THE GLOBAL TRANSMISSION OF U.S. MONETARY POLICY

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ABSTRACT

We quantify global US monetary policy spillovers by employing a high-frequency identification and big data techniques, in conjunction with a large harmonised dataset covering 30 economies. We report three novel stylised facts. First, a US monetary policy tightening has large contractionary effects onto both advanced and emerging economies. Second, flexible exchange rates cannot fully insulate domestic economies, due to movements in risk premia that limit central banks' ability to control the yield curve. Third, financial channels dominate over demand and exchange rate channels in the transmission to real variables, while the transmission via oil and commodity prices determines nominal spillovers.

KEYWORDS

Monetary policy, Trilemma, Exchange Rates, Monetary Policy Spillovers.

JEL

E5, F3, F4, C3.

The Global Transmission of U.S. Monetary Policy

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Abstract

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1 Introduction

The status of the US dollar as the world's reserve currency and its dominant role in global trade and financial markets mean that decisions taken by the Fed have an impact well beyond the borders of the United States. The classic Mundell-Fleming model identifies two international transmission channels of US monetary policy. First, an increase in US interest rates has a contractionary effect, which translates to lower demand for both US and foreign goods ('demand-augmenting' effect). Second, as the dollar appreciates, foreign goods become relatively cheaper, moving the composition of global demand away from US goods and towards foreign goods ('expenditure-switching' effect). These two channels partially offset each other.

Beyond these classic channels, the transmission of monetary policy via financial linkages can have powerful effects (Rey, 2013, 2016; Farhi and Werning, 2014; Bruno and Shin, 2015a,b). A Fed rate hike transmits along the yield curve at longer maturities and reduces the price of risky financial assets. Portfolio rebalancing by investors in the integrated global financial market determines capital outflows in foreign countries and induces upward pressure on foreign longer-term yields and downward price revisions of foreign assets. In turn, the shocks transmits to funding cost of banks, which provide credit to many advanced and emerging economies. Financial conditions abroad may deteriorate abruptly and substantially with powerful destabilising effects.

The relative strength of the different channels is ultimately an empirical question, yet plagued with technical difficulties. In his Mundell-Fleming lecture, Bernanke (2017) summarised the challenges to the existent evidence. First, monetary policy actions are largely endogenous to economic conditions and have strong signalling and coordination effects. Second, the limited availability of data at monthly or higher frequency on financial and cross-border flows has constrained much of the literature. Finally, there are many dimensions along which countries may differ – their cyclical positions and structural features such as trade exposure, financial exposure, openness to capital flows, exchange rate and policy regimes.

We take on these three challenges to provide robust estimates of the impact of US monetary policy across the globe. First, we employ a state-of-the-art high-frequency identification (HFI) for conventional monetary policy shocks, obtained from intraday price revisions of federal funds futures, that directly controls for the information channel of monetary policy as proposed by Miranda-Agrippino and Ricco (forthcoming). Second, we construct a large and harmonised monthly dataset that includes a comprehensive set of macroeconomic and financial variables covering the US, 15 advanced economies (AE), 15 emerging economies (EM), and a rich set of global indicators. Importantly, it also includes country-specific and aggregate harmonised monthly indexes of credit flows and liquidity conditions.[1] The dataset contains over 150,000 observations, spanning the period 1990:1 to 2018:9, and hence qualifies as 'big data' (see Giannone et al., 2018). Third, we adopt modern Bayesian big data Vector Autoregression (BVAR) techniques and study the international transmission of US monetary policy. We gauge the relative strength of the different channels of transmission and we explore how transmission changes conditional on structural features. In particular, we measure spillovers conditional on (i) income levels, (ii) degree of openness to capital, (iii) exchange rate regimes, (iv) dollar trade invoicing, and (v) gross dollar exposure.

We report a rich set of novel findings. First, a US monetary policy tightening has large and fairly homogenous real and nominal contractionary spillovers onto both advanced and emerging economies. Even large economic areas such as the Euro zone are affected. Following a contractionary US monetary policy shock, industrial production contracts globally and prices adjust downwards, while foreign currencies depreciate. Moreover, commodity prices, global financial conditions, global risk appetite, and global cross-border financial flows all contract. Importantly, the country-level responses are much less heterogeneous than previously reported. This provides a striking visual image of the role of the Fed as the global central bank.

Second, a US monetary policy tightening affects countries irrespectively of their exchange rate regimes. Indeed, flexible exchange rates cannot fully insulate economies. Movements in risk premia limit central banks' ability to control the yield curve, even in advanced economies. Central banks attempt to counteract the recessionary effects by lowering the policy rate, but this does not fully transmit along the yield curve, since the increase in risk premia lifts up the long end of the curve, against the policy impulse. These results complement the findings in Kalemli-Özcan (2019) and confirm their validity. Importantly, a comparative analysis shows that both real and nominal spillover effects

[1] Along with the official data from IMF, we employ CrossBorder Capital Ltd indicators on liquidity and financial conditions, covering all of the economies of interest at monthly frequency. The underlying data are mostly publicly available and obtainable from BIS and statistical offices.

are larger in countries with more rigid exchange rate regimes.

Third, our analysis indicates that financial channels dominate over demand and exchange rate channels in the transmission to real variables, while the transmission via oil and commodity prices determines nominal spillovers. The predominance of financial channels in the real transmission is visible both in advanced and emerging economies and confirms Rey (2013)'s seminal work on the role of the global financial cycle in the international transmission of shocks. The 'oil price channel' is an important novel channel not previously reported in the literature and it is explained by the contraction in oil and commodity prices due to lower US and global demand, and stronger US dollar. The contraction of commodity prices is reflected in energy prices abroad and in the differential response of headline CPI as compared to core CPI: while the first contracts, the second does not respond.

We complement these key findings with a number of additional results. We show that advanced and emerging economies that are more open in terms of capital flows, as classified by the Chinn and Ito (2006)'s index, exhibit stronger negative responses of industrial production and CPI compared to less-open ones. Moreover, in analysing the differential responses to contractionary and expansionary US monetary policy shocks, we find some evidence of asymmetric effects, especially in the case of 'fragile' emerging economies, where a US tightening can have powerful effects on production and also create inflationary pressure, destabilise the exchange rate, and force the central bank to hike the rates.

We provide a stylised model to analyse these results and to rationalise the role of the main channels we discuss. Most emerging and advanced economies seem to be characterised by relatively strong financial spillovers that dominate over the classic Mundell-Fleming channels, and by an oil channel that overpowers inflationary effects due to the exchange rate devaluation. The asymmetric effects in fragile emerging economies point to even stronger financial spillovers.

Our results have important policy implications. The depth and reach of the international spillover effects of US monetary policy call for policy coordination and possibly the activation of multiple monetary policy tools abroad. Flexible exchange rates alone are not sufficient to provide monetary autonomy, not even to advanced economies or the Euro Area. This confirms Rey (2013)'s observation on the reduction of the Trilemma of international macroeconomics into a Dilemma. From the point of view of most of the countries in our sample, a US monetary policy shock appears as a negative demand shock that contracts prices and output. Hence, in such a case, the optimal response of an inflation targeting central bank is to loosen its policy stance to counter react the recessionary pressure. However, movements in risk premia affect the policy impulse transmission and limit the effects of traditional monetary policy, possibly calling for unconventional actions to steady the yield curve and support financial conditions. Our results extend to the case of advanced economies the findings in Kalemli-Özcan (2019) on the role of movements in risk premia in the transmission of US monetary policy. Finally, our results on the insulation effects of capital flow management indicate a possible role for these measures, in fragile economies and in emergencies, to steady the economies in line with the IMF's most recent institutional view (see for instance IMF, 2018).

The structure of the paper is the following. The reminder of this section provides a review of the relevant literature. Section 2 introduces a simplified model to help understand the key empirical results. Section 3 describes the methodology and the data used in our empirical exercises. Section 4 discusses the effects of U.S. monetary policy on the global economy. Section 5 and Section 6 study the transmission of US shocks respectively to a set of advanced and emerging economies, and explore the dilemmas faced by domestic central banks. Section 7 explores the role of structural features: exchange rate regimes, capital flow management, and dollar exposure. Section 8 concludes.

Related Literature. Our work is closely related to Rey (2013)'s Jackson Hole lecture and to a number of her subsequent works with different co-authors which have documented the existence of a 'Global Financial Cycle' in the form of a common factor in international asset prices and different types of capital flows (Passari and Rey, 2015; Gerko and Rey, 2017; Miranda-Agrippino and Rey, 2020; Miranda-Agrippino et al., 2020).[2] Compared to those works, we employ an informationally robust identification strategy and a large cross-section of countries and variables, while also comparing effects across policy regimes and other structural characteristics.

In studying the international spillovers of conventional US monetary policy, we con-

[2]Recent papers documenting capital flows cycles are Forbes and Warnock (2012); Cerutti et al. (2019); Acalin and Rebucci (2020); Jordà et al. (2019).

nect to a large literature that has generally reported sizeable real and/or nominal effects, and very large heterogeneity across countries and periods.[3,4] We qualify these previous results by adopting modern econometric and identification techniques and showing robust patterns of response.

The works of Dedola et al. (2017), and Iacoviello and Navarro (2019) are the most closely related to ours in terms of data coverage. Compared to them and to a number of previous works, we improve by adopting a cutting-edge high frequency identification that crucially controls for the information channel of monetary policy, and large Bayesian data techniques that, in combination with a large set of indicators and countries, deliver a landscape view on the international transmission of US monetary policy shocks.[5] Contrarily to the rest of the literature, Ilzetzki and Jin (2021) find that there has been a change over time in the international transmission of US monetary policy, whereby since the 1990s a US tightening is expansionary abroad. Our analysis suggests that these results are possibly be due to information effects, hence to the propagation of macroeconomic shocks other than policy.

Our results complement the literature that studies financial spillovers via cross-border bank lending and international credit channels, by which appreciations of the dollar cause valuation effects, and on the risk-taking channel, by which US monetary policy affects the risk profile and the leverage of financial institutions, firms, and investment funds.[6,7]

[3] Some early contributions on US monetary policy spillovers include: Kim (2001); Forbes and Chinn (2004); Canova (2005); Maćkowiak (2007); Craine and Martin (2008); Ehrmann and Fratzscher (2009); Wongswan (2009); Bluedorn and Bowdler (2011); Hausman and Wongswan (2011); Fukuda et al. (2013). A number of papers have studied the effects of US monetary policy on Europe, or vice-versa, or compared the spillovers from the US and the Euro Area. Among others Ehrmann and Fratzscher (2005); Fratzscher et al. (2016); Brusa et al. (2020); Ca' Zorzi et al. (2020). A different stream of literature has focussed on spillovers to emerging economies in different settings: Chen et al. (2014); Takats and Vela (2014); Aizenman et al. (2016); Ahmed et al. (2017); Anaya et al. (2017); Bhattarai et al. (2017); Siklos (2018); Coman and Lloyd (2019); Vicondoa (2019); Bhattarai et al. (forthcoming).

[4] While our focus is on conventional monetary policy, a number of works have discussed spillovers from unconventional monetary policy actions. For example, Neely (2012); Bauer and Neely (2014) (long-term yields), Stavrakeva and Tang (2015) (exchange rates), Fratzscher et al. (2018) (portfolio flows), Rogers et al. (2018) (risk premia), Curcuru et al. (2018) (conventional vs. unconventional).

[5] A few papers, such as Georgiadis (2016), Feldkircher and Huber (2016) and Dées and Galesi (2019), have also used large panels of countries in Global VAR settings. Unlike this approach, our approach affords us much more modelling flexibility, since we do not need to use GDP or trade weights to model international interactions, and we do not use sign restrictions to identify monetary policy.

[6] As a reference to cross-border bank lending channel see, among others, Cetorelli and Goldberg (2012); Bruno and Shin (2015a); Cerutti et al. (2017); Temesvary et al. (2018); Avdjiev and Hale (2019); Buch et al. (2019); Morais et al. (2019); Albrizio et al. (2020); Bräuning and Ivashina (2020).

[7] On the risk-taking channel see, among others, Adrian and Song Shin (2010); Ammer et al. (2010); Devereux and Yetman (2010); Borio and Zhu (2012); Bekaert et al. (2013); Morris and Shin (2014); Bruno and Shin (2015a); Adrian et al. (2019); Cesa-Bianchi and Sokol (2019); Kaufmann (2020).

A number of works have reported that the short-term rates of flexible exchange rate countries are less correlated to the centre country policy rate than those of peggers and interpreted this as evidence in favour of the effectiveness of flexible rate arrangements.[8] Our results qualify these findings by showing that the limited transmission of the policy impulses due to the movement in risk premia along the maturity structure of the yield curve impairs the effectiveness of countercyclical monetary policy. We also provide qualification to previous results on capital flow management that pointed to the limited effectiveness of these measures (see, for example, Miniane and Rogers, 2007). While our results are silent on side-effects, they indicate that financial openness is an important determinant of spillovers.[9] Similar results for both conventional and unconventional monetary policy have been recently reported by Kearns et al. (2018).

Finally, and more broadly, our results speak to the important literature on reference (see Ilzetzki et al., 2019) and dominant currencies (see Gourinchas and Rey, 2007; Maggiori, 2017; Gourinchas et al., 2019; Maggiori et al., 2019; Gopinath et al., 2020).

2 A Mundell-Fleming type Framework

This section explores the different channels of international transmission of US monetary policy using an old-style Mundell-Fleming type model that generalises the framework of Blanchard (2017) and Gourinchas (2018). While this overly stylised model lacks microfundations and is static in nature, it allows for a transparent discussion of the different channels at play in the international propagation of US policy shocks. The model includes both nominal and real variables, as well as financial spillovers, risk premia, and commodity prices, that are important for our empirical analysis.

The model has two countries: the domestic economy (a small open economy) and the US (a large economy). In deviation from the steady state, domestic and foreign variables

[8] See, for instance, Shambaugh (2004); di Giovanni and Shambaugh (2008); Goldberg (2013); Klein and Shambaugh (2015); Obstfeld (2015); Aizenman et al. (2016); Georgiadis and Mehl (2016); Obstfeld et al. (2019).

[9] Side effects of capital flow management measures are discussed, for instance, in Forbes (2007); Forbes et al. (2016); Erten et al. (2019).

(with superscript US) are determined by the following system of equations:

$$Y = \underbrace{\xi - c\,(I - \Pi^e)}_{\text{domestic demand}} + \underbrace{a\left(Y^{US} - Y\right) + b\left(E + \Pi^{US} - \Pi\right)}_{\text{net export}} - \underbrace{f\left(E + \Pi^{US} - \Pi\right)}_{\text{financial spillovers}} , \tag{1}$$

$$Y^{US} = \xi^{US} - c\left(I^{US} - \Pi^{e,US}\right) , \tag{2}$$

$$E = \underbrace{d\left(I^{US} - I\right) + E^e}_{\text{UIP}} + \underbrace{gI^{US} + \chi}_{\text{risk premia}} , \tag{3}$$

$$\Pi = eY + mE + hC , \tag{4}$$

$$\Pi^{US} = eY^{US} + hC , \tag{5}$$

$$C = lY^{US} , \tag{6}$$

where lower case letters are the non-negative parameters of the model. We define the nominal exchange rate, E, such that an increase corresponds to a depreciation of the domestic currency. Domestic output Y is a function of domestic demand, net exports, and financial spillovers. Domestic demand depends positively on a demand shifter, ξ, and negatively on the domestic real interest rate, $R = I - \Pi^e$, which uses the (log-linearised) Fisher equation. Net exports are increasing both in US output, Y^{US}, and in $\epsilon = E + \Pi^{US} - \Pi$, which is the (log-linearised) definition of the real exchange rate.[10] Moreover, they are decreasing in the domestic output, Y. Financial spillovers impact domestic absorption, and depend negatively on the real exchange rate, as in Gourinchas (2018). This term captures different mechanisms, through which an appreciation of the US dollar could affect the domestic economy via financial links. For example, the reduction of domestic assets as priced in US dollars would cause a deterioration of credit conditions via a tightening of the collateral constraints. The parameter f gauges the strength of these channels, with $f = 0$ being the standard Mundell-Fleming case.

US output, Y^{US}, only depends positively on a demand shifter, ξ^{US}, and negatively on the real interest rate, $I^{US} - \Pi^{e,US}$. The exchange rate E depends on the interest rate differential and the expected exchange rate E^e – the uncovered interest rate parity (UIP) determinants –, and a risk premia term that is a function of interest rates in the US, plus an independent shock χ. The latter also captures deviation from UIP due to risk premia and financial spillovers via changes to risk appetite.

[10] In a static model, a deviation of prices from steady state and inflation are substitutable concepts. We use Π in the model for convenience.

Domestic inflation, Π, is a function of the domestic output gap, the exchange rate, and the price of commodities. This relationship can be interpreted as a static Phillips curve. The last term captures direct spillovers to domestic prices via commodities and oil prices. A reduction in US demand can induce an adjustment in commodity prices (in Eq. 6) that in turn transmits to headline inflation via energy prices. This is a novel 'commodity prices' channel that we explore in the empirical exercises. Under the assumptions of dominant-currency pricing, US inflation Π^{US} is a function of US output, but does not depend on the exchange rate.

By solving Equations (1) to (6) we can express domestic output as a function of demand shifters, risk premia, domestic and US nominal policy rates.[11] We also assume that Π^e, $\Pi^{e,US}$ and E^e are known constant, that we set to zero for the sake of simplicity. Our focus is the response of domestic output to a change in US monetary policy:

$$\frac{\partial Y}{\partial I^{US}} = \frac{1}{\psi} \left[(1-m) \left(bd - fd + (b-f)\, g \right) - ac - ce\,(b-f) \right] \ , \tag{7}$$

where $\psi = 1 + a + (b-f)\, e$. Eq. (7) reflects various channels of transmission of US monetary policy on domestic output. bd captures the domestic trade balance improvement that follows the appreciation of the dollar, i.e. the expenditure-switching channel. ac is the contractionary effect on domestic output of lower US demand via lower domestic exports, i.e. the demand-augmenting effect. In the standard Mundell-Fleming, the effect of a US tightening on domestic output is given by $bd - ac$.[12] The sign of this term determines the baseline 'classic' transmission – i.e. whether a tightening in the US is expansionary or contractionary for the domestic economy, absent other channels.

The financial channels are represented by fd, which captures the negative effect of a dollar appreciation on domestic output via financial spillovers, and by $(b-f)\, g$, which represents the effect of risk premia. Specifically, bg captures the stimulative effect of risk premia on domestic output via the trade balance, and fg the negative effect via financial spillovers. Finally, the terms ceb and cef represent the effects of lower US prices via the exchange rate and financial spillovers respectively.

How does the response of domestic output to US monetary policy depend on the

[11] A detailed discussion of the model and its solution is reported in the Online Appendix, Section A.

[12] In fact, absent financial spillovers (i.e. $f = g = \chi = 0$) and excluding any effect on domestic output coming from movements in prices (i.e. $e = m = h = 0$), the model reduces to the standard Mundell-Fleming, as a special case.

relative strength of the financial channel as compared to the classic channels? Consider the reaction of domestic output to a US tightening, in Eq. (7). We assume that ψ is always positive, i.e.

$$f < b + \frac{1+a}{e} \equiv \widehat{f} \ . \tag{8}$$

This is a technical assumption – which sets an upper bound $\widehat{f}$ – to ensure that a positive demand shock, ξ, has a positive effect on domestic output. We also assume that the direct response of the real exchange rate to a US tightening is positive, i.e. $(1-m)(d+g) - ce > 0$. Under these assumptions, a US tightening causes a decline in domestic output, irrespectively of the classic channels, for

$$f > b - \frac{ac}{(1-m)(d+g) - ce} \equiv \bar{f} \ . \tag{9}$$

How does domestic output respond to domestic monetary policy? The response of domestic output to the domestic interest rate is given by

$$\frac{\partial Y}{\partial I} = \frac{1}{\psi}\left[(1-m)(f-b)\,d - c\right] \ .$$

A domestic tightening contracts domestic output if

$$f < b + \frac{c}{(1-m)\,d} \equiv \bar{\bar{f}} \ . \tag{10}$$

It is easily seen that $\bar{\bar{f}} > \bar{f}$. For any f beyond the threshold $\bar{\bar{f}}$, the effect of domestic monetary policy becomes 'perverse': a tightening induces expansion in the economy.

The two thresholds $\bar{f}$ and $\bar{\bar{f}}$ define regions along the interval $[0, \widehat{f}]$ in which both domestic and US monetary policy can be either expansionary or contractionary for domestic output. The existence of these regions depends on the parameters of the model.[13] In the limit $f \to 0$, the model collapses to the standard Mundell-Fleming case, where the effect of a US tightening is contractionary abroad if $bd > ac$ (i.e. the expenditure-switching channel has to be greater than the demand-augmenting one).

We focus now on the nominal side of the model. How does domestic inflation respond

[13] Conditions for the existence of the two thresholds $\bar{f}$ and $\bar{\bar{f}}$ are given in the Online Appendix, Section A.

to a US tightening, and in particular what is the role of commodity prices?

$$\frac{\partial \Pi}{\partial I^{US}} = e\frac{\partial Y}{\partial I^{US}} + m\left(d+g\right) - hlc\ . \tag{11}$$

The first term on the right-hand side reflects the overall effect of the three channels of transmission on domestic output. The second term, $m\left(d+g\right)$, captures the direct effect of the appreciation of the dollar on import prices coming from the interest rate differential (md) and higher risk premia (mg). The third term is the effect on domestic inflation of lower commodity prices.

A US tightening puts inflationary pressure on domestic prices – due to the depreciation of the domestic currency – if commodity prices spillovers, h, are not too strong. In particular, a US tightening increases domestic inflation, irrespectively of the classic effects, if

$$h < \frac{e}{lc}\left(\frac{\partial Y}{\partial I^{US}}\right) + \frac{m}{lc}\left(d+g\right) \equiv \bar{h}(f)\ , \tag{12}$$

that is a monotonically decreasing function in f, via $\partial Y/\partial I^{US}$. As financial spillovers get stronger, the threshold value $\bar{h}$ becomes smaller.

How does domestic inflation react to domestic monetary policy? One obtains

$$\frac{\partial \Pi}{\partial I} = e\frac{\partial Y}{\partial I} - md\ , \tag{13}$$

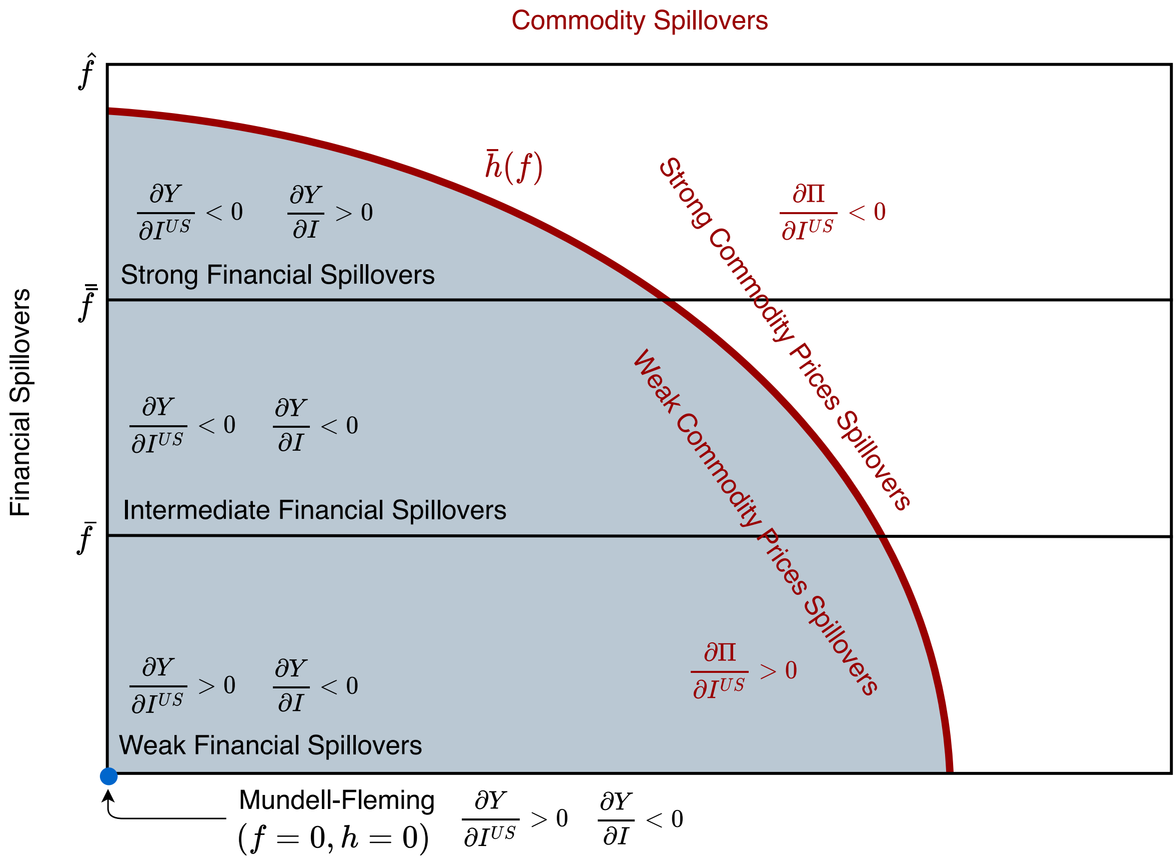
where the first term on the right-hand side reflects the effect on inflation of the change in output via the Phillips curve, and the second term is the effect on inflation via the appreciation of the domestic currency. Whenever domestic monetary policy is 'well-behaved' (i.e. a domestic tightening contracts domestic output) the effect of a domestic tightening on inflation is unambiguously negative. However, when the domestic transmission is 'perverse', a domestic tightening has a deflationary effect only if

$$\frac{\partial Y}{\partial I} < \frac{md}{e}\ ,$$

otherwise it has a perverse effect also on inflation.

