**Número 650**

# Monetary Shocks and Inflation

## GLOBAL EVIDENCE FROM TRILEMMA-BASED IDENTIFICATION

**CAMERON HAAS, MATEO HOYOS, EMILIANO LIBMAN, GUILHERME K. MARTINS, AND ARSLAN RAZMI**

MAYO 2025

CENTRO DE INVESTIGACIÓN Y DOCENCIA ECONONÓMICAS

CIDE

**Advertencia**

Los Documentos de Trabajo del CIDE son una herramienta para fomentar la discusión entre las comunidades académicas. A partir de la difusión, en este formato, de los avances de investigación se busca que los autores puedan recibir comentarios y retroalimentación de sus pares nacionales e internacionales en un estado aún temprano de la investigación.

De acuerdo con esta práctica internacional congruente con el trabajo académico contemporáneo, muchos de estos documentos buscan convertirse posteriormente en una publicación formal, como libro, capítulo de libro o artículo en revista especializada.

ORCID: 0000-0002-6790-2143 (Mateo Hoyos)

## Abstract

After decades of low and stable inflation, recent global events —such as the COVID-19 pandemic and the Russian invasion of Ukraine —triggered a resurgence in inflationary pressures, prompting central banks worldwide to tighten monetary policy. This paper examines whether monetary policy effectively curbs inflation by employing a trilemma-based identification strategy on a panel dataset of 36 developing and 8 developed economies from 1990 to 2017. Using higher-frequency monthly data, we improve on traditional quarterly or annual approaches by more precisely capturing central bank responses. By applying our theory-driven, trilemma-based identification strategy to a sample of developing countries, we bring novel insights to existing literature. Our findings indicate that monetary policy shocks have significant but impermanent effects on inflation. A 100 basis point interest rate hike lowers the price level by 3.7% at its peak after six months, with effects fading within 18 months. Crucially, our results do not exhibit the "price puzzle," reinforcing the credibility of our identification strategy. Additionally, we find that monetary policy effects are state-dependent, with stronger disinflationary impacts during high-inflation periods and in economies with lower GDP per capita or higher commodity export dependence. These findings highlight the heterogeneity in monetary policy transmission, underscoring the need for tailored policy responses across different economic contexts.

**Keywords:** interest rates, monetary experiments, trilemma, instrumental variables, local projections.

**JEL Codes**: E01, E30, E32, E44, E47, E51, F33, F42, F44.

## Resumen

Tras décadas de inflación baja y estable, eventos globales recientes —como la pandemia de COVID-19 y la invasión rusa a Ucrania— provocaron un resurgimiento de las presiones inflacionarias, llevando a los bancos centrales de todo el mundo a endurecer su política monetaria. Este artículo examina si la política monetaria logra efectivamente

reducir la inflación, utilizando una estrategia de identificación basada en la trinidad imposible (trilemma) sobre un panel de datos de 36 economías en desarrollo y 8 desarrolladas entre 1990 y 2017. Usando datos mensuales de mayor frecuencia, mejoramos las aproximaciones tradicionales trimestrales o anuales al capturar con mayor precisión las respuestas de los bancos centrales. Al aplicar nuestra estrategia de identificación, fundamentada teóricamente y basada en el trilemma, a una muestra de países en desarrollo, aportamos nuevas perspectivas a la literatura existente. Nuestros hallazgos indican que los shocks de política monetaria tienen efectos significativos, pero no permanentes sobre la inflación. Un aumento de 100 puntos básicos en la tasa de interés reduce el nivel de precios en un 3.7% en su punto máximo tras seis meses, con efectos que se disipan en un plazo de 18 meses. Es crucial que nuestros resultados no presentan el "price puzzle", lo que refuerza la credibilidad de nuestra estrategia de identificación. Además, encontramos que los efectos de la política monetaria dependen del estado de la economía, siendo más fuertes durante periodos de alta inflación y en economías con menor PIB per cápita o mayor dependencia de exportaciones de materias primas. Estos resultados resaltan la heterogeneidad en la transmisión de la política monetaria y la necesidad de respuestas de política adaptadas a distintos contextos económicos.

**Palabras claves:** tasas de interés, experimentos monetarios, trilemma, variables instrumentales, proyecciones locales.

**Códigos JEL**: E01, E30, E32, E44, E47, E51, F33, F42, F44.

.

# Monetary Shocks and Inflation: Global Evidence from Trilemma-Based Identification

Cameron Haas[a], Mateo Hoyos[b], Emiliano Libman[c], Guilherme K. Martins[d], and Arslan Razmi[a]

[a]Department of Economics, University of Massachusetts at Amherst
[b]Department of Economics, Centro de Investigación y Docencia Económicas (CIDE)
[c]CONICET (Consejo Nacional de Investigaciones Científicas y Tecnológicas)
[d]Department of Economics, University of Leeds

**Abstract**

After decades of low and stable inflation, recent global events —such as the COVID-19 pandemic and the Russian invasion of Ukraine —triggered a resurgence in inflationary pressures, prompting central banks worldwide to tighten monetary policy. This paper examines whether monetary policy effectively curbs inflation by employing a trilemma-based identification strategy on a panel dataset of 36 developing and 8 developed economies from 1990 to 2017. Using higher-frequency monthly data, we improve on traditional quarterly or annual approaches by more precisely capturing central bank responses. By applying our theory-driven, trilemma-based identification strategy to a sample of developing countries, we bring novel insights to existing literature. Our findings indicate that monetary policy shocks have significant but impermanent effects on inflation. A 100 basis point interest rate hike lowers the price level by 3.7% at its peak after six months, with effects fading within 18 months. Crucially, our results do not exhibit the "price puzzle," reinforcing the credibility of our identification strategy. Additionally, we find that monetary policy effects are state-dependent, with stronger disinflationary impacts during high-inflation periods and in economies with lower GDP per capita or higher commodity export dependence. These findings highlight the heterogeneity in monetary policy transmission, underscoring the need for tailored policy responses across different economic contexts.

**JEL codes:** E01, E30, E32, E44, E47, E51, F33, F42, F44.

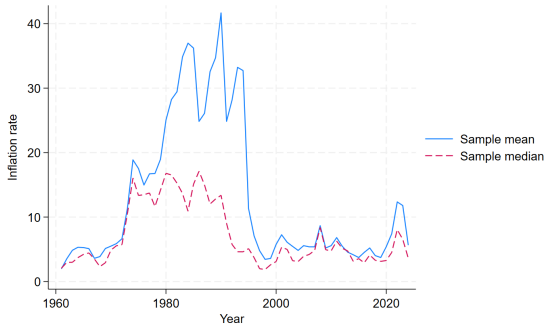
**Keywords:** interest rates, monetary experiments, trilemma, instrumental variables, local projections.

# 1 Introduction

The inflation debate has returned to the forefront of economic discussions. For decades, most economies had low and stable inflation rates, but in 2021 and 2022, inflation surged. In response, central banks around the world deployed their primary demand management tool: raising short-term interest rates. While inflation has since subsided in many places, a critical question remains: was it monetary policy that effectively curbed inflationary pressures? Though many assume an affirmative answer, producing credible empirical evidence remains a challenge, especially for lower-income economies.

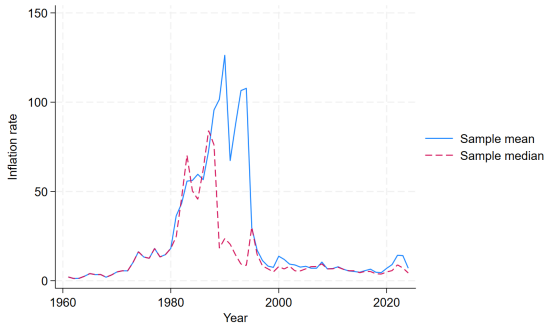
Figure 1 displays the yearly mean and median of inflation in our sample, while figures 2 and 3 display yearly mean and median inflation in developed and developing economies respectively. We can see that inflation peaked for both developing and developed economies in the 1980s, though it did so in the latter at substantially lower inflation rates (a mean of 15%, versus a mean of around 75% for developing economies). From the 1990s until 2021, developing and developed economies alike enjoyed the 'great moderation,' before inflation picked up again.

**Figure 1:** Evolution of inflation



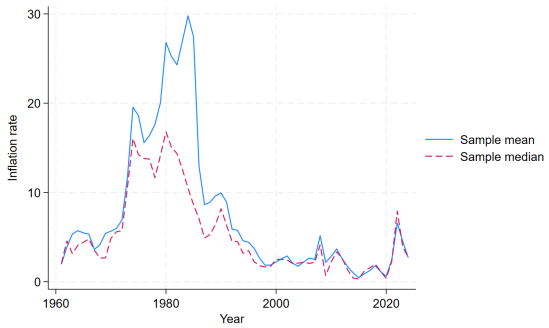

Notes: Sample mean and median of inflation calculated using headline CPI. See table 7 for details on sample.

**Figure 2:** Evolution of inflation, developing countries only




Notes: Sample mean and median of inflation, calculated using headline CPI, developing countries only. See table 7 for details on sample.

**Figure 3:** Evolution of inflation, developed countries only




Notes: Sample mean and median of inflation, calculated using headline CPI, developed countries only. See table 7 for details on sample.

A fundamental issue in understanding the effects of monetary policy is the identification of exogenous sources of variation. In simple terms, central banks adjust interest rates based on the state of the economy and are widely expected to do so. Observed monetary policy changes are, therefore, hardly as good as random. Starting at least with the influential publication by Romer and Romer (2004), a large literature has emerged attempting to directly account for the set of information used by central banks in their decisions to identify exogenous shocks. Another strand of the literature that emerged later models monetary policy shocks as surprise changes in high-frequency asset prices, with Gertler and Karadi (2015) as the main example. Finally, in a set of recent papers Jordà et al. (2020, 2024) have proposed an identification strategy based on the trilemma of international finance, essentially exploiting base countries' interest rate changes to instrument for changes in domestic ones. Nevertheless, the application of these identification strategies was originally

limited only to developed economies, and their use has not been sufficiently explored to gain an understanding of the effectiveness and potential differences of monetary policy in developing economies.

In this paper, we use a trilemma-based identification strategy to analyze the effectiveness of monetary policy in influencing inflation across both developed and developing economies. As discussed later, we believe that this quasi-experimental strategy has advantages over others used by existing literature. The key contributions of our analysis include: (i) pursuing a more theory-driven approach to developing our instrument and extending this identification strategy to a broader sample that includes 36 developing economies alongside 8 developed ones, (ii) employing more granular and recent monthly data spanning from 1990 to 2017, and (iii) exploring the state-dependent effects of monetary policy. This approach provides a valuable means of gaining causal insights into monetary policy in developing economies, addressing the data limitations that often restrict the application of other identification methods commonly used for developed economies. Furthermore, the use of recently published monthly inflation data enhances the instrument's relevance and exogeneity by more precisely capturing the timing of central bank decisions compared to earlier applications relying on annual data (Ha et al., 2023).

