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MONETARY POLICY CYCLICALITY IN EMERGING ECONOMIES

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ABSTRACT

We document a disconnect between policy rates and short-term market rates in emerging economies. On the one hand, central banks in emerging economies follow Taylor-type rules and lower their policy rates when economic activity decelerates. On the other hand, the policy rate transmits only imperfectly to short-term market rates. We hypothesize that this disconnect emerges from these countries' reliance on fluctuating global financial conditions. Following an exogenous U.S. monetary policy tightening, emerging market central banks lower their policy rates in response to decelerating economic activity. Nevertheless, short-term market rates increase at the same time, inducing a contractionary force on economic activity. We show that such disconnect between policy rates and short-term market rates can be rationalized by a model where emerging economies' banks largely rely on international markets for their funding. Our results shed light on the questions of monetary policy cyclicality and autonomy in emerging economies.

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1 Introduction

Emerging economies recurringly experience episodes of capital inflows and outflows, sudden stops and flow reversals as they are notoriously exposed to global financial conditions. During these capital flow episodes, monetary authorities face complex trade-offs. Consider for example the effects of a U.S. monetary tightening causing tight global financial conditions and a deterioration in economic activity in the U.S. and globally. On the one hand, emerging economies' central banks could increase their policy rate in tandem with the Federal Reserve in order to avoid large fluctuations in capital flows and the exchange rates (Calvo and Reinhart, 2002). This choice of mimicking U.S. monetary policy may indicate lack of independent monetary policy linked to "fear of floating." On the other hand, central banks can lower their policy rate to alleviate the deterioration in domestic economic activity induced by contracting global demand and tighter global financial conditions.

We argue that the country's exposure to the global financial cycle, and whether it allows for effective monetary independence (Miranda-Agrippino and Rey, 2020) and the monetary policy's ability to affect local financial conditions (Kalemli-Ozcan, 2019) are at the center of these issues. We show that central banks in emerging economies lower their policy rates in response to deteriorating local economic activity, yet their pass-through to short-term market rates appears severely compromised by their exposure to global financial conditions, mainly fluctuations in their domestic financial intermediaries' funding markets.

We begin by studying the typical behavior of emerging economies' policy rates vis-à-vis local inflation and economic activity. To do so, we first estimate policy rules à la Taylor (1993, 1999) and find that central banks adjust the policy rate in response to changes in both inflation and economic conditions (as measured by GDP growth or the output gap). In this respect, we find that central banks in emerging economies operate similarly to central banks in advanced economies. We then study the correlation of local interest rates with local economic activity (as measured by real GDP growth). We find that policy rates are lower when local economic activity decelerates. However, we also find that short-term market rates, such as 3- and/or 12-month government bond (treasury) rates, tend to *increase* when economic activity contracts. To the contrary, we find that policy rates and short-term market rates both decline in advanced economies when economic activity decelerates. This evidence indicates that local monetary policy is counter-cyclical in emerging and advanced economies alike over the last three decades. However, emerging economies' market rates exhibit a *disconnect* from local policy rates, and the wedge between the two is countercyclical as the wedge is likely driven by a risk premium that moves in tandem with global financial conditions.

To explore our hypothesis that the disconnect between short-term local market rates and policy rates in emerging economies emanates from their reliance on global financial markets, we examine the responses of emerging economies and their interest rates to identified exogenous U.S. monetary policy shocks. Such shocks are shown to be a prominent cause of the global financial cycle (Miranda-Agrippino and Rey, 2020). To extract the exogenous component in U.S. monetary policy changes we follow the high-frequency identification approach in Gertler and Karadi (2015). We find that the disconnect between policy rates and market rates emerges also following a U.S. monetary policy tightening. Additionally, an exogenous increase in U.S. interest rates leads to a contraction in capital inflows, economic activity, and CPI inflation in emerging economies, as well as tighter financial conditions (as captured by the VIX). As a result, even though central banks cut their policy rates, there is an increase in short-term borrowing and lending market rates such as treasury, money market and loan rates.[1] This result suggest that disruptions in global financial markets are a culprit behind the disconnect between policy rates and market rates in emerging economies, given the dependence of emerging economies on external finance.

We write down a simple small-open economy model that can deliver the facts that we documented. In the model, local banks rely not only on domestic deposits but also on the international markets for funding.[2] A U.S. monetary contraction tightens global funding conditions, in addition to causing a decline in global demand. We assume that local banks are the marginal investor in the government bond and household credit markets. As a result, short-term market rates reflect the marginal funding costs of local banks that are a function of both local policy rates and international borrowing rates. Therefore, the pass-through of monetary policy to short-term rates is incomplete and inversely proportional to the local bank reliance on the global funding market. Besides, equilibrium short-term market rates can display opposite cyclical properties than the policy rate if external shocks are a dominant cause of emerging economies' business cycle.

[1] The response of short- term domestic household-firm borrowing/bank lending rates in emerging economies to exogenous U.S. tightening was originally documented in Kalemli-Ozcan, 2019.

[2] See Baskaya et al. (2017) and Hahm et al. (2013) for evidence on banks' domestic and foreign funding sources in emerging markets.

Our paper relates to a large literature. Our model and evidence are both consistent with papers showing the transmission of global financial cycle through local banks' funding conditions (di Giovanni et al., 2022; Fendoglu et al., 2019) and also with papers showing that global funding becomes more costly during periods of tighter U.S. monetary policy, interpreted as deriving from changes in the global perceptions of risk (Miranda-Agrippino and Rey, 2020; Kalemli-Ozcan, 2019).

More broadly, the literature on monetary and fiscal policies in emerging markets was initiated by the seminal work of Kaminsky et al. (2005). In a sample that covers 1960–2003, Kaminsky et al. find strong evidence in favor of procyclical fiscal policy (see also Gavin and Perotti, 1997), and some evidence in support of the notion of procyclical monetary policy, though the authors acknowledge the limitations of this finding since they do not have enough data on monetary policy rates from emerging economies and hence use short-term market rates to proxy for policy rates. More recently, in a sample that covers 1960–2009, Vegh and Vuletin (2013) find a positive correlation between the cyclical components of policy rates and real GDP in emerging economies especially in the more recent part of the sample, after 2000. This is consistent with our results though as we show this was also the case in our entire 1990–2018 sample. Vegh and Vuletin interpret their evidence as "graduation" of emerging economies' central banks from their procyclical monetary policy stance pre-2000s and making counter-cyclical monetary policy with better inflation targeting frameworks. Our contribution is to show emerging markets' central banks' monetary policy have always been counter-cyclical in the last three decades, however, this counter-cyclical stance implied by the policy rates does not directly transmit to short-term market rates.[3] The implication, and our methodological contribution, is thus to show that the common practice of using short-term market rates to proxy for the stance of monetary policy may lead one to draw inaccurate conclusions about the cyclical properties of the monetary policy in emerging economies—as those rates encompass counter-cyclical risk premia—even though this practice appears justified for advanced economies.

We also relate to the empirical literature that investigates the degree of monetary policy autonomy in emerging economies. Recently, Rey (2013) and Miranda-Agrippino and Rey (2020) argue that floaters may not enjoy full monetary autonomy under the global financial

[3] Of course there were countries with procyclical policy, however, our research makes a strong case that these were outliers and not represent the average and/or the median emerging market.

cycle as global leverage and capital flows are significantly affected by changes in global risk aversion and U.S. monetary policy both in floaters and peggers. Obstfeld et al. (2019) document that floaters experience milder macroeconomic and financial fluctuations than peggers during periods of heightened global risk aversion.[4] Kalemli-Ozcan (2019) explains this result by documenting that risk premia in short-term market rates underlie the responses of leverage and capital flows to U.S. monetary policy, where floating rates absorb risk premia shocks, providing some insulation. Taken together, all these papers suggest that floating exchange rate regimes grant some degree of monetary policy autonomy and partial insulation from external shocks, but not a full autonomy as argued by Rey (2013). Our contribution is to show that incomplete monetary autonomy of emerging economies' central banks manifest itself through a disconnect between policy rates and the relevant short-term market rates. This paper can thus shed light on the question of what prevents floaters from enjoying full insulation from external shocks.[5]

Last, this paper is related to the literature on emerging economies' business cycles and the sources of countercyclical real rates, initiated by Neumeyer and Perri (2005). The question was later explored by several insightful studies, such as Aguiar and Gopinath (2007), García-Cicco et al. (2010), Fernández-Villaverde et al. (2011), and Coulibaly (2021). While these papers all work with real models, we develop a model with nominal rigidities that can speak to the nature of monetary transmission in emerging economies. Besides, our mechanism centers around local banks reliance on international markets for funding and fluctuating global funding conditions due to changes in the global perceptions of risk, and thus incorporates elements of the literature on the global financial cycle.

The rest of the paper proceeds as follows. Section 2 studies the behavior of monetary policy rates in emerging economies. Section 3 documents the disconnect between policy rates and short-term market rates in emerging economies. Section 4 develops a general-equilibrium model that rationalizes this disconnect. Section 5 concludes.

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[4] See also Obstfeld et al. (2004), Obstfeld (2015), Aizenman et al. (2010), and Han and Wei (2018).

[5] Some papers analyze the cross-country co-movement of interest rates, although also using market rates to proxy for the monetary policy stance. Shambaugh (2004) examines the extent to which short-term rates co-move with U.S. interest rates, finding that floaters' rates follow U.S. interest rates much less closely than pegs, consistent with the notion that floating exchange rates absorb the risk premia to a certain extent in short-term rates. This result also emerges for exogenous U.S. monetary policy shocks, not just for actual U.S. Fed Funds rate movements (Bluedorn and Bowdler, 2010), and does not appear to rely on the presence of capital controls (Miniane and Rogers, 2007; Klein and Shambaugh, 2015).

2 Monetary Policy in Emerging Economies: What Do They Do?

In this section, we document the behavior of monetary policy vis-à-vis local inflation and economic activity. To characterize the monetary policy stance we use publicly announced *policy rates*. In this sense, we move away from a common practice that uses short-term market rates to proxy for the stance of monetary policy. Short-term market rates such as government bond/treasury rates, money market rates, or lending rates are not entirely "risk-free" in EMEs. Treasury rates are rates at which governments issue their debt instruments, money market rates are rates charged on loans among banks, and lending rates are rates on bank loans (typically corporate loans). While closely related, these market rates are not directly comparable, and they measure the stance of monetary policy only imperfectly. In fact, market rates differ from the policy rate by the time-varying risk premia underlying each specific lending relationship. We will show that distinguishing between policy rates and market rates is of first-order importance in EMEs.

Dataset Our sample focuses on countries and time periods that are characterized by a flexible exchange rate regime. For the classification of exchange rate regimes we rely on the historical exchange rate classification in Ilzetzki et al. (2019), which is a country-quarter level time varying classification.[6] We use available quarterly data from 1990:Q1 to 2018:Q4, an unbalanced sample. Appendix A lists the countries included in the dataset.