We summarise the different 'regimes' in the space defined by financial and commodity prices spillovers, in Figure 1. The diagram reports the two thresholds on f defining the three regions:

Figure 1: Real and Nominal Spillovers



Notes: This schematic representation of the channels assumes that both thresholds $\bar{f}$ and $\bar{\bar{f}}$ exist. Conditions for existence are given by Eq. A.14 and Eq. A.15 in the Online Appendix. It also assumes that in the classic Mundell-Fleming model, at the bottom-left corner of the diagram, a US monetary policy tightening has an expansionary effect abroad.

(i) **Weak financial spillovers** ($f < \bar{f}$) – a tightening in the US is expansionary abroad, while domestic monetary policy has conventional effects. The low right corner is the Mundell-Fleming model (for $f = 0$ and $h = 0$, under the assumption $bd - ac > 0$).

(ii) **Intermediate financial spillovers** ($\bar{\bar{f}} > f > \bar{f}$) – a tightening in the US is contractionary abroad, while domestic monetary policy has conventional effects.

(iii) **Strong financial spillovers** ($f > \bar{\bar{f}}$) – a tightening in the US is contractionary abroad, but domestic monetary policy has perverse effects. A domestic tightening expands output.

As the importance of the financial channel grows, the impact of commodity prices on domestic inflation grows in importance as well. The red negatively sloped curve in Figure 1 is $\bar{h}(f)$ as function of f, and it defines two regions:

(a) **Weak commodity spillovers** ($h < \bar{h}$) – a tightening in the US puts inflationary pressure on prices abroad;

(b) **Strong commodity spillovers** ($h > \bar{h}$) – a tightening in the US has a deflationary effect abroad.

We now elaborate on what is the optimal response of domestic monetary policy authorities to a US tightening, under different policy objectives. First, following Blanchard (2017), we consider an ad-hoc loss function where domestic authorities care about deviations of output from steady state and trade deficits, i.e.

$$L = \frac{1}{2}\mathbb{E}Y^2 - \alpha \mathbb{E}NX \ . \tag{14}$$

This can be seen as a stylised representation of policies aiming at stabilising the exchange rate, such as hard and crawling pegs, possibly due to 'mercantilistic' motives. We also consider a more conventional loss function where monetary authorities care about inflation and the output gap,

$$L = \frac{1}{2}\mathbb{E}Y^2 + \frac{\beta}{2}\mathbb{E}\Pi^2 \ , \tag{15}$$

and that can be thought of as capturing standard monetary policy, via a Taylor rule.

Under the mercantilistic loss function, it is possible to show that the optimal pass-through from US to domestic policy rates is:

$$\frac{\partial I^{opt}}{\partial I^{US}} = -\frac{\Phi_{I^{US}}}{\Phi_I} \ , \tag{16}$$

where $\Phi_I = \partial Y/\partial I$ and $\Phi_{I^{US}} = \partial Y/\partial I^{US}$. Since the mercantilistic loss function does not contemplate price stability, the sign of the optimal monetary policy does not depend on the response of domestic inflation to the US tightening. However it depends on the strength of financial spillovers. When financial spillovers are weak and a US tightening is expansionary abroad, the optimal response of the domestic monetary authority is to tighten. With intermediate financial spillovers, both US and domestic tightenings are contractionary and the optimal response in this case is to loosen the policy stance. Finally, with strong spillovers, domestic monetary policy has the perverse effect of stimulating domestic output on a tightening. In this situation, it is optimal for the domestic central bank to tighten in response to a US tightening.

Under the inflation-output gap loss function the optimal pass-through is instead:

$$\frac{\partial I^{opt}}{\partial I^{US}} = -\frac{\psi \Theta_{I^{US}} \Theta_I}{\Phi_I^2} \left[\beta + \frac{\Phi_{I^{US}} \Phi_I}{\psi \Theta_{I^{US}} \Theta_I} \right] ,$$

where $\Theta_I = \partial \Pi / \partial I$ and $\Theta_{I^{US}} = \partial \Pi / \partial I^{US}$. The domestic economy has one policy lever to stabilise both output and prices. Whenever a domestic policy action can stabilise both objectives contemporaneously, then the direction of the optimal monetary policy is unambiguous. However, when there is a trade-off between inflation and the output gap, what matters for the optimal decision is the policy weight on prices as relative to output stabilisation in the loss function of the domestic monetary authority, β.[14]

3 Data and Empirical Methodology

A central challenge to the study of the international propagation of US monetary policy is how to efficiently extract the dynamic causal relationships from a very large number of time series covering both global and national variables. Our approach combines three elements: a novel harmonised dataset spanning a large number of countries and variables (introduced in Section 3.1); an high-frequency informationally robust identification of US monetary policy shocks (presented in Section 3.2); and state-of-the-art Bayesian dynamic models able to handle large information sets (discussed in Section 3.3).

3.1 Data

In total, our dataset contains over 150,000 data-points covering the US, 30 foreign economies, the Euro Area as an aggregate, and global economic indicators. All variables are monthly.[15] Most of our data are publicly available and provided by national statistical offices, treasuries, central banks, or international organisations (IMF, OECD, and BIS). We also employ liquidity and cross-border flows data at a global and national level from CrossBorder Capital Ltd, a private data provider specialised in the monitoring of global liquidity flows.

[14] In the Online Appendix we show that there exists a threshold $\bar{\beta}$ above which the domestic monetary authority chooses price over output stabilisation. We also show that, when financial spillovers are strong, there are two different instances of perverse domestic monetary policy. One in which a tightening stimulates output but contracts inflation, and another where it stimulates both output and inflation.

[15] If the original series are collected at a daily frequency, we take the end-of-month value.

The dataset contains 18 US macro and financial indicators, including 5 macroeconomic aggregates (industrial production index, CPI, core CPI, export-import ratio, and trade volume), 5 financial indicators (stock price index, nominal effective exchange rate, excess bond premium from Gilchrist and Zakrajšek (2012), 10-year Treasury Bond yield rate, and VIX), gross inflows and outflows, and a monetary policy indicator (1-year Treasury constant maturity rate).[16] Additionally, we include 5 financial and liquidity indices from CrossBorder Capital Ltd – financial conditions, risk appetite, cross-border flows, fixed income and equity holdings. The financial conditions index represents short-term credit spreads, such as deposit-loan spreads. Risk appetite is based on the balance sheet exposure of all investors between equity and bonds. The cross-border flows index captures all financial flows into a currency, including banking and all portfolio flows (bonds and equities). Finally, equity and fixed income holdings measure respectively holdings of listed equities and both corporate and government fixed income assets.

The dataset also includes 17 global economic indicators: industrial production, CPI, and stock price index of OECD countries, the differential between average short-term interest rate across 15 advanced economies in our dataset and the US, the global economic activity index of Kilian (2019), CRB commodity price index, the global price of Brent crude oil, and 3 major currency exchange rates per USD: Euro, Pound Sterling, and Japanese Yen. Finally, we add gross inflows and outflows of Emerging economies from the IMF BOPS and 5 world-aggregated liquidity indexes from CrossBorder Capital Ltd, that are the counterparts of the US indices described above.[17]

At a national level, our dataset covers 30 economies – 15 advanced and 15 emerging (see Table 1). For each country in our sample and the Euro Area, we collect 15 indicators: industrial production, CPI, core CPI, stock price index, export-import ratio, trade volume, nominal bilateral exchange rate, short-term interest rate, policy rate,

[16]Following the convention, we construct gross inflows and outflows from the IMF Balance of Payment data. For instance, gross inflows are the sum of the net incurrence of liabilities in direct, other, and portfolio investment flows from the financial account. Gross outflows are the sum of the net acquisition of assets in the three components above. We interpolate the resulting series, originally at quarterly frequency, to obtain monthly observations.

[17]Table D.1 in the Online Appendix lists all global aggregates and the US variables in our dataset and details the sources, sample availability, and transformations. EM inflows and outflows are the sum of inflows/outflows of 15 emerging economies in our dataset plus Hong Kong, which played the role of financial center for China since 1999. Table D.2 in the Online Appendix lists the variables we collect for each country and the US counterparts, detailing the transformations. A comprehensive list of the countries and sample availability for each variable can be found in the Online Appendix, Table D.3. Table D.7 in the Online Appendix lists the short-term rates used in the construction of the interest rate differential.

Table 1: Country coverage

Advanced	Estimation sample	Emerging	Estimation Sample
Australia	1990:01 - 2018:08	Brazil	1999:12 - 2018:09
Austria	1990:01 - 2018:09	Chile	1995:05 - 2013:11
Belgium	1990:01 - 2018:09	China	1994:08 - 2018:08
Canada	1990:01 - 2018:08	Colombia	2002:09 - 2018:09
Denmark	1999:10 - 2018:09	Czech Rep.	2000:04 - 2018:09
Finland	1990:01 - 2018:09	Hungary	1999:02 - 2018:09
France	1990:01 - 2018:09	India	1994:05 - 2018:04
Germany	1990:01 - 2018:09	Malaysia	1996:01 - 2017:12
Italy	1990:01 - 2018:09	Mexico	1998:11 - 2018:02
Japan	1997:10 - 2018:09	Philippines	1999:02 - 2018:02
Netherlands	1990:01 - 2018:09	Poland	2001:01 - 2018:09
Norway	1995:10 - 2018:09	Russia	1999:01 - 2018:06
Spain	1990:01 - 2018:09	South Africa	1990:01 - 2018:09
Sweden	2001:10 - 2018:09	Thailand	1999:01 - 2018:05
UK	1990:01 - 2018:08	Turkey	2000:06 - 2018:09

Notes: The table lists the advanced and emerging countries in our data set and reports the estimation sample for the exercises in Sections 5 and 6.

long-term interest rate, plus the five liquidity indices (financial conditions, risk appetite, cross-border flows, fixed income and equity holdings). Hence, we have at our disposal a set of variables that reflect the US counterparts for each economy.

Since we cover a large set of advanced and emerging economies, the unbalanced sample size across countries – resulting from structural breaks, reforms, and regulations – and heterogeneity in statistical conventions are of natural concern. In dealing with these issues, we devoted a large effort to the creation of a carefully harmonised dataset. We use the index from CrossBorder Capital as the default indicator for cross-border flows in most of our exercises due to sample availability. This index is close to a net measure of capital inflows. To provide a thorough picture of capital movements, when it is possible we also use inflows and outflows constructed from the official IMF BOPS data. As illustrated in the Online Appendix, our main results are robust to the selection of the two cross-border flow measures.[18]

Our benchmark estimation sample generally spans January 1990 to September 2018 to minimise the impact of historical transformations of the global economy – e.g. the end

[18] The IMF BOPS series are not sufficiently long for Belgium and China, as they start respectively in 2002 and 2005. For the exercise in Section 7, for Belgium we use data on inflows and outflows from the BIS, while for China we extend the IMF series back to 1999 using capital flow data for Hong Kong.

of the Cold War and the transition of China to a market economy – and also to align the data with our US monetary policy instrument.[19]

In Section 7 we classify the countries in our dataset based on selected observables: the degree of capital market openness, exchange rate regimes, trade shares invoiced in USD, and dollar exposure. We divide countries into more- or less-open capital markets based on Chinn and Ito (2006)'s index. We also provide a robustness check based on the measure provided in Fernández et al. (2016). Classification into pegging, managed floating, and freely floating regimes is based on Ilzetzki et al. (2019). Data on the US dollar trade invoicing is from Gopinath (2015). Our measure of dollar exposure is based on Bénétrix et al. (2015).

3.2 Identification of the US Monetary Policy Shock

Monetary policy has strong signalling and coordination effects: a policy decision provides a signal about the Fed's view of the state of the economy and its expectations of economic developments. This is a major challenge to the identification of international spillovers of the Fed's policy actions, as observed by Bernanke (2017). An identification approach not disentangling monetary policy shocks from signals about macroeconomic and financial conditions would confound spillovers from US monetary policy and the effects of macroeconomic and global shocks. The recent macroeconomic literature uses high-frequency market surprises to identify monetary policy shocks. High-frequency surprises are defined as price revisions in federal fund future contracts observed in narrow windows around monetary policy announcements (Gürkaynak et al., 2005; Gertler and Karadi, 2015). This approach has offered a powerful IV to identify the causal effects of monetary policy, that avoids the pitfalls of traditional methods.

However, recent literature on monetary policy shocks has documented the existence of a signalling channel of monetary policy. Policy actions convey to imperfectly informed agents signals about macroeconomic developments (see Romer and Romer, 2000 and Melosi, 2017). The intuition is that to informationally constrained agents a policy rate hike can signal either a deviation of the central bank from its monetary policy rule (i.e.

[19]The estimation sample for the global exercise described in Section 4 spans 1990:01 to 2018:09. However, given the different availability of data across countries, the estimation sample used in the 'median economy' exercises described in Sections 5 and 6 varies. Table 1 details the estimation samples used in each bilateral system.

a contractionary monetary shock) or better-than-expected fundamentals to which the monetary authority endogenously responds. Miranda-Agrippino and Ricco (forthcoming) and Jarociński and Karadi (2020) have shown that high-frequency surprises combine policy shocks with information about the state of the economy due to the information disclosed through the policy action.

To obtain a clean measure of conventional monetary policy, we adopt the informationally robust instrument proposed by Miranda-Agrippino and Ricco (forthcoming) that directly controls for the signalling channel of monetary policy. This instrument is constructed by regressing high-frequency market surprises in the fourth federal fund future onto a set of Greenbook forecasts for output, inflation and unemployment (see Section B in the Online Appendix). The intuition is that the Greenbook forecasts (and revisions) directly control for the information set of the central bank and hence for the macroeconomic information transferred to the agents through the announcement (the signalling channel of monetary policy). This instrument is available from January 1990 to December 2009. We identify US monetary policy shocks using this informationally robust instrument in a Proxy SVAR/SVAR-IV setting, as proposed in Stock and Watson (2012) and Mertens and Ravn (2013).

3.3 BVARs and Asymmetric Priors

In our analysis we consider two main empirical specifications:[20]

- A **US-global VAR** incorporating 31 variables: 15 global and 16 US macroeconomic indicators.

- A battery of 31 **US-foreign country bilateral VARs** covering the 30 countries considered plus the Euro Area. Each model contains 16 US macroeconomic variables, 15 foreign financial and macroeconomic indicators, and two global controls, i.e. the global price of Brent crude oil and Kilian (2019)'s global economic activity index.

[20] Table D.1 in the Online Appendix lists all global and US variables in our specification. Due to data availability, Core CPI, Fixed Income, and Equity Holdings are used only in the endogenous set of advanced economies. Hence, the bilateral system of emerging economies includes only 12 domestic variables and 13 US variables. Table D.12 in the Online Appendix reports the specification we use for each exercise.

In line with the standard macroeconometric practice for monthly data, we consider VAR models that include 12 lags of the endogenous variables:

$$Y_{i,t} = c_i + \sum_{\ell=1}^{12} A_{i\ell} Y_{i,t-\ell} + \varepsilon_{i,t} \ , \quad \varepsilon_{i,t} \sim i.i.d.\mathcal{N}\left(0, \Sigma\right) \ , \tag{17}$$

where i is the index of the unit of interest (the global economy, one of the 30 economies considered, or the Euro Area). The vector of endogenous variables, $Y_{i,t}$, includes the unit-specific macroeconomic and financial indicators, their US counterparts, and, in the case of the bilateral models, the global controls.

It is important to stress that the adoption of large endogenous information sets in our bilateral VAR models captures the rich economic dynamics at the country level and the many potential channels through which US monetary policy can affect the rest of the world. Global controls in the bilateral system allow for higher-order transmission channels, induced by interactions among countries, that are important in correctly capturing international spillovers (see discussion in Georgiadis, 2017).

The use of large information sets requires efficient big data techniques to estimate the models. We adopt a Bayesian approach with informative Minnesota priors (Litterman, 1986). These are the most commonly adopted macroeconomic priors for VARs and formalise the view that an independent random-walk model for each variable in the system is a reasonable centre for the beliefs about their time series behaviour (see Sims and Zha, 1998). While not motivated by economic theory, they are computationally convenient priors, meant to capture commonly held beliefs about how economic time series behave. It is worth stressing that in scientific data analyses, priors on the model coefficients do not incorporate the investigator's subjective beliefs: instead, they summarise stylised representations of the data generating process.

In particular, in estimating the VAR models we elicit asymmetric Minnesota priors that assume the coefficients $A_1, \ldots, A_{12}$ to be a priori independent and normally distributed, with the following moments:

$$\mathbb{E}\left[(A_\ell)_{jk}|\Sigma\right] = \begin{cases} \delta_j & j = k, \ \ell = 1 \\ 0 & \text{otherwise} \end{cases} \qquad \mathbb{V}ar\left[(A_\ell)_{jk}|\Sigma\right] = \begin{cases} \frac{\lambda_1^2}{\ell^2} & \text{for } j = k, \forall \ell \\ \chi_{jk} \frac{\lambda_1^2}{\ell^2} \frac{\Sigma_{jk}}{\omega_k^2} & \text{for } j \neq k, \forall \ell, \end{cases} \tag{18}$$

where $(A_\ell)_{jk}$ denotes the coefficient of variable k in equation j at lag ℓ and δ_j is either 1 for variables in levels or 0 for rates. The prior also assumes that the most recent lags of a variable tend to be more informative than distant lags. This is represented by ℓ^2. The term Σ_{jk}/ω_k^2 accounts for differences in the scales of variables k relative to variable j. In our specification, the hyperparameters ω_k^2 are fixed using sample information: the variance of residuals from univariate regressions of each variable onto its own lags. The hyperparameter λ_1 controls the overall tightness of the random walk prior.[21]

Taking one step further from the standard Minnesota priors, the hyperparameter χ_{jk} breaks the symmetry across the VAR equations and allows for looser or tighter priors for some lags of selected regressors in a particular equation j. In our setting, the hyperparameter χ_{jk} is crucially important because it enables us to rule out a direct response of some US variables to economic conditions in another country. Specifically, in the US-global system, we set $\chi_{jk} = 0$ for all coefficients directly connecting US indicators to major exchange rates, global liquidity, and the OECD variables. In other words, we rule out a direct response of US indicators to these variables, while allowing for the possibility of a direct response via oil price and commodity price index. These variables are known to be good proxies of global economic activity. In the bilateral systems, we impose $\chi_{jk} = 0$ for all coefficients directly connecting US variables to periphery country indicators. However, global indicators allow for an indirect response of US variables via higher-order effects (as proposed in Georgiadis, 2017). These restrictions are of great importance in reducing parameter uncertainty and alleviating multicollinearity problems. This is particularly relevant when studying the channels of transmission of US policy shocks.

The adoption of asymmetric priors complicates the estimation problem, as discussed in Carriero et al. (2019) and Chan (2019), making it impossible to use dummy variables to implement the priors. Instead we employ the efficient methodology proposed in those papers.[22] The tightness of the priors' hyperparameters are estimated by using the optimal prior selection approach proposed by Giannone et al. (2015).

[21] Tables D.1 and D.2 in the Online Appendix contain information about transformations and priors of all the variables discussed above. Importantly, if $\lambda_1 = 0$, the prior information dominates, and the VAR shrinks to a vector of independent random walks or white noise processes according to the prior we impose. Conversely, as $\lambda_1 \to \infty$, the prior becomes less informative, and the posterior asymptotically only reflects sample information.

[22] Standard Minnesota priors are implemented as Normal-Inverse Wishart priors that force symmetry across equations, because the coefficients of each equation are given the same prior variance matrix. This implies that own lags and lags of other variables must be treated symmetrically.

3.4 Estimation of Median-Group Responses

In several exercises we estimate median group dynamic responses to US monetary policy shocks for selected groups of countries based on some common structural characteristic. The goal is to provide an indication about how a synthetic 'median' economy, representative of the underlying group, would be affected by the shock.

To do this, we aggregate the bilateral VARs to obtain the median result across countries, which we interpret as the median group estimator. While less efficient than the pooled estimator under dynamic homogeneity, it delivers consistent estimates of the average dynamic effect of shocks if dynamic heterogeneity is present (see Canova and Ciccarelli, 2013, for a discussion).[23] Importantly, we opt for the median group estimator instead of the mean group estimator in order to reduce the importance of outliers (e.g. episodes of hyperinflation in some countries within the sample period).

In our empirical approach, the estimation of confidence bands for the parameters of interest relies on the standard Gibbs sampling algorithm. For each bilateral VAR model, we obtain s draws (after burn-in) from the conditional posterior distribution of A, the companion matrix of Eq. (17) expressed in SUR form, and Σ, the corresponding variance-covariance matrix, and compute the structural impulse responses for each draw.

We aggregate the country responses into 'median' economy IRFs as follows. For each country, we take one draw of the impulse responses of a specific variable and compute the median at each horizon. We repeat this for all s available draws, and for all variables. This delivers s structural impulse responses for each variable that can be interpreted as the response of the 'median' economy to the shock. What we report in the charts are the median, 68%, and 90% confidence bands computed over these s 'median' draws.[24]

4 The Global Propagation of U.S. Monetary Policy

What are the effects of a tightening in US monetary policy onto the global economy? We explore this question in a bilateral VAR that incorporates US and global variables,

[23] If we were willing to assume that the data generating process featured dynamic homogeneity across countries (and to condition on the initial values of the endogenous variables), a pooled estimation with fixed effects, capturing idiosyncratic but constant heterogeneities across units, would be the standard approach to estimate the parameters of the model. However, in our setting dynamic heterogeneity seems to be a likely property of the systems.

[24] See the Online Appendix, Section C, for additional details.

on the sample from January 1990 to September 2018. In the system, US variables are constrained to endogenously respond only to other US indicators and to proxies of global economic conditions. While this setting allows for 'spillback' effects in the US policy and economic variables (see Obstfeld, 2020), it alleviates the strong collinearity problems due to coordination effects around US monetary policy actions.

In this section and the following, the causal effects of conventional monetary policy shocks are identified with the informationally robust instrument, that is available from January 1990 to December 2009. The US monetary policy shock is normalised to induce a 100 basis points increase in our policy indicator, the 1-year treasury constant maturity rate. All the IRFs reported in this section are jointly obtained in a large Bayesian VAR. All figures display median responses, 68% and 90% posterior coverage bands. It is important to observe that since the system is linear, responses for expansionary and contractionary shocks are symmetric.

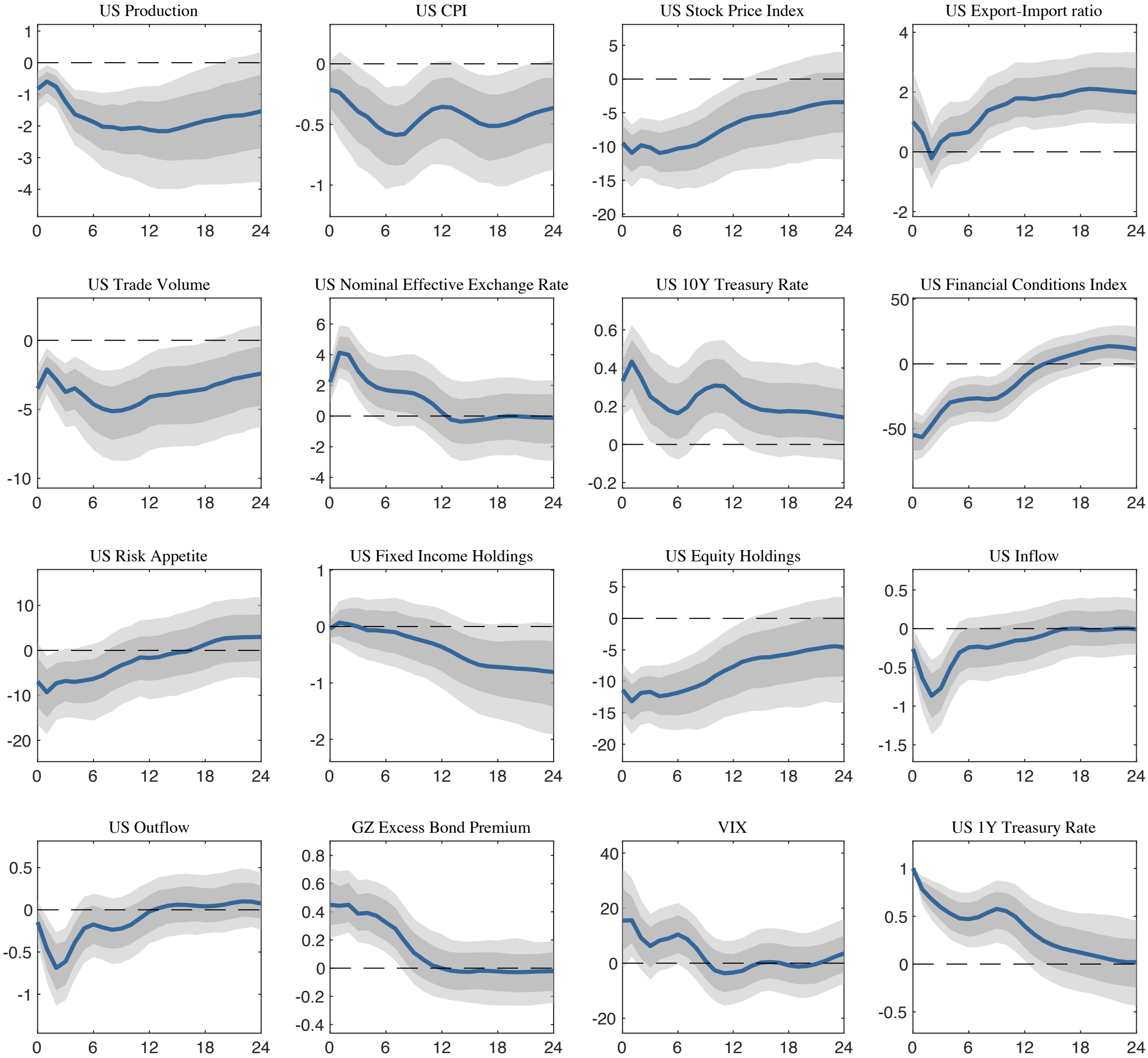
4.1 Effects of Monetary Policy in the US

Let us start from the effects of monetary policy in the US, in Figure 2. Following an unexpected tightening in the policy rate, the shock transmits along the yield curve by moving the shorter maturities more than the long end of the curve, as shown by the increase in the 10-year rate. The term spread decreases, and the yield curve flattens down, while prices of risky financial assets (the S&P index) strongly revise downwards. The policy hike affects both real and nominal quantities. US industrial production and CPI sharply contract on impact to remain significantly below equilibrium over a horizon of 24 months. Importantly, there is no trace of price or output puzzles in the responses.