Our findings reveal that monetary policy shocks have significant but somewhat short-lived impacts on inflation. On average, a 100 basis point increase in interest rates leads to an immediate decline in the price level, with the strongest impact observed six months after the shock, when prices are 3.7% lower compared to the baseline. The effect gradually diminishes over time, with prices returning to baseline levels by the 18-month mark. Importantly, our findings do not exhibit the "price puzzle" often noted in the monetary policy literature, where interest rate hikes are paradoxically associated with rising prices in the short term (Ha et al., 2024; Rusnak et al., 2013). This absence of the puzzle highlights the reliability of the trilemma-based identification strategy, which is well-suited to isolating exogenous monetary policy shocks without the confounding impact of omitted variable biases.

We further conduct extensive robustness checks to validate our findings. First, we test alternative specifications for unanticipated changes in base country interest rates, ensuring that our results do not depend on one particular specification. Second, we examine the relevance of assuming a common interest rate pass-through for pegged and floating exchange rate regimes, a critical aspect given ongoing debates in the literature on the potential collapse of the trilemma into a dilemma in highly globalized financial markets (Rey, 2016). Third, we address potential violations of the exclusion restriction by controlling for spillovers through exchange rates and current account channels, as base country interest rate changes could affect domestic economies through direct trade and exchange rate mechanisms rather than monetary policy. Our results remain consistent across these tests, providing robust evidence for the validity of our identification strategy and the reliability of our conclusions.

The paper also contributes to the debate on the state-dependence of monetary policy efficacy. During high-inflation episodes, monetary shocks lead to significantly larger (proportional) reductions in price levels compared to periods of low inflation, where the effects are smaller and less consistent. In addition, the strength of the monetary policy impact varies with the structural characteristics of the economy. In countries with lower GDP per capita, the price level falls more sharply following interest rate shocks, with the magnitude of the effect being particularly pronounced in the months immediately after the shock. Similarly, in countries with a higher dependency on commodity exports, monetary shocks result in greater and more sustained price-level responses. These patterns persist across alternative specifications and highlight the variability in the inflationary response to monetary policy under different economic conditions, reinforcing the need to examine these dynamics separately from average effects.

Besides this introduction, the paper is structured as follows. The next section presents a brief overview of the literature on monetary policy and inflation, with a particular focus on potential differences between developed and developing economies. Section 3 discusses the empirical approach. Section 4 presents the main results while Section 5 discusses some robustness checks. Section 6 provides an extended discussion of the results. Finally, Section 7 concludes with some additional thoughts and ideas for further research.

# 2 Monetary policy in developed and developing economies

How do macroeconomic policies affect real variables? While the so-called "classical" vision argued that monetary policy should have a direct effect only on prices with little -if any- effect on real variables, economists from a "Keynesian" background have argued that the most direct effect of monetary shocks is on quantities, and eventually on prices. Important for this debate is how money and prices are connected. The traditional transmission mechanism of monetary policy operates through changes in financial variables, which eventually impact inflation (Friedman, 1970; Taylor, 1995). The authorities typically aim to influence the money supply or a short-term interest rate, hoping to affect long-term rates.

In a closed economy set-up, looser (tighter) monetary conditions tend to decrease (increase) interest rates and expand (contract) credit supply, and for given expectations about future inflation, the real rates of interest decrease (increase), thus expanding (contraction) demand and inflation. In an open economy, monetary policy also affects the exchange rate, influencing activity levels and the cost of imported inputs and exports. Additionally, the monetary policy stance may affect expectations,

which could in turn affect inflation dynamics.

Since the rational expectations revolution, the discussion has been shaped differently in many ways. As is well known, this revolution emphasized the importance of inflation expectations for inflation dynamics. It has become common to distinguish between anticipated and unanticipated shocks or changes in independent variables. The camp is usually divided between those who argue that only unexpected monetary policy shocks or money surprises will affect output and employment (Barro & Rush, 1980; Lucas Jr, 1972; Phelps, 1967; Friedman, 1968) and those who assert that anticipated monetary policy shocks also have real effects on the economy (Romer & Romer, 1994).

Another important distinction that the rational expectations revolution brought to the table is between transitory and permanent shocks. More precisely, a permanent change in the money supply or the short-term interest rate will have a stronger effect on output and prices than a transitory change, while anticipated changes may have effects on the same variables even before the monetary conditions change. Recent debates in developed economies have evolved around this idea. Whereas those who argued that the shocks that increased inflation were permanent advocated for a tight response of monetary policy, those who believed that the shocks were transitory suggested that a more nuanced response was needed (see Blanchard and Bernanke, 2023).

The empirical literature on monetary policy has primarily focused on identifying monetary policy shocks and analyzing their effects on macroeconomic variables. A widely used approach relies on high-frequency asset price data to capture monetary policy surprises around policy announcements. This identification strategy has become a gold standard in the field, as demonstrated by Gertler and Karadi (2015), who use high-frequency surprises as external instruments in a VAR framework to assess the transmission of monetary shocks. Their findings indicate that even modest movements in short-term interest rates can lead to significant changes in credit costs, driven largely by shifts in term premia and credit spreads. More recently, Bauer and Swanson (2023) reassess the validity of this identification strategy, addressing concerns about the exogeneity of monetary policy surprises. They expand the set of monetary policy announcements and adjust for potential endogeneity, ultimately finding that the estimated effects of monetary shocks on macroeconomic variables are larger and more significant than previously thought.

Another strand of empirical literature employs local projections and instrumental variables to explore the effects of monetary policy through alternative sources of quasi-experimental variation. These studies emphasize the design of robust identification strategies, often leveraging exogenous shifts in monetary conditions to isolate causal effects. For instance, Jordà et al. (2020) exploit the trilemma of international finance, which constrains interest rate autonomy in economies with fixed

exchange rates and open capital markets. Using historical panel data since 1870, they show that monetary interventions have sizable and statistically significant effects on real economic activity, with magnitudes that depend on cyclical conditions, inflation levels, and credit market dynamics. Despite differences in methodology, these studies broadly support the conventional view that contractionary monetary policy reduces output and inflation, reinforcing the standard predictions of macroeconomic theory.

While this result is qualitatively in line with expectations, it goes against another common argument in contemporary literature. Labeled the "neo-Fisherian" response, several papers have documented that contractionary monetary policy tends to increase prices (Barth III & Ramey, 2001; Estrella, 2015), and depending on whether shocks are permanent or not, the rate of inflation. The key idea is that if the nominal interest rate is raised and expected to remain high permanently, and if the real rate is pinned by fundamentals (like productivity or demographics), then expected inflation must rise to maintain the Fisher identity.[1] Uribe (2022) proposes a New Keynesian model where a permanent increase in the interest rate increases the rate of inflation, while a transitory increase has the expected effect (i.e., it reduces the rate of inflation). His main finding is that permanent monetary shocks that increase the nominal interest rate and inflation in the long-run cause increases in interest rates, inflation, and output in the short run and explain about 45 percent of inflation changes. Thus, despite a partial consensus on the general effects of monetary policy on inflation, the debate is far from settled.

Some more recent papers have started to include developing countries in their sample. For instance, Checo et al. (2024) focus on 18 emerging market economies and identify monetary policy shocks using forecasts of policy rate decisions by analysts of major financial institutions and research and consultancy companies. They find evidence that, in these economies, monetary tightening lifts bond yields, curbs real activity, reduces inflation, and impacts leveraged firms more strongly. They highlight that these effects are similar to the ones found in developed economies. Brandão-Marques et al. (2024) rely on local projections to analyze the effect of monetary policy on output growth and inflation and find that interest rate hikes reduce output growth and inflation once they account for the behavior of the exchange rate. Deb et al. (2023) construct a novel dataset of monetary policy shocks for a sample of advanced and emerging market economies during 1991-2023. They show that tightening monetary policy negatively impacts economic activity (although the effects on inflation and inflation expectations take time to materialize). Across countries, monetary policy is more effective in countries with flexible exchange rate regimes,[2] more developed financial systems, credible monetary policy frameworks,

[1] Nominal interest rate is (approximately) equal to the sum of the real rate and expected inflation: $i_t = r_t + \pi_t^e$.

[2] Although, macroeconomic theory suggests that this could be misleading since countries with flexible exchange rates would be expected to have more monetary policy sovereignty.

and when uncertainty is low.

Closely related to these results, Kalemli-Özcan (2019) shows that changes in the US policy rates have a stronger effect on emerging market countries than on advanced economies; presumably, changes in the risk premium, when combined with the weak transmission mechanism of monetary policy in countries with less developed financial systems, explains why the decisions of the Fed have more impact in emerging markets. Her main argument is that risk perceptions are also affected by interest rate changes in the base country, which, in turn, substantially affects the flow of capital to emerging economies. The argument that global risk aversion, as measured by the VIX, is related to monetary policy in the United States was also highlighted by others, such as Miranda-Agrippino and Rey (2022).

Frankel (2010) adds different reasons why emerging and developed economies might differ with respect to the response to monetary policy shocks. Developing countries tend to have less developed institutions, particularly lower central bank credibility, less competitive banking systems, and trade goods more exposed to international competition (commodities or labor-intensive manufactures). The author also highlights that international investors are more sensitive to increases in debt in emerging economies. These entail greater exposure to supply shocks and trade volatility, in particular, procyclicality of international finance, lower credibility with respect to price stability and default risk, and procyclicality of fiscal policy, particularly given the imposition of austerity in crises. Camara et al. (2024) suggest that a US monetary contraction generates a large decline in US imports and that it is primarily via this decline that a US monetary contraction affects the rest of the world. They reach this conclusion by observing that the rest of the world experiences large export declines in response to a US monetary policy contraction. They find that EMEs face a stronger contraction.

Finally, besides the literature on (i) the general effects of monetary policy on inflation and (ii) possible heterogeneities between developed and developing countries, a third discussion relevant for us is the one on state-dependencies of the monetary policy shocks. Eichenbaum et al. (2022) argue that the efficacy of monetary policy depends on the distribution of savings from refinancing mortgages. Using data from the US, they argue that using a prolonged period of low interest rates to combat recessions weakens the effectiveness of monetary policy once interest rates return to normal. Consequently, if the economy experiences a negative shock during this time, policymakers will have fewer resources available to counteract its effects. Alpanda et al. (2021) analyzed data from developed economies and found that the effects of monetary policy are weaker during economic downturns, periods of low household debt, and high interest rates. They concluded that the effects of the business cycle tend to dominate in these situations. The authors attribute this phenomenon to constraints related to collateral and debt service on household borrowing. Jordà et al. (2020), also looking at developed economies, find that monetary loosening has a

much weaker effect on GDP than a contractionary shock, that increases in interest rates are more effective in higher inflation episodes, and that credit growth amplifies monetary restraint.

# 3 Econometric approach

## 3.1 Constructing the trilemma instrument

Our empirical approach, based on that of Jordà et al. (2024), exploits the open economy trilemma. A country can have any two of the following three at any given point in time: an open capital account, a fixed exchange rate, and monetary policy independence. While few countries have completely open capital accounts or fully independent monetary policy, countries that are open to capital flows and manage their currency to some extent surrender full monetary autonomy. If base country interest rates are set independently of conditions in pegging countries, this creates exogenous variation in domestic rates which can be used to construct an instrument.