We collect all available data on policy rates (i^P) as well as treasury rates (i^T) and money market rates (i^M). Policy rates are the target interest rate set by central banks in their efforts to influence short-term interest rates as part of their monetary policy strategy. For policy interest rates, our preferred data source is the *BIS*. If *BIS* data are not available we use data from the *IMF International Financial Statistics* or from national sources retrieved from *Bloomberg*. The choices of the sources are of no material difference. In fact, when all sources are available the correlation between *BIS* rates and data from alternative sources is always above 0.96. The maturity of short-term interest rates in our sample is 3 months.[7] The sources of treasury and money market rates are *IMF International Financial Statistics* or national

[6] A country is considered to have a flexible exchange rate regime if, in a given quarter, its exchange rate was within a moving band that is narrower than or equal to +/-2 percent or was classified as managed floating, freely floating or freely falling in Ilzetzki et al. (2019).

[7] We find similar results when using 1-month rates or 12-month rates.

sources retrieved from *Bloomberg*. See Appendix Tables A.2-A.4 for more details about the data.

To present few examples from our dataset, we focus on three big external shock to EMEs: COVID-19, Taper Tantrum, and Global Financial Crisis. During the COVID-19 pandemic both AEs and EMEs lowered their monetary policy rates to counter the economic recession, as shown in Figure 1a. In fact, we observe that the vast majority of EMEs' central banks cut their policy rates also during the Global Financial Crisis (GFC) and Taper Tantrum episodes, as shown in the Figures 1b and 1c, respectively.[8] This is interesting since EME currencies have also depreciated during these events and given a high degree of exchange rate pass-through, such currency depreciations can feed back into inflation.[9] In addition, depreciations can cause balance sheet distress for governments and firms that have borrowed in foreign currency. In the next sections, we will have a deeper look on the behavior of policy rates and market rates both as a response to fluctuations in local economic activity and also to U.S. monetary policy.

Estimation of central banks' reaction function To summarize a central bank's reaction function, macroeconomists frequently use interest rate rules, such as the ones put forward by Taylor (1993, 1999). Such policy rules describe how the monetary authority adjusts its policy instrument (typically the short-term policy rate) in response to deviations of inflation and economic conditions from their objectives. A standard version of a Taylor-type rule is: $i_t^P = \rho i_{t-1}^P + (1-\rho)\left(\phi_\pi \pi_t + \phi_y \tilde{y}_t\right) + \varepsilon_t^P$. According to this rule, the central bank adjusts the policy rate in response to changes in inflation (with coefficient ϕ_π) and economic conditions, such as output growth or the output gap (with coefficient ϕ_y). The rule allows for policy smoothing by including a first-order autoregressive term in the Taylor rule, and for i.i.d. monetary policy shocks, ε_t^P.

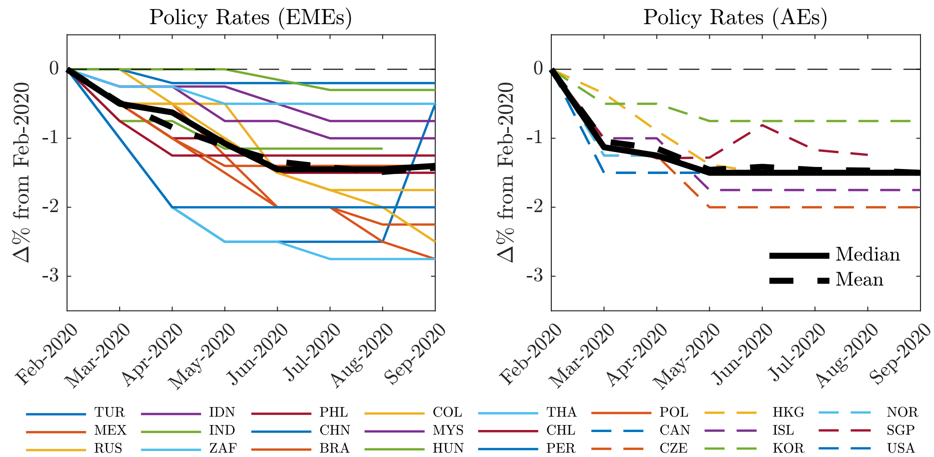
To estimate the central bank's reaction function we thus consider the following regression:

$$i_t^P = \alpha + \beta_1 i_{t-1}^P + \beta_2 \pi_t + \beta_3 \tilde{y}_t + \epsilon_t \tag{1}$$

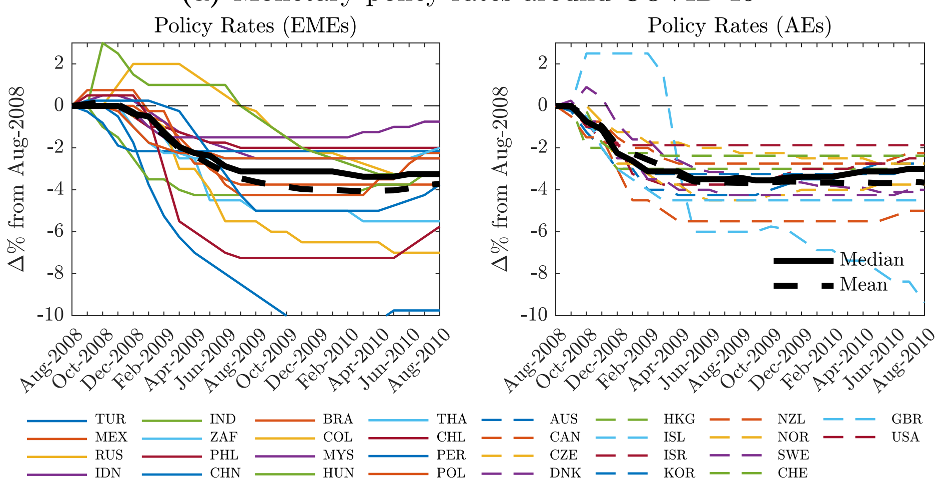
[8] Figure 1 uses data from Bloomberg Finance L.P.; IMF, World Economic Outlook database. Focusing largely on the sudden stops occurred in 2008Q4 around GFC, Eichengreen and Gupta find that monetary policy was eased in response to these sudden stops more often than it is tightened (only 8 out of 43 EMs tightened). They rely on IMF reports and market commentary to code changes in monetary policies, following the narrative approach of Romer and Romer (1989) and Alesina et al. (2018).

[9] Several studies document a high exchange rate pass-through into import prices in EMEs (see, for example, Burstein and Gopinath, 2014).

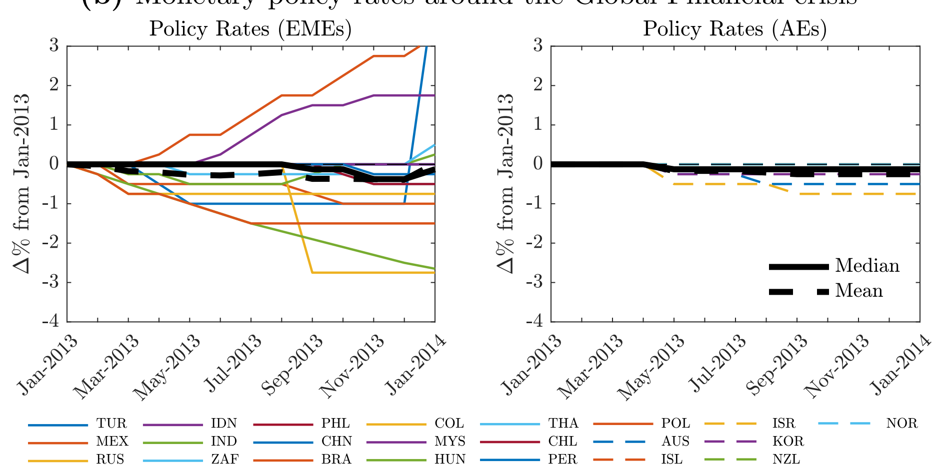
Figure 1: Monetary policy rates around episodes of global financial distress



(a) Monetary policy rates around COVID-19



(b) Monetary policy rates around the Global Financial crisis



(c) Monetary policy rates around the Taper Tantrum

We follow Carvalho et al. (2021) in using OLS to estimate the parameters of the Taylor rule. To estimate equation (1) we use the country's policy rate. Inflation is the rate of change in the consumer price index (CPI). To measure economic conditions, we use either the rate of change in the country's real gross domestic product (Δgdp_t) or the country's output gap, $Output\ gap_t$, from IMF (2020, Chapter 3).[10]

Table 1: Estimated central banks' reaction function

	Emerging Economies		*Advanced Economies*	
	i_t^P	i_t^P	i_t^P	i_t^P
	(1)	(2)	(3)	(4)
i_{t-1}^P	0.860***	0.826***	0.944***	0.930***
	(0.0058)	(0.0079)	(0.0075)	(0.0082)
π_t	0.394***	0.419***	0.304***	0.265***
	(0.027)	(0.034)	(0.029)	(0.028)
Δgdp_t	0.00892**		0.00133	
	(0.0037)		(0.0017)	
$Output\ gap_t$		0.0591***		0.0844***
		(0.020)		(0.011)
R-Squared	0.93	0.87	0.96	0.95

Notes: The table reports estimates of equation (1) by OLS. For both emerging and advanced economies, columns (1) and (3) use real GDP growth to proxy for economic activity while columns (2) and (4) use the output gap. These regressions feature country fixed effects. Data are at a quarterly frequency. The sample period is 1990:q1–2018:q4. Standard errors are reported in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

We report the results of the estimated central banks' reaction function in Table 1 for both the panel of advanced and the panel of emerging economies.

First, we note that the R-squared of these regressions is very high, indicating that Taylor rules appear to describe the conduct of monetary policy in these countries fairly well. Second, the estimates of Taylor rule coefficients are generally similar across emerging and advanced economies, both qualitatively and quantitatively.

In both sets of economies, the central bank raises its policy rate in response to higher inflation and improving economic conditions, measured either with GDP growth or the output

[10] Spline interpolation is applied to annual output gap data to obtain quarterly figures.

gap. For emerging economies, the specification with the output gap implies that the point estimates for ϕ_π and ϕ_y are around 2.4 and 0.34, respectively. These estimates are both statistically and economically significant and, again, similar to the corresponding estimates for advanced economies. In line with the literature, we estimate a significant amount of interest rate smoothing by central banks in both sets of economies.

We verify that these results are not driven by the high-inflation countries or crisis periods. To do so, we exclude countries that have experienced inflation rates above 40 percent over a 12-month period and periods during the 6 months immediately following a currency crisis and accompanied by a regime switch.[11] Appendix Table A.5 reports the estimates of Taylor rule coefficients for this modified sample. All results remain statistically significant.

We thus observe that the monetary policy behavior, as captured by estimated central banks' reaction functions, does not point to "monetary policy procyclicality" in emerging economies. Below we argue that the notion of monetary policy procyclicality emerges only when one uses short-term market rates to proxy for the stance of monetary policy in emerging economies.

3 Short-Term Borrowing-Lending Costs in EMEs

Cyclical behavior of short-term rates We now turn to examining the cyclical behavior of short-term rates. This is a commonly used metric to assess whether monetary policy acts pro- or countercyclically (see, for example, Kaminsky, Reinhart, and Végh, 2005, and Vegh and Vuletin, 2013).