The interest rate movement induces an exchange rate appreciation of the US dollar vis-à-vis the other currencies, as is visible in the positive response of the nominal effective exchange rate. Despite the dollar appreciation, the monetary policy contraction has an overall positive impact on the balance of trade and the export-import ratio improves. This happens through a compression of import that adjust downwards more than export.[25] The overall effect of the shock on trade is negative and traded volumes contract. The demand-augmenting effect dominates the expenditure-switching effect: lower demand

[25] In the benchmark model, we only include the export-import ratio and traded volumes to avoid collinearity problems.

Figure 2: Effects of Monetary Policy in the US



Note: Responses to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample 1990:01 – 2018:09. BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands. These responses are estimated jointly to those reported in Figure 3.

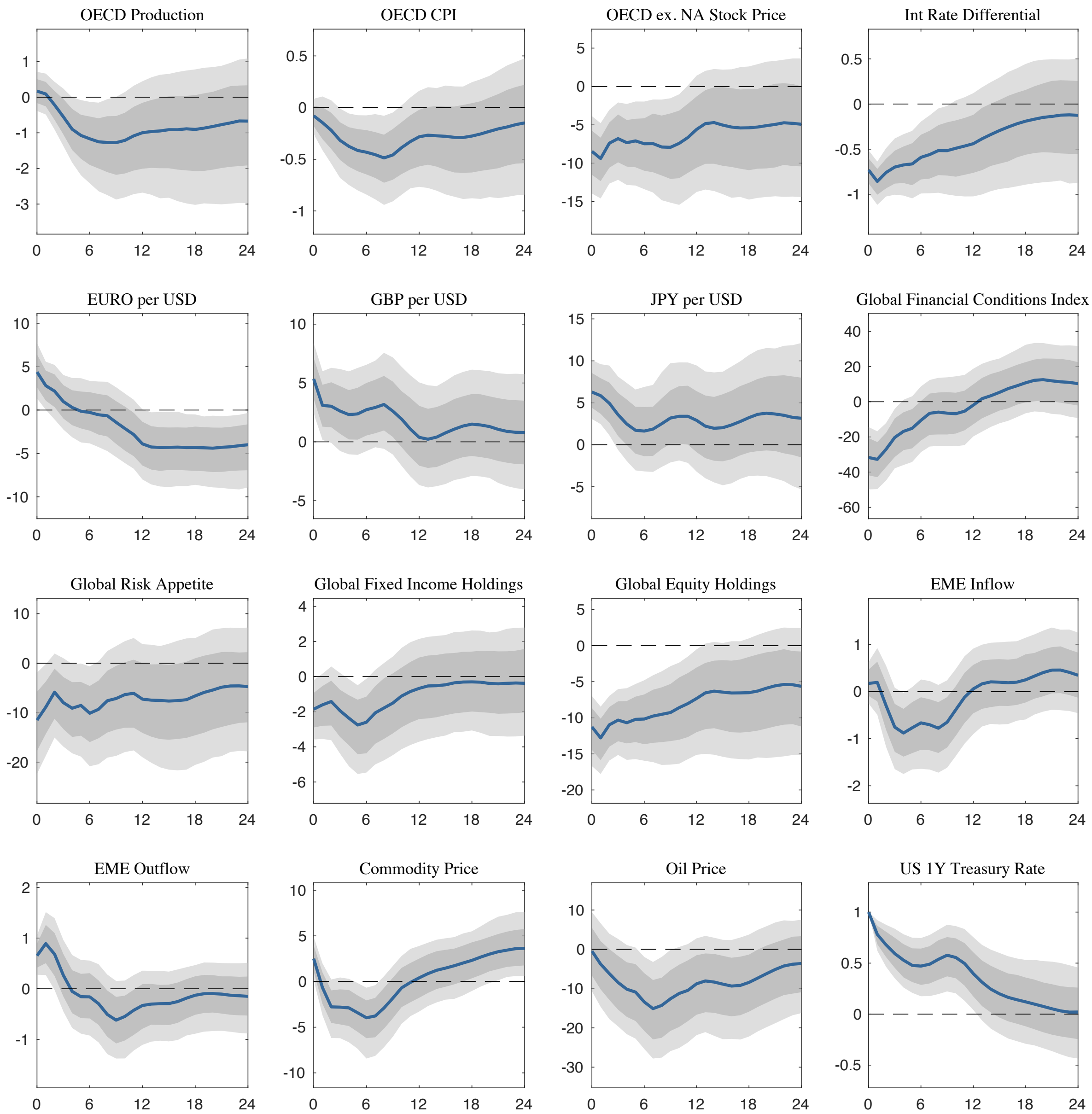
makes imports fall more than exports, despite the foreign goods becoming cheaper in relative terms.

The monetary tightening affects the financial system, as is evident in the responses of the indicators of financial distress: Gilchrist and Zakrajšek (2012)'s excess bond premium soars on impact and remains above trend for roughly 10 months, with the VIX showing similar dynamics. The financial conditions index – an index of very short-term credit spreads, such as deposit loan spreads – also shows a deterioration in credit conditions. Broadly, these responses indicate the activation of the credit channel of monetary policy transmission (Bernanke and Gertler, 1995).

Risk appetite is reduced by the policy tightening, in a risk-off event. This is also visible in the response of equity holdings, that fall significantly on impact, pointing to a portfolio rebalancing towards less-risky assets. Both gross capital inflows and outflows (in percentages of GDP) suffer similar contractions, as capital flows dry up and the overall financial activity slows down.

4.2 Global Spillovers

Figure 3: Global Effects of US Monetary Policy



Note: Global responses to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample 1990:01 – 2018:09. BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands. These responses are estimated jointly to those reported in Figure 2. The response of the policy indicator appears in both figures for readability.

The global economy responds to US monetary policy tightenings by mirroring the economic contraction in the US, albeit with a slight delay (in Figure 3 – IRFs are obtained from the same BVAR model). This high altitude view shows strong global spillover effects to both real and nominal variables, from the US to the global economy. OECD industrial production and CPI contract, moving in tandem with their US counterparts. The peak effect of OECD CPI, in particular, closely matches that of the US price level – around -0.5%. Commodity prices, especially the oil price, also revise downwards, indicating the existence of a powerful 'commodity prices channel' from commodity prices to headline inflation.

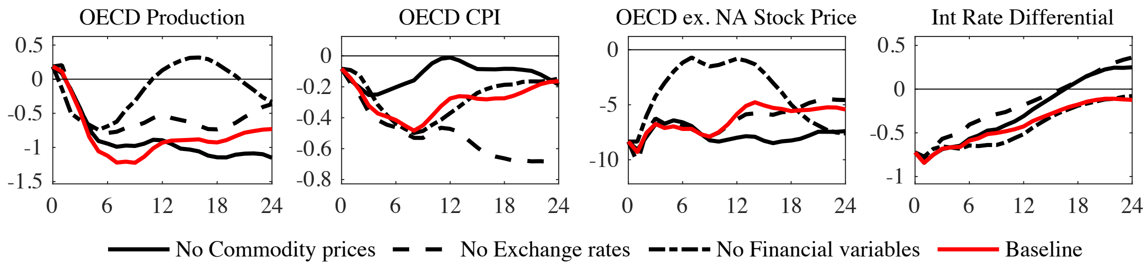
The US dollar appreciation is visible in the response of the exchange rate against three of the major currencies – Euro, British Pound sterling, and Japanese Yen. The average short-term interest rate differential between 15 advanced economies and the US falls by 0.7 percentage points on impact. This indicates that non-US short-term rates raise by roughly 30bp in response to a 100bp movement in US rates. The contraction in the differential persists for at least one year.

Global risk appetite falls, and equity holdings decrease in both the US and the rest of the world, suggesting worldwide portfolio rebalancing towards safe assets, in a risk-off scenario. These adjustments lead to a global contraction in cross-border flows, inducing outflows and immobilising capital. This is especially true for emerging markets: while US capital flows mainly reflect the general weakening of transactions, EMs face with both capital stops and flights. The deterioration of global economic conditions and portfolio rebalancing out of risky assets put downward pressure on foreign asset prices, and the world's stock markets revise downwards.[26] Financial conditions tighten on impact, pointing to an increase in short-term rate spreads and activation of the financial channel.

The landscape view of the response of the global economy to US monetary policy provides a powerful image of the Fed as a global central bank. Interestingly, our results are consistent with Rey (2013)'s 'global financial cycle' argument: the dynamics of stock prices and other financial variables in the US and in the global economy appear to be synchronised as financial conditions deteriorate. These responses are also compatible with the risk-taking and credit channels of monetary policy (Bruno and Shin, 2015a): a contractionary shock shrinks asset demand and increases risk premia. Financial spreads

[26] This index is a weighted average of stock prices in advanced economies excluding North America, so the commonality with US stock prices is not mechanical.

FIGURE 4: CHANNELS OF TRANSMISSION, GLOBAL ECONOMY



Note: Lines correspond to impulse responses obtained with the baseline specification (solid red); assuming the Brent crude and commodity prices do not react (solid black); exchange rates do not react (dashed black); financial conditions, risk appetite, cross-border flows, the excess bond premium, and VIX do not react (dashed-dotted black). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample 1990:01 – 2018:09. BVAR(12) with asymmetric conjugate priors. A full set of responses can be found in the Online Appendix, Section E.10.

increase, followed by a deterioration in financial and credit market conditions. A fall in asset prices pushes financial intermediaries to de-leverage to meet their value-at-risk constraints, and it further contracts the economy. Financial channels operate not only domestically but also globally.

4.3 Disentangling the Channels

What is the relative importance of the various channels at play in the international propagation of the shock? To answer this question we perform a counterfactual exercise (see for example Ramey, 1993 and Uribe and Yue, 2006) in which we shut down (zero out) the feedback (transmission coefficients) from specific endogenous variables that are thought to capture some of the channels of interest.

Specifically, we employ the VAR model estimated in this section and sequentially shut down the following variables: (i) commodity and oil prices, (ii) nominal exchange rates, and (iii) some of the financial variables (financial conditions, risk appetite, and cross-border flows). This reveals the importance of commodity prices, the exchange rate channel, and the financial channel. In doing this, effectively, we look into the following question: how would the response of a variable of interest change if the shock was not transmitted via a specific indicator – e.g. how would the response of CPI or industrial production in a domestic economy differ if US monetary policy did not have a direct effect on exchange rates, liquidity, or commodity prices? [27]

Two results stand out in the channel analysis (Figure 4). First, OECD industrial pro-

[27]Results in this section are not to be interpreted as a policy exercise, since they are subject to the Lucas' critique.

duction and the stock price contract less and rebound more quickly when the endogenous responses of financial conditions, risk appetite, and cross-border flows are shut. On the backdrop of responses of the classic channels – demand and exchange rates –, these results indicate that financial channels play a dominant role in the global propagation of US monetary policy shocks.

Second, the response of CPI becomes immaterial when oil and commodity prices cannot respond to the shock. These results are novel and highlight that nominal contractionary effects are in fact due to the response of oil and commodities and their importance in the headline inflation basket (what we label as the commodity price channel). Once their effect is factored out, the upward pressure from the pass-through of higher dollar prices and the downward pressure from weaker demand roughly balance out.

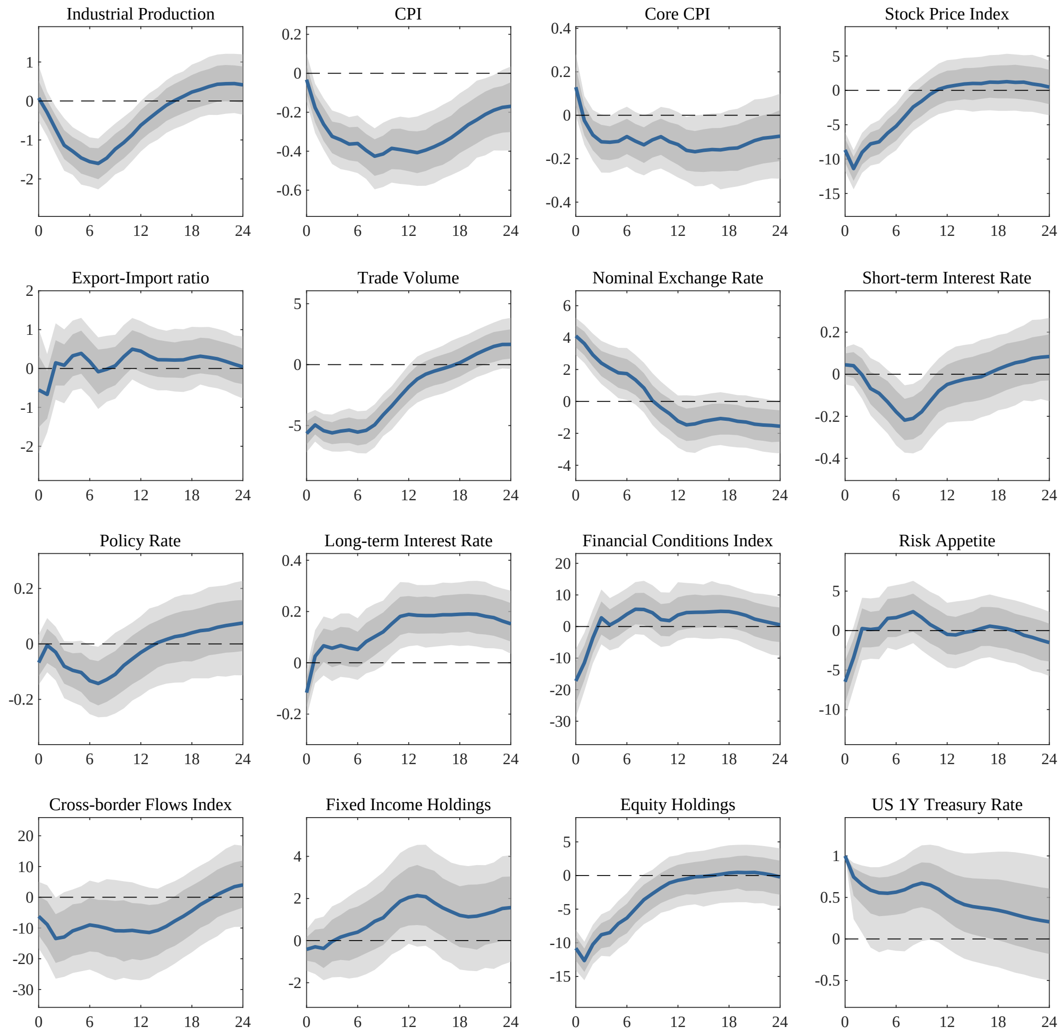
In line with the insights of our model, overall results indicate that financial channels dominate in the global transmission to real variables, while the commodity price channel determines price spillovers. Conversely, the role of classic channels seems to be more limited. For example, the three major exchange rates seem to have a smaller impact – they affect CPI and the stock price marginally and only in the medium run.

There are two caveats to the analysis in this section. First, some of the variables (for example, OECD indicators) mechanically capture the direct response of the US economy. Second, global aggregates can mask large heterogeneity across countries in terms of cyclical positions, structural features, and financial market conditions, all of which could be important determinants of differential sensitivity to the shock. We further explore these dimensions in the next sections.

5 Transmission to Advanced Economies

We now focus on the effects of US monetary policy on advanced economies, by studying the responses to a US tightening in bilateral VARs incorporating variables for the US and one of the 15 advanced economies at the time (countries are reported in Table 1). Individual country responses are aggregated into advanced median group responses. US indicators are constrained to respond to economic conditions in periphery countries only via the spillback effects captured by global variables.

Figure 5: Median Responses of Advanced Economies



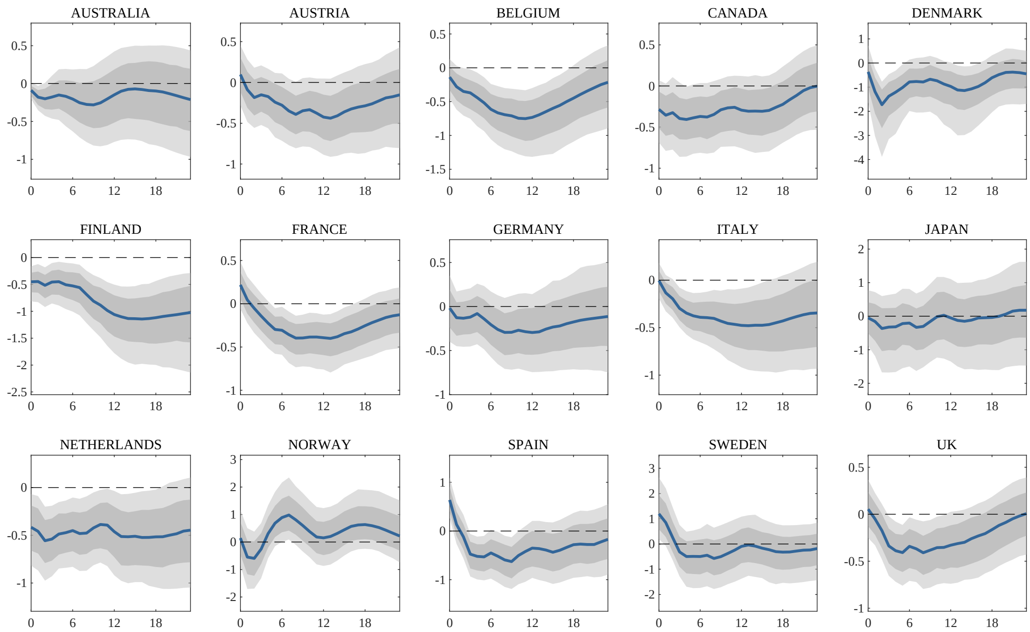
Note: Median responses of 15 advanced economies to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1. BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands.

5.1 Median Responses of Advanced Economies

Following a contractionary monetary policy shock in the US, the currency of the median advanced economy depreciates (Figure 5). The US policy tightening transmits to both real and nominal variables in the median advanced economy. There is a sharp decline in domestic industrial production, accompanied by a very persistent drop in CPI. Core CPI also falls, though it is only significant at the 68% level. The demand-reducing effect from the US dominates over the expenditure-switching effect: the overall trade volume drops but the export-import ratio does not change significantly.

The policy rate does not move on impact but subsequently eases for around 6 months.

Figure 6: Response of CPI in Advanced Economies



Note: Responses of CPI in 15 advanced economies to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1. BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands.

This is compatible with policy easing of a central bank responding to deteriorating internal conditions and following a Taylor rule. The easing is transmitted to the short-term interest rate, while the the long-term rate moves up, inducing a steepening of the yield curve. This indicates that movements in risk premia impair the transmission of the policy change to the long-end of the yield-curve, and hence to the economy (a similar disconnect but between short rates and monetary policy rates for emerging economies has been reported by Kalemli-Özcan, 2019). Indeed, the economic contraction is sizeable but smaller than the one suffered by the global and the US economies. Notably, flexible exchange rates and policy easing partially insulate the median advanced economy, yet the US monetary shock contracts output. Cross-border flows indicate net outflows while financial conditions and risk appetite deteriorate, and investors switch their portfolios from risky to safe assets. This suggests both portfolio rebalancing across assets and risk-rebalancing across countries.

At the country level, responses are fairly homogeneous in constrast to the high degree of heterogeneity reported in the previous literature. This provides robustness to our results and justifies the choice of pooling across advanced economies to present median estimated IRFs. Figure 6 shows the response of CPI to a contractionary US monetary policy shock for the 15 AEs in our sample. CPI is contracting for at least 11 out of 15 economies and the responses of the remaining countries are either not significant or marginally significant. Interestingly, Australia and Norway are commodity exporters.

Financial variables also respond in a strongly homogeneous way across countries. Stock prices (Online Appendix, Figure E.3) contract in all 15 countries, and the long-term government bond yields (Online Appendix, Figure E.4) shift upwards for all except Belgium and Spain. Cross-border flows (Online Appendix, Figure E.5) dry up with only a few exceptions: France, Germany, Sweden, and the UK.

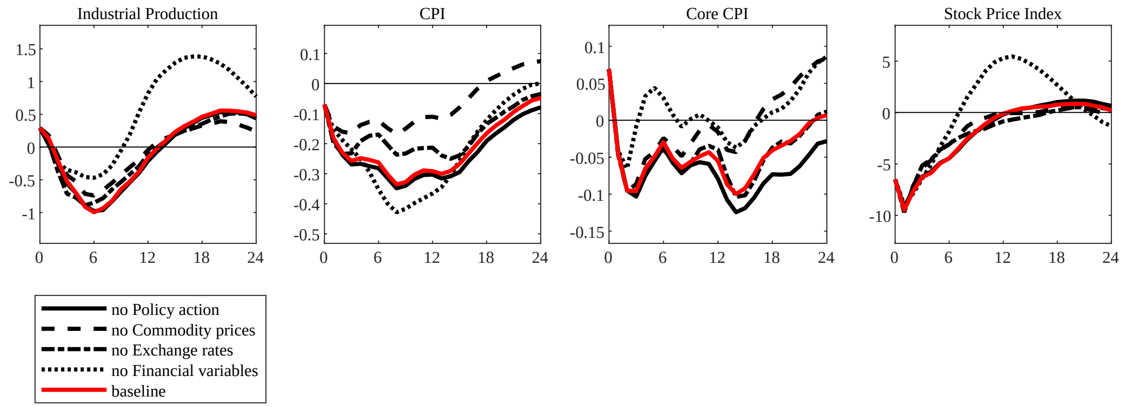
In sum, a contractionary US monetary policy shock leads to a recession in advanced economies. The financial channel seems to play a significant role in the transmission, given strong co-movements of financial variables with the US counterparts. As the global financial cycle negatively affects financial conditions, cross-border flows, and asset prices, the developed world suffers from credit shortages and the resulting contraction of the real economy. Traditional trade channels seem to play a relatively minor role. Central banks attempt to counteract the recessionary pressure by lowering interest rates marginally, but they tend to fail in their price stabilisation mandates: prices do not revert for at least 18 months. Overall, the contraction in both real and nominal variables and the response of the policy rate are in line with the case of intermediate financial spillovers and strong commodity price spillovers, as represented by our model.

5.2 Disentangling the Channels

We further assess the importance of the various transmission channels at play by selectively zeroing out the coefficients of some of the variables of interest in the estimated models, as done in Section 4.3. Along with the three sets of variables we examined in the global case – commodity and oil prices, exchange rates, and all financial variables – we also shut down the policy rate of advanced economies, as it is informative about the reaction of the monetary authority. This allows to assess the relative importance of the policy response, commodity prices, the exchange rate channel, and the financial channel in the transmission of the US monetary policy shock.