In the absence of time-varying risk or capital controls, interest rates in a country with a fixed peg will move one-to-one with the base country's interest rate. Though this interest rate pass-through will diminish the less rigid the exchange rate regime (or the tighter the capital controls), only in the corner cases of pure floats and financial autarky will there be zero-interest rate pass-through. Jordà et al. (2024) demonstrate that in a New Keynesian model of a small open economy, the effect of a base-country interest rate shock on GDP is related to the effect of a domestic interest rate shock by the following equation:

$$\beta = \frac{\gamma_p}{\lambda} - \theta\alpha, \tag{1}$$

where $\beta$ is the response to a domestic policy shock, $\lambda$ is the interest rate pass-through, $\theta$ is the tradable output share, $\gamma_p$ is the response to a base country shock, and $\alpha$ is a spillover parameter determining how base-country interest rates influence tradable output. If, in the limit, $\theta\alpha$ tends towards zero, we can recover $\beta$ from $\gamma_p$. This means that base country monetary shocks are valid instruments for domestic monetary shocks. Since tradables are a small share of GDP, and tradable export demand is more sensitive to domestic than foreign rates ($\beta > \alpha$), it is reasonable to expect that $\theta\alpha$ is close to 0.

Base country interest rate shocks may influence inflation in pegging countries through channels other than domestic interest rates, violating the exclusion restriction. Net exports are one such channel. As noted earlier if the base country is a major trading partner of the pegging country, an interest rate shock could diminish base country demand and reduce net exports through the demand channel. Therefore,

a result that monetary policy is effective in curbing inflation may instead reflect the impact of lower net exports on inflation. In the other direction, if interest rate pass-through is less than perfect, an increase in base country rates would tend to appreciate its currency against the domestic currency, potentially boosting net exports and impacting inflation. To address the net export and exchange rate channels, we later control for the current account balance as a percentage of GDP and for import terms of trade.

Another possible challenge is identifying the moment a monetary shock lands. Even if domestic conditions have no impact on monetary authorities in base countries, domestic policymakers may try to preempt rate changes in the base country. We therefore focus only on unanticipated shocks when constructing the trilemma instrument, rather than taking raw differences in base country interest rates.

To find unanticipated movements in base country interest rates, we first estimate a Taylor rule for each base country. For $\Delta R_t^j$, i.e., the change in the interest rate of base country $j$ in month $t$, we estimate

$$\Delta R_t^j = \boldsymbol{x}_t \beta_j + \eta_{j,t} \tag{2}$$

where $x_t^j$ is a vector of macroeconomic controls.[3] Taking the difference between observed values of $\Delta R_t^j$ and the fitted values $\Delta \widehat{R}_t^j$ yields unanticipated changes in the interest rate:

$$\Delta \widetilde{R}_t^j = \Delta R_t^j - \Delta \widehat{R}_t^j. \tag{3}$$

The impact of base country monetary shocks on pegging countries will depend in part on the openness of their capital account, with less open economies experiencing greater monetary policy autonomy. To account for this, we weight by capital account openness $k_{i,t}$. For country $i$ that is pegged to currency $j(t)$ at time $t$, the trilemma instrument is equal to the unanticipated change in the base country's interest rate weighted by capital account openness:

$$z_{i,t} = k_{i,t} \Delta \widetilde{R}_t^{j(t)}. \tag{4}$$

## 3.2 First stage

Based on the arguments made in section 3.1, the trilemma instrument $z_{i,t}$ is plausibly exogenous. However, we need to ensure that the trilemma instrument is relevant. To

[3] In our baseline specification, we use headline CPI inflation, the growth of industrial output, the lagged interest rate, and commodity price inflation as controls. Two lags of inflation, industrial output growth, and the interest rate are also included.

do so, we estimate the equation

$$\Delta R_{i,t} = \lambda_F z^F_{i,t} + \lambda_P z^P_{i,t} + \boldsymbol{x}_{i,t}\xi + \kappa_i + \epsilon_{i,t}, \tag{5}$$

where $z^F_{i,t} = \begin{cases} 0 & \text{for pegs} \\ z_{i,t} & \text{for floats} \end{cases}$

and $z^P_{i,t}$ is defined in a symmetric manner for pegs. We include country fixed effects to control for time-invariant characteristics specific to each country. Because the effective variation in monetary policy originates from a limited number of base countries, we do not include monthly fixed effects which could absorb most of our exogenous variation. Instead, we use an import price index as a proxy for how global shocks affect each country specifically, thereby capturing period-specific price shocks.[4] As mentioned earlier, in our baseline, we estimate equation (5) using the log of import terms of trade, terms of trade inflation, two lags of logged headline CPI, and the lagged interest rate as controls. Standard errors are clustered by country. The first two columns come from a regression with two instruments for $\Delta R_{i,t}$ ($z^F_{i,t}$ and $z^P_{i,t}$), while the third column shows the results of the regression with a single instrument $z_{i,t}$.

**Table 1:** First stage results

| | Pegs | Floats | Both |
|---|---|---|---|
| $\lambda$ | .27 | .05 | .20 |
| $t$ | 3.31 | .64 | 3.31 |
| p | 0.002 | .526 | 0.002 |
| Observations | 7023 | | 7288 |
| F | 14.02 | | 15.52 |

Notess: Results from fitting equation 5 with the full sample. Columns one and two display results with $\lambda_F \neq \lambda_P$, and column three displays results when $\lambda_F = \lambda_P$. Standard errors are clustered by country, with two lags of log HCPI, log import terms of trade, terms of trade inflation, the lagged bill rate, and country-fixed effects as controls.

These results match the predictions of the trilemma: countries that peg their currencies are more sensitive to external monetary shocks. The coefficient on floats is smaller and statistically insignificant. Although monetary conditions may be transmitted from base countries to nonpegging countries through financial and goods markets, floats have more monetary autonomy and should therefore be less sensitive to base country shocks. Our complete sample passthroughs are significantly lower than in Jordà et al. (2024), who find a passthrough of 0.61 for pegs after World War II. Restricting our sample to developed economies only, our pass-through estimate for

[4] Jordà et al. (2024) use global GDP growth to capture these shocks. Given our monthly frequency and the unavailability of such data, we employ two proxies in the appendix—annual global GDP growth and monthly US industrial production—with results that are essentially the same as in the baseline.

**Table 2:** First stage results, developed countries only

| | Pegs | Floats | Both |
|---|---|---|---|
| $\lambda$ | .47 | .06 | .34 |
| $t$ | 5.94 | 1.02 | 3.37 |
| p | 0.00 | 0.33 | 0.006 |
| Observations | 2352 | | 2445 |
| F | 23.79 | | 15.06 |

Notes: Results from fitting equation 5 with only the developed countries in our sample. Columns one and two display results with $\lambda_F \neq \lambda_P$, and column three displays results when $\lambda_F = \lambda_P$. Standard errors are clustered by country, with two lags of log HCPI, log import terms of trade, terms of trade inflation, the lagged bill rate, and country-fixed effects as controls.

pegs is significantly closer. Given that the latter paper has a longer sample including the Gold Standard and Bretton Woods eras, and is restricted to only advanced economies, a difference in the passthroughs is not surprising.

## 3.3 Second stage

To estimate the response of inflation to monetary policy, we use local projections (Jordà, 2005). Since monetary policy may operate with lags, it is important to consider the dynamic response of inflation to interest rate shocks. Although Vector Autoregressions (VARs) can also estimate dynamic responses, local projections bring several important benefits. With a VAR, we would have to estimate the entire dynamic system driving inflation. This comes with two major disadvantages. First, the causes and propagation methods of inflation are disputed, and using a univariate approach allows us to remain agnostic on the origins of inflation. Second, by paring down the number of variables, we can work with a larger sample than would otherwise be possible.

Letting $p_{i,t}$ be the log of headline consumer price index (HCPI) in period $t$, we estimate:

$$p_{i,t+h} - p_{i,t} = \alpha_{i,h} + \Delta R_{i,t}\beta_h + \boldsymbol{x}_{i,t}\gamma_h + u_{i,t+h}, \tag{6}$$

$$\Delta R_{i,t} = \lambda_F z^F_{i,t} + \lambda_P z^P_{i,t} + \boldsymbol{x}_{i,t}\xi + \kappa_i + \epsilon_{i,t}. \tag{7}$$

where $h = -6, ..., 18$. Thus, our dependent variable is the cumulative percent change in the price level, and $\beta_h$ represents the parameter capturing the response of the price level to changes in the interest rate.

## 3.4 State dependency

Another possibility, which the literature on monetary policy is beginning to explore, is that the impact of monetary policy depends on the state of the economy. If so, looking only at the average effect of monetary policy may obscure important insights. The challenge with investigating state dependence is finding exogenous states. Even with credibly exogenous shocks, if states are not also exogenous, causal conclusions may be misleading. In three of the four state-dependencies we consider, we argue that the states are unrelated to inflation.

To model state dependency, we run the following local projection:

$$p_{i,t+h} - p_{i,t} = \alpha_{i,h} + \beta_{0,h} z_{i,t} + \beta_{1,h} D_{i,t} z_{i,t} + \mathbf{x_{i,t}} + \epsilon_{\mathbf{i,t}}$$

where $D_{i,t}$ is a dummy equal to 1 if a certain condition is fulfilled and 0 otherwise. $\beta_{0,h}$ is the impact of the exogenous shock after $h$ periods and $\beta_{1,h}$ is the coefficient on the interaction term. In terms of interpretation, if $D_{i,t} = 1$, a 100bps shock to base country interest rates will result in a price level $\beta_{0,h} + \beta_{1,h}$ percent lower than the baseline after $h$ periods. If $D_{i,t} = 0$, the impact after $h$ periods will be $\beta_{0,h}$.

## 3.5 Data sources and sample

We draw from a variety of data sources, with an eye to breadth of coverage. Monetary policy data for developing countries is not widely available, nor is core CPI data. To maximize coverage, we use headline CPI and treasury bill rates from the IMF-IFS for price level data and interest rates respectively.[5] Peg and exchange rate regime data are taken from the database in Ilzetzki et al. (2022), while we use the capital account openness index developed by Quinn et al. (2011).

When estimating Taylor rules for base countries, we use headline CPI for inflation, short-term interest rates from OECD dataset, and the industrial production index from OECD stat as a proxy for GDP (unlike GDP, industrial production is available at a monthly frequency). For controls, we draw upon various sources, which can be found in the appendix along with other details.

Our sample contains 44 countries; 8 developed and 36 developing. These countries are geographically dispersed: one North American, ten European, thirteen Asian, fourteen African, and eight in Latin America or the Caribbean. A complete list of countries may be found in the appendix. Our unbalanced panel is at a monthly frequency and begins in January 1990. The dollar is the predominant base currency: 5,766 country-months have the dollar as base currency. The USD is followed by the Euro with 1,749 country-months and the Deutschmark with 551. When estimating

[5]We also use interest rates on short-term government securities as an independent variable.

a Taylor rule for the European Central Bank, we use inflation and industrial output data from Germany.[6] Further, we assume that the dollar predominates in USD/Euro baskets.

**Table 3:** Country-months by peg

| Base currency | Country-months |
|---|---|
| Euro | 1736 |
| Deutschmark | 522 |
| USD Dollar | 5711 |
| USD/Euro basket | 450 |
| Total | 8419 |

Notes: Number of country-months with each base currency in our sample.