To this end, we study the relationship between current GDP growth and interest rates both contemporaneously and at short-term horizons. We do so because policy interest rates tend to respond gradually to observed changes in GDP (see, for example, Table 1). In particular, we use a reduced form local projection approach where we regress interest rates and risk premia at horizons within 2 years on current real GDP growth, controlling for lag of the dependent variable. More specifically, we consider the following regression relationships:

$$i^j_{t+h} = \alpha^j_h + \beta^j_h \Delta gdp_t + \gamma^j_h i^j_{t-1} + \epsilon^j_{t+h}; \tag{2}$$

$$rp^k_{t+h} = \alpha^{rp,k}_h + \beta^{rp,k}_h \Delta gdp_t + \gamma^{rp,k}_h rp^k_{t-1} + \epsilon^{rp,k}_{t+h}; \tag{3}$$

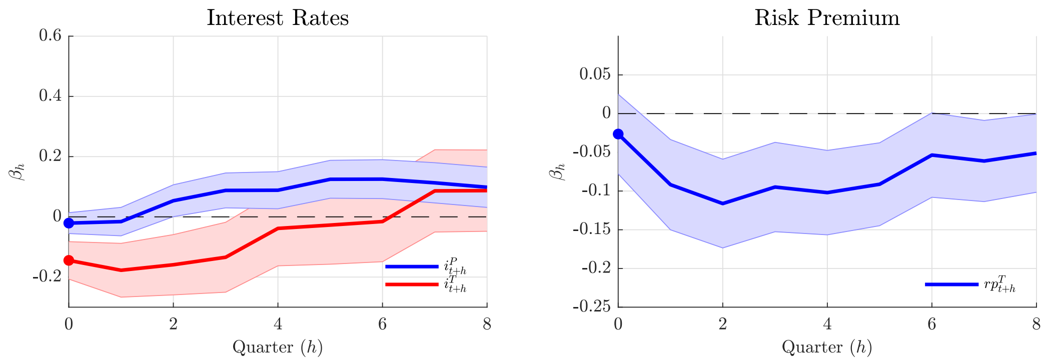
for $j = P, T, M$, $k = T, M$ and $h = 0, \ldots, 8$ quarters.

[11] Thus, we exclude the "freely falling" category in Ilzetzki et al. (2019).

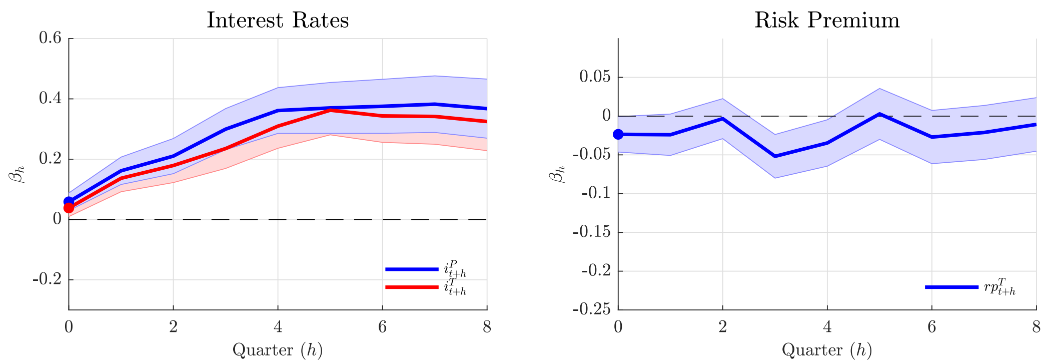
In regression equation (2), i^T and i^M denote the country's short-term treasury and money market rates, respectively, and gdp_t is the country's real GDP. To measure risk premia, we simply take the difference between market rates and policy rates. For instance, in regression equation (3), the risk premium in treasury rates is defined as $rp_t^T = i_t^T - i_t^P$. Here we broadly refer to rp as "risk premium" and acknowledge that it can represent credit, liquidity or policy risk. The coefficients of interest are the β_h's in equations (2) and (3). The β_h's in equation (2) captures the relationship between current real GDP growth and specific interest rates, both contemporaneously and in the near future. Instead, the β_h's in equations (3) capture the dynamic relationship between current real GDP growth and the risk premia in treasury and money market rates.

Figure 2: Dynamic properties of interest rates and risk premia

(a) Emerging Economies



(b) Advanced Economies

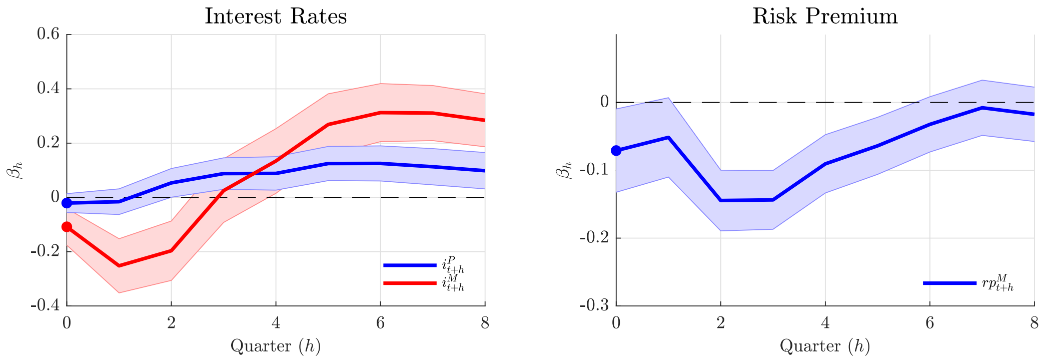


Notes: The figure reports the panel estimates of β_h's in regression equations (2) and (3). 90% confidence intervals are shown by the shaded areas. These regressions feature country fixed effects. Data are at a quarterly frequency.

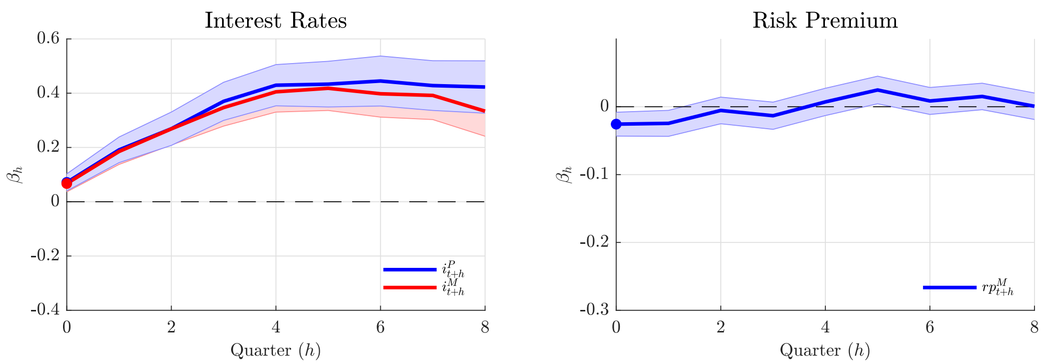
Figure 2 depicts the estimated β^h's in regression equations (2)-(3) for both emerging and

Figure 3: Dynamic properties of interest rates and risk premia (using money market rates)

(a) Emerging Economies



(b) Advanced Economies



Notes: The figure reports the panel estimates of β_h's in regression equations (2) and (3). 90% confidence intervals are shown by the shaded areas. These regressions feature country fixed effects. Data are at a quarterly frequency.

advanced economies. We observe that in emerging economies high real GDP growth predicts a significant increase in policy rates within two years. In these countries, however, high real GDP growth predicts a significant decline in treasury rates within two years as well as a significant decline in the risk premium implied by treasury rates. To the contrary, in advanced economies, policy and treasury rates exhibit a very similar relationship with real GDP growth as well as risk premium that is only mildly countercyclical. Similar results emerge if one uses money market rates instead on treasury rates, as shown in Figure 3.

Taken together, these findings indicate that there is a systematic difference in the cyclical behavior of short-term risk premia between emerging and advanced economies. In fact, risk premia in shirt-rates are strongly countercyclical in emerging economies while they are largely a-cyclical in advances economies. For this reason, the common practice of using short-term market rates to proxy for the stance of monetary policy leads to inaccurate conclusions about monetary policy cyclicality in emerging economies (whereas this is not the case, qualitatively, in advanced economies). In other words, the evidence based on short-term market rates may induce one to argue that monetary policy acts pro-cyclically in emerging economies but countercyclically in advanced economies, even though this is not the case.

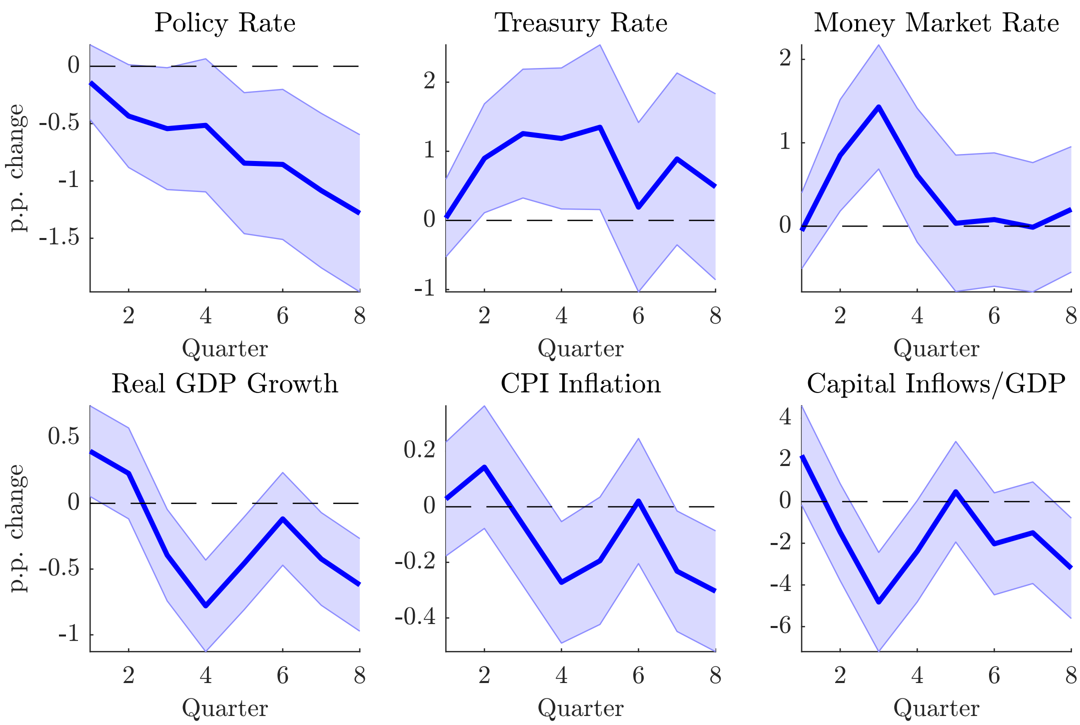
Policy rates as measures of the monetary policy stance In the context of emerging and developing economies, one may be concerned that policy rates are not an appropriate measure of the monetary policy stance. In fact, some of these countries may not use an interest rate as the main monetary policy tool. To address this concern, we reproduce our main results for the subsample of EMEs that conduct interest-rate-based monetary policy. To determine whether the central bank uses a policy rate as the primary monetary policy instrument for most part of the sample period, we follow Brandão-Marques et al.'s (2021) classification based on the examination of historical reports, such as IMF Article IV staff reports, and monetary policy reports issued by central banks.[12] Notwithstanding the smaller sample size, the results for this subsample of EMEs, reported in Figure A.1 align closely with the baseline results, indicating a strong degree of monetary policy counter-cyclicality and a significant difference in cyclicality between policy rates and short-term market rates.