As in the global system, financial channels dominate the transmission to real variables, while the commodity price channel dominates the transmission to prices in the advanced economies (see Figure 7). Industrial production and stock prices revert to equilibrium

Figure 7: Channels of Transmission, Advanced Economies

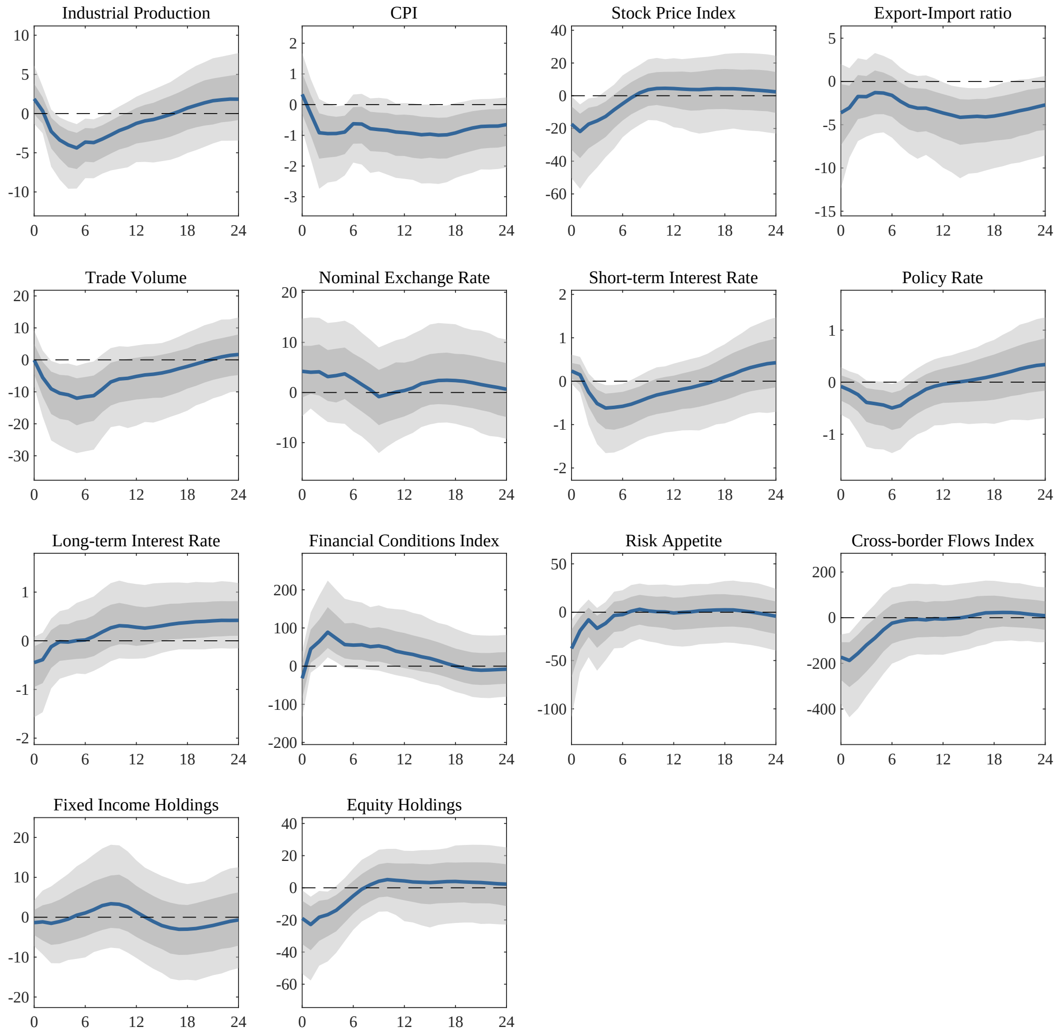


Note: Lines correspond to impulse responses obtained with the baseline specification (solid red); assuming the policy rate does not react (solid black); the Brent crude and commodity prices do not react (dashed black); exchange rates do not react (dashed-dotted black); financial conditions, risk appetite, cross-border flows, the excess bond premium, and VIX do not react (dotted black). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1. BVAR(12) with asymmetric conjugate priors. A full set of responses can be found in Figure E.11, in the Online Appendix.

quickly and overshoot when the transmission via variables proxying for the financial channel – i.e. financial conditions, risk appetite, and cross-border flows – is shut. Conversely, headline CPI shows a milder contraction when oil and commodity prices are not allowed to propagate the shock. Interestingly, core CPI, which does not contain energy prices, shows a mild and not significant response with weaker dependence on commodity prices. The response of core CPI is largely explained by the financial variables and hence correlates with the output contraction. Absent that, there is an expansion of core prices possibly due to pass-through effects.

Financial variables and cross-border flows seem to be key in the transmission of the US shock to the stock market and real economy. Oil and commodity prices provide deflationary pressures on headline prices in advanced economies. The effects of central bank actions and exchange rates appear to be relatively small, possibly due to the movements in risk premia discussed above. The broad picture seems to indicate that the transmission of the US monetary policy shock activates financial channels that limit the action of central banks in advanced economies. However, the overall effect of the financial channel is such that monetary policy can still operate via traditional inflation targeting and by easing economic conditions in response to adverse external shocks – this would correspond to the case of intermediate financial spillovers, in the framework of our model.

Figure 8: Euro Area



Note: Responses of Euro Area to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample 1999:01 – 2018:09. BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands.

5.3 A Case Study: the Euro Area

Somehow surprisingly, our results indicate that even advanced economies are affected by the recessionary effects of a monetary policy tightening in the US. To provide further evidence, we study US policy spillovers to the Euro Area – a large economic bloc with a flexible exchange rate and open capital markets (in this case, our sample starts in 1999:01). Following a surprise US monetary policy tightening, the Euro Area also suffers recessionary effects (Figure 8). Output, prices, and the stock market all contract. Trade volume drops by more than in the US at the trough, and the export-import ratio also falls, indicating the prominence of the demand-reducing effect over the expenditure-switching one.

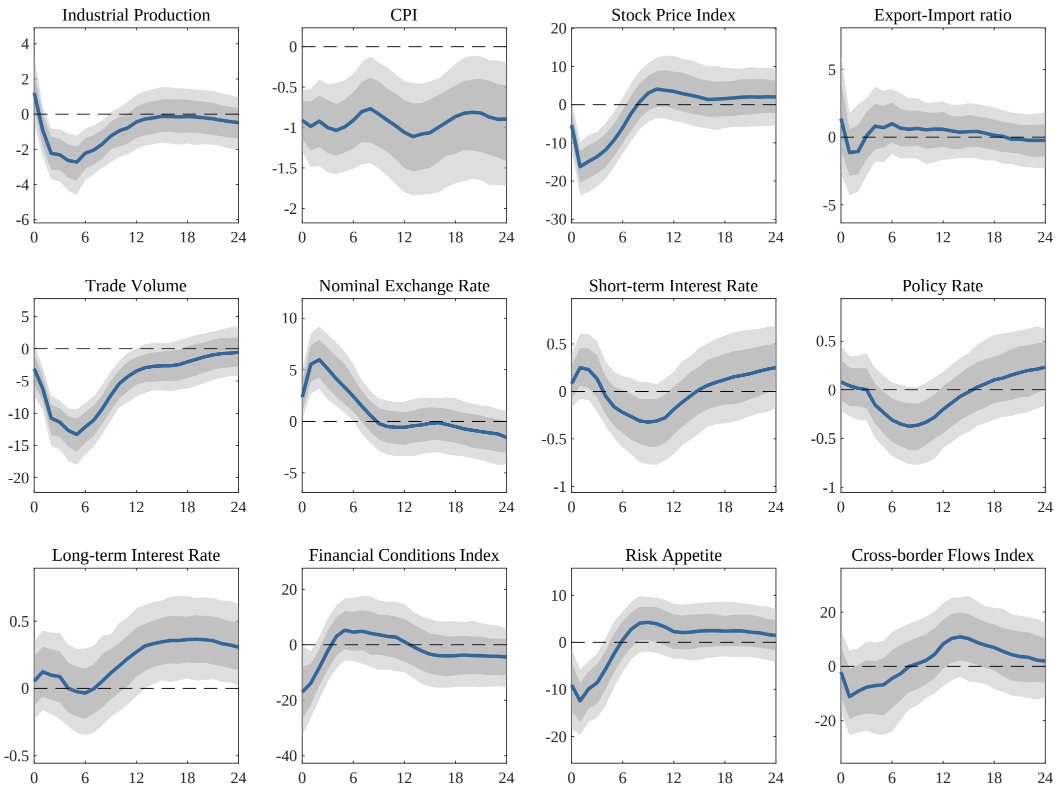
The ECB's policy rate responds to deteriorating internal conditions consistently with a Taylor rule and the easing is transmitted through the yield curve to longer maturities. The role of risk premia is marginally visible at longer horizons in the response of the long-term rate. The policy easing improves financial conditions, but it is not enough to stabilise the economy: CPI does not fully revert at all horizons. Capital outflows and devaluation of equities are more severe for the EA than the median AE. The negative responses in capital flows, risk appetite, and equity holdings not only co-move but also display the same dynamics of the global economy. Overall, results suggest that the Euro Area, while better insulated than smaller economies, still experiences a sizeable decline in economic activity due to financial and commodity spillovers, reduced foreign demand, and deteriorating internal conditions.

6 Transmission to Emerging Economies

Despite the improved resilience to external shocks, as compared to the 1990s, emerging economies are still thought to be vulnerable to US monetary policy spillovers and to the deterioration of global financial conditions (see for example Carstens and Shin, 2019). In studying how US policy shocks affect this large group of countries, it is important to stress that they are largely heterogeneous and sometimes categorised in emerging, developing, and frontier markets. In fact, they can differ along several dimensions, such as the monetary policy framework adopted, the dependence on dollar denominated funds, the degree of invoicing in dollars, the size of their internal markets, and the degree of openness to capital flows.

We explore these dimensions in steps. First, in this section, we discuss median responses to US monetary policy actions and contrast them with the responses of advanced economies. As in the previous section, we present median IRFs, aggregated across countries, to a contractionary monetary policy shock. Second, we focus on a sample of countries that are particularly exposed to US monetary policy spillovers – Turkey, Brazil, Chile, Mexico, and South Africa –, that are sometimes referred to as 'fragile five'. For these countries, we focus on the potentially asymmetric effects of tightenings and loos-

Figure 9: Median Responses of Emerging Economies



Note: Median responses of 15 emerging economies to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1. BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands.

ings of US monetary policy. Finally, in Section 7, we look at the role of different policy regimes as determinants of spillover effects by grouping countries by their (i) exchange rate regimes and (ii) degree of openness to capital flows.

It is important to stress that the quality and reliability of EMs data is an important concern in any empirical exercise. In the light of this observation, the use of a relatively recent sample and the adoption of a median estimator for the responses are helpful in averaging out and alleviating potential data issues.

6.1 Median Responses of Emerging Economies

In the wake of an unexpected tightening of the US monetary policy stance, the economy of the median emerging country contracts (Figure 9). The national currency depreciates, indicating that the median emerging economy was adopting flexible exchange rates in the time-sample of interest.[28] Yet, movement in the exchange rate is not enough to insulate the economy from strong spillover effects. The expenditure-switching channel is largely dominated by the other channels – demand and financial – and output, prices, and the stock market contract.

Interestingly, the effect of higher import prices is dominated by the contraction in demand and possibly subdued commodity prices. Headline inflation responds negatively, immediately, and sharply. The trough response of output in the median emerging economy is around -2.5% and in line with the US economy, while prices react even more strongly than in the US, with a very persistent drop of 1%. It is worth noticing that several countries in this sample are commodity exporters, and hence in aggregate the joint effect of lower commodity prices and lower demand puts downward pressure on the economy. These results are consistent with the findings in the literature that emerging markets are more vulnerable to external shocks (e.g. Maćkowiak, 2007 and Iacoviello and Navarro, 2019).

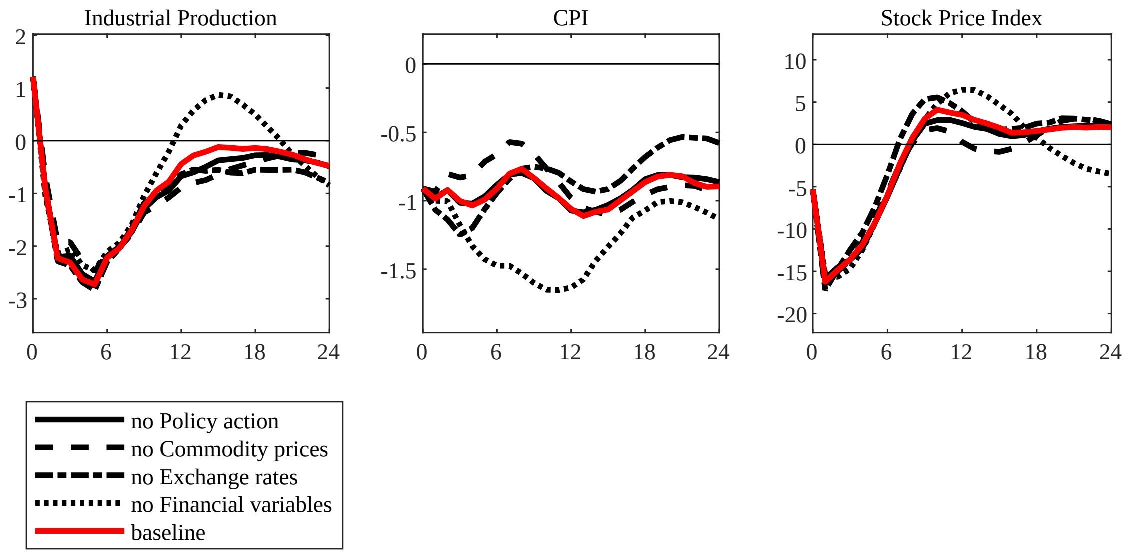
The joint contraction of output and prices, in line with the effects of a large demand shock, allows the central bank to lower its policy rate – potentially putting more downward pressure on the domestic currency. Yet, the policy easing is marginally transmitted to short rates but not long rates, suggesting that risk premia are limiting the effectiveness of the policy action. This evidence supports findings by Kalemli-Özcan (2019), who argues that capital flows in and out of EMs are sensitive to fluctuations in global investors' risk perceptions, induced by changes in the US monetary policy.

Financial conditions and risk appetite deteriorate, while the stock market contracts. The response of cross-border flows indicates capital outflows, although this is only significant in the aggregate at the 68% level.[29] Importantly, exchange-rate and interest-rate changes move in the same direction: the currency depreciates against the dollar, while long-term yields rise and bond prices fall. This co-movement suggests that sovereign bonds have higher durations in dollar terms than in local currency terms, and hence are riskier to international investors. This is mechanisms behind the 'original sin redux'

[28] Emerging economies in our analysis have less flexible exchange rate regimes than AEs. None of our EMs is classified as a pure floater, however, very few of them have hard pegs. We discuss this dimension in detail in Section 7.

[29] In general, emerging economies in our analysis have stricter capital controls than the advanced ones. The median value of Chinn-Ito index for AEs is 0.965, while it is only 0.338 for EMs. Table D.9 in the Online Appendix reports average values of the index for all countries.

Figure 10: Channels of Transmission, Emerging Markets



Note: Lines correspond to impulse responses obtained with the baseline specification (solid red); assuming the policy rate does not react (solid black); the Brent crude and commodity prices do not react (dashed black); exchange rates do not react (dashed-dotted black); financial conditions, risk appetite, cross-border flows, excess bond premium, and VIX do not react (dotted black). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1. BVAR(12) with asymmetric conjugate priors. The full set of responses can be found in the Online Appendix, Figure E.12.

suggested by Carstens and Shin (2019). By borrowing in own currency EMs reduce their 'original sin', but insofar as they borrow from foreigners they are still exposed to flight of capitals due to the exchange-rate and interest-rate linkage that increased duration and risks for foreign lenders.

Unlike the case of advanced economies, the median responses mask a larger degree of heterogeneity in some of the key variables (Figures E.7 – E.9, in the Online Appendix). The response of CPI to a contractionary shock induces a price decline for 11 out of 15 economies (Figure E.7). Responses of Brazil, Mexico, Philippines, and Turkey are not significant at any level. Industrial production generally shrinks, and stock prices tumble in all countries, except Brazil and Malaysia (Figure E.8). Interestingly, exchange rates, interest rates, and cross-border flows – all markers of policy regimes – show a large degree of heterogeneity across countries. Long-term government bond yields tend to move upwards, but responses are not significant in some cases (Figure E.9).

The channel analysis for the median EM, while not in contradiction with what we found for AEs, reveals a limited differential role for each group of variables (Figure 10). Output still bounces back more when the financial variables do not react, but now it happens only after 9 months. Shutting down oil and commodity prices reduces the extent of the fall in headline inflation, but only marginally. No channel seems to be predominant in the transmission to stock prices. An interpretation is that the shock transmits across the economy due to the multiple exposure to the dollar – through trade, invoicing, reserves, credit, etc. – and therefore all variables are rather evenly affected. Indeed, it is worth observing that several of our economies are also commodity exporters: hence, effects on price, production, and the stock market are likely to be transmitted via several variables in a similar way.

To summarise, the median emerging economy contracts in response to a US monetary tightening. Stock prices, exchange rate, financial conditions, and risk appetite strongly co-move in the US, advanced, and emerging economies. Spillover effects are stronger for EMs than AEs, with trough responses now almost one-to-one with the US counterparts. As for advanced economies, prices fall in the median responses and across most of the EMs in our sample. It suggests that the increase in imported prices is dominated by recessionary pressures at home and possibly commodity price effects. At least in the median country, as in the case of AEs, the overall effect of the financial channel is strong but does not induce 'perverse' effects, and hence the monetary policy can operate by easing economic conditions in response to adverse external shocks. Importantly, responses of cross-border flows, policy rates, interest rates, and exchange rates are more heterogeneous than for AEs. This reflects more diverse structural characteristics, policy regimes, and the role of country-specific risks among EMs. In the following sections, we explore some of these features.

6.2 Asymmetric Effects in the 'Fragile Five'

US monetary policy tightenings are often deemed as particularly dangerous for emerging markets, where the capital movements triggered by the policy change can interact with pre-existing 'conditions'. In fact, in the case of US monetary loosenings, financial conditions in third countries ease and capital flows into local bonds and risky assets. However, when these favourable conditions are reversed abruptly, the foreign economy may be exposed to swift reversals of international capital flows with powerful destabilising effects. Such mechanism may provoke episodes of sudden stops – capital flights, hyperinflation, and deep recessions – and induce a policy stance informed by the 'fear of floating', asymmetries in the policy response of foreign monetary authorities to positive and negative US monetary policy shocks, and foreign exchange market interventions to avoid sudden and large depreciations of the currency.

To study whether there are asymmetries in the transmission of contractionary and expansionary US monetary policy shocks in the case of 'fragile' economies, we proceed in two steps. First, we zoom in on the 'fragile five' EMs – Turkey, Brazil, Chile, Mexico, and South Africa – to provide a more granular view of how policy regimes and country-specific fragilities interact in shaping asymmetric responses to US policy shocks. This is an interesting pool of countries that either experiences currency crises (Mexico in 1994, Brazil in 1999, and Turkey in 2001) or conducted particularly prudent monetary policy (Chile, South Africa) for fear of exposing themselves to global shocks.[30]

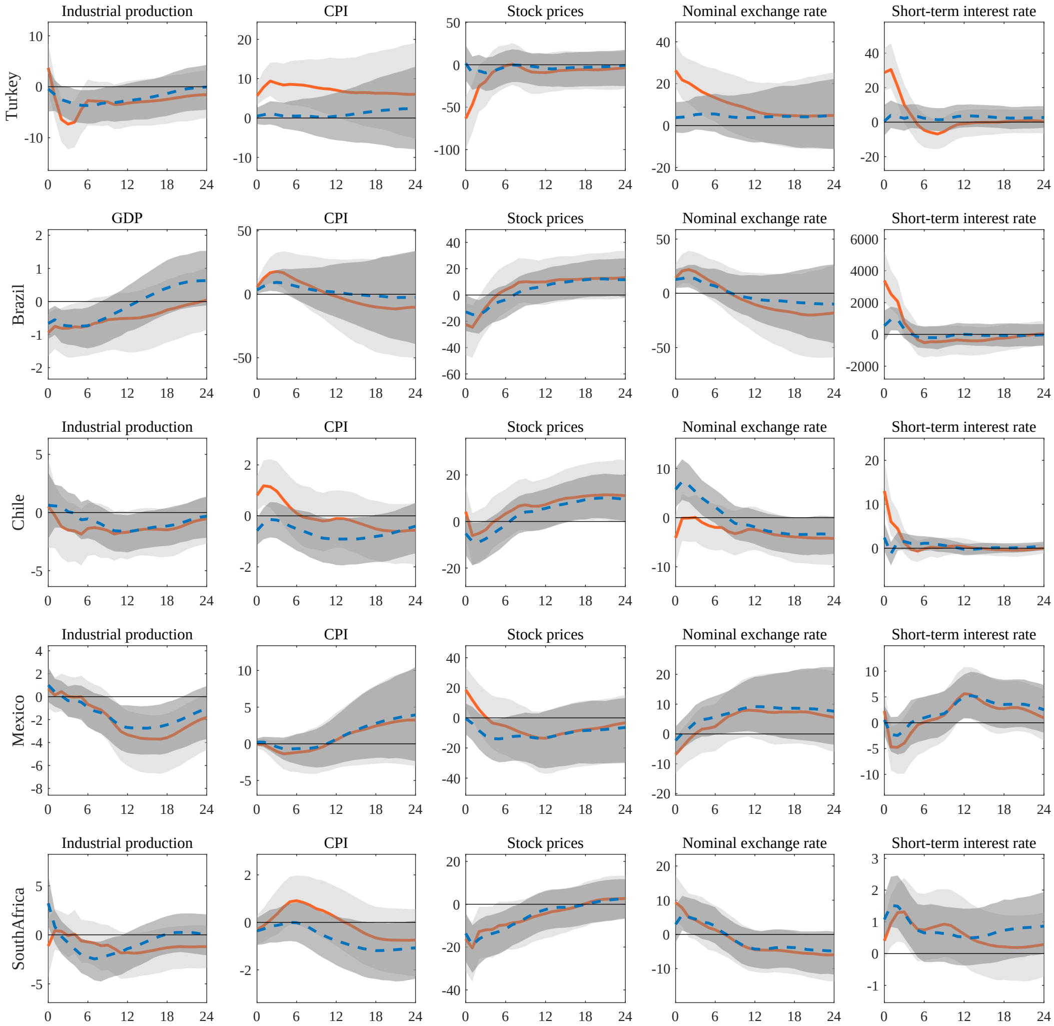
Second, we divide our monetary policy instrument into positive (tightening) and negative (loosening) parts. Then, we identify the shock in the bilateral VARs by employing these two different external instruments.[31] For ease of comparison, we flip the loosening response and normalise both shocks to induce a 100bp increase in the US 1-year rate. Hence, for instance, a negative response of US production to the loosening shock in the chart means that the actual response is expansionary.

The asymmetric responses of the 'fragile five' countries reveal important insight (Figure 11). Following a tightening, financial conditions worsen and capital starts flowing out of the fragile economies. This is visible in the responses of the domestic currencies that fall in all countries but Chile. Interestingly, the Chilean peso only reacts to a loosening, which would be consistent with 'fear of depreciation'. Contrarily to the aggregate median economy, all the 5 EMs experience a price hike following the US tightening. Inflation rises due to the steep devaluation of the domestic currency that implies higher prices of imported goods. This rise is particularly dramatic in Turkey and Brazil. For instance, Turkey's CPI increases by 5% on impact for a tightening and the effect persists for 12 months. For a loosening the response of prices is not significant, as there is no effect on

[30] In the Online Appendix, we perform similar exercises for the global economy, and the median advanced and emerging economies (Figures E.18 to E.20).

[31] This amounts to assuming that while the system is still linear, tightenings and loosenings are two different types of shock with distinct transmissions. It can be seen as a reduced form stylised way to gauge the extent of the different impacts of tightenings and loosenings while maintaining large information sets. Alternatively, one could explore the same effects using a Local Projections approach. However, the gain in flexibility in the IRFs could be offset by the increase in the uncertainty of the estimates and the reduction in data points used for the estimation.

Figure 11: Asymmetric Effects in the 'Fragile Five'



Note: Orange line – median responses of each EM to a contractionary US monetary policy shock. Dashed blue line – median responses of each EM to an expansionary shock. Shocks are normalised to induce a 100bp rise in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table D.13 in the Online Appendix. For Brazil, we replace IP by monthly GDP interpolated backwards from 1996:01 to 1990:01. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

the exchange rate.

Central banks react to the exchange rates plummeting by hiking rates in the attempt of steadying the economy. In fact, in all cases except Mexico, we observe an increase in the short-term rate response upon a US tightening and a decrease in the case of a loosening. This in turn exacerbates the contraction of the national economy. In particular, we observe a dramatic surge in the short-term rate on impact for Brazil, Turkey, and Chile. This bears the pattern of the crises experienced by these countries: for instance, Brazil suffered various hyperinflationary spells during the 1980s and 1990s.[32] Overall, responses show the pattern of a classic emerging market crisis (similar to what described, for example, by Eichengreen et al., 2007). Through the lens of our model, the fragile economies can be understood as economies with strong financial spillovers where monetary policy has to play a perverse role in order to stabilise the economy against capital flights and hyperinflation.

7 Exchange Rates and Capital Flow Management

Since the wave of financial crises in the emerging markets in the late 1990s, there has been a step change in macroeconomic policy, with most central banks embracing floating exchange rates, the build up of large foreign exchange reserves in an effort to create buffer against external shocks, and a shift in government borrowing from foreign to national currencies. How effective are these policies in insulating countries from US monetary policy?

In this section, we try to answer this question by exploring the role of different policy regimes. We group countries by their (i) exchange rate regimes (as defined by Ilzetzki et al., 2019) and (ii) degree of openness to capital (on the basis of Chinn and Ito, 2006's index). These are two key dimensions of the classical Trilemma. We also briefly discuss the role of (iii) dollar trade invoicing (see Gopinath, 2015) and (iv) dollar gross exposure (see Bénétrix et al., 2015) in the transmission of US monetary policy. The Online Appendix reports results for these additional exercises.