We allow the interest rate pass-through from the base country to differ between pegs and floats. To ensure that only credibly pegged exchange rates are counted as pegs, we classify a country-month as pegged if and only if its has been classified as such for the past 6 months. In other words, if the coarse RR measurement in Ilzetzki et al. (2022) has been 1 or 2 for the same period. Since countries using the Euro are simultaneously pegged to all other Eurozone members and a pure float with regards to the world as a whole, they could reasonably be considered either floats or pegs. Since intra trade hovers around 60% for the Eurozone, we follow Ilzetzki et al. (2022) in classifying Eurozone countries as hard pegs. As a result, our sample has 5,146 country-months classified as pegs and 2,339 country-months classified as floats.

# 4 Results

## 4.1 Baseline results

Table 3 displays our main results. In the baseline case, a 100bps shock immediately leads to a fall in price level relative to month 0. The difference is greatest 6 months after the shock, where the price level is 3.69% lower than in the no-shock baseline. However, 18 months after the shock, the price level is slightly higher than the baseline, but not significantly so in the statistical sense.

Since $z^F_{i,t}$ is a weaker instrument, we also check if we obtain similar results when we restrict the sample to pegs by setting $z^F_{i,t} = 0$. A similar picture emerges, with the impact of monetary policy marginally higher. This confirms that even if the trilemma instrument is a weak one for floats, this does not significantly drive our results. Finally, confirming the advantage of pursuing an instrumental variable approach,

[6]Using EU-wide data does not give significantly different results.

**Table 4:** Response of log price level to a 100bps shock

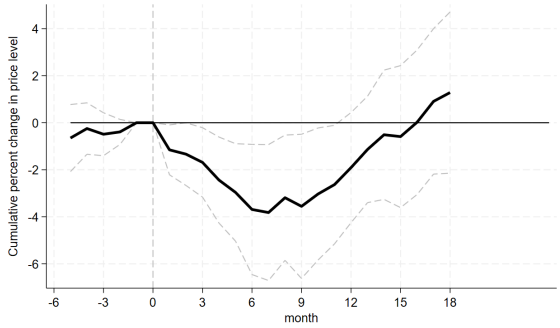
| Months after shock | Full sample | p-value | Pegs only | p-value | OLS | p-value |
|---|---|---|---|---|---|---|
| 3 | -1.69 ** | 0.03 | -1.55 * | 0.06 | 0.11*** | 0.00 |
| 6 | -3.69 *** | 0.01 | -3.55 *** | 0.01 | 0.26*** | 0.00 |
| 9 | -3.56 ** | 0.02 | -3.49** | 0.03 | 0.32*** | 0.00 |
| 12 | -1.91 | 0.11 | -1.93 | 0.11 | 0.31*** | 0.00 |
| 15 | -.59 | 0.70 | -2.25 | 0.16 | 0.25* | .05 |
| 18 | 1.28 | 0.46 | -1.32 | 0.55 | 0.27* | .09 |
| Observations | 7023 | | 4582 | | 7023 | |

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Columns 1-4 present regression results from equations 6 and 7, and columns 5-6 present regression results from fitting equation 6 with OLS. Standard errors are clustered by country, with two lags of log HCPI, log import terms of trade, terms of trade inflation, the lagged bill rate, and country-fixed effects as controls.

we find that without an instrument, a 100 bps shock actually increases the price level by up to 3%. This is the well-known price puzzle.

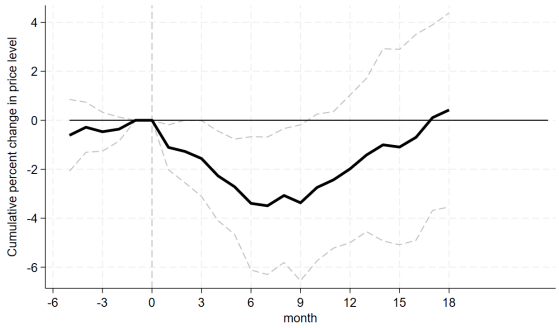
The impulse response functions can be seen in figures 4, 5, and 6.

**Figure 4:** Baseline results



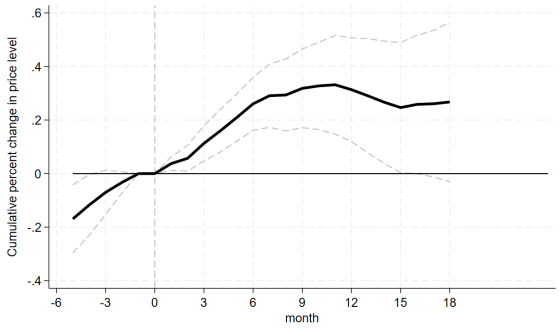

Notes: Response of inflation to a 100bps shock to domestic interest rates. Interest rates instrumented with trilemma IVs. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Figure 5:** Baseline results, pegs only




Notes: Response of inflation to a 100bps shock to domestic interest rates, only pegs. Interest rates instrumented with trilemma IVs. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Figure 6:** Baseline results, no instrument used




Notes: Response of inflation to a 100bps shock to domestic interest rates. Estimated using OLS. Dashed lines display 95% confidence intervals with standard errors clustered by country.

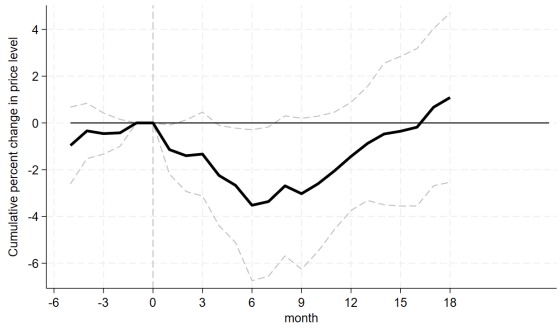
Our regressions pass the standard tests for exogeneity, with Sargan-Hansen p-values typically being above 0.9 and never below 0.6.

## 4.2 Robustness checks

Some recent work suggests that, in an era of financial globalization, the trilemma has collapsed into a "dilemma" (Rey, 2016). According to this view, any country with an open capital account loses monetary policy autonomy regardless of exchange rate regime as international capital and credit flows transmit financial conditions from advanced economies to developing economies. If this view is strictly correct, an implication is that the pass-through coefficient should not depend on whether a

country floats or pegs. In figure 7 we test this hypothesis. Using a single pass-through coefficient does not qualitatively change our results, but it does reduce the magnitude. Instead of prices falling 3.5% relative to the baseline after 6 months, prices only fall 2% relative to the baseline. This, in conjunction with table 1, indicates that the concept of a policy trilemma continues to retain relevance.

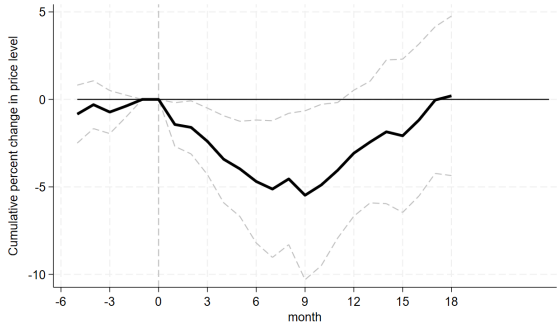
**Figure 7:** Results with a single pass-through coefficient




Notes: Response of inflation to a 100bps shock to domestic interest rates. Interest rates instrumented with a single trilemma IV for floats and pegs. Dashed lines display 95% confidence intervals with standard errors clustered by country.

Using capital account openness as a weight in our instrument does not drive our results. In equation 4, we implicitly control for this by multiplying the trilemma instrument by capital account openness. With an unweighted trilemma instrument, the impact of monetary policy is still significant, in the same direction, and actually a bit greater, as seen in figure 8.

**Figure 8:** Results instrumented but unweighted by capital account openness

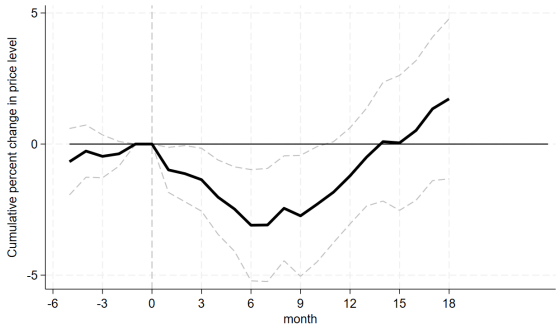



Notes: Response of inflation to a 100bps shock to domestic interest rates. Interest rates instrumented with trilemma IV unweighted by capital account openness. Dashed lines display 95% confidence intervals with standard errors clustered by country.

As mentioned earlier, the greatest challenge to our identification strategy is the net exports channel. Even if base country shocks are exogenous to domestic economic conditions, a rise in the base country interest rate will induce lower base country spending and, thus, lower exports from other countries. The effect on aggregate demand in these countries could, therefore, generate an alternative channel through which base country shocks affect inflation in other countries. In figures 9 and 10 we control for the current account as a percentage of GDP and the exchange rate to ensure net exports are not driving our results. Our results change little; the price is the lowest relative to the baseline after 6 months, with prices 3% lower than otherwise. Out until 12 months, the impact of monetary policy is statistically significant.

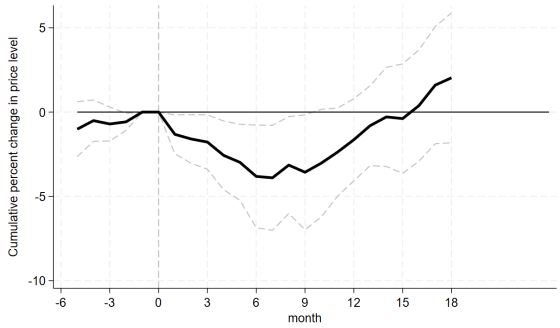
Although our panel includes developing and developed economies, our results are driven by developing ones. We consider a country developing if it is considered emerging or developing by the World Bank, and developed otherwise (the exact classification can be seen in the appendix). Figure 11 shows that when restricting our sample to developing economies, a 100bps shock reduces the price level by 5% relative to the baseline after 9 months, with a return to the baseline after 15 months. Due to fewer observations, the results are not significant for as many months. This perhaps is not surprising given that most of the developed countries have floating exchange rates in our sample -at least relative to countries outside the Eurozone- and the estimated interest rate pass-through is lower for these countries. Moreover, many of these countries experienced a confluence of very low interest rates and inflation in the years following the Great Financial Crisis of 2008-09.

**Figure 9:** Results controlling for the current account



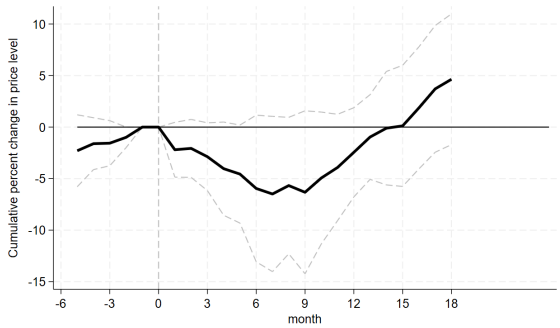

Notes: Response of inflation to a 100bps shock to domestic interest rates with balance of payments as an additional control. Interest rates instrumented with trilemma IVs. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Figure 10:** Results controlling for current account and exchange rate




Notes: Response of inflation to a 100bps shock to domestic interest rates with balance of payments and the exchange rate as additional controls. Interest rates instrumented with trilemma IVs. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Figure 11:** Results, developing countries only




Notes: Response of inflation to a 100bps shock to domestic interest rates with developed countries dropped from sample. Interest rates instrumented with trilemma IV. Dashed lines display 95% confidence intervals with standard errors clustered by country.