Dynamic effects of a U.S. monetary policy shock The cyclical behavior of policy rates summarizes the general tendencies of monetary policy in EMEs. However, this may conceal a different behavior of central banks in response to different shocks. We now study the effects of an identified U.S. monetary policy shock, which is exogenous and external from the viewpoint of the small open economies in the sample. We trace out the effects of the U.S. monetary policy shocks on policy rates as well as short-term market rates and macroeconomic aggregates.

All economic agents in EMEs pay close attention to the stance of U.S. monetary policy as it affects global demand as well as the cost of international borrowing. To extract the exogenous component in U.S. monetary policy changes we follow the high-frequency identification approach in Gertler and Karadi (2015). In particular, the baseline U.S. policy indicator is the 12-month U.S. treasury rate, and it is instrumented with Gertler and Karadi's (2015)

[12] The countries selected as conducting interest-rate based monetary policy are: Armenia, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Egypt, Guatemala, Hungary, Malaysia, Mexico, Pakistan, Paraguay, Peru, Philippines, Poland, Romania, Russia, South Africa, Sri Lanka, Thailand, Turkey, Ukraine, Uruguay, and Vietnam.

Figure 4: Dynamic effects of a U.S. monetary policy tightening



Notes: Impulse responses are obtained from panel local projections. 90% confidence intervals (calculated using Newey-West standard errors) are shown by the shaded areas. The U.S. policy (12-month U.S. treasury rate) is instrumented by Gertler and Karadi (2015) shock FF4 (estimated from surprises in 3-month Fed Fund Futures). Controls include 4 lags of the dependent variable, U.S. 12-month treasury rate, output growth and inflation differentials. The impulse is an impact 1 percentage point increase in the U.S. policy rate.

estimated surprises in 3-month Fed Fund Futures (FF4). To trace out the effects of U.S. monetary policy shocks, we use panel local projections with instrumental variables (see Jordà, 2005, and Stock and Watson, 2018). Our regression specification is:

$$y_{j,t+h} = \alpha_j + \beta_h \hat{i}_t^{US} + \gamma_h W_t + \varepsilon_{j,t+h} \qquad h = 0, 1, 2, 3 \ldots \tag{4}$$

where, as above, $y_{j,t+h}$ is a vector of macro and financial variables of country j at time $t+h$, and controls (W_t) include four lags of the dependent variable, U.S. 12-month treasury rate, global capital inflows, output growth differentials and inflation differentials. In regression equation (4), $\hat{i}_t^{US}$ denote the instrumented 12-month U.S. treasury rate, obtained from the first stage regression equation: $\hat{i}_t^{US} = \alpha + \delta Z_t + u_t$ where Z_t are Gertler and Karadi's (2015) estimated surprises in 3-month Fed Fund Futures.

Figure 4 reports the impulse responses to an identified U.S. monetary tightening. We find that an exogenous increase in U.S. interest rates leads to a delayed decline in EMEs GDP, CPI inflation and capital inflows, in spite of monetary policy easing.[13] The response of policy rates are unique to our paper. The other responses, including VIX and the exchange rate, and short term lending rates, are consistent with those in Miranda-Agrippino and Rey (2020), and in (Kalemli-Ozcan, 2019).

Let us elaborate on the response of the policy rate and the short-term interest rates. In the wake of a tightening in U.S. monetary policy, central banks in EMEs cut their policy rates while both treasury and money market rates significantly increase. As a result, a U.S. monetary policy tightening brings about a significant increase in risk premia, as in (Kalemli-Ozcan, 2019), to the point of generating qualitatively opposite responses in policy and market rates.

4 A Simple Model

We develop a simple model to rationalize a disconnect between short-term market rates and policy rates in a net-borrower small-open economy. There are two key elements in the model mechanism. First, local banks rely not only on domestic deposits but also on the international markets for funding in channeling funds to local households and government, as shown in the empirical literature cited earlier. Second, global funding conditions worsen when U.S. monetary policy tightens, which is also documented by now by a large literature.[14]

Because local banks are the marginal investor in the government bond and household credit markets, short-term market rates reflect the marginal funding costs of local banks (a weighted average of both local policy rates and international borrowing rates). We show that the model's pass-through of monetary policy to short-term rates is incomplete and inversely proportional to the local bank reliance on the global funding market. We also show the model equilibrium responses following a U.S. monetary policy tightening.

4.1 Environment

We specify a dynamic general equilibrium open-economy model consisting of a small (home) and a large (foreign) country, where the latter could be understood as the U.S. Shocks in the

[13] Our measure of capital inflows is total debt inflows to GDP from Avdjiev et al. (2022).

[14] In other words, the international borrowing rate for emerging economies raises by more that the international risk-free rate when U.S. monetary policy tightens.

large economy (e.g. a monetary tightening) affect the small economy, but not vice versa. In its core, the framework includes sticky prices, monopolistically competitive producers and producer currency pricing (PCP).[15]

There is a continuum of agents of unit mass in the world, where the segment $[0, n)$ inhabits the home (H) country and the segment $(n, 1]$ occupies the foreign (F) country. Like in De Paoli (2009), we take the limit of the home economy size n to zero. It is taken after deriving the equilibrium conditions for the two-country model. Note that variables with * refer to foreign country.

Asset markets are incomplete and segmented. A continuum of risk-neutral commercial banks operate in the home economy. They collect deposits from home households (in home currency) and global intermediaries (in dollars). In turn, they lend to home households and to the government (in home currency). Home intermediaries are the marginal investors in the local treasury bond market, consistent with the observation that local commercial bank are often designated as "market makers" in emerging economies. Global intermediaries charge a time-varying premium over the foreign risk-free interest rate to lend to home intermediaries.

Households There is a representative household who is risk-averse and has preferences

$$E_t \sum_{j=0}^{\infty} \beta^j \left[\frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\eta}}{1+\eta} \right] \tag{5}$$

where β is the discount factor, C_t is consumption, N_t refers to hours worked, σ is the parameter of relative risk aversion, and η is the inverse Frisch elasticity. Consumption is a composite of consumption of home and foreign goods. Namely,

$$C_t \equiv \left[v^{\frac{1}{\theta}} C_{H,t}^{\frac{\theta-1}{\theta}} + (1-v)^{\frac{1}{\theta}} C_{F,t}^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}} \tag{6}$$

where $C_{H,t}$ and $C_{F,t}$ are index of consumption of home and foreign goods respectively and are given by the CES functions

$$C_{H,t} \equiv \left[\left(\frac{1}{n} \right)^{\frac{1}{\iota}} \int_0^n C_{H,t}(i)^{\frac{\iota-1}{\iota}} di \right]^{\frac{\iota}{\iota-1}} \tag{7}$$

[15] We would obtain similar results if we assume dollar pricing, as in Goldberg and Tille (2009) and Gopinath et al. (2020).

$$C_{F,t} \equiv \left[\left(\frac{1}{1-n} \right)^{\frac{1}{\iota}} \int_n^1 C_{F,t}(i)^{\frac{\iota-1}{\iota}} di \right]^{\frac{\iota}{\iota-1}}$$

here $i \in [0,1]$ is the good variety, and $\iota > 1$ is the elasticity of substitution between varieties. $\theta > 0$ refers to the substitutability between home and foreign goods. $\upsilon \in [0,1]$ is the home consumers' preference for home goods and is a function of the size of the home economy, n, and of the degree of trade openness, λ, such that $\upsilon = (1-n)\lambda + 1$.

Home households can save in home-currency deposits D_t^H at gross nominal rate R_t^P. In order to borrow, home households have access to a home-currency one-period nominal riskless bond B_t^H with gross interest rate R_t^T. Note that R^T represents the short-term market rate and R^P is the home policy rate (or home deposit rate).

The representative household owns home firms and home banks, and receives their respective profits every period, as well as lump-sum transfers (or taxes) from the fiscal authority. The home household's flow budget constraint thus reads

$$-\frac{B_{t+1}^H}{R_t^T} + \frac{D_{t+1}^H}{R_t^P} + P_t C_t = W_t N_t - B_t^H + D_t^H + \Pi_t^B + \Pi_t^F + T_t^G \tag{8}$$

where P_t is the price index of the composite consumption good, W_t is the nominal wage, Π_t^B and Π_t^F are the banks' and firms' profits respectively, and T_t^G are lump-sum transfers from the fiscal authority. The price of the composite consumption good is a function of the home consumption good price index, $P_{H,t}$, and the foreign good price index, $P_{F,t}$, such that $P_t = P_{H,t}^{1-\lambda}(S_t P_{F,t})^{\lambda}$. The nominal exchange rate S_t is rate of exchange between home and foreign currency (between pesos and dollars).[16]

The problem of the home household consists in choosing $\{C_t, N_t, B_{t+1}^H, D_{t+1}^H\}$ such that it maximizes its utility function, (5), subject to the budget constraint, (8). In addition, we assume that the home households must hold at least a positive amount of deposits $\frac{D_{t+1}^H}{R_t^P} \geq \bar{D}$, $\forall t$. Because the home economy is a net borrower, in equilibrium this constraint will hold with equality, and the relevant interest rate for intertemporal consumption decisions will be the short-term market rate R_t^T.[17]

[16] An increase in S_t implies a depreciation of the peso against the dollar.

[17] The assumption that households are forced to hold a positive amount of deposits even if they end up being net borrowers may appear stark. We note that one can obtain a similar outcome in models with savers and borrowers households (Iacoviello, 2005; Gerali et al., 2010). We conjecture that the model's qualitative implications would not change in such alternative framework.

The first-order conditions thus read:

$$C_t^{\sigma} N_t^{\eta} = \frac{W_t}{P_t} \tag{9a}$$

$$\beta E_t \left[\frac{C_{t+1}^{-\sigma}}{C_t^{-\sigma}} R_t^T \frac{P_t}{P_{t+1}} \right] = 1 \tag{9b}$$

$$\frac{D_{t+1}^H}{R_t^P} = \bar{D} \tag{9c}$$

Firms There is a continuum of firms in both countries that produce output using a constant-returns-to-scale production function. Production uses only home labor and the economy-wide production functions are $Y_t = N_t$ and $Y_t^{\star} = N_t^{\star}$ for the home and foreign country respectively.

Each producer prices its output in their own currency (PCP) and price setting follows a partial adjustment rule à la Calvo (1983). Under this setting, there is a standard demand function for each variety of good and each producer maximizes profits taking as given aggregate market prices. At any period, a fraction $(1 - \alpha)$ of firms, $\alpha \in [0, 1)$, is able to change its price, while the remaining α percentage is unable and must charge the same price as last period. When given the chance to adjust, producers pick the price that maximizes the present discounted value of expected profits. Households, as owners of the firms, are the recipients of the profits, Π_t^F, where

$$\Pi_t^F = P_{H,t} Y_t - P_t C_t \tag{10}$$

Fiscal Authority The government has an exogenous spending target $T_t^G > 0$ that is financed by issuing one-period nominal treasury bonds $B_t^T > 0$. These bonds are only traded between the fiscal authority and the home banks at a gross nominal interest rate R_t^T. If, at any given period, the government borrows more funds than the previous period, it rebates the excess resources to the households as a lump-sum transfer. The fiscal authority's flow budget constraint is thus

$$\frac{B_{t+1}^T}{R_t^T} - B_t^T = T_t^F \tag{11}$$

Monetary Authority As per the empirical evidence in Section 2, the home central banks follows a Taylor-type rule targeting CPI inflation and output, which determine the equilibrium nominal policy rates R_t^P. Namely,

$$\frac{R_t^P}{R^P} = \left(\frac{R_{t-1}^P}{R^P}\right)^{\rho_r} \left(\frac{\pi_t}{\pi}\right)^{(1-\rho_r)\phi_\pi} \left(\frac{Y_t}{Y}\right)^{(1-\rho_r)\phi_y} \tag{12}$$

where variables without a time subscript denote steady-state values.