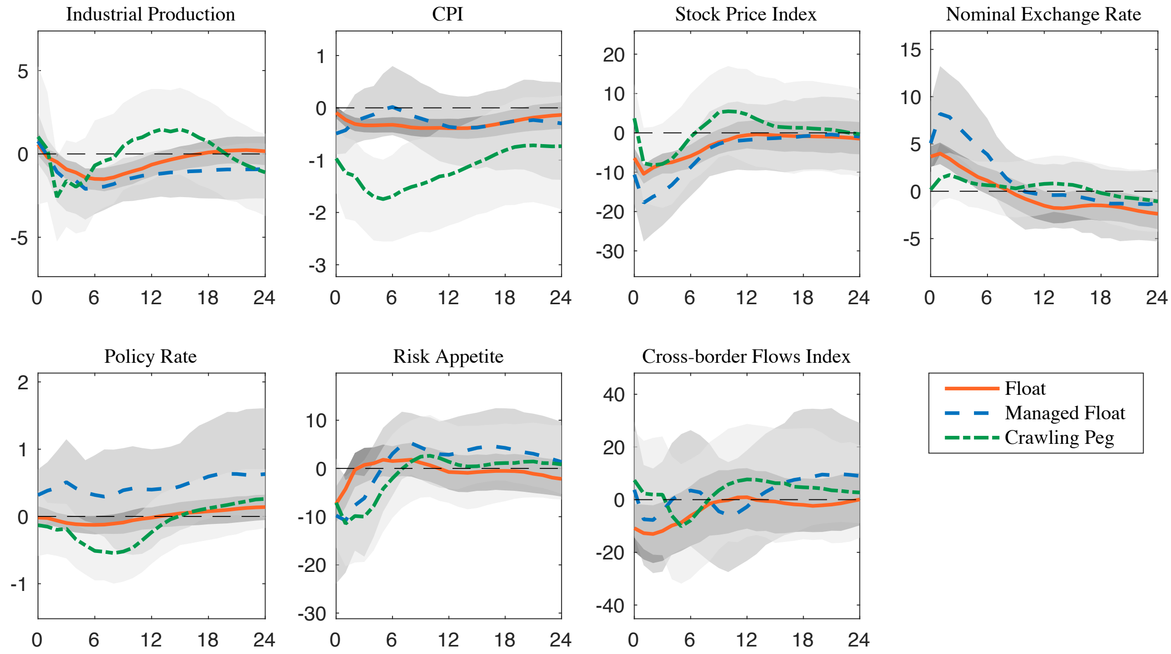
7.1 Exchange Rate Regimes

To explore the role of exchange rate regimes, we classify countries into three different groups: (i) floaters, (ii) managed floaters, and (iii) crawling peggers. We assign each country to the regime corresponding to its sample median value of Ilzetzki et al. (2019)'s classification.[33] In our sample, there are 17 floaters (all AEs except Canada,

[32]The annualised policy interest rate (SELIC) grew exponentially since the early 1980s and peaked in February 1990 at 355,085.6%. By May 1990, various reforms among which a redenomination of the currency brought the SELIC annual rate down to 65%. In June 1994, however, the SELIC was at a new annual high of 15,405.6%. After the introduction of the Real in July 1994, Brazil managed to rein in inflation and stabilise interest rates. The average policy rate from 1995 to 2018 is around 17%.

[33]We use Ilzetzki et al. (2019)'s 'fine' classification to construct the three exchange rate regimes. Table D.8 in the Online Appendix contains more information about these criteria.

Figure 12: Exchange rate regimes

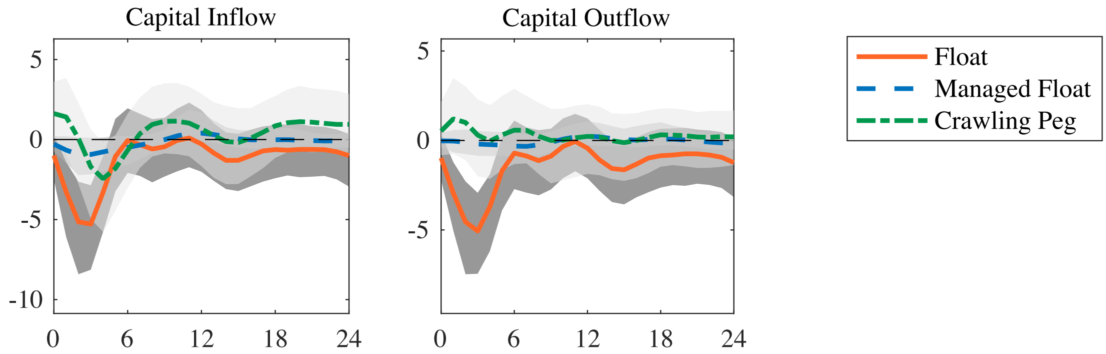


Note: Orange line – median responses of 17 floaters (15 advanced economies except Canada, plus Czech Republic, Hungary, and Poland), Dotted blue line – median responses of 7 managed floaters (Brazil, Canada, Chile, Colombia, Mexico, South Africa, and Turkey), Green dash-dotted line – median responses of 6 crawling peggers (China, India, Malaysia, Philippines, Russia, and Thailand). Data on exchange rate regimes are from Ilzetzki et al. (2019). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

plus the Czech Republic, Hungary, and Poland), 7 managed floaters (Brazil, Canada, Chile, Colombia, Mexico, South Africa, and Turkey), and 6 crawling peggers (China, India, Malaysia, Philippines, Russia, and Thailand). As before, we obtain median group responses by aggregating IRFs from the countries' bilateral models.

A few important results emerge when comparing the median responses of the three different exchange rate groups (Figure 12). First, the exchange rate response validates our classification: it depreciates for the first two groups, but does not react for the crawling pegs. The stronger depreciation of the exchange rate in the managed float group reveals the relative weakness of this group as compared to the free floaters, that are mainly advanced economies. Second, US monetary policy spillovers affect all regimes – output, CPI, stock prices, and risk appetite contract in all three groups – but the recessionary effects are minimal for floaters. Crawling peggers suffer the most severe deflation by fully importing the US monetary policy shock. The trough response of output is also the strongest for peggers, although bands are large. The policy response reveals that floaters and peggers loosen their policy rates. Floaters experience significant

Figure 13: Exchange rate regimes: Inflows and Outflows

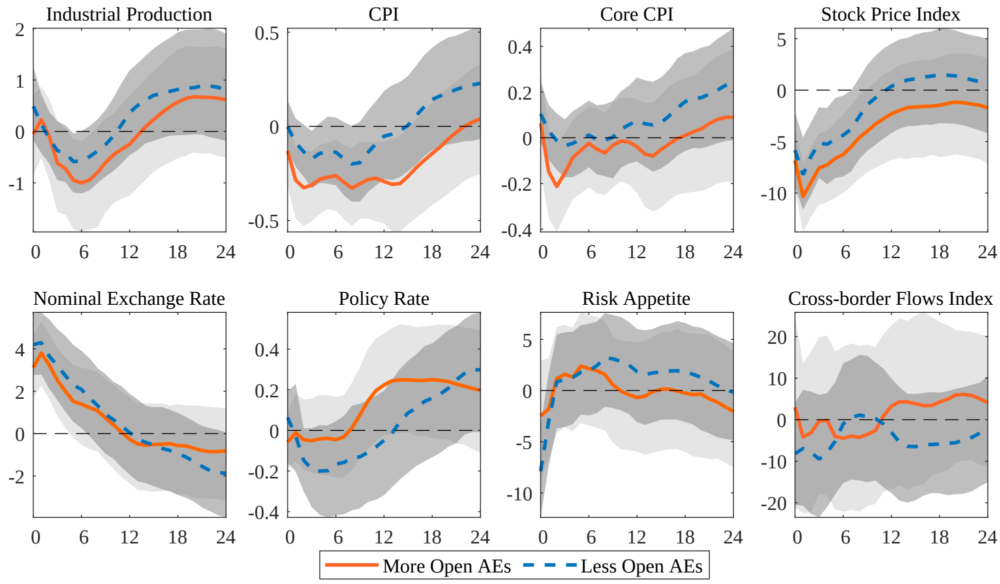


Note: Orange line – median responses of 17 floaters (15 advanced economies except Canada, plus Czech Republic, Hungary, and Poland), Dotted blue line – median responses of 7 managed floaters (Brazil, Canada, Chile, Colombia, Mexico, South Africa, and Turkey), Green dash-dotted line – median responses of 6 crawling peggers (China, India, Malaysia, Philippines, Russia, and Thailand). Data on exchange rate regimes are from Ilzetzki et al. (2019). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

capital outflows while peggers, that also manage capital flows, are largely unaffected. Importantly, managed floaters have to hike rates, possibly to avoid capital outflows. This group is indeed formed by countries that combine managed but flexible exchange rates with relatively more open capital markets. Interestingly, the policy rate seems to stabilise capital flows: cross-border flows remain steady for this group. Conversely, floaters experience significant capital outflows in the absence of the capital controls that shield the peggers.

We further examine the implications of policy regimes for capital flows and decompose net capital flows into gross inflows and outflows by using the IMF BOPS data (Figure 13).[34] Floaters, that are mostly AEs, suffer from a significant fall in both inflows and outflows while managed floaters experience only mild drop in inflows and no reaction in outflows. Peggers are faced with a stronger but not significant contraction in inflows (and some outflows) with a delay. Overall, responses corroborate our findings: consistent with the 'fear of floating' argument, managed floaters seem to target capital flow stability by mimicking the US monetary policy and hence being exposed to larger real and nominal splillovers, as compared to floaters.

Figure 14: Advanced Economies with more v. less Openness to Capital



Note: Orange line – median responses of 5 AEs (Canada, Denmark, Germany, Netherlands, and UK), whose overall degree of capital openness corresponds to the bottom 1/3 among 15 advanced economies. Dotted blue line – median responses of 6 AEs (Australia, France, Italy, Norway, Spain, and Sweden), whose overall degree of capital openness corresponds to the top 1/3. Data on capital flow management are from Chinn and Ito (2006). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

7.2 Capital Flows Managment

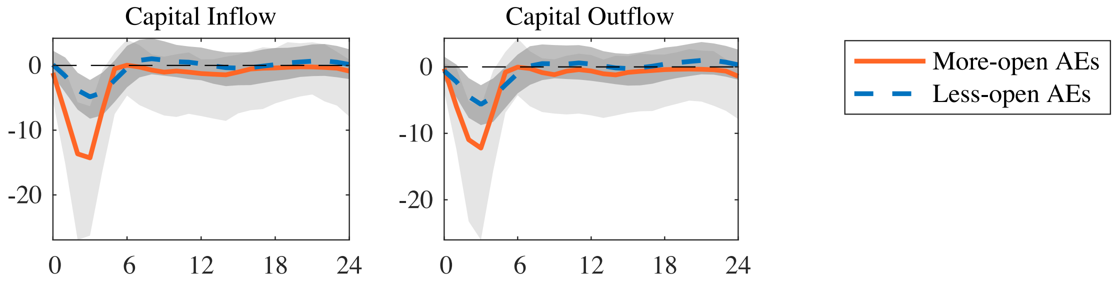
We explore the role of capital flow management in the transmission of US monetary spillovers by comparing (i) more- and less-open advanced economies and (ii) more- and less- open emerging markets. To construct more- and less-open country groups, we calculate the arithmetic average over the sample period of the Chinn-Ito index, which measures the degree of de jure capital market openness of a country.[35] Then, we classify countries in the top tercile as more-open capital markets and countries in the bottom tercile as less-open ones.

For advanced economies, the group of more-open capital markets consists of five countries: Canada, Denmark, Germany, Netherlands, and the UK. The relatively less-open markets are Australia, France, Italy, Norway, Spain, and Sweden. Importantly, all coun-

[34] The median group responses in Figure 13 are computed using the same specification used for Figure 12, except we substitute the cross-border flow index with the two gross flows in each underlying bilateral VAR. Figure E.13 in the Online Appendix shows that results are robust.

[35] We use the *ka_open* index, which is a continuous measure and ranges between 0 and 1. The higher the number is, the more open a country's capital market is. Table D.9 in the Online Appendix contains more information about the classification.

Figure 15: AEs Openness to Capital: Inflows and Outflows



Note: Orange line – median responses of 5 AEs (Canada, Denmark, Germany, Netherlands, and UK), whose overall degree of capital openness corresponds to the bottom 1/3 among 15 advanced economies. Dotted blue line – median responses of 6 AEs (Australia, France, Italy, Norway, Spain, and Sweden), whose overall degree of capital openness corresponds to the top 1/3. Data on capital flow management are from Chinn and Ito (2006). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

tries in both groups adopt a flexible exchange rate regime during our sample period, 1990 – 2018. We obtain median responses of each group by aggregating the IRFs from the countries' bilateral models.

Spillover effects from the US are relatively stronger for economies that have more open capital markets (Figure 14). In fact, responses of output and CPI are (marginally) more negative, significant, and persistent if the capital markets are more globally integrated. Responses of other variables are mostly identical: co-movements among stock prices, exchange rates, and the risk-appetite are in line with results shown in the previous sections. It is important to stress that all the AEs have a high degree of openness to capital, so the difference between the two groups along this dimension is only marginal.[36]

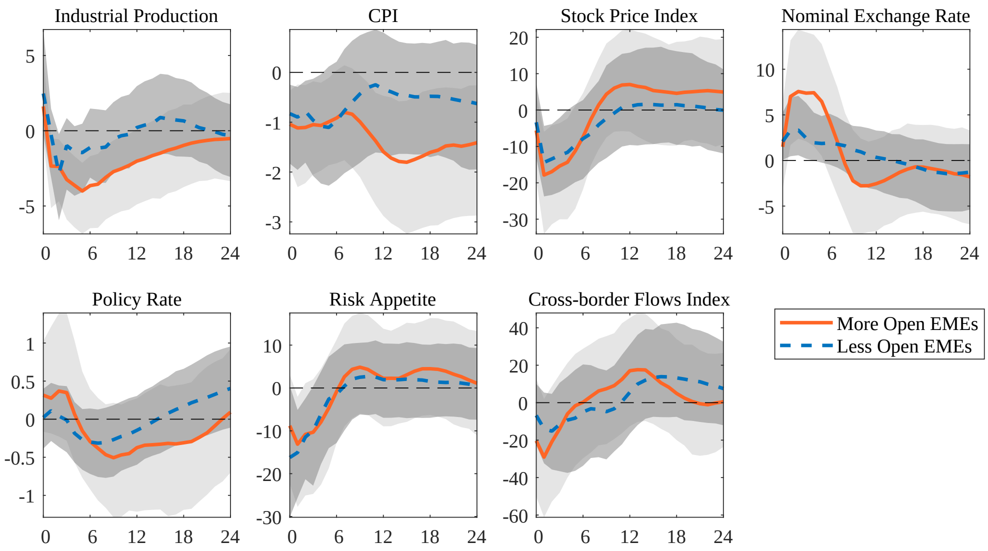
We also decompose net capital flows into gross inflows and outflows by using the IMF BOPS data (Figure 15).[37] The two sides of flows drop and mirror each other for both groups of AEs due to contraction of global financial activities, however the magnitude is larger for the more open capital markets. This result indicates that even marginal differences in the degree of openness to capitals can result in larger spillover effects, via capital flows.

Next, we compare the median responses of EMs with more and less openness to capital (Figure 16). Focusing on EMs is more informative about the role of capital openness since countries are more heterogeneous in this respect. Indeed, the difference between the two

[36] The average value of the Chinn-Ito index for more- and less-open AEs is 0.998 and 0.897 respectively, on a scale from 0 to 1.

[37] The median group responses in Figure 15 are computed using the same specification used for Figure 14, except we substitute the cross-border flow index with the two gross flows in each underlying bilateral VAR. Figure E.14 in the Online Appendix shows that the results are robust.

Figure 16: Emerging Economies with more v. less Openness to Capital



Note: Orange line – median responses of 5 EMs (Chile, Czech Republic, Hungary, Mexico, and Poland), whose overall degree of capital openness corresponds to the bottom 1/3 among 15 emerging economies. Dotted blue line – median responses of 5 EMs (Brazil, India, South Africa, Thailand and Turkey), whose overall degree of capital openness corresponds to the top 1/3. Data on capital restrictions are from Chinn and Ito (2006). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

groups is significantly larger than for AEs: the average value of the Chinn-Ito index for more and less open EMs is 0.469 and 0.354 respectively. Chile, the Czech Republic, Hungary, Mexico, and Poland have more open capital markets, while Brazil, India, South Africa, Thailand, and Turkey have relatively closed capital markets.[38] Importantly, the two groups do not only differ in terms of capital openness but also in terms other structural features: for example, we find a prevalence of floaters among more open markets and a prevalence of peggers among less open ones.

Differences in spillover effects between EMs with open and less-open capital markets are stark (see Figure 16). Output turns significantly negative for the open markets and the median response stays below trend for almost two years. The output response of less-open countries, however, is mostly not significant and reverts quickly. CPI responses of the two groups overlap for six months, but only open markets experience a significant fall afterwards. Importantly, cross-border flows contract on impact for more-open markets, while they are mostly unresponsive for the other group. Also, even though the nominal

[38]To classify countries, we follow the same approach as for AEs: we take countries whose sample average of the Chinn-Ito index falls into the top and bottom tercile as more and less open capital markets respectively. Table D.9 in the Online Appendix provides additional details.

exchange rate depreciates for both groups, it depreciates more for the open markets. Responses of cross-border flows and the exchange rates validate our classification. Finally, we find almost no difference in the responses of stock prices, policy rates, and risk appetite.

7.3 Trade and Financial Exposure to the US Dollar

We conclude this section by focussing on EMs to explore the role of (i) the share of trade invoiced in dollars and (ii) gross dollar exposure as determinants of US monetary policy spillovers. We use data from Gopinath (2015) to classify countries between high and low dollar trade invoicing, while we follow Bénétrix et al. (2015) to divide countries between high and low exposure to the dollar.[39]

Countries with a high degree of dollar trade invoicing/gross dollar exposure display responses that are similar to those of crawling peggers, while economies that are less dependent on the dollar behave similarly to managed floaters (Figures E.15 and E.16, in the Online Appendix). We also conduct a robustness check on capital controls by using a different index, constructed by Fernández et al. (2016). Results in Figure E.17 in the Online Appendix are consistent with those in Figure 16 reported above.

The degree of openness to capital flows and the exchange rate regime are two important dimensions for understanding the global transmission of US monetary policy. The responses of industrial production and CPI are stronger and more negative for economies that have more open capital markets. Crucially, neither flexible nor the 'middle-ground' exchange rate regimes can fully insulate economies from US monetary policy shocks that transmit through both financial and classic channels. Importantly, different policy dimensions and country characteristics – exchange rate regime, openness of capital markets, dollar trade invoicing, and gross dollar exposure – appear to be related, and the choice of the regime is likely to be endogenous and determined by country-specific deeper structural features.

[39] Gopinath (2015) reports the fraction of a country's exports/imports invoiced in a foreign currency. We construct a measure of gross dollar exposure for each country by taking the sum of USD total assets and liabilities as a percentage of GDP from the dataset of Bénétrix et al. (2015). As done for the degree of capital openness, we select countries that are in the top and bottom tercile in terms of the sample average of the two measures, then we compare their median responses. See Tables D.10 and D.11 in the Online Appendix for details about the classifications.

8 Conclusion

We study how US monetary policy is transmitted across the globe by employing an informationally robust high-frequency identification of policy shocks and large VAR techniques. Incorporating a large dataset of macroeconomic and financial indicators at a monthly frequency, we study the effects of US monetary policy shocks on the global economy, 15 AEs, 15 EMs, and the Euro Area.

Our approach delivers a number of novel findings. First, US monetary policy shocks induce large and fairly homogenous real and nominal spillovers onto both advanced economies and emerging markets. While this testifies the role of the dollar as the dominant global currency, the reach of the international spillovers calls for policy coordination and the use of multiple policy tools to minimise adverse effects.

Second, financial channels dominate over demand and exchange rate channels in the transmission to real variables, while the transmission via oil and commodity prices determines nominal spillovers. The latter is an important novel channel not previously reported in the literature that causes prices and output to co-move, for most of the economies considered. This enables an expansionary policy response against a US tightening.

Third, due to financial channels, spillovers affect countries irrespectively of their monetary policy regime. Flexible exchange rates cannot fully insulate domestic economies, even for advanced economies, as movements in risk premia constrain the central bank's ability to transmit the policy impulse along the yield curve. While traditional monetary policy is not fully effective, unconventional monetary policy actions targeting financial conditions and the full yield curve could be.

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Online Appendix to
The Global Transmission of U.S. Monetary Policy

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Abstract

The Online Appendix is structured as follows. Section A details a self-contained exposition of the model presented in Section 2 of the main text. Section B provides additional details about the informationally robust identification strategy we adopt in the empirical exercises. Section C explains in greater detail the procedure we follow to aggregate impulse responses from bilateral VARs into median group responses. Section D contains a set of tables that detail the sources, sample availability, and transformations for the variables used in our empirical exercises. We also report details of the classifications we use in Section 7 of the main text, and list the specifications we adopt for each empirical exercise. Section E provides additional charts that complement the empirical results presented in the main text.

Keywords: Monetary policy, Trilemma, Exchange Rates, Foreign Spillovers.
JEL Classification: E5, F3, F4, C3.

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A A Mundell-Fleming type Framework

This section derives the model presented in Section 2 of the main text. The model generalises the framework of Blanchard (2017) and Gourinchas (2018) by adding nominal variables and spillovers via commodity prices. This static old-style model provides an intuitive illustration of the international transmission channels of monetary policy discussed in the literature:

1. The *demand-augmenting* channel: a US monetary tightening depresses US demand, which reduces domestic exports, lowering domestic output.

2. The *expenditure-switching* channel: a US monetary tightening appreciates the dollar vis-à-vis the domestic currency, which increases domestic exports, reduces domestic imports, but also makes domestic imports more expensive. If the Marshall-Lerner condition holds, the appreciation of the dollar increases net exports, which stimulates domestic output.

3. The *financial* channel: the appreciation of the dollar tightens collateral constraints of domestic firms that borrow in dollars, lowering domestic output.

The model has two countries: the domestic economy (a small open economy) and the US (a large economy). In deviation from the steady state, domestic and foreign variables (with superscript US) are determined by the following system of equations:

$$Y = \underbrace{\xi - c\left(I - \Pi^{e}\right)}_{\text{domestic demand}} + \underbrace{a\left(Y^{US} - Y\right) + b\left(E + \Pi^{US} - \Pi\right)}_{\text{net export}} - \underbrace{f\left(E + \Pi^{US} - \Pi\right)}_{\text{financial spillovers}} , \tag{A.1}$$

$$Y^{US} = \xi^{US} - c\left(I^{US} - \Pi^{e,US}\right) , \tag{A.2}$$

$$E = \underbrace{d\left(I^{US} - I\right) + E^{e}}_{\text{UIP}} + \underbrace{gI^{US} + \chi}_{\text{risk premia}} , \tag{A.3}$$

$$\Pi = eY + mE + hC , \tag{A.4}$$

$$\Pi^{US} = eY^{US} + hC , \tag{A.5}$$

$$C = lY^{US} , \tag{A.6}$$

where lower case letters are the non-negative parameters of the model. We define the nominal exchange rate, E, such that an increase corresponds to a depreciation of the domestic currency. Domestic output Y is a function of domestic demand, net exports, and financial spillovers. Domestic demand,

$$A = \xi - c\left(I - \Pi^{e}\right) ,$$

depends positively on a demand shifter, ξ, and negatively on the domestic real interest rate, $I - \Pi^{e}$. We adopt a log-linearised Fisher equation,

$$R = I - \Pi^{e} ,$$

where R is the real domestic interest rate, I is the nominal interest rate, and Π^e is expected future inflation. Net export,

$$NX = a\left(Y^{US} - Y\right) + b\left(E + \Pi^{US} - \Pi\right) ,$$

is increasing both in US output, Y^{US}, and in the real exchange rate, $E + \Pi^{US} - \Pi$, and it is decreasing in domestic output, Y. The log-linearised definition of the real exchange rate is

$$\epsilon = E + \Pi^{US} - \Pi ,$$

where E is the nominal exchange rate and Π^{US} and Π represent inflation in the US and in the domestic economy respectively.[1] Financial spillovers impact domestic absorption, and depend negatively on the real exchange rate, as in Gourinchas (2018). This term captures different mechanisms, through which an appreciation of the US dollar could affect the domestic economy via financial links. For example, the reduction of domestic assets as priced in US dollars would cause a deterioration of credit conditions via a tightening of the collateral constraints. The parameter f gauges the strength of these channels, with $f = 0$ being the standard Mundell-Fleming model.

US output, Y^{US}, only depends positively on a demand shifter, ξ^{US}, and negatively on the real interest rate, $I^{US} - \Pi^{e,US}$. The exchange rate E depends on the interest rate differential and the expected exchange rate E^e – the uncovered interest rate parity (UIP) determinants –, and a risk premia term

$$\chi(I^{US}) = gI^{US} + \chi ,$$

that is a function of interest rates in the US and an independent shock χ. This term also captures deviation from UIP due to risk premia and financial spillovers via changes to the risk appetite.

We assume that domestic inflation, Π, is a function of domestic output, the exchange rate, and the price of commodities. This relationship can be interpreted as a static Phillips curve. The effect of changes in the nominal exchange rate, E, on inflation is given by m and depends on the pricing paradigm:

1. Under *producer-currency pricing* there is full pass-through to the import prices faced by the domestic economy, as these are defined in dollars (i.e. an appreciation of the dollar leads to higher domestic prices as imports are more expensive).

2. Under *local-currency pricing* there is no pass-through, as domestic import prices are defined in the domestic currency (i.e. no effect of E on Π).

3. Under *dominant-currency pricing* (with the dollar as dominant currency) there is again full pass-through, as both import and export prices for the domestic economy are now defined in dollars (i.e. an appreciation of the dollar leads to higher domestic prices as imports and exports are more expensive).

[1] In a static model, a deviation of prices from steady state and inflation are substitutable concepts. We use Π in the model for convenience.

The last term in Eq. (A.4) captures direct spillovers to domestic inflation via commodities and oil prices. A reduction in US demand can induce an adjustment in commodity prices (in Eq. A.6) that in turn transmits to headline inflation via energy prices. This is a novel 'commodity prices' channel that we explore in the empirical exercises. Under the assumptions of dominant-currency pricing, US inflation Π is a function of US output, but does not depend on the exchange rate.