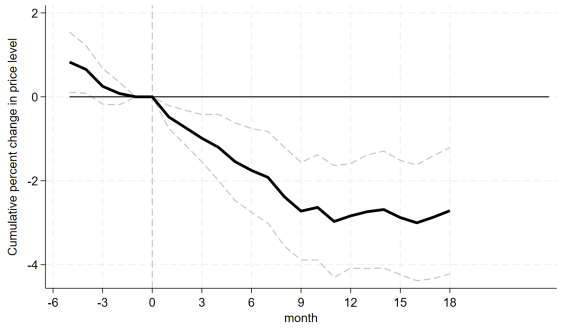
## 4.3 State dependency

We analyze five state variables to investigate the state-dependent effects of monetary policy. First, we classify country-month observations into high- and low-inflation states. Next, we apply a similar classification for both import and export commodity dependence. Next, we divide observations into two states based on GDP per capita. Finally, we classify countries into two groups based on their central government debt and reserves as a proportion of GDP. All results on state dependence are robust to the use of a continuous interaction term (see the appendix for more details).

Since the trilemma instrument and an interaction term are our independent variables, the interpretation of our state-dependent local projections in terms of domestic interest rates is less straightforward. However, assuming a pass-through coefficient of around .25 (our actual estimate was .27), the impulse response function for the interaction term $z_{i,t} \cdot D_{i,t}$, where $D_{i,t} \in (0, 1)$ is the state variable can be interpreted as the difference in the effect of a 25bps shock between the two states. A positive interaction term indicates that monetary policy is less effective when $D_{i,t} = 1$, while a negative interaction term indicates increased monetary policy effectiveness

We define high inflation on a country-specific basis to account for some countries having persistently high inflation rates. A country-month is in a high inflation state if monthly inflation is above that country's median inflation. Both state-dependent theoretical models and empirical evidence suggest that the pass-through of shocks to prices can be faster and increase with the size of the shock in high inflation situations since firms are more willing to bear the adjustment costs in these cases.[7] *A priori*, therefore, we should expect monetary policy shocks to have a greater impact in high inflation periods. Further, an increase in the base country interest rate may even turn into an initial decline in the real interest rate in low inflation countries if the pass-through into domestic interest rates experiences sufficient lags. Figure 12 presents the impulse response function for the interaction term $z_{i,t} \cdot \text{highinflation}_{i,t}$. The overall picture is consistent with our *a priori* expectation, with a shock to interest rates being significantly more effective in a high-inflation environment.

**Figure 12:** State dependent local projections, high inflation




Notes: Impulse response function for interaction term $z_{i,t}D_{i,t}$, where $D_{i,t} = 1$ when a country has above-median inflation. Dashed lines display 95% confidence intervals with standard errors clustered by country.

Figures 13 and 14 investigate the relationship between commodity dependence and the effectiveness of monetary policy. Country-months are grouped according to the percentage of commodities in their imports/exports, respectively. Those

[7] See Karadi et al. (2024) and Cavallo et al. (2024)

with above median shares are classified as commodity-import (or export) dependent. We find no significant difference between the effectiveness of monetary policy in high/low commodity import dependent countries. For commodity export dependence, a different picture emerges. Over most of the 18 month horizon, the interaction term for commodity export dependence is negative and significant, meaning monetary policy is more effective. Commodity exporters are more likely to suffer demand shocks versus supply-driven inflation, making interest rates more effective.

In figure 15, countries are divided into two groups depending on whether they are above or below the median sample GDP per capita in that year.[8] The high GDP per capita state is then used to create the interaction term. We find that monetary policy is less effective in high GDP countries, though the interaction term is not statistically significant.

Figure 16 shows the interaction between monetary policy and central government debt.[9] For the first twelve months following a monetary shock, the interaction term is near-zero, indicating little difference between low and high debt countries. However, from 12 months onwards, monetary policy is less effective in high debt countries, though not statistically significantly so. This could possibly reflect trade-offs between the desire to dampen inflation/depreciation and the need to service debt. Consider a highly indebted small open economy whose currency is managed relative to the US dollar. If the US increases its interest rates and, in response, the small open economy raises its interest rates to avoid depreciation, this might initially curb inflation. However, even if depreciation is avoided, debt servicing costs would increase regardless of whether the debt is denominated in foreign or domestic currency. Pressure to balance these two considerations may thus lead monetary policy instruments to work at cross-purposes, reducing the impact of interest rate shocks.

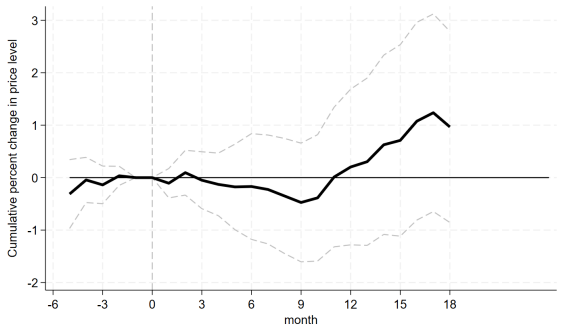
Finally, figure 17 investigates whether monetary shocks are more effective in countries with large foreign exchange reserves. Countries are classified as high reserve if their reserve to GDP ratio is in the top quartile of the sample. Although we find that monetary policy is slightly more effective in high-reserve countries, the difference captured by the interaction term is not statistically significant. Table 9 in the appendix shows that low-reserve countries have an interest rate pass-through of 0.43, whereas high-reserve countries have an interest rate pass-through of 0.21. After a shock to base country interest rates, a country can avoid depreciation through a mix of interest rate hikes and sale of reserves. Having a large stock of reserves comes

[8]Though classification as high/low GDP per capita changes over time, as an example, in 2010 the "low GDP countries" were Albania, Algeria, Barbados, Bolivia, Egypt, Ghana, Jamaica, Kenya, Kyrgyzstan, Madagascar, Mozambique, Nigeria, Pakistan, Rwanda, Sierra Leone, Sri Lanka, Tanzania, Uganda, and Zambia. The "high GDP countries" were Belgium, Brazil, Greece, Hong Kong, Iceland, Israel, Italy, Lebanon, Malaysia, Mauritius, Mexico, Romania, Saudi Arabia, Spain, Sweden, Thailand, Trinidad and Tobago, and Uruguay.

[9]We use the IMF measure of central government to GDP, which includes both foreign and domestic debt.

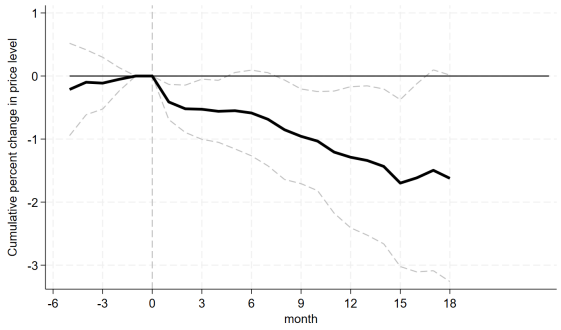
with a few potential benefits when it comes to fighting inflation. First, exchange rates are more credibly fixed in high-reserve countries, so the monetary regime helps anchor expectations. Second, any feedback between the interest rate and risk premia is likely diminished, further enhancing credibility.

**Figure 13:** State dependent local projections, commodity import dependence



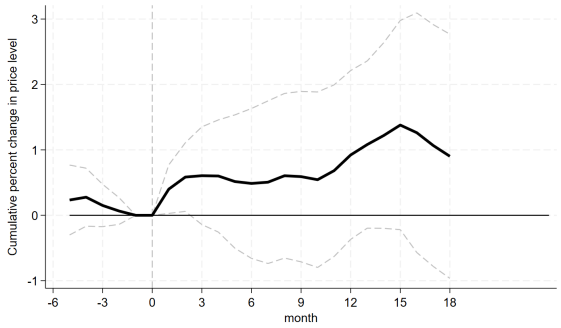

Notes: Impulse response function for interaction term $z_{i,t}D_{i,t}$, where $D_{i,t} = 1$ when a country has commodity imports as a percentage of total imports greater than the sample median. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Figure 14:** State dependent local projections, commodity export dependence



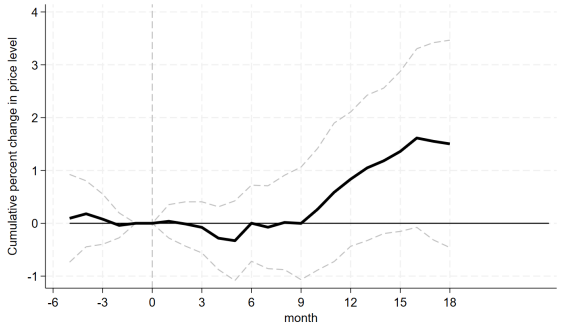

Notes: Impulse response function for interaction term $z_{i,t}D_{i,t}$, where $D_{i,t} = 1$ when a country has commodity exports as a percentage of total exports greater than the sample median. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Figure 15:** State dependent local projections, GDP per capita



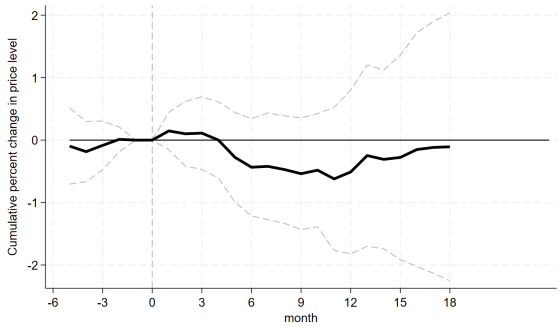

Notes: Impulse response function for interaction term $z_{i,t}D_{i,t}$, where $D_{i,t} = 1$ when a country has GDP per capita greater than the year mean. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Figure 16:** State dependent local projections, debt to GDP




Notes: Impulse response function for interaction term $z_{i,t}D_{i,t}$, where $D_{i,t} = 1$ when a country has central government debt to GDP greater than the sample median. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Figure 17:** State dependent local projections, FX reserve level




Notes: Impulse response function for interaction term $z_{i,t}D_{i,t}$, where $D_{i,t} = 1$ when a country has reserves to GDP in the sample's top quartile. Dashed lines display 95% confidence intervals with standard errors clustered by country.

# 5 Discussion of results

Our results suggest that monetary shocks have significant but relatively short-lived impacts on the price level. Although this is consistent with other papers using local projections to study monetary policy and inflation, there are some crucial differences that can be attributed to varying identification strategies and samples.