The home central bank provides home deposits D_t^{CB} to home banks at gross nominal rate R_t^P. All proceeds earned from deposits are subsequently rebated to home households via lump-sum transfers T_t^{CB}. Thus, the monetary authority's flow budget constraint reads

$$D_t^{CB} - \frac{D_{t+1}^{CB}}{R_t^P} = T_t^{CB} \tag{13}$$

The home central bank controls the home deposit rate R_t^P by supplying deposits to home commercial banks. To conform to observed practices, we assume that home banks, however, never take up central bank deposits, hence $D_{t+1}^{CB} = 0$, $\forall t$.

We add central bank deposits ("discount window lending") solely to formalize why the policy rate and the home deposit rate must be equivalent in our model. In practice, however, we then assume home banks do not borrow from the central bank in equilibrium.

Home Banks The local financial sector is populated by risk-neutral banks. Home banks are the only agents in the economy that make short-term loans to households, B_t^H, and hold short-term government bonds, B_t^T. Banks raise home deposits from households, D_t^H, and the monetary authority, D_t^{CB}, at the gross policy rate R_t^P (in pesos). Finally, they raise foreign deposits, $D_t^{\star,\$}$, at the gross foreign dollar interest rate $\hat{R}_t^{\ *}$ (in dollars).

Summing up, banks' assets include loans to households and the government, while its liabilities include deposits by households, the central bank, and foreign liabilities. The balance sheet accounting identity reads

$$\frac{B_{t+1}}{R_t^T} = \frac{D_{t+1}}{R_t^P} + \frac{S_t D_{t+1}^{\star,\$}}{\hat{R}_t^\star} \tag{14}$$

where $B_{t+1} = B_{t+1}^H + B_{t+1}^T$, and $D_{t+1} = D_{t+1}^H + D_t^{CB}$.

The banks' realized profits at $t+1$ are

$$\Pi_{t+1}^B = B_{t+1} - D_{t+1} - S_{t+1} D_{t+1}^{\star,\$} \tag{15}$$

Let us use ω_t to define the share of foreign liabilities $\omega_t = \frac{S_t D_{t+1}^{*,\$}}{B_{t+1}} \frac{R_t^T}{\hat{R}_t^*}$. The home bank expected profits can be then written as

$$E_t \Pi^B_{t+1} \equiv E_t \left(1 - (1-\omega_t) \frac{R^P_t}{R^T_t} - \omega_t \frac{S_{t+1}}{S_t} \frac{\hat{R}^\star_t}{R^T_t} \right) B_{t+1} \tag{16}$$

In this model, home banks choose between home and foreign sources of funding taking the respective rates, R^P_t and $\hat{R}^\star_t$, as given. In equilibrium, the home deposit market clears, and given the above assumptions: $\frac{D_{t+1}}{R^P_t} = \frac{D^H_{t+1}+D^{CB}_t}{R^P_t} = \frac{D^H_{t+1}}{R^P_t} = \bar{D}$. The foreign deposit market feature an infinitely elastic supply of deposits at $\hat{R}^\star_t$. The home bond market clearing instead implies: $B_{t+1} = B^H_{t+1} + B^T_{t+1}$.

As a result, risk-neutrality and perfect competition across banks implies that expected bank profits are nil in each period, and the home bank demands a short-term market rate that satisfies the following condition:

$$R^T_t - R^P_t = \omega_t E_t \left(\frac{S_{t+1}}{S_t} \hat{R}^*_t - R^P_t \right) \tag{17}$$

where, again, ω_t is the share of foreign liabilities. We discuss the implications of equation (17) below.

Global intermediaries The international financial sector is populated by global financial intermediaries. These intermediaries borrow at the dollar risk free rate R^*_t. and lend to home banks at the dollar rate $\hat{R}_t{}^*$. We follow Bianchi and Lorenzoni (2022) in assuming that the emerging economy's dollar borrowing rate can differ from the dollar risk free rate, $\hat{R}_t{}^* \neq R^*_t$. In addition, we assume that the dollar funding premium $\hat{R}_t{}^*/R^*_t$ is increasing in the level of the foreign risk free rate, R^*_t. In our framework, we do not take a stance on what originates the difference between $\hat{R}_t{}^*$ and R^*_t. We mean to capture *unmodeled* changes in global risk perception that are correlated with U.S. monetary policy stance, as in Miranda-Agrippino and Rey (2020).[18]

Besides, we assume that global intermediaries can hold both home- and foreign-currency reserves. This results in the following UIP condition:

$$E_t \left(\frac{S_{t+1}}{S_t} R^\star_t - R^P_t \right) = 1 \tag{18}$$

[18] Ilzetzki and Jin (2021) make a similar reduced form assumption, motivated by the evidence in Miranda-Agrippino and Rey (2020)

Thus, UIP holds in the this model when measured using risk-free rates.

Foreign Economy The foreign economy, interpreted to be the U.S., consist of a continuum of households that save/borrow at the international risk-free rate $R_t^\star$, and a continuum of monopolistically-competitive firms that operate under sticky prices. The foreign central bank follows a Taylor-type rule targeting CPI inflation and output, which determine the equilibrium international nominal policy rates $R_t^\star$.

$$\frac{R_t^*}{R^*} = \left(\frac{R_{t-1}^*}{R^*}\right)^{\rho_r} \left(\frac{\pi_t^*}{\pi^*}\right)^{(1-\rho_r)\phi_\pi} \left(\frac{Y_t^*}{Y^*}\right)^{(1-\rho_r)\phi_y} \exp\left(\varepsilon_{m,t}^\star\right) \tag{19}$$

where there is a shock to the Taylor rule, $\varepsilon_{m,t}^\star$, represents an exogenous change in U.S. monetary policy stance.

Market Clearing Wages adjust in each economy in order to clear the labor market. As for the goods market, given the size of the SOE ($n \to 0$), as in De Paoli (2009), home goods market clearing implies that

$$Y_t = Q_t^{\frac{\theta\lambda}{1-\lambda}} \left[(1-\lambda)C_t + \lambda Q_t^\theta C_t^*\right] \tag{20}$$

where $Q_t = \frac{S_t P_t^*}{P_t}$ is the real exchange rate. The assumption on the size of the domestic economy, n, also implies that the goods market clearing condition for the foreign country is

$$Y_t^* = C_t^* \tag{21}$$

The bond and deposit markets also clear as described above. To derive an equation for the net foreign asset position, we can make use of the household budget constraint (equation (8)), the firms' profits (equation (10)), the governments' budget constraint (equation (11)), the Central Bank's budget constraint (equation (13)), and banks' profits (equation (15)). This yields the country budget constraint.

$$P_{H,t}Y_t - P_t C_t = -S_t \left(\frac{D_{t+1}^{\star,\$}}{\hat{R}_t^\star} - D_t^{\star,\$}\right) \tag{22}$$

Economically, equation (22) indicates that any fluctuations in net exports are reflected in corresponding fluctuations in home banks' foreign deposits, as these are the only source of external borrowing available to the small open economy.

Model Solution We solve the model as a log-linear approximation around a deterministic steady state in which the small open economy is a net external borrower (i.e. $D^\star > 0$). The foreign-liability share in steady state is then well defined and between 0 and 1, that is $\omega \in (0,1)$. For simplicity we consider a steady state in which $S = 1$, $\hat{R}^\star = R^\star$, so that $R^T = R^P = R^\star = 1/\beta$. Below, we show that shocks can drive a wedge among these rates outside of the steady-state equilibrium.

4.2 Discussion of assumptions

Before we move on, let us discuss some of the assumptions that we made.

First, we have assumed that home households' supply of deposit is inelastic. As a result, any household borrowing in excess of household deposits should be satisfied by banks raising foreign deposits. Alternatively, we could have assumed that banks cannot perfectly substitute between home and foreign deposits (e.g., total deposit are a CES aggregate of home and foreign deposit). This representation would lead to qualitatively similar results.

Second, we have assumed that global intermediaries can arbitrage across home and foreign deposits. As a result, the UIP condition holds when evaluated using risk-free policy rates (see eq. (18)). It should be noted, however, that the UIP condition fails when evaluated using home market rates or the international borrowing rate. We spell out this observation at the end of Section 4.3.

Third, for simplicity we solve the model around a steady state in which $\hat{R}^\star = R^\star$. As we will show below this implies that variations in the share of foreign liabilities ω_t relative to steady state do *not* have a *first-order* effect on the wedge between market and policy rate. To a first-order, all the variation in this wedge will be driven by variation in the international borrowing rate relative to the international risk free rate, *for a given steady-state share of foreign liabilities* ω.

4.3 Disconnect between Short-term Market Rate and Policy Rate

In this model a disconnect between short-term market rate and policy rate may emerge. We analyzed the model by log-linearizing the equilibrium equations around the deterministic steady state. Small-case letters (such as i_t^P) denote log-linear versions of the variables in levels (such as R_t^P). The log-linear version of equation (17) reads

$$i_t^T = (1-\omega)i_t^P + \omega E_t \left(s_{t+1} - s_t + \hat{i}_t^\star \right), \tag{23}$$

Equation (23) describes the equilibrium relationship among interest rates in our log-linear model. In particular, we see that the short-term market rate i_t^T reflects the marginal funding costs of local banks, which is a weighted average of local policy rates, i_t^P, and international borrowing rates (converted in pesos). One implication of equation (23) is that the pass-through of monetary policy to short-term rates is incomplete. In fact, *ceteris paribus* a 1% increase in the local policy rate implies a $(1-\omega)$% increase in the short-term market rate i_t^T. In fact, the degree of pass-through incompleteness depends on local banks' reliance on the global funding market, governed by ω. If $\omega = 0$, the pass-through is complete because local banks only rely on local deposits. Instead, $\omega = 1$ the pass-through is zero as local banks only borrow from international market for funding. For intermediate values of ω, the case studied below, the pass-through is incomplete.

To study the pass-through in general equilibrium one needs to understand how international rates and exchange rates adjust in equilibrium. Towards this end, combine equation (23) with the log-linear version of the UIP equation (18), to reach:

$$i_t^T - i_t^P = \omega E_t \left(\hat{i}_t^\star - i_t^\star \right). \tag{24}$$

Equation (24) reveals that a wedge between market and policy rates emerges as long as international borrowing rates differ from international risk free rates. In fact, if $\hat{i}_t^\star - i_t^\star = 0$ then equilibrium rates and exchange rate adjust so that the wedge $i_t^T - i_t^P$ is zero at all times. However, if $\hat{i}_t^\star - i_t^\star$ fluctuates, then the wedge $i_t^T - i_t^P$ will fluctuate along with global financial conditions.