The Phillips curve for the US, Eq. (A.5), can be simplified under the assumption of dominant-currency pricing. Hence, US inflation is a function of the US output gap, but does not depend on the exchange rate. Finally, Eq. (A.6) relates the price of commodities, C, to US output, that in this case acts as a proxy for global demand.

To solve the model, we assume that Π^e, $\Pi^{e,US}$ and E^e are known constant that we set to zero. Combining Equations (A.1) to (A.3) we obtain an expression for domestic output as a function of the demand shifters, the risk premium, domestic and US policy rates, and inflation in the two countries:

$$\begin{aligned} Y = \frac{1}{1+a} & \left[\left(\xi + a\xi^{US} \right) + (b-f)\,\chi + ((f-b)\,d - c)\,I \right. \\ & \left. + ((b-f)\,(d+g) - ac)\,I^{US} + (b-f)\left(\Pi^{US} - \Pi\right) \right] \ . \end{aligned} \tag{A.7}$$

It is important to observe that when $f = g = \chi = 0$, and when any effect on domestic output coming from movements in prices is ruled out, one obtains the standard Mundell-Fleming. In this case, the effect of a US tightening on domestic output is given by $bd - ac$, which are respectively the expenditure-switching and demand-augmenting channels of international transmission.

Substituting in Π and Π^{US} and solving for Y gives

$$\begin{aligned} Y = \frac{1}{\psi} & \left\{ \left[\xi + (a + (b-f)\,e)\,\xi^{US} \right] + (1-m)\,(b-f)\,\chi \right. \\ & - \left[(1-m)\,(b-f)\,d + c \right] I \\ & \left. + \left[(1-m)\,(b-f)\,(d+g) - (a + (b-f)\,e)\,c \right] I^{US} \right\} \ , \end{aligned} \tag{A.8}$$

where $\psi = 1 + a + (b-f)\,e$.

Looking at Eq. (A.8), it is clear that if ψ was negative then the model would imply that a positive demand shock, either domestic or from the US, would reduce domestic output. We rule out these counterfactual effects by adding an assumption to the model.

Assumption 1. *Positive demand shocks increase domestic output, i.e.*

$$\psi = 1 + a + (b-f)\,e > 0 \ .$$

This assumption is reflected in a requirement in terms of the strength of the financial channel, i.e.

$$f < b + \frac{1+a}{e} \equiv \widehat{f} \ , \tag{A.9}$$

which sets an upper bound $\widehat{f}$ to the maximum strength of financial spillovers.

Before discussing how US monetary policy transmits to the domestic economy, it is important to observe that, combining Equations (A.1) to (A.4), the real exchange rate can be expressed as follows:

$$E + \Pi^{US} - \Pi = e\xi^{US} + \left[(1-m)(d+g) - ce\right] I^{US} - d(1-m) I - eY \ . \tag{A.10}$$

The term $(1-m)(d+g) - ce$ is the direct response of the real exchange rate to a US tightening. We add the following assumption to the model.

Assumption 2. *The direct response of the real exchange rate to a US tightening is positive, i.e.*

$$(1-m)(d+g) - ce > 0 \ .$$

A.1 Monetary Policy Transmission and Financial Spillovers

We now discuss how the effects of foreign and domestic monetary policy depend on the strength of the financial channel. The response of domestic production to a change in US monetary policy is given by

$$\frac{\partial Y}{\partial I^{US}} = \frac{1}{\psi}\left[(1-m)(bd - fd + (b-f)g) - ac - ce(b-f)\right] \ . \tag{A.11}$$

Eq. (A.11) reflects the various channels of transmission of US monetary policy on domestic output: bd captures the domestic trade balance improvement that follows the appreciation of the dollar. This is the expenditure-switching effect. ac is the contractionary effect on domestic output of lower US demand via lower domestic exports. This is the demand-augmenting effect. In the standard Mundell-Fleming, the effect of a US tightening on domestic output is given by $bd - ac$, which are respectively the expenditure-switching and demand-augmenting channels of international transmission. The sign of this term determines the baseline 'classic' transmission – i.e. whether absent other channels a tightening in the US is expansionary or contractionary for the domestic economy.

The financial channels are represented by fd, which captures the negative effect of a dollar appreciation on domestic output via financial spillovers, and by $(b-f)g$, which represents the effect of risk premia. Specifically, bg captures the stimulative effect of risk premia on domestic output via the trade balance, and fg the negative effect via financial spillovers. Finally, the terms ceb and cef represent the effects of lower US prices via the exchange rate and financial spillovers respectively.

While the denominator in Eq. (A.11) is always positive by Assumption 1, the numerator is negative, and therefore a US tightening causes a decline in domestic output, if

$$f > b - \frac{ac}{(1-m)(d+g) - ce} \equiv \bar{f} \ , \tag{A.12}$$

where the second term on the right hand side is positive by Assumption 2. $\bar{f}$ is the threshold below which a US tightening has an expansionary effect on domestic output. Comparing the upper bound $\widehat{f}$ with the threshold $\bar{f}$ it is immediately seen that $\widehat{f} > \bar{f}$.

Let us focus on the effects of a change to the domestic policy rate. The response of domestic output to the domestic interest rate is given by

$$\frac{\partial Y}{\partial I} = \frac{1}{\psi}\left[(1-m)(f-b)\,d - c\right] \ .$$

The numerator is negative, and therefore a domestic tightening contracts domestic output if

$$f < b + \frac{c}{(1-m)\,d} \equiv \bar{\bar{f}} \ . \tag{A.13}$$

This gives us a threshold $\bar{\bar{f}}$ above which a domestic monetary policy tightening has the perverse effect of expanding domestic output. Comparing $\bar{\bar{f}}$ with the threshold $\bar{f}$, it is easily seen that $\bar{\bar{f}} > \bar{f}$.

The presence of the two thresholds $\bar{f}$ and $\bar{\bar{f}}$, in the space $[0, \widehat{f}]$ depends on the parameters of the model. The condition $\bar{\bar{f}} < \widehat{f}$ has to hold to have an interval of values of f for which (i) a US tightening contracts domestic output and domestic monetary policy has the perverse effect of expanding domestic output; (ii) but demand shocks still have conventional and not 'perverse' effects. This implies the condition:

$$\frac{c}{(1-m)\,d} < \frac{1+a}{e} \ . \tag{A.14}$$

When this condition is not satisfied, a domestic tightening is always contractionary on the space $[0, \widehat{f}]$. Moreover, from conditions (A.9) and (A.12), there will be an interval of values $0 < f < \bar{f}$ such that a US tightening has an expansionary effect on domestic output only if

$$b > \frac{ac}{(1-m)(d+g) - ce} \ , \tag{A.15}$$

otherwise a US tightening is always contractionary.[2] If both conditions are satisfied, the two thresholds $\bar{f}$ and $\bar{\bar{f}}$ can be represented by the diagram in Figure A.1.

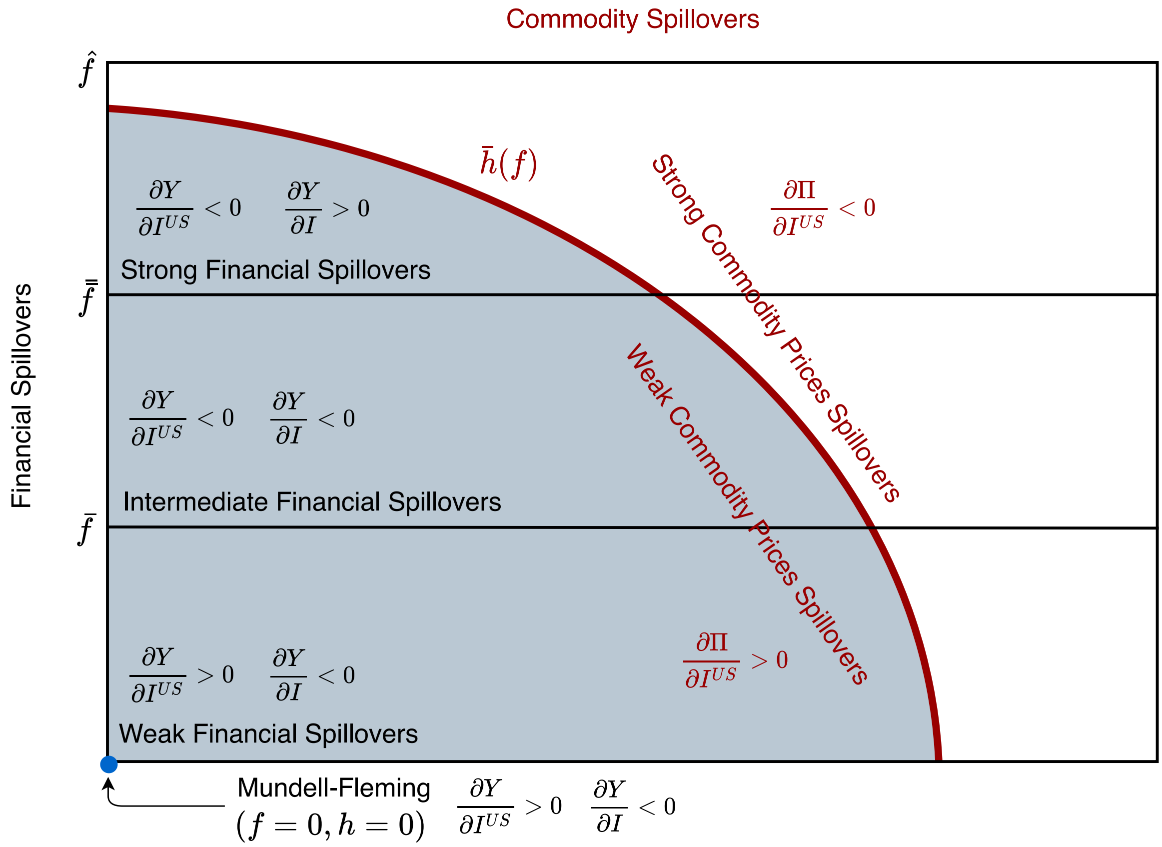
The diagram reports the two thresholds on f defining the following three regions:

(i) **Weak financial spillovers** ($f < \bar{f}$) – a tightening in the US is expansionary abroad, while domestic monetary policy has conventional effects. The low right corner is the Mundell-Fleming model (for $f = 0$ and $h = 0$, under the assumption $bd - ac > 0$).

(ii) **Intermediate financial spillovers** ($\bar{\bar{f}} > f > \bar{f}$) – a tightening in the US is contractionary abroad, while domestic monetary policy has conventional effects.

[2] In the classic Mundell-Fleming model (i.e. $f = g = \xi = 0$ and $e = m = h = 0$), condition (A.15) simplifies to $bd > ac$, which requires the expenditure-switching channel to be greater than the demand-augmenting one.

Figure A.1: A Graphical Representation of the Model



(iii) **Strong financial spillovers** ($f > \bar{\bar{f}}$) – a tightening in the US is contractionary abroad, but domestic monetary policy has perverse effects. A domestic tightening expands output.

If condition (A.14) is not satisfied, then the region of intermediate financial spillovers would extend to $\hat{f}$ and the region of strong financial spillovers would disappear. In this scenario, domestic monetary policy is never 'perverse': a domestic tightening never has a stimulative effect on the domestic economy. If condition (A.15) is not satisfied, then the region of intermediate financial spillovers would extend to $f = 0$ and the region of weak financial spillovers would disappear. In this scenario, US monetary policy never has an expansionary effect on domestic output. If neither condition is satisfied, then only the region of intermediate financial spillovers remains. Both domestic and US monetary policies always have a contractionary effect on domestic output.

A.2 Monetary Policy Transmission and Commodity Prices

How does domestic inflation respond to a US tightening?

$$\frac{\partial \Pi}{\partial I^{US}} = e\frac{\partial Y}{\partial I^{US}} + m\,(d + g) - hlc\ . \tag{A.16}$$

The first term on the right-hand side of Eq. (A.16) reflects the overall effect of the three channels of transmission on domestic output. The second term, $m\,(d+g)$, captures the direct effect of the appreciation of the dollar on import prices coming from the interest rate differential (md) and higher risk premia (mg). The third term is the effect on domestic inflation of lower commodity prices.

Conditional on a positive (or not too negative) response of output, the effect of a US tightening on domestic prices is inflationary if commodity price spillovers, h, are not too strong. In particular, a US tightening increases domestic inflation if

$$h < \frac{e}{lc}\left(\frac{\partial Y}{\partial I^{US}}\right) + \frac{m}{lc}\,(d+g) \equiv \bar{h}\ . \tag{A.17}$$

This gives us a threshold $\bar{h}$ above which a US monetary tightening has a contractionary effect on domestic inflation.

Intuitively, as financial spillovers get stronger, the threshold $\bar{h}$ becomes smaller. In other words, as the importance of the financial channel grows, the impact of commodity prices on domestic inflation grows in importance as well. In fact, it is possible to show that the threshold $\partial Y/\partial I^{US}$ is monotonically decreasing in f. The first derivative of $\partial Y/\partial I^{US}$ (see Eq. A.11) with respect to f is

$$\frac{\partial^2 Y}{\partial I^{US}\partial f} = -\frac{(a+1)\,(1-m)\,(d+g) - ce}{(1+a+(b-f)\,e)^2}\ . \tag{A.18}$$

Consider the numerator. Given that $(1-m)\,(d+g) - ce > 0$ by assumption 2, also $(a+1)\,(1-m)\,(d+g) - ce$ must be positive, hence Eq. (A.18) is always negative. The downward sloping relationship $\bar{h}$ is depicted as a function of f as the red negatively sloped curve in Figure A.1, where h is the variable on the horizontal axis. This threshold defines two regions:

(a) **Weak commodity spillovers** ($h < \bar{h}$) – a tightening in the US puts inflationary pressure on prices abroad;

(b) **Strong commodity spillovers** ($h > \bar{h}$) – a tightening in the US is deflationary abroad.

The intersection of $\bar{h}$ with the x-axis of Figure A.1 (where f is on the vertical axis) is given by

$$\bar{h}\,(0) = \frac{e}{lc\,(1+a+be)}\,\{b\,[(1-m)\,(d+g) - ce] - ac\} + \frac{m}{lc}\,(d+g)\ ,$$

which is always positive if

$$b > \frac{ac}{(1-m)\,(d+g) - ce}\ .$$

This implies that $\bar{h}\,(0) > 0$ as long as $\bar{f}$ exists (see condition A.15), but it could be negative otherwise. In other words, when $\bar{f}$ does not exist, there are combinations of parameters for which $\partial\Pi/\partial I^{US}$ is *always* negative. Given that $\bar{h}$ is monotonically decreasing, for $\bar{h}(0) > 0$, the intersection with the y-axis lies always in the positive quadrant. It is easy to show that there are two asymptotes:

$$\lim_{f \to \hat{f}} \bar{h} = -\infty \ ,$$
$$\lim_{f \to -\infty} \bar{h} = \frac{c}{l}\left[(1-m)(d+g) - ce\right] + \frac{m}{cl}(d+g) \ .$$

By Assumption 2, the second asymptote is always a positive number.

How does domestic inflation react to domestic monetary policy?

$$\frac{\partial \Pi}{\partial I} = e\frac{\partial Y}{\partial I} - md \ . \tag{A.19}$$

The first term on the right-hand side of Eq. (A.19) reflects the effect on inflation of the change in domestic demand. The second term is the effect on inflation via the appreciation of the domestic currency. Whenever domestic monetary policy is 'well-behaved' (i.e. a domestic tightening contracts domestic output) the effect of a domestic tightening on inflation is unambiguously negative. However, when the domestic transmission is 'perverse', a domestic tightening has a deflationary effect only if

$$\frac{\partial Y}{\partial I} < \frac{md}{e} \ ,$$

otherwise it has a perverse effect also on inflation.

A.3 Optimal Monetary Policy with Mercantilistic Motive

What is the optimal response for the domestic economy to a US tightening? To answer this we need to assume a loss function for the domestic economy. Following Blanchard (2017), we first assume that domestic authorities care about deviations of output from steady state and trade deficits. This can be seen as a stylised representation of policy aiming at stabilising the exchange rate – hard and crawling pegs, possibly due to 'mercantilistic' motives. Let the loss function be

$$L = \frac{1}{2}\mathbb{E}Y^2 - \alpha \mathbb{E}NX \ .$$

Under perfect foresight, the optimal level of output is given by

$$Y^{opt} = -\alpha\left[a + be + \frac{(1-m)\,bd}{\frac{1}{\psi}\left[(1-m)\,(f-b)\,d - c\right]}\right] \ . \tag{A.20}$$

Combining Eq. (A.20) and Eq. (A.8) we obtain the optimal value of I,

$$I^{opt} = \frac{1}{\Phi_I}\left\{Y^{opt} - \frac{1}{\psi}\left[\xi + (a + (b-f)\,e)\,\xi^{US}\right] - \frac{1}{\psi}(1-m)(b-f)\,\chi - \Phi_{I^{US}} I^{US}\right\} \ ,$$

where $\Phi_I = \partial Y/\partial I$ and $\Phi_{I^{US}} = \partial Y/\partial I^{US}$. The optimal pass-through from US to domestic policy rates is

$$\frac{\partial I^{opt}}{\partial I^{US}} = -\frac{\Phi_{I^{US}}}{\Phi_I} \ .$$

Assuming that $\bar{f}$, $\bar{\bar{f}}$, and $\bar{h}$ exist, we can distinguish three cases as in Gourinchas (2018). The three regions and the relative optimal policy responses are represented on the vertical axis of Figure A.2.[3]

1. **Weak financial spillovers** ($f < \bar{f}$). When financial spillovers are weak, a US monetary tightening is expansionary abroad, while a domestic tightening is contractionary. It follows from condition (A.3) that the optimal response to a US tightening is a domestic tightening. When $f = 0$ the financial channel is shut down and we get back the traditional Mundell-Fleming.

2. **Intermediate financial spillovers** ($\bar{f} < f < \bar{\bar{f}}$). In this case, both a US and a domestic monetary policy tightening are contractionary for the domestic output. The optimal response to a US tightening in this case is a domestic loosening.

3. **Strong financial spillovers** ($f > \bar{\bar{f}}$). With strong spillovers, domestic monetary policy has a perverse effect on domestic output. A domestic monetary tightening has a stimulative effect rather than a contractionary effect on output. The optimal response to a US tightening in this case is a domestic tightening.

A.4 Optimal Monetary with Inflation Targeting

Monetary authorities in advanced economies usually have a price stability mandate. This can be represented by the following loss function where monetary authorities care about output gap and inflation:

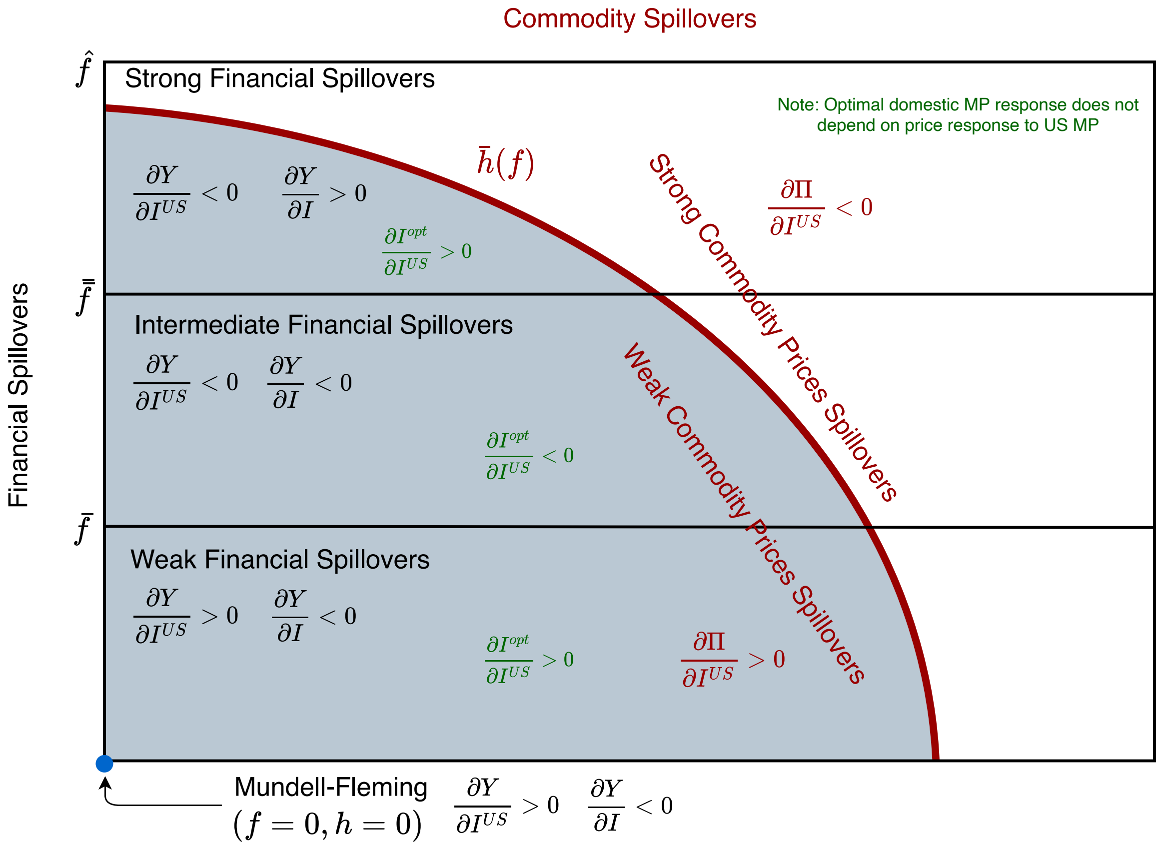
$$L = \frac{1}{2}\mathbb{E}Y^2 + \frac{\beta}{2}\mathbb{E}\Pi^2 \ .$$

Under perfect foresight, the domestic economy sets the nominal interest rate to minimise the loss function. The optimal level of output is given by:

$$Y^{opt} = -\beta\Pi\frac{\Theta_I}{\Phi_I} \ , \tag{A.21}$$

[3]As the optimal pass-through does not depend on inflation, the optimal monetary response does not change if we are above or below the threshold $\bar{h}$.

Figure A.2: Optimal Monetary Policy (Mercantilistic Motive)



where $\Theta_I = \partial \Pi / \partial I$. Optimal output depends on the policy weight on inflation in the loss function of the central bank, β, on domestic inflation, Π, and on the relative importance of the response of output and inflation to a domestic tightening, Θ_I / Φ_I. Combining Eq. (A.21) and Eq. (A.8) we obtain the optimal value of I,

$$I^{opt} = -\frac{1}{\Phi_I}\left[\left[\xi + (a + (b-f)\,e)\,\xi^{US}\right] + (1-m)\,(b-f)\,\chi + \Phi_{I^{US}} I^{US} + \psi\beta\Pi\frac{\Theta_I}{\Phi_I}\right] ,$$

where $\Phi_{I^{US}} = \partial Y / \partial I^{US}$. The optimal pass-through from US to domestic policy rates is

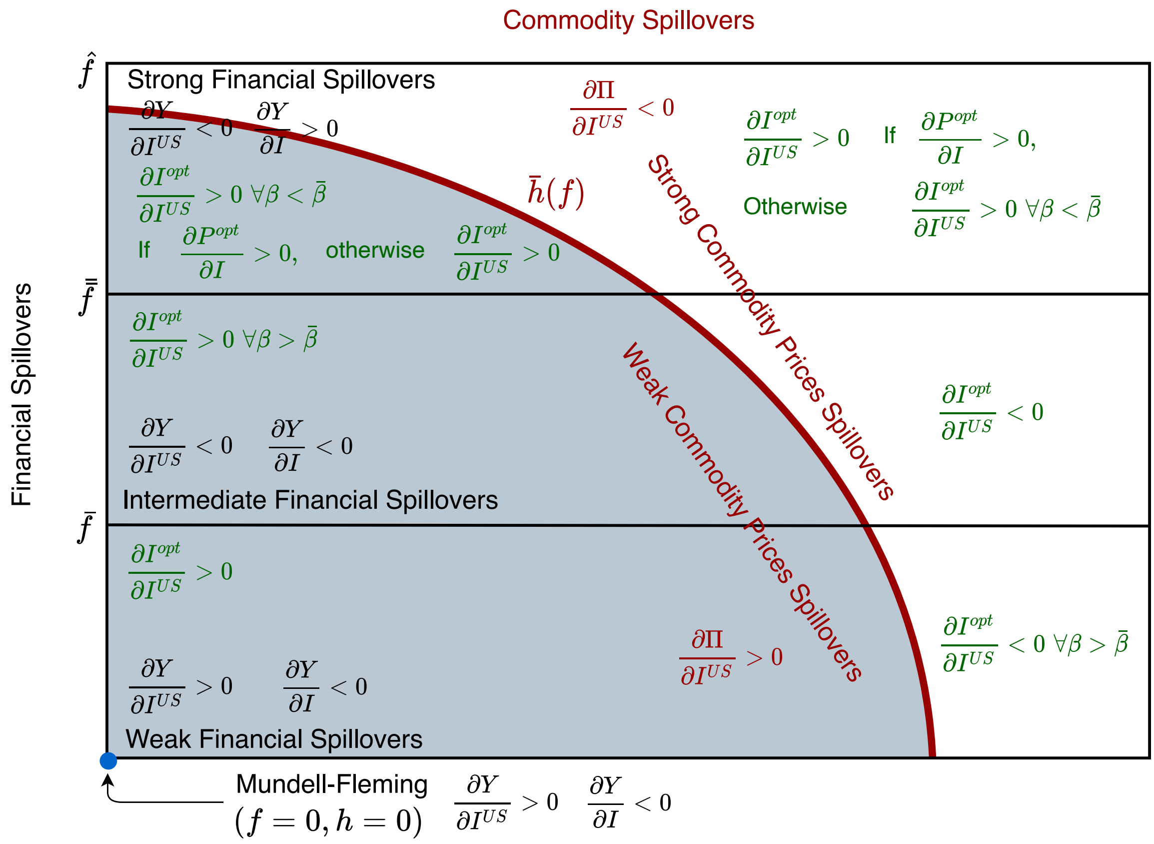
$$\frac{\partial I^{opt}}{\partial I^{US}} = -\frac{1}{\Phi_I}\left[\Phi_{I^{US}} + \psi\beta\frac{\Theta_{I^{US}}\Theta_I}{\Phi_I}\right] ,$$

which we can rewrite as

$$\frac{\partial I^{opt}}{\partial I^{US}} = -\frac{\psi\Theta_{I^{US}}\Theta_I}{\Phi_I^2}\left[\beta + \frac{\Phi_{I^{US}}\Phi_I}{\psi\Theta_{I^{US}}\Theta_I}\right] .$$

Assuming that $\bar{f}$, $\bar{\bar{f}}$, and $\bar{h}$ exist, we can distinguish six cases, that are depicted in Figure A.3. For each region, we indicate the sign of $\Theta_{I^{US}}$, Θ_I, $\Phi_{I^{US}}$, and Φ_I with the

Figure A.3: Optimal Monetary Policy (Output and Price Stabilisation)



superscript $(+)$, $(-)$, or $(\pm)$ (when the sign is not determined).