Furceri et al. (2018), Deb et al. (2023) and Checo et al. (2024) identify monetary policy shocks using professional interest rate forecasts. Taking the difference between actual and anticipated interest rates yields the unforecasted shock. This shock is then regressed upon macroeconomic fundamentals to account for monetary authorities' private information, with the residuals used as exogenous shocks. A subtle difference between the three studies is that Checo et al. (2024) use Bloomberg forecasts, which are continuously updated until the monetary policy announcement. Furceri et al. (2018) and Deb et al. (2023) find that monetary policy is significantly less impactful on price levels, with a 100bps shock only reducing the price level by .3% and .2% respectively. In Checo et al. (2024), a 100bps shock leads to prices 2% lower relative to baseline, with the impact lasting up to 36 months.

Even if interest rate shocks identified using forecast error or Taylor-rule residuals are plausibly exogenous, this approach has major limitations; in particular, it implies that anticipated interest rate changes have no impact on inflation. Suppose, for example, that monetary authorities pre-announced a schedule of randomly selected interest rate increases. There would then be zero forecast error, as agents would know the precise future path of interest rates, and therefore no interest-rate shock according to the forecast error approach. Nevertheless, agents would adjust their behavior in response by modifying the path of consumption and investment, which

could plausibly affect inflation.

With a panel of 18 developing countries, Brandão-Marques et al. (2024) finds that a 100bps increase in interest rates will have a maximum impact after 11 months with the price level falling 0.3% relative to baseline. Their identification strategy is to take residuals from fitted Taylor rules and use those as exogenous shocks. While this approach does not suffer from the same conceptual limitations as forecast error identification, private information held by monetary authorities cannot be ruled out as generating unanticipated monetary shocks. For example, internal data suggesting surging prices available only to the Federal Reserve might result in decisions that, while not explained by publicly available data, are still reactive and hence endogenous.

Given our different identification strategy, it is not surprising that the aforementioned studies reach different conclusions. More interestingly, Jordà et al. (2020) also uses the trilemma to identify exogenous monetary policy shocks but arrive at different results. Although monetary shocks have similar quantitative impacts (reducing the price level by 3% on impact), Jordà et al. (2020) find more persistent impacts of monetary policy shocks. Even after four years, the price level is 3% lower than the baseline after a 100bps shock, whereas monetary shocks in our study dissipate after 16 to 18 months.

One explanation lies in the differences in our sample. Jordà et al. (2020) uses a database for 20 advanced economies spanning from 1890 to the present. Therefore, their database encompasses the gold standard era, the great depression, the turmoil of two world wars and their aftermath, the breakdown of the Bretton Woods system, and the Volcker shock. Our post-1990 sample takes place during the great moderation, floating exchange rates (coexisting with the euro within the European Monetary Union), and the zero interest rate years in much of the developed economy group after the Great Recession. Crucially, this means there is less variability in monetary policy in our sample, which is reflected in the trilemma instruments. In Jordà et al. (2020), the trilemma instrument has a mean near zero and a standard deviation of 0.78. In our sample, the trilemma instrument also has a near-zero mean, but a standard deviation of only 0.15. We hypothesize that larger shocks are more persistent.

Another possible explanation is that monetary policy shocks are less persistent in small/developing open economies. Since the 1990s, remaining barriers to trade and cross-border investment have been consistently dismantled. With diminished policy space and greater susceptibility to international economic conditions, many of the economies in our sample, which are relatively open and economically small, may be primarily driven by external shocks. While we do not directly study the channels whereby monetary policy influences inflation (reduced consumption, investment, etc), it is plausible that the propagation of monetary policy is, past a certain horizon, drowned out by external shocks.

Another aspect that may have weakened the persistence of monetary policy

shocks in our sample is that, since the 1990s, there has been a shift in financial movements in emerging economies from sovereign flows to private flows, which are more sensitive to global risk aversion (see Avdjiev et al. (2022)). Bräuning and Ivashina (2020) show how the volume of loans issued by foreign banks is much more sensitive to US monetary cycles in the case of emerging economies, creating a much stronger connection between US monetary policy and EME credit cycles. Kalemli-Özcan (2019) incorporates and measures the effect of US monetary policy and EME risk premium. When the US rate increases (decreases), the EME risk premium also increases (decreases), and thus the pass-through is larger than one, explaining the stronger connection. Therefore, when tight monetary policy in advanced economies is unwound, credit flows to emerging markets may counteract the effects of contractionary monetary policy.

The stronger and more immediate effects of monetary policy shocks that we find on price levels in developing economies can be explained by two key mechanisms: more frequent price adjustments and higher exchange rate pass-through. As Karaca and Tugan (2017) highlight, prices in developing economies change more frequently, with nearly half of prices adjusting within a typical quarter. This contrasts with the slower adjustment dynamics in higher-income countries, where price rigidity dampens the immediate impact of monetary shocks on price levels. These authors also highlight that developing economies exhibit a higher exchange rate pass-through because of greater exposure to exchange rate volatility and imported consumer goods. Edwards (2006) explains that the trade structure of developing economies—characterized by significant consumer import reliance—exposes them to exchange rate fluctuations, amplifying the impact of monetary policy on prices through exchange rate pass-through. Mishkin (2007) further explains that underdeveloped financial markets in these economies exacerbate these effects by limiting the ability of firms and households to absorb shocks, forcing faster price-level adjustments. Moreover, developing economies are frequently commodity importers and exporters. Positive shocks to base country rates drive down global commodity prices, which creates another deflationary channel through reduced export earnings and cheaper imports (Vegh et al., 2017). Together, these factors explain why developing economies experience more pronounced and immediate price effects compared to those observed in developed ones (Ocampo & Ojeda-Joya, 2022).

Our results also relate to the literature on the price puzzle. With some samples and some specifications, interest rate increases are temporarily followed by a higher price level, before price levels drop relative to the baseline. This puzzle sometimes appears even after employing an identification strategy to address endogeneity issues. For example, Checo et al. (2024) finds a minor increase in CPI immediately after a monetary shock. However, as noted by Rusnak et al. (2013), the price puzzle is well explained by omitted variable bias. Typically, the puzzle disappears when commodity prices and output gaps are included as controls, or once forward-looking expectations

are incorporated (Ha et al., 2024; Rusnak et al., 2013). Although output-gap data is sparse for developing countries, our inclusion of commodity prices (either explicitly or through terms of trade) is sufficient to resolve the price puzzle on average.

Another explanation for why we do not find the price puzzle in our sample is our identification strategy. As noted by Balke et al. (1994), the price puzzle is particularly found in the 60s and 70s, with a strong moderation in the 80s. The authors argue that this is related to the Central Banks' behavior in these years: in the 1960s and 70s, the monetary authorities responded to signals of higher future inflation by increasing interest rates, but, importantly, not enough to fully offset the subsequent inflation. Therefore, we would find a positive correlation between interest rates and inflation. Our identification strategy, using an instrument based on the trilemma of international finance, is effective in eliminating this source of the price puzzle as it is able to capture more exogenous monetary shocks. This can also help explain why the absence of signs of a price puzzle in our sample is much more robust in the case of developing countries (see figure 11). The shocks in these countries tend to be much more exogenous than in the case of high-income developed economies.

The state-dependent effects of monetary policy illustrate how economic contexts fundamentally shape the transmission of monetary shocks. In high-inflation regimes, our findings reveal that contractionary monetary shocks lead to significant price declines, consistent with Ascari and Haber (2022)'s observation that higher inflation facilitates more frequent price adjustments, amplifying the immediate effects of monetary policy. Similarly, Ball and Mankiw (1994) argue that in such environments, the costs of not adjusting prices outweigh menu costs, fostering dynamic price responses. In contrast, low-inflation states exhibit the presence of the price puzzle, whereby prices paradoxically rise following contractionary shocks. This phenomenon, even after controlling for commodity prices and terms of trade, may reflect alternative mechanisms such as central bank signaling, lagged adjustments, or inflation expectations, alongside nominal rigidities that make firms reluctant to reduce prices. These findings highlight the importance of inflationary contexts in shaping monetary policy transmission and call for further exploration of nominal rigidities and forward-looking behaviors in low-inflation environments.

In commodity-exporting economies, the transmission of monetary policy may operate through distinct channels linked to their export structure. One potential explanation is offered by Frankel (2008), who highlights a "commodity channel" through which interest rate changes influence commodity prices. Tighter monetary policy, by increasing the cost of holding inventories and appreciating the domestic currency, can exert downward pressure on global commodity prices. For economies reliant on commodity exports, such price movements may translate into lower export revenues, reduced incomes, and weaker domestic demand, thereby amplifying the disinflationary effects of monetary policy. This mechanism suggests that the composition of trade, particularly dependence on commodity exports, could intensify

the responsiveness of inflation to interest rate shocks.

Our exploration of the role of high foreign reserves yields high FX reserve countries demonstrate the insulating effects of such reserves. With high reserves, the currency is less susceptible to speculative attacks and self-fulfilling prophecies of the sort described in the second generation of currency crisis models. With increased monetary policy credibility, monetary policy becomes more effective at anchoring inflation expectations. High debt to GDP countries appear to have shorter-lived effects of contractionary monetary policy. Highly-indebted countries, especially those with dollarized liabilities, are especially resistant to depreciation, and may target inflation more aggressively using non-monetary tools (Vegh et al., 2017).

# 6 Concluding Remarks

This study provides comprehensive evidence on the effectiveness of monetary policy in controlling inflation in the short-run across developed and developing economies. By employing a trilemma-based identification strategy, we capture the exogenous effects of monetary policy shocks and analyze their consequences using high-frequency data.

Our findings reveal that while monetary shocks significantly reduce inflation, the effects are transient. An increase in interest rates of 100 bps leads to an immediate fall in prices, whose peak is after 6 months with a 3.7% reduction. After that, the effects begin to dissipate, and after 18 months there is no statistically significant effect. Importantly, these results are robust across various robustness checks and highlight the absence of the "price puzzle" often associated with monetary tightening. Additionally, the study underscores the state-dependent nature of monetary policy impacts, with stronger responses observed in high-inflation periods and commodity-exporting economies.

The results have important implications for policymakers, particularly in developing countries. First, the estimates remind us that monetary policy is an effective inflation-fighting tool in developing economies, even if the effect is not permanent. Second, our analysis bears on the debate on the trilemma issue and shows that exchange rate regimes continue to be relevant to monetary policy transmission. Third, they emphasize the need for tailored monetary strategies that consider structural economic characteristics and the broader macroeconomic environment. Furthermore, the observed heterogeneities suggest the need to explore global monetary policy coordination, particularly from the perspective of small, open economies that are heavily influenced by external shocks.

By offering nuanced insights into the dynamics of monetary policy and inflation, this paper contributes to the ongoing debate on how central banks can effectively navigate complex economic landscapes in both advanced and emerging markets.

Future research could expand on this work by exploring the role of nominal rigidities, inflation expectations, central bank credibility, and trade composition in shaping monetary policy transmission.

# References


Alpanda, S., Granziera, E., & Zubairy, S. (2021). State dependence of monetary policy across business, credit and interest rate cycles. *European Economic Review*, *140*, 103936.

Ascari, G., & Haber, T. (2022). Non-linearities, state-dependent prices and the transmission mechanism of monetary policy. *The Economic Journal*, *132*(641), 37–57.

Avdjiev, S., Hardy, B., Kalemli-Özcan, Ş., & Servén, L. (2022). Gross capital flows by banks, corporates, and sovereigns. *Journal of the European Economic Association*, *20*(5), 2098–2135.