Overall, then, the equilibrium properties of the local market rate i^T will depend on the joint comovement of local policy rates i_t^P and global financial conditions, captured by $\hat{i}_t^\star - i_t^\star$.

Last, it is worth noting that in this model the wedge $i_t^T - i_t^P$ is related to local banks' marginal funding costs, and it *indirectly* represents a risk premium. In fact, (risk-neutral) local banks pass the international borrowing premium $\hat{i}_t^\star - i_t^\star$ through to local households and government in proportion to their foreign liability share.

Note on UIP Using the above equations, one can show that the UIP condition holds when evaluated using risk-free policy rates but not when evaluated using the home market rate. In fact, UIP using risk-free rate – the log-linear version of (18) – implies:

$$E_t\left(s_{t+1}-s_t\right)-\left(i_t^P-i_t^\star\right)=0.$$

However, the UIP condition using short-term market rates implies that:

$$E_t\left(s_{t+1}-s_t\right)-\left(i_t^T-i_t^\star\right)=-\left(i_t^T-i_t^P\right)$$

which is generally different from zero as long as $i_t^T-i_t^P\neq 0$. This is the case in our dynamic equilibrium as long as $\omega>0$ and $\hat{i}_t^\star\neq i_t^\star$, as shown in equation (24).

4.4 Dynamic Responses to Foreign Monetary Policy Tightening

We now examine the equilibrium responses to a tightening in foreign monetary policy (interpreted as a unanticipated increase in the Fed Funds rate). To do so, we parametrize the model as follows. We set $\beta=0.99$ which implies a steady state annual risk-free interest rate of about 4%, $\eta=1$ which implies a unit Frisch elasticity, and $\sigma=0.5$ which implies a IES = 2. Our calibration of the Calvo parameter ($\alpha=0.75$) implies an average duration of price contracts of about one year. We set the consumption share of imports, $\lambda=0.2$, and the trade elasticity $\theta=1.5$. These values are standard in the open-economy literature.

Parameter	Description	Value
β	Time discount	0.99
σ	CRRA parameter	0.5
η	Inverse Frisch elasticity	1
α	Calvo parameter	0.75
λ	Trade openness	0.20
θ	Trade elasticity	1.5
ρ_r	Taylor rule smoothing	0.7
ϕ_π	Taylor rule inflation response	1.5
ϕ_y	Taylor rule output response	0.5
B	SOE steady-state borrowing	Target: $\omega=0.3$
ξ	Elasticity of global funding conditions	See text

Table 2: Parameterization
This parameterization is used to illustrate the effects of a foreign monetary policy tightening in Figure 5. Each period is a quarter.

The Taylor rule coefficient on consumer price inflation, ϕ_π, equals 1.5, the coefficient on output ϕ_y, equals 0.5, while the parameter that governs the degree of interest rate smoothing, ρ_r, equals 0.70. These values are in line with typically estimated values in the DSGE literature and those that we report for emerging economies in Section 2. Finally we calibrate households' steady-state borrowing to pin down a foreign-liability share $\omega = 0.30$ which is consistent with the evidence in di Giovanni et al. (2022) on Turkish banks' share of non-core funding (typically in foreign currency).

To close the model we need to define and parametrize a functional form for the international borrowing rate. Following the discussion above, we assume that the dollar funding premium $\hat{i}_t^\star - i_t^\star$ is increasing in the level of the foreign risk free rate $i_t^\star$, so that:

$$\hat{i}_t^* - i_t^* = \xi i_t^\star \tag{25}$$

where $\xi > 0$. We parametrize ξ to generate a three-fold increase in the international borrowing rate relative to the U.S. risk free rate in the wake of a monetary policy tightening.

While we stress that this parameterization is meant to be illustrative, we note that all these parameter values are generally plausible. That said, the results below should be interpreted as qualitative prediction of a calibrated model.

Figure 5 depicts the impulse response to an exogenous U.S. monetary policy tightening that induces an increase in international borrowing costs. The impulse is a 1 p.p. shock to the foreign economy's Taylor rule. Because of the general-equilibrium responses in foreign output and inflation, the central bank endogenously adjust its policy rate ("the systematic component") and in equilibrium we observe an increase in the foreign policy rate that is less that 1 p.p..

In response to the shock, home economic activity contracts on impact because of (i) the decline in foreign aggregate demand and (ii) the decline in home aggregate demand caused by higher market rates. This is noteworthy since this latter result does not need any borrowing/collateral constraint which is typical modeling strategy for an open economy to generate sudden stops and contractionary depreciations. We also allow full expenditure switching effects, which is why economic activity recover in the subsequent periods. These expenditure switching effects would be dampened (on the export side) if we had assumed dollar pricing, in line with the evidence in Goldberg and Tille (2008) and Gopinath (2016).[19]

[19] Consistently, our model shows a depreciation of the EME exchange rate and a higher the UIP premia as also

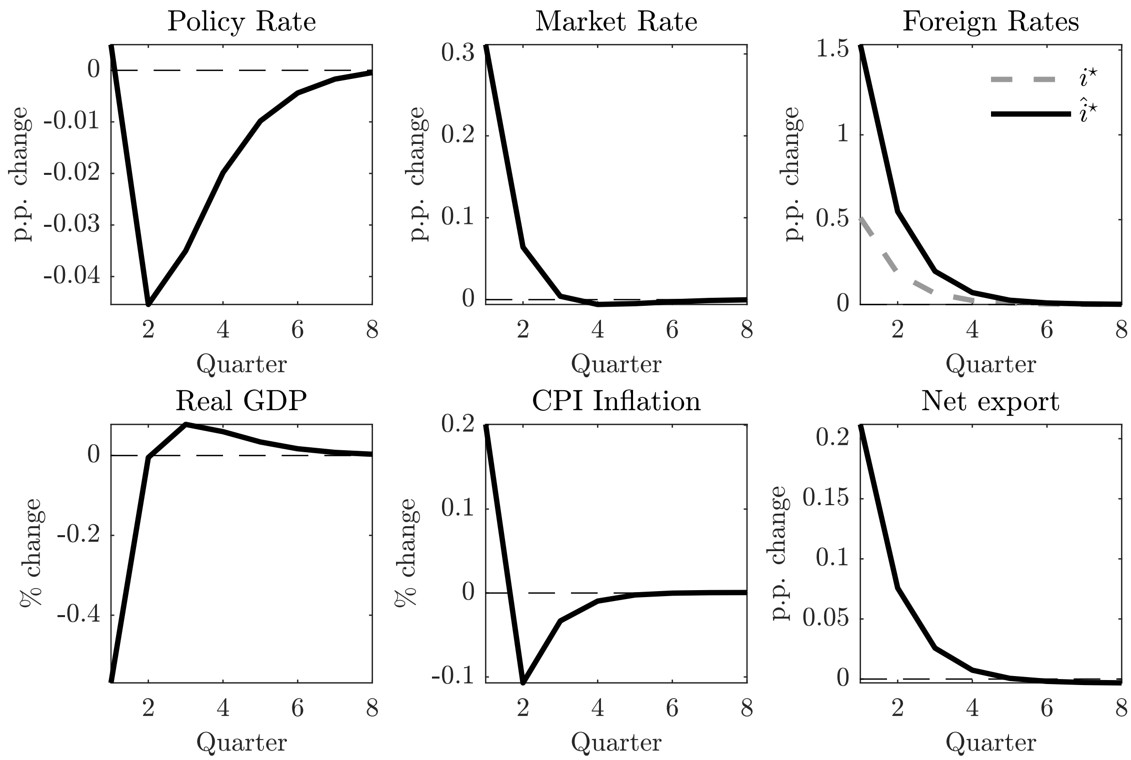


Figure 5: Impulse Responses to a Foreign Monetary Policy Tightening

In terms of consumer prices, instead, we observe an inflation increases on impact and a subsequent decline. The initial increase is due to the sharp exchange rate depreciation that makes imported goods more expensive. The decline in local and foreign aggregate demand prevail subsequently in the response of CPI inflation.

In this context, the home central bank reduces its policy rate in line with its Taylor rule, trading off the observed responses of output and inflation. Nevertheless, short term market rates *increase*, as we observe in the data (Figure 4). In fact, market rates reflect policy rates only partially and their equilibrium increase is due to the force imparted by worsened global financial conditions. The response of the market rate is consistent with the evidence that the transmission of global financial cycle goes through local banks' funding conditions. Overall, the model suggests that equilibrium short-term market rates can display opposite cyclical properties than the policy rate if external shocks are a dominant cause of emerging economies' business cycle.

shown in Kalemli-Ozcan, 2019.

5 Conclusions

Understanding how central banks conduct monetary policy in emerging economies is crucial given that they face complex and evolving trade offs (Gourinchas, 2018; Akinci and Queraltó, 2018; Egorov and Mukhin, 2020; Boz et al., 2020; Auclert et al., 2021). In this paper, we documented that the monetary policy transmission in emerging economies is impaired and this manifests itself through a disconnect between policy rates and short-term market rates. Thus, even though central banks respond to worsening economic activity by cutting policy rates – a "counter-cyclical" monetary policy – their stimulus transmits to market rates – the rates relevant for consumption and investment decisions – only imperfectly. This evidence is consistent with a model in which market rates reflect local banks' marginal funding costs which partly depend on global financial conditions. This paper thus sheds new light on the related questions of monetary policy cyclicality and autonomy in emerging economies.

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Appendix

A Sample

Table A.1: List of countries

A. Emerging Economies

Afghanistan, Islamic Republic of	Ecuador	Malta	Serbia, Republic of
Albania	Egypt	Mauritania	Seychelles
Angola	Gambia, The	Mauritius	Sierra Leone
Argentina	Georgia	Mexico	Singapore
Armenia, Republic of	Ghana	Moldova	Slovak Republic
Azerbaijan, Republic of	Guatemala	Mongolia	Slovenia
Bangladesh	Hungary	Morocco	South Africa
Belarus	India	Mozambique	Sri Lanka
Bolivia	Indonesia	Myanmar	Tanzania
Brazil	Iraq	Nepal	Thailand
Bulgaria	Jamaica	Nicaragua	Tunisia
Cambodia	Kazakhstan	Nigeria	Turkey
Chile	Kenya	Pakistan	Uganda
China	Korea, Republic of	Paraguay	Ukraine
Colombia	Kosovo, Republic of	Peru	Uruguay
Congo, Democratic Republic of	Kuwait	Philippines	Vietnam
Costa Rica	Kyrgyz Republic	Poland	Zambia
Croatia	Latvia	Romania	
Czech Republic	Libya	Russian Federation	
Dominican Republic	Malaysia	Rwanda	

B. Advanced Economies

Australia	Germany	Japan	Sweden
Canada	Iceland	New Zealand	Switzerland
Denmark	Ireland	Norway	United Kingdom
Euro Area	Israel	Portugal	
Finland	Italy	Spain	

Table A.2: Dataset: policy rates

Country	Start	End	Observations	Country Group	Source	*Bloomberg* ticker
Australia	1990q1	2018q4	116	AE	BIS, IMF	
Canada	1992q4	2017q3	100	AE	BIS, IMF	
Denmark	1990q1	1998q4	36	AE	BIS, IMF	
Euro Area	1998q4	2018q4	81	AE	Bloomberg	EURR002W
Germany	1990q1	1998q4	36	AE	Bloomberg	DERPDRT