First, let us focus on the region $h < \bar{h}$, where $\Theta_{I^{US}} \equiv \frac{\partial \Pi}{\partial I^{US}} > 0$.

1. **Weak financial spillovers** ($f < \bar{f}$). In this region domestic inflation and output move in the same direction both following a US tightening (inflation and output increase) and a domestic tightening (inflation and output decrease). Therefore it is always optimal to tighten in response to a US tightening.

$$\frac{\partial I^{opt}}{\partial I^{US}} = -\frac{\psi \Theta_{I^{US}}^{(+)} \Theta_I^{(-)}}{\Phi_I^2} \left[\beta + \frac{\Phi_{I^{US}}^{(+)} \Phi_I^{(-)}}{\psi \Theta_{I^{US}}^{(+)} \Theta_I^{(-)}} \right] > 0 \; .$$

2. **Intermediate financial spillovers** ($\bar{f} < f < \bar{\bar{f}}$). In this region, following a US tightening, domestic inflation and output move in opposite directions.

$$\frac{\partial I^{opt}}{\partial I^{US}} = -\frac{\psi \Theta_{I^{US}}^{(+)} \Theta_I^{(-)}}{\Phi_I^2} \left[\beta + \frac{\Phi_{I^{US}}^{(-)} \Phi_I^{(-)}}{\psi \Theta_{I^{US}}^{(+)} \Theta_I^{(-)}} \right] \; .$$

Therefore, the sign of the optimal domestic monetary response depends on the weight on inflation in the loss function, β. The optimal response to a US tightening is a domestic tightening if:

$$\beta > -\frac{1}{\psi}\frac{\overset{(-)}{\Phi_{I^{US}}}\overset{(-)}{\Phi_I}}{\overset{(+)}{\Theta_{I^{US}}}\overset{(-)}{\Theta_I}} \equiv \bar{\beta} \ . \tag{A.22}$$

3. **Strong financial spillovers** ($f > \bar{\bar{f}}$). As in the previous region also here, following a US tightening, domestic inflation and output move in opposite directions. The important difference is that here inflation and output might move in opposite directions also following a *domestic* tightening.

$$\frac{\partial I^{opt}}{\partial I^{US}} = -\frac{\psi\overset{(+)}{\Theta_{I^{US}}}\overset{(\pm)}{\Theta_I}}{\Phi_I^2}\left[\beta + \frac{\overset{(-)}{\Phi_{I^{US}}}\overset{(+)}{\Phi_I}}{\psi\overset{(+)}{\Theta_{I^{US}}}\overset{(\pm)}{\Theta_I}}\right] \ .$$

We have two scenarios.[4] If $\Theta_I > 0$ (domestic monetary policy has a perverse effect on both output and inflation) then a domestic tightening would stabilise output but exacerbate inflation, while a domestic loosening would achieve the opposite. As a consequence, the sign of the optimal domestic monetary response depends on the weight on inflation in the loss function, β. It will be optimal to tighten if $\beta < \bar{\beta}$. If $\Theta_I < 0$ (domestic monetary policy has a perverse effect on output but not on inflation) then a domestic tightening would stabilise output and inflation at the same time. In this case the optimal response to a tightening in the US is always a domestic tightening.

Second, let us focus on the region $h > \bar{h}$, where $\Theta_{I^{US}} \equiv \frac{\partial \Pi}{\partial I^{US}} < 0$.

1. **Weak financial spillovers** ($f < \bar{f}$). In this region domestic inflation and output move in the opposite directions following a US tightening (inflation contracts and output increase).

$$\frac{\partial I^{opt}}{\partial I^{US}} = -\frac{\psi\overset{(-)}{\Theta_{I^{US}}}\overset{(-)}{\Theta_I}}{\Phi_I^2}\left[\beta + \frac{\overset{(+)}{\Phi_{I^{US}}}\overset{(-)}{\Phi_I}}{\psi\overset{(-)}{\Theta_{I^{US}}}\overset{(-)}{\Theta_I}}\right] \ .$$

The sign of the optimal domestic monetary response depends on the weight on inflation in the loss function, β. The optimal response to a US tightening is a domestic tightening if $\beta < \bar{\beta}$.

2. **Intermediate financial spillovers** ($\bar{f} < f < \bar{\bar{f}}$). Here, following a US tightening, domestic inflation and output comove. It is always optimal to loosen in response to a US tightening.

$$\frac{\partial I^{opt}}{\partial I^{US}} = -\frac{\psi\overset{(-)}{\Theta_{I^{US}}}\overset{(-)}{\Theta_I}}{\Phi_I^2}\left[\beta + \frac{\overset{(-)}{\Phi_{I^{US}}}\overset{(-)}{\Phi_I}}{\psi\overset{(-)}{\Theta_{I^{US}}}\overset{(-)}{\Theta_I}}\right] \ .$$

[4] See Eq. (A.19) and discussion thereof.

3. **Strong financial spillovers** ($f > \bar{\bar{f}}$). As in the previous region also here, following a US tightening, domestic inflation and output comove. The important difference is that here inflation and output might move in opposite directions following a domestic tightening.

$$\frac{\partial I^{opt}}{\partial I^{US}} = -\frac{\psi \Theta_{I^{US}}^{(-)} \Theta_{I}^{(\pm)}}{\Phi_I^2} \left[\beta + \frac{\Phi_{I^{US}}^{(-)} \Phi_{I}^{(+)}}{\psi \Theta_{I^{US}}^{(-)} \Theta_{I}^{(\pm)}} \right] .$$

We have two scenarios.[5] If $\Theta_I > 0$ (domestic monetary policy has a perverse effect on both output and inflation) then a domestic tightening would stabilise output and inflation at the same time. In this case the optimal response to a US tightening is always a domestic tightening. If $\Theta_I < 0$ (domestic monetary policy has a perverse effect on output but not on inflation) then a domestic tightening would stabilise output but exacerbate inflation, while a domestic loosening would achieve the opposite. As a consequence, the sign of the optimal domestic monetary response depends on the weight on inflation in the loss function, β. It will be optimal to tighten if $\beta < \bar{\beta}$.

To summarise: the domestic economy has one policy lever to stabilise both output and inflation. Whenever a domestic policy action can stabilise both objectives contemporaneously, then the direction of the optimal monetary policy is unambiguous. However, when there is a trade-off between inflation and output stabilisation, what matters for the optimal decision is the weight on price relative to output stabilisation in the loss function of the domestic monetary authority, β. We showed that there exists a threshold $\bar{\beta}$ above which the domestic monetary authority chooses price over output stabilisation. We also showed that, when financial spillovers are strong, there are two sub-regimes in the case perverse domestic monetary. On in which a tightening stimulates output but contracts inflation, and another where it stimulates both output and inflation.

[5]See Eq. (A.19) and discussion thereof.

B Identification of the US Monetary Policy Shock

The informationally robust instrument proposed by Miranda-Agrippino and Ricco (forthcoming) is obtained in three steps. First, the high-frequency market-based surprises in the fourth federal funds futures (FF4) around FOMC announcements of Gürkaynak et al. (2005) are projected on Greenbook forecasts and forecast revisions for real output growth, inflation (measured as the GDP deflator) and the unemployment rate. The following regression is run at FOMC meeting frequency:

$$FF4_m = \alpha_0 + \sum_{j=-1}^{3} \theta_j F_m^{cb} x_{q+j} + \sum_{j=-1}^{2} \vartheta_j \left[F_m^{cb} x_{q+j} - F_{m-1}^{cb} x_{q+j} \right] + MPI_m. \tag{B.1}$$

where $FF4_m$ denotes the high-frequency market-based monetary surprise computed around the FOMC announcement indexed by m. $F_m^{cb} x_{q+j}$ denotes Greenbook forecasts for the vector of variables x at horizon $q+j$ that are assembled prior to each meeting, and $\left[F_m^{cb} x_{q+j} - F_{m-1}^{cb} x_{q+j} \right]$ denotes revisions to forecasts between consecutive FOMC meetings. The forecast horizon is expressed in quarters, and q denotes the current quarter. These forecasts are typically published a week prior to each scheduled FOMC meeting and can be thought of as a proxy of the information set of the FOMC at the time of making the policy decision. For each surprise, the latest available forecast is used.

Second, the monthly instrument $\overline{MPI}_t$ is constructed by summing the daily MPI_m within each month. In the vast majority of cases, there is only one FOMC decision per month; the monthly surprise simply equals the daily one in these cases. Similarly, months without FOMC meetings are assigned a zero.

Finally, the autoregressive component in the monthly surprises is removed. Let $\overline{MPI}_t$ denote the result of the monthly aggregation described in the previous step. Our monthly monetary policy instrument MPI_t is constructed as the residuals of the following regression:

$$\overline{MPI}_t = \phi_0 + \sum_{j=1}^{12} \phi_j \overline{MPI}_{t-j} + MPI_t \ . \tag{B.2}$$

C Estimation of Median Group Responses

In several exercises we estimate median group dynamic responses for selected groups of countries to US monetary policy shocks. The goal is to provide an indication about how a synthetic 'median' economy would be affected by the shock. We aggregate the country responses into 'median' economy IRFs by taking sequentially each Gibbs sampler draw of the impulse responses for each country and obtaining the median response across countries at each horizon. We take draws sequentially starting from the firsts one, but this is equivalent to drawing each draw without replacement from the set of draws we have available for each country, and taking at each horizon the median value across countries. We proceed sequentially purely because of coding convenience. This procedure delivers a set of draws that can be interpreted as the response of the 'median' economy to the shock. The aggregation algorithm is the following:

1. For each Gibbs sampler iteration, stack the impulse responses of all countries in the group and compute the median across countries at each horizon.

2. Repeat the procedure for each Gibbs sampler iteration and store all median values obtained.

3. Sort these values and pick the median and corresponding bands at each horizon.

4. Repeat the above steps for all the variables in the endogenous set.

For US indicators and global controls we do not obtain the median across bilateral country-pair models, as we would be taking the median across several instances of the same country. We just stack all IRFs coming from the various bilateral models.

D Data Appendix

Table D.1: Global variables

Variable Name	Description	Source	Code	Start date	End date	Logs	RW
OECD Production	OECD production, total industry excl. construction, SA	Datastream	OCOPRI35G	1975:01	2019:06	•	•
OECD CPI	OECD CPI, All items, NSA	Datastream	OCOCP009F	1975:01	2019:07	•	•
OECD Stock Price	OECD Stock price index (excl. North America), EoM	Datastream	TOTMKEF(PI)	1975:01	2019:09	•	•
Interest Rate Differential	Average of 15 advanced economies minus US, short term	IMF, OECD, FRED		1989:06	2019:01		
Euro per USD	Exchange rate, National currency per US dollar, EoM	BIS		1975:01	2019:01	•	
GBP per USD	Exchange rate, National currency per US dollar, EoM	IMF		1975:01	2019:02	•	
JPY per USD	Exchange rate, National currency per US dollar, EoM	IMF		1975:01	2019:02	•	
Global Financial Conditions Index	Short-term credit spreads, weighted average	CrossBorder Capital	CBCFCI	1975:01	2019:03	•	
Global Risk Appetite	Composite index, Equity minus Bond exposure index, weighted average	CrossBorder Capital	CBCRA	1978:05	2019:03		
EM Inflow	Gross capital inflows to 15 EMs, percentage of GDP, Interpolated	IMF, GFD		1980:01	2019:09		•
EM Outflow	Gross capital outflows from 15 EMs, percentage of GDP, Interpolated	IMF, GFD		1980:01	2019:09		•
Global Fixed Income Holdings	Holdings of government and corporate fixed income, weighted average	CrossBorder Capital	CBCFIHUSD	1975:01	2019:10	•	•
Global Equity Holdings	Holdings of listed equities, weighted average	CrossBorder Capital	CBCEHUSD	1975:01	2019:10	•	•
Commodity Price	CRB commodity price index	Datastream	T80440	1975:01	2019:09	•	•
Oil Price	Crude oil dated Brent U$/BBL, EoM	Datastream	S219FD	1975:01	2019:01	•	•
US Production	Production of total industry, SA	OECD MEI		1975:01	2018:12	•	•
US CPI	US CPI, All items, NSA	OECD		1975:01	2018:12	•	•
US Stock Price	US Stock price index, EoM	Datastream	TOTMKUS(PI)	1975:01	2019:09	•	•
US Export-Import ratio	US Exports as a percentage of imports	OECD		1975:01	2019:03		•
US Trade Volume	US Exports plus imports	OECD		1975:01	2019:03	•	•
US Nominal Effective Exchange Rate	BIS Nominal effective exchange rate, narrow basket	BIS		1975:01	2019:01	•	•
US 10Y Treasury Rate	US 10-year treasury constant maturity rate, EoM	FRED	DGS10	1975:01	2019:01		
US Financial Conditions Index	Short-term credit spreads	CrossBorder Capital	CBCFCI	1975:01	2019:03	•	
US Risk Appetite	Composite index, Equity exposure index minus Bond exposure index	CrossBorder Capital	CBCRA	1978:05	2019:03		
US Inflow	Gross capital inflows to US, percentage of GDP, Interpolated	IMF, GFD		1980:01	2019:09		•
EM Outflow	Gross capital outflows from US, percentage of GDP, Interpolated	IMF, GFD		1980:01	2019:09		•
US Fixed Income Holdings	Holdings of government and corporate fixed income	CrossBorder Capital	CBCFIHUSD	1975:01	2019:10	•	•
US Equity Holdings	Holdings of listed equities	CrossBorder Capital	CBCEHUSD	1975:01	2019:10	•	•
Excess Bond Premium	Gilchrist and Zakrajšek excess bond premium	FRED		1975:01	2019:08		
VIX	Chicago Board Options Exchange, CBOE volatility index	FRED	VIXCLS	1990:01	2018:09	•	
1Y Treasury Rate	US 1-year treasury constant maturity rate, EoM	FRED	DGS1	1975:01	2019:01		

Notes: The table lists all variables included in the analysis of the reaction of global aggregates to a US monetary policy shock (Section 4 of the main text). The first part of the table contains the global aggregates, and the second part contains the US variables included. *Logs* indicates logarithmic transformations. *RW Prior* indicates assignment of a random walk prior vis-à-vis a white noise prior. The monetary policy variable used is the US one-year treasury constant maturity rate. Estimation sample: 1990:01 – 2018:09.

Table D.2: Endogenous set for the 'median economy' exercises

Foreign set	Logs	RW Prior	U.S. set	Logs	RW Prior
Industrial Production Index	•	•	US Industrial Production Index	•	•
Consumer Price Index	•	•	US Consumer Price Index	•	•
Core CPI Index	•	•	US Core CPI Index	•	•
Nominal Stock Price Index	•	•	US Nominal Stock Price Index	•	•
Export/Import ratio		•	US Export/Import ratio		•
Trade Volume	•	•	US Trade Volume	•	•
Nominal USD Exchange Rate	•	•	US Nominal Effective Exchange Rate	•	•
Short-term Interest Rate			US 10-Year Treasury Constant Maturity Rate		
Policy Rate			US Financial Conditions Index, CBC	•	
Long-term Interest Rate			US Risk Appetite, CBC		
Financial Conditions Index, CBC	•		US Cross-Border Flows Index, CBC	•	
Risk Appetite, CBC			US Fixed Income Holdings, CBC	•	•
Cross-Border Flows Index, CBC	•		US Equity Holdings, CBC	•	•
Fixed Income Holdings, CBC	•	•	US Excess Bond Premium		
Equity Holdings, CBC	•	•	CBOE VIX	•	
			US 1-year Treasury constant maturity rate		
Global price of Brent Crude	•	•			
Kilian (2019) Global Economic Activity Index					

Notes: The table lists all variables used in the 'median country' exercises (Sections 5 and 6 of the main text). Due to data availability, Core CPI, Fixed Income and Equity Holdings are used only in the endogenous set of AEs. The left part of the table displays the endogenous variables of the foreign economy, while the right part contains US endogenous variables. The bottom contains global controls that are part of the endogenous set. *Logs* indicates logarithmic transformations. *RW Prior* indicates assignment of a random walk prior vis-à-vis a white noise prior. The monetary policy variable used is the US one-year treasury constant maturity rate.

Table D.3: Data coverage

	Industrial Prod.	CPI	Core CPI	Stock Price	Export	Import	Exchange Rate	Short-term Rate
Australia	1975:01 - 2019:05	1986:11 - 2018:12	1975:01 - 2019:06	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1975:01 - 2019:01
Austria	1975:01 - 2018:10	1975:01 - 2018:12	1975:01 - 2019:06	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1989:06 - 2019:01
Belgium	1975:01 - 2018:11	1975:01 - 2019:01	1976:06 - 2019:07	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1975:01 - 2019:01
Brazil	1975:01 - 2018:11	1979:12 - 2018:12	1991:01 - 2018:12	1994:07 - 2019:09	1975:01 - 2019:04	1975:01 - 2019:04	1975:01 - 2019:02	1982:12 - 2019:01
Canada	1975:01 - 2018:10	1975:01 - 2018:12	1975:01 - 2019:06	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1975:01 - 2019:04
Chile	1991:01 - 2018:06	1975:01 - 2018:08	1978:12 - 2018:12	1989:07 - 2019:09	1975:01 - 2018:05	1975:01 - 2018:05	1975:01 - 2019:02	1985:01 - 2018:12
China	1990:01 - 2019:08	1986:01 - 2018:08	2008:01 - 2019:07	1994:05 - 2019:09	1992:01 - 2019:03	1992:01 - 2019:03	1975:01 - 2019:02	1990:01 - 2019:01
Colombia	1990:01 - 2018:11	1975:01 - 2018:12	1995:01 - 2019:07	1992:01 - 2019:09	1991:01 - 2019:03	1991:01 - 2019:03	1975:01 - 2019:02	1986:01 - 2019:01
Czech Rep.	1990:01 - 2018:11	1991:01 - 2018:11	1995:01 - 2019:06	1993:11 - 2019:09	1991:01 - 2019:03	1991:01 - 2019:03	1993:01 - 2019:02	1993:01 - 2018:12
Denmark	1975:01 - 2018:11	1975:01 - 2018:12	1975:01 - 2019:06	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1987:01 - 2019:01
Finland	1975:01 - 2018:11	1975:01 - 2018:12	1976:06 - 2019:06	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1975:01 - 2019:01
France	1975:01 - 2018:11	1975:01 - 2019:01	1975:01 - 2019:06	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1989:02 - 2019:03
Germany	1975:01 - 2018:11	1975:01 - 2018:12	1975:01 - 2019:06	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1975:01 - 2019:01
Hungary	1985:01 - 2018:11	1980:01 - 2018:12	1990:01 - 2019:07	1991:06 - 2019:09	1991:01 - 2019:02	1991:01 - 2019:02	1975:01 - 2019:02	1988:12 - 2019:01
India	1975:01 - 2018:08	1975:01 - 2018:04	NA	1990:01 - 2019:09	1990:01 - 2019:03	1990:01 - 2019:03	1975:01 - 2019:02	1993:01 - 2019:01
Italy	1975:01 - 2018:11	1975:01 - 2018:12	1975:01 - 2019:07	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1978:10 - 2019:01
Japan	1975:01 - 2018:11	1975:01 - 2018:12	1975:01 - 2019:06	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1986:07 - 2019:03
Malaysia	1975:01 - 2017:12	1975:01 - 2018:08	NA	1986:01 - 2019:09	1975:01 - 2018:03	1975:01 - 2018:03	1975:01 - 2019:02	1986:01 - 2019:09
Mexico	1980:01 - 2018:02	1975:01 - 2018:12	1980:01 - 2019:07	1988:01 - 2019:09	1980:01 - 2019:03	1980:01 - 2019:03	1975:01 - 2019:02	1978:01 - 2019:01
Netherlands	1975:01 - 2018:11	1975:01 - 2018:12	1975:01 - 2019:07	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1982:01 - 2019:01
Norway	1975:01 - 2018:11	1975:01 - 2018:12	1979:01 - 2019:07	1980:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1979:01 - 2019:01
Philippines	1996:01 - 2018:07	1975:01 - 2018:07	2000:01 - 2019:07	1987:09 - 2019:09	1975:01 - 2018:02	1975:01 - 2018:02	1975:01 - 2019:02	1976:01 - 2018:12
Poland	1985:01 - 2018:12	1989:01 - 2018:12	1995:01 - 2019:06	1994:03 - 2019:09	1991:01 - 2019:02	1991:01 - 2019:02	1975:01 - 2019:01	1991:06 - 2019:01
Russia	1993:01 - 2018:11	1992:01 - 2018:12	2003:01 - 2019:07	1998:01 - 2019:09	1991:01 - 2019:03	1991:01 - 2019:03	1992:06 - 2018:08	1997:01 - 2018:12
South Africa	1975:01 - 2019:07	1975:01 - 2018:12	2002:01 - 2019:06	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1975:01 - 2019:01
Spain	1975:01 - 2018:11	1975:01 - 2018:12	1976:01 - 2019:06	1987:03 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1977:01 - 2019:01
Sweden	1975:01 - 2018:11	1975:01 - 2018:12	1975:01 - 2019:06	1982:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1982:01 - 2019:01
Thailand	1999:01 - 2018:07	1975:01 - 2018:08	1984:12 - 2019:08	1987:01 - 2019:09	1975:01 - 2018:05	1975:01 - 2018:05	1975:01 - 2019:02	1992:01 - 2019:01
Turkey	1985:01 - 2018:10	1975:01 - 2018:12	1994:01 - 2019:06	1988:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1978:12 - 2019:01
UK	1975:01 - 2018:11	1975:01 - 2018:12	1975:01 - 2019:06	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:02	1985:02 - 2019:03
US	1975:01 - 2018:12	1975:01 - 2018:12	1975:01 - 2019:06	1975:01 - 2019:09	1975:01 - 2019:03	1975:01 - 2019:03	1975:01 - 2019:01	1975:01 - 2019:01
Euro Area	1975:07 - 2019:08	1990:01 - 2019:09	1996:01 - 2019:09	1994:01 - 2019:09	1990:01 - 2019:08	1990:01 - 2019:08	1975:01 - 2019:01	1994:01 - 2019:01

Table D.4: Data coverage (cont'd)