Balke, N. S., Emery, K. M., et al. (1994). Understanding the price puzzle. *Federal Reserve Bank of Dallas Economic Review, Fourth Quarter*, 15–26.

Ball, L., & Mankiw, N. G. (1994). Asymmetric price adjustment and economic fluctuations. *The Economic Journal*, *104*(423), 247–261.

Barro, R. J., & Rush, M. (1980). Unanticipated money and economic activity. In *Rational expectations and economic policy* (pp. 23–73). University of Chicago Press.

Barth III, M. J., & Ramey, V. A. (2001). The cost channel of monetary transmission. *NBER Macroeconomics Annual*, *16*, 199–240.

Bauer, M. D., & Swanson, E. T. (2023). A reassessment of monetary policy surprises and high-frequency identification. *NBER Macroeconomics Annual*, *37*(1), 87–155.

Blanchard, O., & Bernanke, B. (2023). What caused the us pandemic-era inflation? *NBER Working Paper*(w31417).

Brandão-Marques, L., Meeks, R., & Nguyen, V. (2024). *Monetary policy with uncertain inflation persistence.* International Monetary Fund. Retrieved from https://www.elibrary.imf.org/view/journals/001/2024/047/article-A001-en.xml

Bräuning, F., & Ivashina, V. (2020). US monetary policy and emerging market credit cycles. *Journal of Monetary Economics*, *112*, 57–76.

Camara, S., Christiano, L., & Dalgic, H. (2024). The international monetary transmission mechanism. *NBER Macroeconomics Annual*, *39*.

Cavallo, A., Lippi, F., & Miyahara, K. (2024). Large shocks travel fast. *American Economic Review: Insights*, *6*(4), 558–74. Retrieved from https://www.aeaweb.org/articles?id=10.1257/aeri.20230454 doi: 10.1257/aeri.20230454

Checo, A., Grigoli, F., & Sandri, D. (2024). *Monetary policy transmission in emerging markets: Proverbial concerns, novel evidence.* Retrieved from https://www.bis.org/publ/work1170.htm

Deb, P., Estefania-Flores, J., Firat, M., Furceri, D., & Kothari, S. (2023). *Monetary policy transmission heterogeneity: Cross-country evidence.* Retrieved from https://www.imf.org/en/Publications/WP/Issues/2023/09/28/Monetary-Policy-Transmission-Heterogeneity-Cross-Country-Evidence-539662

Edwards, S. (2006). The relationship between exchange rates and inflation targeting revisited. *NBER Working Paper*(w12163).

Eichenbaum, M., Rebelo, S., & Wong, A. (2022). State-dependent effects of monetary policy: The refinancing channel. *American Economic Review*, *112*(3), 721–761.

Estrella, A. (2015). The price puzzle and var identification. *Macroeconomic Dynamics*,

*19*(8), 1880–1887.

Frankel, J. (2008). The effect of monetary policy on real commodity prices. In *Asset prices and monetary policy* (pp. 291–333). University of Chicago Press.

Frankel, J. (2010). Monetary policy in emerging markets. In *Handbook of monetary economics* (Vol. 3, pp. 1439–1520). Elsevier.

Friedman, M. (1968). The role of monetary policy. *The American Economic Review*, *58*(1), 1–17.

Friedman, M. (1970). A theoretical framework for monetary analysis. *Journal of Political Economy*, *78*(6), 1385–1386.

Furceri, D., Loungani, P., & Zdzienicka, A. (2018). The effects of monetary policy shocks on inequality. *Journal of International Money and Finance*, *85*, 168-186. Retrieved from https://www.sciencedirect.com/science/article/pii/S0261560617302279 doi: https://doi.org/10.1016/j.jimonfin.2017.11.004

Gertler, M., & Karadi, P. (2015). Monetary policy surprises, credit costs, and economic activity. *American Economic Journal: Macroeconomics*, *7*(1), 44–76.

Ha, J., Kim, D., Kose, M. A., & Prasad, E. S. (2024). Resolving puzzles of monetary policy transmission in emerging markets. *NBER Working Paper*(w33133).

Ha, J., Kose, M. A., & Ohnsorge, F. (2023). One-stop source: A global database of inflation. *Journal of International Money and Finance*, *137*, 102896.

Ilzetzki, E., Reinhart, C. M., & Rogoff, K. S. (2022). Rethinking exchange rate regimes. In G. Gopinath, E. Helpman, & K. S. Rogoff (Eds.), *Handbook of international economics 6* (p. 91-145). Elsevier: North Holland. Retrieved from https://www.ilzetzki.com/irr-data

Jordà, Ò. (2005). Estimation and inference of impulse responses by local projections. *American Economic Review*, *95*(1), 161–182. Retrieved from https://www.aeaweb.org/articles?id=10.1257/0002828053828518 doi: 10.1257/0002828053828518

Jordà, Ò., Schularick, M., & Taylor, A. M. (2020). The effects of quasi-random monetary experiments. *Journal of Monetary Economics*, *112*, 22-40. Retrieved from https://www.sciencedirect.com/science/article/pii/S0304393218302587 doi: https://doi.org/10.1016/j.jmoneco.2019.01.021

Jordà, Ò., Singh, S. R., & Taylor, A. M. (2024). The long-run effects of monetary policy. *Review of Economics and Statistics*, *Forthcoming*.

Kalemli-Özcan, Ş. (2019). Us monetary policy and international risk spillovers. *NBER Working Paper*(w26297).

Karaca, E., & Tugan, M. (2017). Aggregate dynamics after a shock to monetary policy in developing countries. *International Journal of Central Banking*, *13*(1), 261–296.

Karadi, P., Nakov, A., Nuno, G., Pasten, E., & Thaler, D. (2024). Strike while the iron is hot: Optimal monetary policy with a nonlinear phillips curve. *CESifo Working Paper Series*(11372). Retrieved from <https://ideas.repec.org/p/ces/ceswps/_11372.html>

Lucas Jr, R. E. (1972). Expectations and the neutrality of money. *Journal of Economic Theory*, *4*(2), 103–124.

Miranda-Agrippino, S., & Rey, H. (2022). The global financial cycle. In *Handbook of international economics* (Vol. 6, pp. 1–43). Elsevier.

Mishkin, F. S. (2007). *Monetary policy strategy*. MIT Press.

Ocampo, J. A., & Ojeda-Joya, J. (2022). Supply shocks and monetary policy responses in emerging economies. *Latin American Journal of Central Banking*, *3*(4), 100071. Retrieved from https://www.sciencedirect.com/science/article/pii/S2666143822000254 doi: https://doi.org/10.1016/j.latcb.2022.100071

Phelps, E. S. (1967). Phillips curves, expectations of inflation and optimal unemployment over time. *Economica*, 254–281.

Quinn, D., Schindler, M., & Toyoda, M. A. (2011). Assessing measures of financial openness and integration. *IMF Economic Review*, *59*(3), 488–522. doi: 10.1057/imfer.2011.18

Rey, H. (2016). International channels of transmission of monetary policy and the mundellian trilemma. *IMF Economic Review*, 6–35.

Romer, C. D., & Romer, D. H. (1994). What ends recessions? *NBER Macroeconomics Annual*, 13–57.

Romer, C. D., & Romer, D. H. (2004). A new measure of monetary shocks: Derivation and implications. *American Economic Review*, *94*(4), 1055–1084.

Rusnak, M., Havranek, T., & Horvath, R. (2013). How to solve the price puzzle? a meta-analysis. *Journal of Money, Credit and Banking*, *45*(1), 37–70. Retrieved 2024-09-02, from http://www.jstor.org/stable/23320076

Taylor, J. B. (1995). The monetary transmission mechanism: An empirical framework. *The Journal of Economic Perspectives*, *9*(4), 11–26.

Uribe, M. (2022). The neo-fisher effect: Econometric evidence from empirical and optimizing models. *American Economic Journal: Macroeconomics*, *14*(3), 133–162.

Vegh, C., Morano, D., Freidheim, D., & Rojas, D. (2017). *Between a rock and a hard place: the monetary policy dilemma in latin america and the caribbean* (LAC Semi-annual Report No. 334). Washington, DC: The World Bank.

# A Summary statistics

**Table 5:** Summary statistics

| Variable | $\Delta R_{i,t}$ | Inflation | Trilemma Instrument | Commodity price inflation | Exchange rate |
|---|---|---|---|---|---|
| SD | 1.27 | 5.34 % | .15 | 24% | 535.129 |
| Mean | -.05 | .06 | -.01 | 4% | 214.32 |
| Variance | 1.61 | .29% | .02 | 6% | 286363 |
| Median | -.00 | 4.38% | -.01 | 4% | 19.58 |
| Min | -34.49 | -6.33 % | -1.53 | -65% | .04 |
| Max | 23.11 | 34.01% | 1.21 | 53% | 3667.51 |
| N | 8419 | 8407 | 8419 | 8419 | 7548 |

# B Data and sources

**Table 6:** Data sources

| Variable | Source |
|---|---|
| Base country data | Ilzetzki et al. (2022) |
| Exchange rate classification | Ilzetzki et al. (2022) |
| Base country interest rate | Short-term interest rates, OECD stat |
| Base country industrial output index | OECD stat |
| Headline inflation | IMF International Financial Statistics (IFS) |
| Short-term interest rates | IFS (Treasury Bills, Percent per annum ) |
| Trade openness | World Development Indicators (WDI) |
| Current account as a percentage of GDP | IMF World Economic Indicators (WEO) |
| Import terms of trade | IFS |
| Capital account openness | Quinn et al. (2011) |
| Commodity dependence (imports and exports) | UNCTAD |
| Debt to GDP | IFS |
| FX Reserves to GDP | IFS |

# C Further robustness checks

## C.1 Changes to the baseline

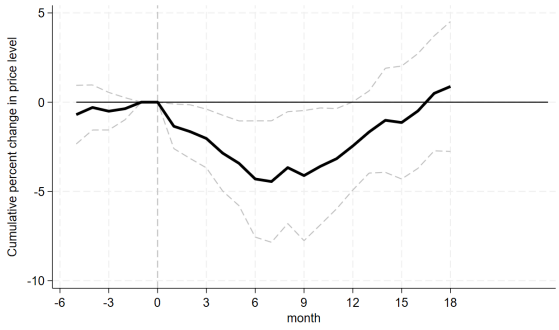
We want to ensure that our results are not sensitive to the specification of the Taylor rule in our zero stage. We therefore recalculate the trilemma instruments with (1) base country Taylor rules without lags of the bill rate and (2) base country monetary

**Table 7:** Country list. Starred countries classified as developed.

| Europe | Asia | Africa | Latin America & Carribbean |
|---|---|---|---|
| Albania | Bangladesh | Algeria | Bahamas |
| Belgium* | Georgia | Egypt | Barbados |
| Bulgaria | Hong Kong* | Ghana | Bolivia |
| Greece* | Israel* | Kenya | Brazil |
| Hungary* | Kyrgyzstan | Madagascar | Jamaica |
| Iceland* | Lebanon | Mauritius | Mexico |
| Italy | Malaysia | Mozambique | Trinidad & Tobago |
| Romania | Pakistan | Nigeria | Uruguay |
| Spain | Nepal | Rwanda | |
| Sweden* | Saudi Arabia* | Sierra Leone | |
| | Sri Lanka | South Africa | |
| | Thailand | Tanzania | |
| | | Uganda | |
| | | Zambia | |

policy which only responds to inflation. Figures 18 and 19 display cases 1 and 2 respectively - results are largely unchanged.