Iceland	1998q1	2018q4	76	AE	BIS, Bloomberg	ICBRANN
Israel	1995q1	2018q4	96	AE	BIS, Bloomberg	ISBRANN
Japan	2008q4	2015q4	29	AE	BIS, Bloomberg	BOJDPBAL
New Zealand	1999q1	2018q4	80	AE	BIS, IMF	
Norway	1990q1	2017q1	109	AE	BIS, IMF	
Portugal	1990q1	1993q2	14	AE	IMF	
Sweden	1994q2	2014q4	75	AE	BIS, Bloomberg	SWRRATEI
Switzerland	2000q1	2011q2	46	AE	BIS, Bloomberg	SZLTTR
United Kingdom	1990q1	2018q4	116	AE	BIS, Bloomberg	UKBRBASE
Afghanistan, Islamic Republic of	2015q1	2018q4	16	EME	.	
Albania	1992q3	2013q4	86	EME	IMF	
Angola	2011q4	2018q4	29	EME	IMF	
Argentina	2002q1	2018q4	68	EME	BIS, Bloomberg	ARLLMONP
Armenia, Republic of	1999q4	2018q4	77	EME	IMF	
Azerbaijan, Republic of	1993q1	2018q4	27	EME	IMF	
Bangladesh	1990q1	2011q4	88	EME	Bloomberg	BNRPREPO
Belarus	2000q1	2018q4	44	EME	IMF	
Bolivia	1999q1	2008q3	39	EME	Bloomberg	BOPXIX
Brazil	1994q3	2018q4	98	EME	BIS, IMF	
Bulgaria	1991q1	1996q4	24	EME	IMF	
Cambodia	1994q1	1997q3	13	EME	IMF	
Chile	1995q2	2018q4	95	EME	BIS, IMF	
China	2005q3	2018q4	54	EME	BIS, Bloomberg	CHLR12MC
Colombia	1995q2	2018q4	95	EME	BIS, IMF	
Congo, Democratic Republic of	2006q1	2018q2	26	EME	IMF	
Costa Rica	2006q1	2018q4	52	EME	IMF	
Croatia	1993q4	1998q4	21	EME	BIS, IMF	
Czech Republic	1995q4	2018q4	93	EME	BIS, Bloomberg	CZARANN
Dominican Republic	2004q1	2017q3	55	EME	Bloomberg	BCRDONRT
Egypt	2006q1	2018q4	39	EME	Bloomberg	EGBRDRAR
Gambia, The	1990q1	2018q4	116	EME	IMF	
Georgia	2008q1	2018q4	44	EME	Bloomberg	9151P270
Ghana	1990q1	2018q1	113	EME	Bloomberg	GHBRPOLA
Guatemala	1997q1	2018q4	88	EME	Bloomberg	GUIRLR
Hungary	1990q1	2018q4	116	EME	BIS, Bloomberg	HBBRANN
India	1990q1	2018q4	100	EME	BIS, Bloomberg	RSPOYLDP
Indonesia	1990q1	2018q4	116	EME	BIS, IMF	
Iraq	2004q3	2008q4	18	EME	Bloomberg	IQITPR
Jamaica	2002q1	2018q1	65	EME	.	
Kazakhstan	2005q2	2018q4	55	EME	IMF	
Kenya	2006q2	2018q3	50	EME	IMF	
Korea	1999q2	2018q4	79	EME	BIS, IMF	
Kuwait	1990q1	2002q4	50	EME	IMF	
Kyrgyz Republic	2000q1	2018q4	76	EME	IMF	
Libya	1990q1	2013q1	76	EME	IMF	
Malaysia	1995q4	2018q4	66	EME	BIS, IMF	
Malta	1990q1	2007q4	72	EME	IMF	
Mauritania	1990q1	2012q4	92	EME	IMF	
Mauritius	2006q4	2018q4	49	EME	IMF	
Mexico	1998q4	2018q4	81	EME	BIS, Bloomberg	2736R001
Moldova	2000q1	2018q4	76	EME	Bloomberg	9216R001
Mongolia	2007q3	2018q4	46	EME	IMF	
Morocco	1994q1	2008q2	48	EME	IMF	

Mozambique	2012q1	2018q4	23	EME	Bloomberg	MZBRANN
Myanmar	2012q2	2018q2	25	EME	Bloomberg	MMDRCBR
Nepal	1990q1	2018q4	105	EME	IMF	
Nicaragua	1990q1	1995q1	14	EME	IMF	
Nigeria	2007q1	2018q4	48	EME	Bloomberg	NGCBANN
Paraguay	2011q1	2018q4	32	EME	IMF	
Peru	2001q1	2018q4	72	EME	BIS, Bloomberg	PRRRONUS
Philippines	1990q1	2018q4	108	EME	BIS, Bloomberg	PPCBON
Poland	1993q1	2018q4	96	EME	BIS, Bloomberg	POREANN
Romania	2003q1	2012q3	39	EME	BIS, Bloomberg	ROKEPOLA
Russia	1992q1	2018q4	98	EME	BIS, IMF	
Rwanda	1990q1	2017q2	99	EME	IMF	
Serbia	1997q1	2018q4	80	EME	BIS, Bloomberg	SEKEPOLA
Sierra Leone	1990q1	2018q4	44	EME	Bloomberg	7246R001
Singapore	1990q1	2018q4	116	EME	Bloomberg	5766R001
Slovak Republic	2001q2	2008q4	31	EME	IMF	
Slovenia	1992q1	2001q2	38	EME	IMF	
South Africa	1995q1	2018q4	96	EME	BIS, IMF	
Tanzania	1992q2	2012q4	83	EME	IMF	
Thailand	2000q2	2018q4	75	EME	BIS, Bloomberg	BTRRHALL
Tunisia	2000q1	2018q4	76	EME	Bloomberg	TNPORATE
Turkey	1990q1	2018q4	115	EME	BIS, Bloomberg	TUBROBRA
Uganda	2011q3	2018q4	22	EME	Bloomberg	UGCBANNC
Uruguay	2007q3	2018q2	44	EME	Bloomberg	URDAIC
Vietnam	1996q1	2018q3	91	EME	IMF	
Zambia	2012q2	2018q4	27	EME	Bloomberg	ZMCBRATE

Notes: The table reports the sample coverage of policy rates and their sources. When data come from national sources we retrieve it from *Bloomberg* and report the relevant *Bloomberg* ticker in the last column.

Table A.3: Dataset: treasury rates

Country	Start	End	Observations	Country Group	Source	*Bloomberg* ticker
Australia	2009q2	2018q4	39	AE	Bloomberg	GACGB3M
Canada	1997q3	2018q4	85	AE	IMF, Bloomberg	GCAN3M,1566591
Denmark	1993q2	1998q4	23	AE	Bloomberg	GDGT3M
Germany	1993q2	1998q4	23	AE	Bloomberg	GETB1
Iceland	2000q1	2018q3	51	AE	Bloomberg	ICLB3MAY
Israel	1992q1	2018q4	108	AE	Bloomberg	ISMB03M
Italy	1990q4	1996q3	24	AE	Bloomberg	GBOTS3MO
Japan	1992q3	2014q3	89	AE	Bloomberg	GJTB3MO,GTJPY3MGovt
New Zealand	1999q1	2018q4	80	AE	Bloomberg	NZB3MAY
Norway	1995q2	2018q4	95	AE	Bloomberg	GNGT3M
Portugal	1990q1	1993q2	14	AE	IMF, Bloomberg	GTPTE3MGovt,1826591
Sweden	1993q2	2015q1	88	AE	Bloomberg	GSGT3M
Switzerland	2002q1	2011q2	38	AE	Bloomberg	SWIB3MAY
United Kingdom	2000q1	2018q4	76	AE	Bloomberg	UKTT3MAY
Albania	2010q1	2013q4	16	EME	IMF, Bloomberg	ALAT3MAV,9146591
Angola	2004q3	2018q3	34	EME	Bloomberg	AOTB3MAY,6146R005
Argentina	2015q4	2018q3	12	EME	Bloomberg	LBAC3MAY
Armenia, Republic of	2010q4	2018q4	32	EME	Bloomberg	ARTB3MAY

Brazil	2007q1	2018q4	48	EME	IMF, Bloomberg	2236591,GEBR03M
China	2011q1	2018q4	32	EME	Bloomberg	GCNY3M,OECNR002,findIMFversion
Czech Republic	1993q3	2018q4	83	EME	Bloomberg	9356R003,CZTA3MAY
Egypt	2006q1	2018q4	52	EME	Bloomberg	EGTBY3,EGPT3MCBEP
Gambia, The	2015q3	2018q4	12	EME	Bloomberg	CBGMTP3M
Ghana	1990q1	2018q4	116	EME	IMF, Bloomberg	6526591,GHAB3MAY
Hungary	1990q1	2018q3	114	EME	IMF, Bloomberg	HUTZ3MAY,GTHUF3MGovt,9446591
India	2000q2	2018q1	72	EME	Bloomberg	IYTB3M,FBTB3M
Indonesia	2012q1	2018q4	28	EME	Bloomberg	BV3M0132,ASCIAY3M
Iraq	2002q4	2008q4	22	EME	Bloomberg	4336R002
Jamaica	1997q4	2018q4	75	EME	Bloomberg	JMTB3MYL
Kenya	1995q1	2018q4	96	EME	IMF, Bloomberg	KNRETB91,6646591
Korea	1999q2	2018q4	69	EME	Bloomberg	GTKRW3MGovt
Kosovo, Republic of	2012q1	2017q1	12	EME	Bloomberg	KSTT3MAY
Kuwait	1990q1	2002q4	46	EME	IMF	
Kyrgyz Republic	1994q1	2018q4	100	EME	IMF	
Latvia	1994q3	1999q4	22	EME	IMF, Bloomberg	LRTB03AD,9416591
Malaysia	1990q1	2016q4	80	EME	IMF, Bloomberg	MA3MAY,C1133M,5486R001,5486591
Malta	1990q1	2007q4	72	EME	IMF, Bloomberg	1816591,CBMP3M
Mauritius	1997q3	2018q4	77	EME	Bloomberg	BMTB91WY
Mexico	1991q1	2018q4	105	EME	Bloomberg	GCETAA91,MPTBCCMPNCurncy
Moldova	2013q2	2018q4	23	EME	Bloomberg	MKTB3MNY
Mongolia	2012q4	2017q3	18	EME	Bloomberg	MGFX12WK
Mozambique	2003q2	2018q3	62	EME	IMF, Bloomberg	MZTB3MAY,6886591
Myanmar	2015q1	2018q4	16	EME	Bloomberg	MB3MAY
Nepal	1990q1	2018q4	106	EME	IMF, Bloomberg	NPRTTB91,5586591
Nigeria	2008q1	2018q4	44	EME	Bloomberg	NIAT3MAV,NGTB3M
Pakistan	1998q3	2018q4	81	EME	Bloomberg	PAK3CY
Philippines	1990q1	2018q3	106	EME	IMF, Bloomberg	GTPHP3MGovt,5666591
Poland	1995q2	2008q4	48	EME	Bloomberg	PDAT3MAY
Romania	1994q1	2012q3	67	EME	IMF	
Russia	2010q1	2018q4	36	EME	Bloomberg	MICXRU3M
Rwanda	2009q2	2018q4	38	EME	Bloomberg	RWTB3MAY
Serbia	2003q2	2016q1	49	EME	Bloomberg	SRAT3MAV,BIEEBO3M
Seychelles	2008q1	2018q4	44	EME	Bloomberg	SCTB3MAY
Sierra Leone	1990q1	2018q4	116	EME	IMF, Bloomberg	SETT3MAY,7246591
Singapore	1998q1	2018q4	84	EME	Bloomberg	MASB3M
Slovenia	1998q2	2001q2	13	EME	IMF, Bloomberg	9616591,SVAT3MAY
South Africa	1995q1	2018q4	96	EME	IMF, Bloomberg	SATA3MAV,1996591
Sri Lanka	1995q1	2018q4	96	EME	Bloomberg	SLTN3MYD
Tanzania	1993q4	2018q2	99	EME	IMF, Bloomberg	TZTB3MAY,7386591
Thailand	1999q4	2018q2	58	EME	Bloomberg	TH3MAY
Turkey	1990q1	2008q2	58	EME	IMF	
Uganda	1990q1	2018q4	116	EME	IMF, Bloomberg	UATB3MAY,7466591
Ukraine	2014q1	2018q4	11	EME	Bloomberg	UKAUAY3M
Uruguay	2015q2	2018q3	13	EME	Bloomberg	NUTB3MAY
Zambia	2003q4	2018q4	61	EME	Bloomberg	ZMITTBAM,ZITB3MAY

