GDP_{y+1,m})$ and the 1-year ahead forecast for CPI $E_{y,m}(CPI_{y+1,m})$ using the following weighted averages:

$$E_{y,m}(GDP_{y+1,m}) = w_m \times (GDP\ forecast\ for\ year\ y) + (1 - w_m) \times (GDP\ forecast\ for\ year\ y+1)$$
$$E_{y,m}(CPI_{y+1,m}) = w_m \times (CPI\ forecast\ for\ end\ of\ year\ y) + (1 - w_m) \times (CPI\ forecast\ for\ end\ of\ \ year\ y+1)$$

where the weight w_m is determined based on the month m (Jan = 1, Feb = 2, etc.) in which the forecast is made:

$$w_m = (13 - m)/12$$

We then use these values to compute forecasts of year-on-year GDP growth and CPI inflation for each quarter.

Annex III. Summary Statistics

Annex Table III.1. Summary Statistics

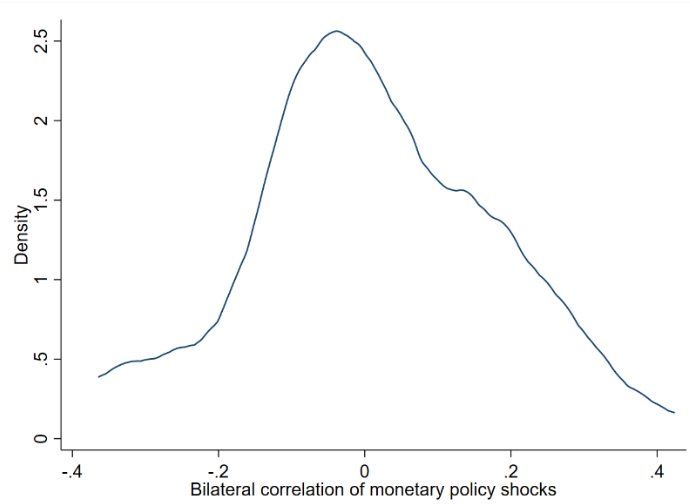
Variable	Mean	Standard Deviation	10th Percentile	50th Percentile	90th Percentile
Real GDP (yoy change, percent)	2.4	3.6	-0.9	2.4	5.5
CPI (yoy change, percent)	2.9	2.8	0.2	2.3	6.3
Core CPI (yoy change, percent)	2.4	2.3	0.4	1.8	5.1
Short-term rate (percent)	3.3	3.4	0.0	2.6	7.4
10-year government bond yield (percent)	4.0	2.4	0.8	3.9	7.2
Term spread (percent)	0.7	1.9	-0.9	0.9	2.6
NEER (yoy change, percent)	0.3	6.9	-7.5	0.6	7.2
REER (yoy change, percent)	0.3	6.9	-7.3	0.3	7.6
Commodity prices (yoy change, percent)	7.5	25.3	-23.5	4.4	45.9
Consumption (yoy change, percent)	2.3	3.3	-0.5	2.2	5.4
Investment (yoy change, percent)	2.3	9.5	-8.6	2.7	11.8
Imports (yoy change, percent)	4.4	9.0	-5.5	4.5	13.8
Exports (yoy change, percent)	4.1	8.2	-3.7	3.9	12.4
Net exports (yoy change, percent of t-1 GDP)	0.04	1.8	-1.7	0.0	1.8
Real credit (yoy change, percent)	3.8	6.1	-2.9	3.4	10.7
Monetary policy shock (percent)	0.0	0.4	-0.4	0.0	0.4

Annex IV. Cross-Country Correlations of Monetary Policy Shocks

Annex Table IV.1. Cross-Country Correlation Matrix of Monetary Policy Shocks

	BRA	CHL	COL	HUN	IDN	IND	MEX	PER	POL	RUS	THA
BRA	1.00	0.14	0.10	-0.19	0.33	-0.11	-0.05	0.09	0.00	0.24	0.10
CHL	0.14	1.00	0.05	-0.15	-0.04	-0.08	-0.03	0.20	0.27	0.42	0.12
COL	0.10	0.05	1.00	0.23	0.05	-0.04	-0.08	-0.36	0.01	-0.04	-0.07
HUN	-0.19	-0.15	0.23	1.00	-0.08	-0.08	-0.30	-0.16	0.04	-0.35	-0.04
IDN	0.33	-0.04	0.05	-0.08	1.00	-0.04	0.30	0.22	0.11	-0.09	-0.02
IND	-0.11	-0.08	-0.04	-0.08	-0.04	1.00	0.12	-0.01	-0.24	-0.29	0.17
MEX	-0.05	-0.03	-0.08	-0.30	0.30	0.12	1.00	0.24	-0.10	0.14	-0.01
PER	0.09	0.20	-0.36	-0.16	0.22	-0.01	0.24	1.00	0.04	0.17	-0.03
POL	0.00	0.27	0.01	0.04	0.11	-0.24	-0.10	0.04	1.00	0.06	-0.11
RUS	0.24	0.42	-0.04	-0.35	-0.09	-0.29	0.14	0.17	0.06	1.00	-0.17
THA	0.10	0.12	-0.07	-0.04	-0.02	0.17	-0.01	-0.03	-0.11	-0.17	1.00

Annex Figure IV.1. Distribution of the Cross-Country Correlations of the Monetary Policy Shocks



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Working Paper No. WP/2026/096