**Figure 18:** Baseline results, no bill rate lags in 0-stage

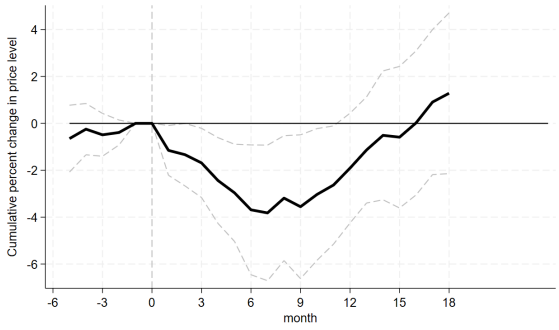



Notes: Response of inflation to a 100bps shock to domestic interest rates. Interest rates instrumented by a trilemma IVs not incorporating lagged bill rates in estimations of unanticipated monetary shocks. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Table 8:** Time coverage

| Country | Data starts | Country | Data starts |
|---|---|---|---|
| Albania | July 1994 | Malaysia | Jan 1990 |
| Algeria | June 1998 | Mauritius | Dec 2001 |
| Bahamas | Jan 1990 | Mexico | Jan 1990 |
| Bangladesh | July 2006 | Mozambique | Jan 2004 |
| Barbados | Jan 1990 | Nepal* | Jan 1990 |
| Belgium | Jan 1990 | Nigeria | Apr 1994 |
| Bolivia | Jan 1994 | Pakistan | July 1994 |
| Brazil | Jan 1995 | Romania | April 2001 |
| Bulgaria | Jan 2006 | Rwanda | March 1999 |
| Canada | Jan 1990 | Saudi Arabia | June 2009 |
| Egypt | Jan 1997 | Sierra Leone | Jan 2006 |
| Georgia | Jan 2001 | South Africa | Mar 1995 |
| Ghana | Oct 1990 | Spain | Jan 1990 |
| Greece | Jan 2000 | Sri Lanka | Dec 2001 |
| Hong Kong | Dec 1992 | Sweden | Jan 1990 |
| Hungary | Jan 1990 | Tanzania | Dec 1993 |
| Iceland | Nov 1992 | Thailand | Feb 2001 |
| Israel | Jan 1995 | Trinidad and Tobago | Jan 1990 |
| Italy | Jan 1990 | Uganda | Jan 1993 |
| Jamaica | Jan 1990 | Uruguay | Oct 1995 |
| Kenya | Jun 1994 | Zambia | Sep 2001 |
| Kyrgyzstan | Dec 1999 | | |
| Lebanon | Dec 2007 | | |
| Madagascar | Aug 2000 | | |

**Figure 19:** Baseline results,inflation-only monetary rule



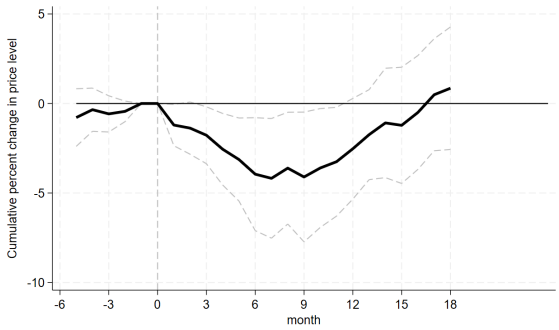

Notes: Response of inflation to a 100bps shock to domestic interest rates. Interest rates instrumented by a trilemma IVs with unanticipated shocks estimated assuming central banks are solely focused on inflation. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Table 9:** Interest rate pass-through by reserve level.

| | Low reserve | High reserve |
|---|---|---|
| $\lambda$ | .43 | .21 |
| $t$ | 2.15 | 1.91 |
| p | 0.04 | .06 |
| Observations | 7953 | |
| F | 14.32 | |

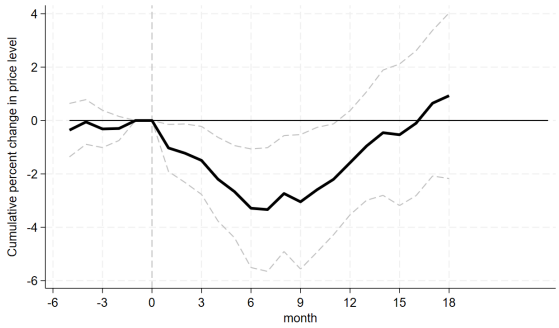
To capture global shocks, we used import terms of trade. However, our results are robust to the inclusion of global GDP growth as well, as shown in figure 20. Global GDP growth is at an annual frequency, so we also test if results are robust to the inclusion of the monthly US industrial output index as a proxy for US growth. Figure 21 shows that the results are indeed robust to including US growth.

**Figure 20:** Baseline results, global growth included as a control




Notes: Response of inflation to a 100bps shock to domestic interest rates controlling for global growth. Interest rates instrumented by trilemma IVs. Dashed lines display 95% confidence intervals with standard errors clustered by country.

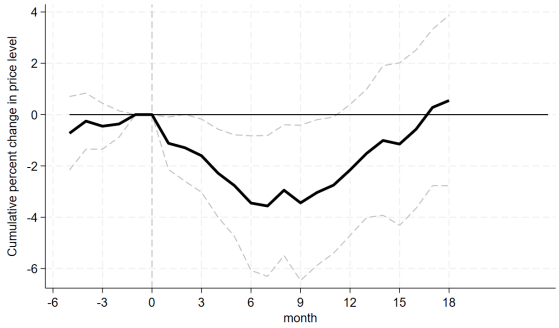
**Figure 21:** Baseline results, US industrial index growth as control




Notes: Response of inflation to a 100bps shock to domestic interest rates controlling for US growth. Interest rates instrumented by trilemma IVs. Dashed lines display 95% confidence intervals with standard errors clustered by country.

Rey (2016) argues that there is a global financial cycle, jointly determining capital flows, monetary policy, and other economic outcomes. This global financial cycle closely tracks the VIX. To double-check that the VIX is not influencing our results, we include the log of VIX as a control in our baseline in figure 22. Results are once again unchanged.

**Figure 22:** Baseline results, log VIX as a control

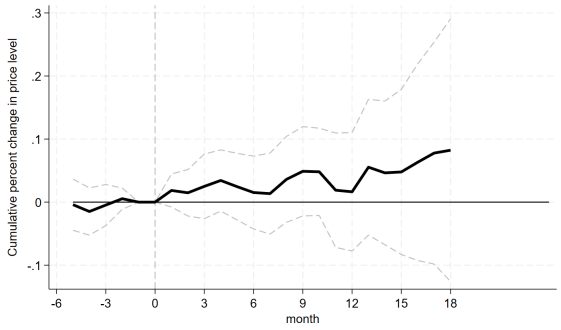



Notes: Response of inflation to a 100bps shock to domestic interest rates controlling for log VIX. Interest rates instrumented by trilemma IVs. Dashed lines display 95% confidence intervals with standard errors clustered by country.

## C.2 State-dependent local projections

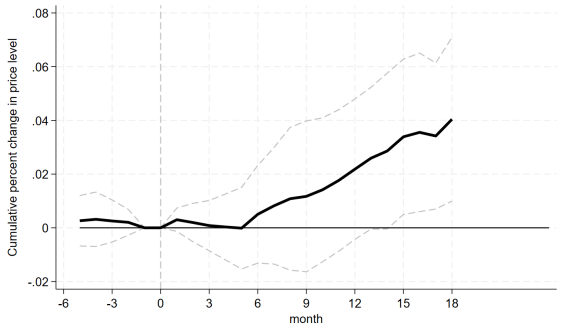
In this section, we display the results from state-dependent local projections with a continuous interaction term. These figures show that our state-dependent results are robust to alternative specifications of states.

**Figure 23:** State dependent local projections, continuous FX reserve interaction term



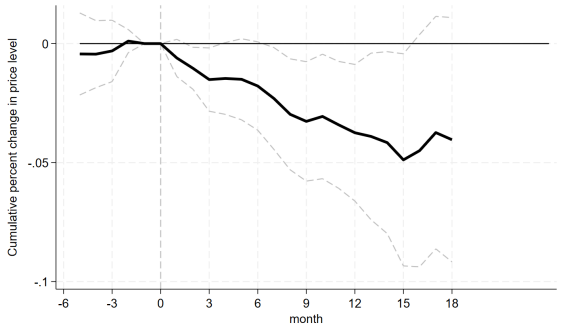

Notes: Impulse response function for interaction term $z_{i,t}B_{i,t}$, where $B_{i,t}$ is the country's reserves to GDP ratio. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Figure 24:** State dependent local projections, continuous debt to GDP interaction term



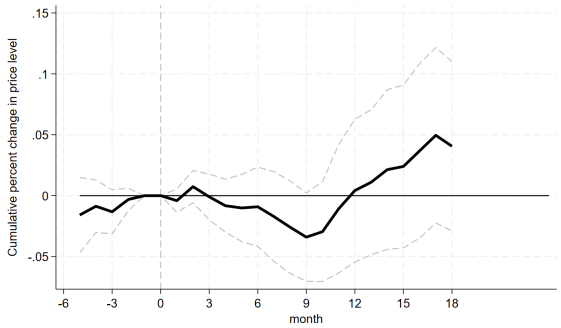

Notes: Impulse response function for interaction term $z_{i,t}B_{i,t}$, where $B_{i,t}$ is the country's central government debt to GDP ratio. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Figure 25:** State dependent local projections, continuous commodity export share interaction term



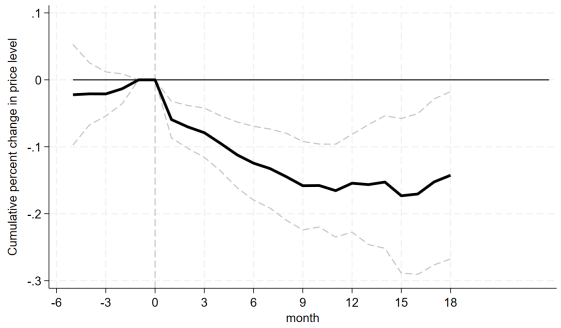

Notes: Impulse response function for interaction term $z_{i,t}B_{i,t}$, where $B_{i,t}$ is the country's commodity export to total export ratio. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Figure 26:** State dependent local projections, continuous commodity import share interaction term




Notes: Impulse response function for interaction term $z_{i,t}B_{i,t}$, where $B_{i,t}$ is the country's commodity import to total import ratio. Dashed lines display 95% confidence intervals with standard errors clustered by country.

**Figure 27:** State dependent local projections, continuous inflation interaction term




Notes: Impulse response function for interaction term $z_{i,t}B_{i,t}$, where $B_{i,t}$ is the country's inflation rate. Dashed lines display 95% confidence intervals with standard errors clustered by country.


Documentos
de trabajo
Novedades
Fondo
editorial
Revistas
LIBROS
eBooks
Libros