Notes: The table reports the sample coverage of treasury rates and their sources. When data come from national sources we retrieve it from *Bloomberg* and report the relevant *Bloomberg* ticker in the last column.

Table A.4: Dataset: money market rates

Country	Start	End	Observations	Country Group	Source	*Bloomberg* ticker
Australia	1996q4	2018q4	89	AE	Bloomberg	ADBB3MCMPNCurncy
Canada	1991q4	2018q4	109	AE	Bloomberg	CDOR03
Denmark	1990q1	1998q4	36	AE	Bloomberg	CIBO03M
Euro Area	1998q4	2014q4	65	AE	Bloomberg	EUDRCCMPNCurncy
Finland	1990q1	1994q4	20	AE	IMF	
Iceland	1998q3	2018q4	82	AE	Bloomberg	SEDL3MDE
Ireland	1991q2	1996q3	22	AE	Bloomberg	DIBO03M
Israel	2000q4	2018q4	73	AE	Bloomberg	TELBOR03
Italy	1991q1	1996q3	23	AE	Bloomberg	RIBORM3M
Japan	1990q1	2017q2	106	AE	Bloomberg	JY0003M
New Zealand	1995q4	2018q4	93	AE	Bloomberg	NDBB3MCMPNCurncy
Norway	1990q1	2018q4	116	AE	Bloomberg	NIBOR3M
Portugal	1990q1	1993q2	14	AE	Bloomberg	OEPTR005
Sweden	1990q1	2015q1	101	AE	Bloomberg	STIB3M
Switzerland	1990q1	2011q2	86	AE	Bloomberg	SF0003M
United Kingdom	1990q1	2018q4	116	AE	Bloomberg	BP0003M
Argentina	2001q4	2011q4	41	EME	Bloomberg	ARLBP90
Chile	2001q4	2018q4	69	EME	Bloomberg	CLTN90DS,CLTN90DN
China	2005q3	2018q4	54	EME	Bloomberg	CNIBR3M,SHIF3M
Colombia	1995q1	2018q4	96	EME	Bloomberg	COMM90D
Costa Rica	2016q1	2018q4	12	EME	Bloomberg	CRRI3M
Czech Republic	1993q2	2018q4	103	EME	Bloomberg	PRIB03M
Hungary	1997q2	2018q4	87	EME	Bloomberg	BUBOR03M
India	1998q4	2018q4	81	EME	Bloomberg	IN003M
Indonesia	1997q2	2018q4	87	EME	Bloomberg	JIIN3M
Kazakhstan	2001q3	2018q4	70	EME	Bloomberg	KZDR90D
Korea	2004q3	2018q4	58	EME	Bloomberg	KRBO3M
Kuwait	1990q1	2002q4	44	EME	IMF, Bloomberg	KIBOB3M,4436586
Malaysia	1990q1	2018q4	89	EME	Bloomberg	KLIB3M
Mexico	1997q1	2018q4	88	EME	IMF, Bloomberg	MXIB91DT,2736586
Nigeria	2008q1	2018q4	42	EME	Bloomberg	NRBO3M
Pakistan	2001q3	2018q4	69	EME	Bloomberg	PKDP3M
Paraguay	2012q3	2018q4	26	EME	Bloomberg	PYMM3MON
Peru	2002q3	2018q4	66	EME	Bloomberg	PRBOPRB3
Philippines	2001q2	2018q4	70	EME	Bloomberg	PREF3MO
Poland	1996q3	2018q4	90	EME	Bloomberg	WIBR3M
Romania	1998q1	2012q3	59	EME	Bloomberg	BUBR3M
Russia	2000q3	2018q4	74	EME	Bloomberg	MMIBR3M,MOSKP3
Serbia	2005q3	2018q4	54	EME	Bloomberg	9421P276
Singapore	1999q3	2018q4	78	EME	Bloomberg	SIBF3M
Slovak Republic	1995q1	2008q4	56	EME	Bloomberg	BBOR3M
South Africa	1999q1	2018q4	80	EME	Bloomberg	JIBA3M
Sri Lanka	2000q4	2018q4	70	EME	Bloomberg	SLBR3MON
Thailand	2002q2	2018q4	67	EME	Bloomberg	BOFX3M
Tunisia	2016q2	2018q4	11	EME	Bloomberg	TUNBOR3M
Turkey	2006q4	2018q4	49	EME	Bloomberg	TRLXB3M
Vietnam	2009q2	2018q4	39	EME	Bloomberg	VNCD3MO

Notes: The table reports the sample coverage of money market rates and their sources. When data come from national sources we retrieve it from *Bloomberg* and report the relevant *Bloomberg* ticker in the last column.

B Additional Tables and Figures

Taylor rule estimates excluding high-inflation countries and crisis periods Table A.5 reports the estimates of Taylor rule coefficients for a sample that excludes countries that have experienced inflation rates above 40 percent over a 12-month period and periods during the 6 months immediately following a currency crisis and accompanied by a regime switch.[20] The results for this subsample of EMEs are reported in Table A.5.

Table A.5: Estimated central banks' reaction function (excluding high-inflation countries and crisis periods)

	Emerging Economies		*Advanced Economies*	
	i_t^P	i_t^P	i_t^P	i_t^P
i_{t-1}^P	0.889***	0.873***	0.944***	0.930***
	(0.0066)	(0.0073)	(0.0075)	(0.0082)
π_t	0.213***	0.330***	0.304***	0.265***
	(0.023)	(0.027)	(0.029)	(0.028)
Δgdp_t	0.0102***		0.00133	
	(0.0034)		(0.0017)	
$Output\ gap_t$		0.0324**		0.0844***
		(0.016)		(0.011)
R-Squared	0.90	0.89	0.96	0.95

Notes: The table reports estimates of equation (1) by OLS. For both emerging and advanced economies, the first specification uses real GDP growth to proxy for economic activity while the second specification uses the output gap. These regressions feature country fixed effects. Data are at a quarterly frequency. Standard errors are reported in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

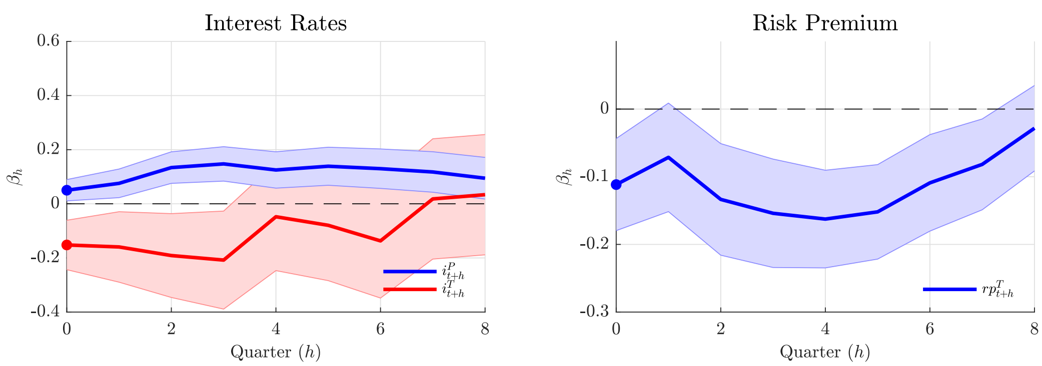
Results for subsample of EMEs that conduct interest-rate-based monetary policy Here we report our main results for the subsample of EMEs that uses a policy rate as the primary monetary policy instrument for most part of the sample period, following Brandão-Marques et al.'s (2021) classification based on the examination of historical reports, such as

[20] Thus, we exclude the "freely falling" category in Ilzetzki et al. (2019).

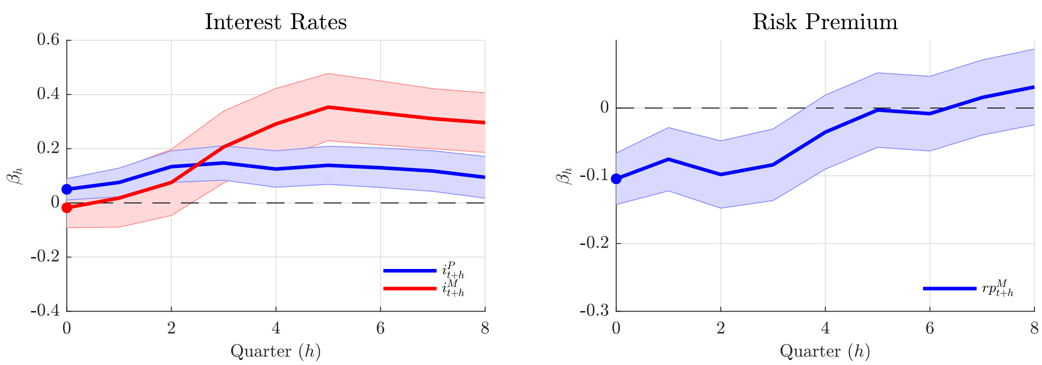
IMF Article IV staff reports, and monetary policy reports issued by central banks. The countries selected as conducting interest-rate based monetary policy are: Armenia, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Egypt, Guatemala, Hungary, Malaysia, Mexico, Pakistan, Paraguay, Peru, Philippines, Poland, Romania, Russia, South Africa, Sri Lanka, Thailand, Turkey, Ukraine, Uruguay, and Vietnam. The results for this subsample of EMEs are reported in Figure A.1.

Figure A.1: Dynamic properties of interest rates and risk premia (subsample of EMEs that conduct interest-rate-based monetary policy)

(a) Emerging Economies – Treasury Rates



(b) Emerging Economies – Money Market Rates



Notes: The figure reports the panel estimates of β_h's in regression equations (2) and (3). 90% confidence intervals are shown by the shaded areas. These regressions feature country fixed effects. Data are at a quarterly frequency.