	Policy Rate	Long-term Rate	Fin. Conditions	Risk Appetite	Cross-Border Flows	Capital Flow	Fixed Income Hold.	Equity Holdings
Australia	1976:04 - 2018:08	1975:01 - 2019:01	1975:01 - 2019:03	1978:05 - 2019:03	1975:01 - 2019:03	1989:03 - 2019:10	1988:04 - 2019:10	1975:01 - 2019:10
Austria	1975:01 - 2018:08	1975:01 - 2019:01	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1992:03 - 2019:10	1989:10 - 2019:10	1975:01 - 2019:10
Belgium	1975:01 - 2019:01	1975:01 - 2019:01	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1980:03 - 2019:10	1989:10 - 2019:10	1975:01 - 2019:10
Brazil	1986:06 - 2018:11	1999:12 - 2019:02	1976:02 - 2019:03	1991:12 - 2019:03	1980:01 - 2019:03	1980:03 - 2019:10	2002:01 - 2019:10	1993:10 - 2019:10
Canada	1975:01 - 2018:08	1975:01 - 2019:08	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1980:03 - 2019:10	1989:01 - 2019:10	1975:01 - 2019:10
Chile	1995:05 - 2018:12	1994:08 - 2013:11	1976:04 - 2019:03	1978:05 - 2019:03	1980:01 - 2019:03	1991:03 - 2019:10	2002:10 - 2019:10	1975:12 - 2019:10
China	1990:03 - 2018:11	1990:01 - 2019:02	1982:01 - 2019:03	1994:08 - 2019:03	1982:10 - 2019:03	1999:03 - 2019:10	2000:10 - 2019:10	1993:07 - 2019:10
Colombia	1995:04 - 2018:12	2002:09 - 2019:02	1975:02 - 2019:03	1988:04 - 2019:03	1977:01 - 2019:03	1996:03 - 2019:09	1989:10 - 2019:10	1984:12 - 2019:10
Czech Rep.	1995:12 - 2018:12	2000:04 - 2019:01	1992:05 - 2019:03	1996:12 - 2019:03	1994:02 - 2019:03	1993:03 - 2019:10	2006:01 - 2019:10	1993:08 - 2019:10
Denmark	1975:01 - 2018:12	1983:05 - 2019:01	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1981:03 - 2019:10	1999:10 - 2019:10	1975:01 - 2019:10
Finland	1975:01 - 2019:01	1975:01 - 2019:01	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1980:03 - 2019:10	1989:10 - 2019:10	1975:01 - 2019:10
France	1975:01 - 2019:01	1975:01 - 2018:12	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1980:03 - 2019:10	1989:10 - 2019:10	1975:01 - 2019:10
Germany	1975:01 - 2019:01	1975:01 - 2019:02	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1980:03 - 2019:10	1989:10 - 2019:10	1975:01 - 2019:10
Hungary	1987:01 - 2018:12	1999:02 - 2019:01	1977:02 - 2019:02	1994:10 - 2019:02	1977:01 - 2019:02	1989:12 - 2019:10	1997:10 - 2019:10	1991:06 - 2019:10
India	1975:01 - 2018:11	1994:05 - 2019:02	1975:02 - 2019:03	1978:05 - 2019:03	1977:01 - 2019:03	1980:03 - 2019:10	1998:10 - 2019:10	1975:01 - 2019:10
Italy	1975:01 - 2019:01	1980:01 - 2019:01	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1980:03 - 2019:10	1989:10 - 2019:10	1975:01 - 2019:10
Japan	1975:01 - 2019:01	1975:01 - 2019:01	1975:01 - 2019:03	1978:05 - 2019:03	1976:03 - 2019:03	1985:03 - 2019:10	1997:10 - 2019:10	1975:01 - 2019:10
Malaysia	1995:11 - 2018:12	1996:01 - 2019:02	1975:02 - 2019:03	1983:05 - 2019:03	1977:01 - 2019:03	1999:03 - 2019:10	2005:01 - 2019:10	1980:01 - 2019:10
Mexico	1998:11 - 2018:12	1980:01 - 2019:02	1975:02 - 2019:03	1981:04 - 2019:03	1978:01 - 2019:03	1980:03 - 2019:10	2005:10 - 2019:10	1975:01 - 2019:10
Netherlands	1985:06 - 2019:01	1975:01 - 2018:12	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1980:03 - 2019:10	1989:10 - 2019:10	1975:01 - 2019:10
Norway	1982:04 - 2018:12	1985:01 - 2019:01	1975:01 - 2019:03	1983:05 - 2019:03	1976:01 - 2019:03	1980:03 - 2019:10	1995:10 - 2019:10	1980:01 - 2019:10
Philippines	1986:01 - 2018:12	1999:02 - 2019:02	1975:02 - 2019:03	1978:05 - 2019:03	1976:04 - 2019:03	1980:03 - 2019:10	2015:01 - 2019:10	1975:01 - 2019:10
Poland	1993:01 - 2018:12	2001:10 - 2019:02	1975:02 - 2019:02	1994:08 - 2019:02	1989:03 - 2019:02	2000:03 - 2019:10	2003:10 - 2019:10	1991:04 - 2019:10
Russia	1992:01 - 2018:11	1999:01 - 2018:06	1993:02 - 2019:03	1997:10 - 2019:03	1995:02 - 2019:03	1994:03 - 2019:10	2004:01 - 2019:10	1994:06 - 2019:10
South Africa	1980:12 - 2018:12	1975:01 - 2019:01	1975:02 - 2019:03	1978:05 - 2019:03	1976:03 - 2019:03	1980:03 - 2019:10	1975:01 - 2019:10	1975:01 - 2019:10
Spain	1975:01 - 2019:01	1978:03 - 2019:01	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1980:03 - 2019:10	1989:10 - 2019:10	1975:01 - 2019:10
Sweden	1975:01 - 2019:01	1975:01 - 2019:01	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1980:03 - 2019:10	2001:10 - 2019:10	1975:01 - 2019:10
Thailand	1994:01 - 2019:01	1979:12 - 2019:02	1975:02 - 2019:03	1979:10 - 2019:03	1976:04 - 2019:03	1980:03 - 2019:10	1989:10 - 2019:10	1976:06 - 2019:10
Turkey	1986:04 - 2019:01	2000:06 - 2019:01	1975:02 - 2019:03	1991:05 - 2019:03	1980:01 - 2019:03	1984:03 - 2019:10	2003:10 - 2019:10	1995:12 - 2019:10
UK	1975:01 - 2018:12	1975:01 - 2018:08	1975:01 - 2019:03	1978:05 - 2019:03	1976:05 - 2019:03	1980:03 - 2019:10	1987:01 - 2019:10	1975:01 - 2019:10
US	1975:01 - 2019:01	1975:01 - 2019:01	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1980:03 - 2019:10	1975:01 - 2019:10	1975:01 - 2019:10
Euro Area	1999:01 - 2019:01	1975:01 - 2019:09	1975:01 - 2019:03	1978:05 - 2019:03	1976:01 - 2019:03	1999:03 - 2019:10	1989:10 - 2019:10	1975:01 - 2019:10

TABLE D.5: Data sources for endogenous variables

	Industrial Prod.	CPI	Core CPI	Stock Price	Export	Import	Exchange Rate	Short-term Rate
Australia	Datastream	Datastream	Datastream	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
Austria	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
Belgium	OECD MEI	OECD MEI	Datastream	Datastream	OECD MEI	OECD MEI	IMF IFS	Datastream
Brazil	OECD MEI	OECD MEI	Datastream	Datastream	OECD MEI	OECD MEI	IMF IFS	IMF IFS
Canada	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	IMF IFS
Chile	Datastream	IMF IFS	Datastream	Datastream	IMF IFS	IMF IFS	IMF IFS	IMF IFS
China	Datastream	IMF IFS	Datastream	Datastream	OECD MEI	OECD MEI	IMF IFS	Datastream
Colombia	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
Czech Rep.	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
Denmark	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
Finland	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	IMF IFS
France	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	IMF IFS
Germany	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
Hungary	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	IMF IFS
India	IMF IFS	IMF IFS	NA	Datastream	IMF IFS	IMF IFS	IMF IFS	Datastream
Italy	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
Japan	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	IMF IFS
Malaysia	IMF IFS	IMF IFS	NA	Datastream	IMF IFS	IMF IFS	IMF IFS	IMF IFS
Mexico	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
Netherlands	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
Norway	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
Philippines	Datastream	IMF IFS	Datastream	Datastream	IMF IFS	IMF IFS	IMF IFS	IMF IFS
Poland	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
Russia	OECD MEI	OECD MEI	Datastream	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
South Africa	Datastream	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	IMF IFS
Spain	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	OECD MEI
Sweden	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	IMF IFS
Thailand	Datastream	IMF IFS	Datastream	Datastream	IMF IFS	IMF IFS	IMF IFS	Datastream
Turkey	Datastream	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	IMF IFS
UK	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	IMF IFS	BOE
US	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	BIS	OECD MEI
Euro Area	OECD MEI	OECD MEI	OECD MEI	Datastream	OECD MEI	OECD MEI	BIS	OECD MEI

Notes: Acronyms correspond to the following sources. IMF IFS: IMF International Financial Statistics database; OECD MEI: OECD Main Economic Indicators database; Datastream: Thomson-Reuters Datastream database; BIS: Bank of International Settlements Statistics warehouse; CBC: CrossBorder Capital; ECB: European Central Bank Statistical Data Warehouse; FRED: Federal Reserve Bank of St. Louis Data Service; GFD: Global Financial Database.

TABLE D.6: Data sources for endogenous variables (cont'd)

	Policy Rate	Long-term Rate	Fin. Conditions	Risk Appetite	Cross-Border Flows	Capital Flows	Fixed Income Hold.	Equity Holdings
Australia	BIS	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Austria	ECB	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Belgium	ECB	Datastream	CBC	CBC	CBC	BIS, GFD	CBC	CBC
Brazil	BIS	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Canada	BIS	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Chile	IMF IFS	Datastream	CBC	CBC	CBC	IMF, GFD	CBC	CBC
China	OECD MEI	Datastream	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Colombia	BIS	Datastream	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Czech Rep.	BIS	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Denmark	BIS	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Finland	OECD MEI	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
France	ECB	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Germany	IMF IFS	OECD MEI	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Hungary	BIS	OECD MEI	CBC	CBC	CBC	IMF, GFD	CBC	CBC
India	BIS	Datastream	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Italy	ECB	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Japan	OECD MEI	Datastream	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Malaysia	BIS	Datastream	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Mexico	BIS	Datastream	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Netherlands	ECB	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Norway	Norges Bank	OECD MEI	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Philippines	BIS	Datastream	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Poland	BIS	OECD MEI	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Russia	BIS	OECD MEI	CBC	CBC	CBC	IMF, GFD	CBC	CBC
South Africa	BIS	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Spain	ECB	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Sweden	Riksbank	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Thailand	Datastream	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Turkey	IMF IFS	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
UK	BIS	IMF IFS	CBC	CBC	CBC	IMF, GFD	CBC	CBC
US	FRED	OECD MEI	CBC	CBC	CBC	IMF, GFD	CBC	CBC
Euro Area	BIS	OECD MEI	CBC	CBC	CBC	IMF, GFD	CBC	CBC

Notes: Acronyms correspond to the following sources. IMF IFS: IMF International Financial Statistics database; OECD MEI: OECD Main Economic Indicators database; Datastream: Thomson-Reuters Datastream database; BIS: Bank of International Settlements Statistics warehouse; CBC: CrossBorder Capital; ECB: European Central Bank Statistical Data Warehouse; FRED: Federal Reserve Bank of St. Louis Data Service; GFD: Global Financial Database.

Table D.7: Sources of short term interest rates

	Short-term interest rate	Source
Australia	Interbank 3 Month	OECD MEI
Austria	VIBOR 3 month	OECD MEI
Belgium	T-bill Rate (3 months)	Datastream
Brazil	Deposit Rate (90 day)	IMF IFS
Canada	T-bill Rate (3 months)	IMF IFS
Chile	Deposit Rate (90 day)	IMF IFS
China	Deposit Rate (90 day)	Datastream
Colombia	Deposit Rate (90 day)	OECD MEI
Czech Rep.	PRIBOR 3 Month	OECD MEI
Denmark	CIBOR 3 Month	OECD MEI
Finland	HELIBOR 3 Month	IMF IFS
France	T-bill Rate (3 months)	IMF IFS
Germany	FIBOR 3 Month	OECD MEI
Hungary	T-bill Rate (3 months)	IMF IFS
India	Lending Rate	Datastream
Italy	T-bill Rate (3 months)	OECD MEI
Japan	T-bill Rate (3 months)	IMF IFS
Malaysia	T-bill Rate (3 months)	IMF IFS
Mexico	T-bill Rate (3 months)	OECD MEI
Netherlands	AIBOR 3 month	OECD MEI
Norway	NIBOR 3 month	OECD MEI
Philippines	Deposit Rate (90 day)	IMF IFS
Poland	WIBOR 3 month	OECD MEI
Russia	Interbank 1-3 Month	OECD MEI
South Africa	T-bill Rate (3 months)	IMF IFS
Spain	Interbank 3 Month	OECD MEI
Sweden	T-bill Rate (3 months)	IMF IFS
Thailand	Interbank 1 Month	Datastream
Turkey	Deposit Rate (90 day)	IMF IFS
UK	T-bill Rate (3 months)	Bank of England

TABLE D.8: Classification of countries by Exchange Rate Regimes

Ilzetzki et al. (2019) Fine Classification				
Floats	Managed floats	Median IRR	Crawling pegs	Median IRR
14 AEs*	Brazil	12	China	5
Czech Republic	Canada	12	India	7
Hungary	Chile	12	Malaysia	11
Poland	Colombia	12	Philippines	10
	Mexico	12	Russia	8
	South Africa	12	Thailand	11
	Turkey	12		

Notes: Medians across sample period of each country. 12: +/- 5% de facto moving band, managed floating; 11: +/- 2% moving band; 10: de facto crawling band, +/- 5%; 8: de facto crawling band, +/- 2%; 7: de facto crawling peg; 5: pre-announced crawling peg. Czech Republic, Hungary, and Poland are classified as floaters relative to the US dollar, since their currencies are anchored to Euro.
* 14 AEs are all of the AEs in our sample minus Canada. The median value of all 14 countries is 13, which corresponds to a freely floating regime in the Ilzetzki et al. (2019) classification.

Table D.9: Classification of countries by Financial Market Openness

Chinn-Ito Index, the Sample Average					
ADVANCED	Australia	0.828	EMERGING	Brazil	0.369
	Austria	0.968		Chile	0.635
	Belgium	0.968		China	0.166
	Canada	1		Colombia	0.403
	Denmark	0.994		Czech Rep.	0.951
	Finland	0.968		Hungary	0.907
	France	0.948		India	0.166
	Germany	1		Malaysia	0.411
	Italy	0.948		Mexico	0.674
	Japan	0.989		Philippines	0.389
	Netherlands	0.990		Poland	0.476
	Norway	0.895		Russia	0.465
	Spain	0.905		South Africa	0.169
	Sweden	0.946		Thailand	0.284
	UK	1		Turkey	0.323
ADVANCED	MEDIAN	0.968	EMERGING	MEDIAN	0.403
	TOP 33%	0.989		TOP 33%	0.469
	BOTTOM 33%	0.948		BOTTOM 33%	0.354
	ST.DEV	0.048		ST.DEV	0.245

	Advanced		Emerging	
	Open (Top 33%)	Less Open (Bottom 33%)	Open (Top 33%)	Less Open (Bottom 33%)
	Canada	Australia	Chile	Brazil
	Denmark	France	Czech Rep.	India
	Germany	Italy	Hungary	South Africa
	Netherlands	Norway	Mexico	Thailand
	UK	Spain	Poland	Turkey
		Sweden		
Sample Average	0.997	0.912	0.729	0.222

Notes: The measure of financial openness is the arithmetic mean of the *ka_ open* index from Chinn and Ito (2006), which ranges from 0 (mostly closed) to 1 (mostly open). The Chinn-Ito index is available at yearly frequency up until 2017. It covers the sample from 1990 until 2017 for AEs. The coverage varies across EMs according to their sample availability (see Table 1).

Table D.10: Classification of EMs by Trade Invoicing in Dollars

Country	Exports			Imports		
	Avg. shares	High	Low	Avg. shares	Top 1/3	Bottom 1/3
Brazil	0.943	•		0.844	•	
Chile	NA			NA		
China	NA			NA		
Colombia	0.990	•		0.990	•	
Czech Rep.	0.136		•	0.192		•
Hungary	0.181		•	0.265		•
India	0.864	•		0.855	•	
Malaysia	0.9	•		0.9*	•	
Mexico	NA			NA		
Philippines	NA			NA		
Poland	0.305		•	0.303		•
Russia	NA			NA		
South Africa	0.52			0.52*		•
Thailand	0.821			0.789		
Turkey	0.461		•	0.591		
MEDIAN	0.670			0.690		
TOP 33%	0.864			0.844		
BOTTOM 33%	0.461			0.52		

Notes: Data from Gopinath (2015). Numbers in the second and fourth columns represent the average share of exports/imports into a country invoiced in US dollars, averaged across all years starting from 1999. We calculate the average, top and bottom tertile values excluding 5 countries with no data available (indicated as 'NA'). A country belongs to the 'High' group if its share of exports/imports invoiced in the USD corresponds to the top tertile and to the 'Low' group if it falls below the bottom tertile among 10 EMs listed above.
* Only exports invoicing data are available for Malaysia and South Africa. We assume that import USD invoicing shares are roughly the same as the export ones for these two countries.

TABLE D.11: Classification of EMs by Gross Dollar Exposure

Country	Total USD Assets + Liabilities	High Exposure	Low Exposure
Brazil	35.443		
Chile	80.519	•	
China	38.887		
Colombia	44.310		
Czech Rep.	30.494		•
Hungary	28.121		•
India	24.684		•
Malaysia	78.865	•	
Mexico	45.227		
Philippines	55.743	•	
Poland	20.216		•
Russia	61.570	•	
South Africa	30.956		•
Thailand	47.550	•	
Turkey	38.548		
MEDIAN	38.887		
TOP 33%	46.001		
BOTTOM 33%	33.947		

Notes: We construct a measure of gross dollar exposure for each country by taking the sum of total USD assets and liabilities as a share of domestic GDP, from the dataset of Bénétrix et al. (2015). Numbers in the second column represent the average of this measure over the sample, which varies from 1990:01 – 2019:09 for the longest (South Africa) to 2002:09 – 2018:09 for the shortest (Colombia). A country belongs to the 'High exposure' group if its gross dollar exposure corresponds to the top tertile and the 'Low exposure' group if it falls below the bottom tertile among 15 EMs listed above.

Table D.12: Model Specifications

Variable	Source	Transformations		Models				
		Logs	RW Prior	(1)	(2)	(3)	(4)	(5)
Industrial Production Index	OECD	•	•	√	√	√	√	√
CPI	OECD	•	•	√	√	√	√	√
Core CPI	OECD	•	•	√	√			
Nominal Stock Price Index	Datastream	•	•	√	√	√	√	√
Export/Import ratio	OECD		•	√	√	√	√	
Trade Volume	OECD	•	•	√	√	√	√	
Nominal USD Exchange Rate	BIS	•	•	√	√	√	√	√
Short-term Interest Rate	OECD			√	√	√	√	√
Policy Rate	BIS			√	√	√	√	
Long-term Interest Rate	IMF			√	√	√	√	
Financial Conditions Index, CBC	CBC	•		√	√	√	√	
Risk Appetite, CBC	CBC			√	√	√	√	
Capital Inflow	IMF, GFD		•		√		√	
Capital Outflow	IMF, GFD		•		√		√	
Cross-Border Flows Index, CBC	CBC	•		√		√		
Fixed Income Holdings, CBC	CBC	•	•	√	√			
Equity Holdings, CBC	CBC	•	•	√	√			
Global price of Brent Crude	FRED	•	•	√	√	√	√	√
Global Economic Activity Index	Kilian (2019)			√	√	√	√	√
CRB Commodity Price Index	Datastream	•	•					√
US Industrial Production Index	OECD	•	•	√	√	√	√	√
US CPI	OECD	•	•	√	√	√	√	√
US Core CPI	OECD	•	•	√	√			√
US Nominal Stock Price Index	Datastream	•	•	√	√	√	√	√
US Export/Import ratio	OECD		•	√	√	√	√	√
US Trade Volume	OECD	•	•	√	√	√	√	√
US Nominal Effective Exchange Rate	BIS	•	•	√	√	√	√	√
US 10-Year Treasury Constant Maturity Rate	FRED			√	√	√	√	√
US Financial Conditions Index, CBC	CBC	•		√	√	√	√	√
US Risk Appetite, CBC	CBC			√	√	√	√	√
US Capital Inflow	IMF, GFD		•		√		√	
US Capital Outflow	IMF, GFD		•		√		√	
US Cross-Border Flows Index, CBC	CBC	•		√		√		√
US Fixed Income Holdings, CBC	CBC	•	•	√	√			√
US Equity Holdings, CBC	CBC	•	•	√	√			√
US Excess Bond Premium	FRED			√	√	√	√	√
CBOE VIX	FRED	•		√	√	√	√	√
US 1-Year Treasury Constant Maturity Rate	FRED			√	√	√	√	√

Models: (1) Bilateral BVAR specification for AEs in Section 5 and AE groups based on capital openness measures in Section 7, Figure 14; (2) specification for AE groups in Section 7, Figure 15 ; (3) specification for EMs in Section 6 and group exercises based on exchange rate regimes and capital flow management in Section 7, Figures 12 and 16; (4) specification for the exchange rate regime exercise in Section 7, Figure 13; (5) specification for the analysis of asymmetric effects of 'Fragile Five' EMs in Section 6, Figure 11 .

TABLE D.13: Sample coverage for 'Fragile Five'

Countries	Estimation Sample
Turkey	1990:01 – 2018:09
Brazil	1990:01 – 2018:09
Chile	1991:01 – 2018:06
Mexico	1990:01 – 2018:02
South Africa	1990:01 – 2018:09

Notes: The set of endogenous variables includes five main local indicators: industrial production, CPI, stock prices, exchange rate, and short-term interest rate. It also includes all US variables detailed in Table D.2, the global controls and the CRB commodity price index. For Brazil, the end-of-month stock price series is interpolated backwards from 1994:07 to 1990:01 by regressing it on the monthly average stock prices (from OECD MEI) in a simple linear regression estimated by OLS. For Brazil, we also replace industrial production by monthly GDP (from FRED, BRALORSGPNOSTSAM). We interpolate GDP backwards from 1996:01 to 1990:01 by linear regression on the year-on-year growth rate of IP, using OLS. The results we obtain by using industrial production are qualitatively similar.

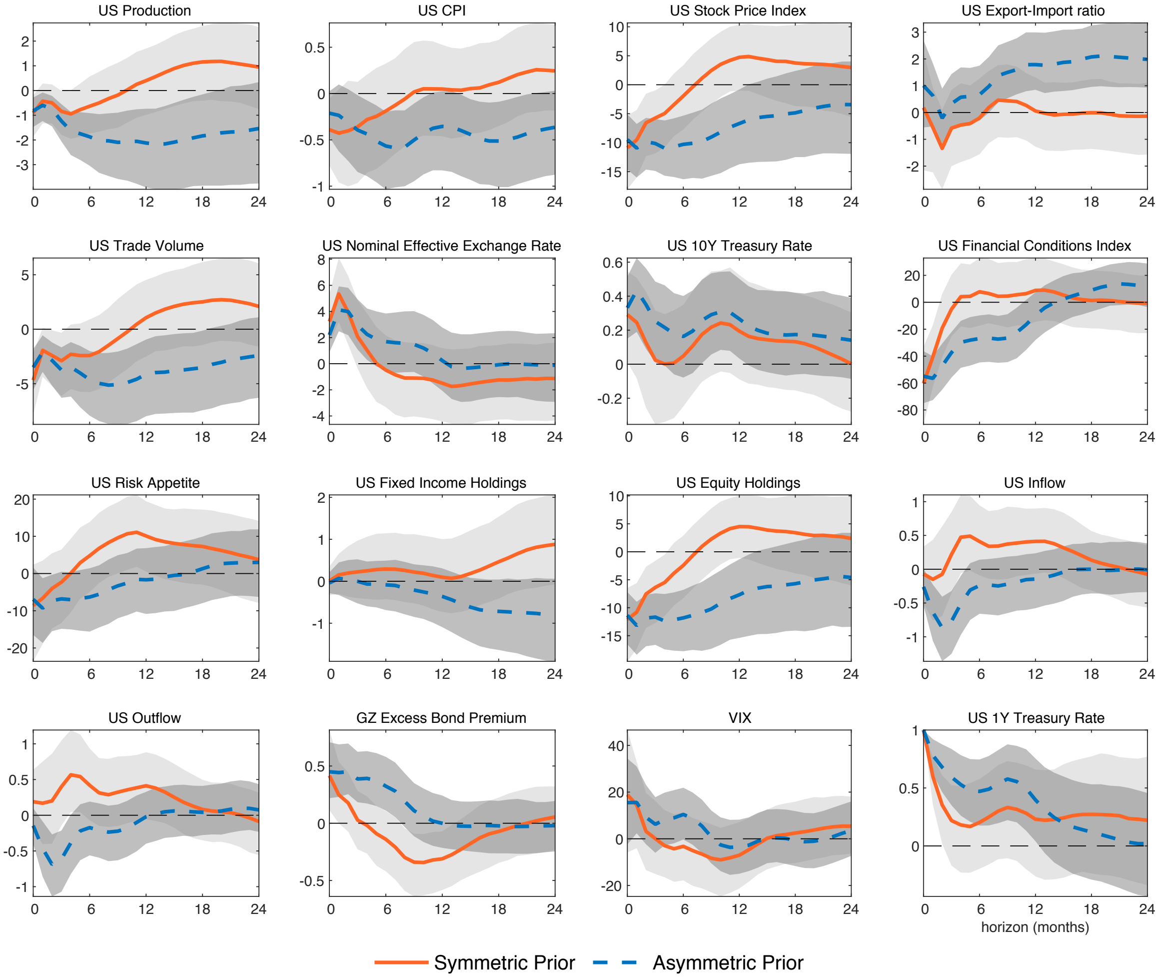
Table D.14: Country coverage for EM asymmetric responses

Countries	Estimation Sample	Countries	Estimation Sample
Brazil	1990:01 - 2018:09	Malaysia	1990:01 - 2017:12
Chile	1991:01 - 2018:06	Mexico	1990:01 - 2018:02
China	1990:12 - 2018:08	Philippines	1990:01 - 2018:07
Colombia	1992:01 - 2018:09	Poland	1991:06 - 2018:09
Czech Rep.	1993:11 - 2018:09	South Africa	1990:01 - 2018:09
Hungary	1991:06 - 2018:09	Turkey	1990:01 - 2018:09
India	1993:01 - 2018:04		

Notes: The set of endogenous variables includes five main local indicators: industrial production, CPI, stock prices, exchange rate, and short-term interest rate. It also includes all US variables detailed in Table D.2, the global controls and CRB commodity price index. The end-of-month stock price series is interpolated backwards by regressing it on the monthly average stock prices by simple OLS regression and obtaining the fitted values for Brazil (from 1994:07 to 1990:01), China (from 1994:05 to 1990:12), and Poland (from 1994:03 to 1991:05). For the Philippines, we interpolate backwards industrial production from 1996:01 to 1990:01 by using Kalman filter techniques and exploiting the correlations obtained from a BVAR(12) estimated on all indicators for the Philippines.

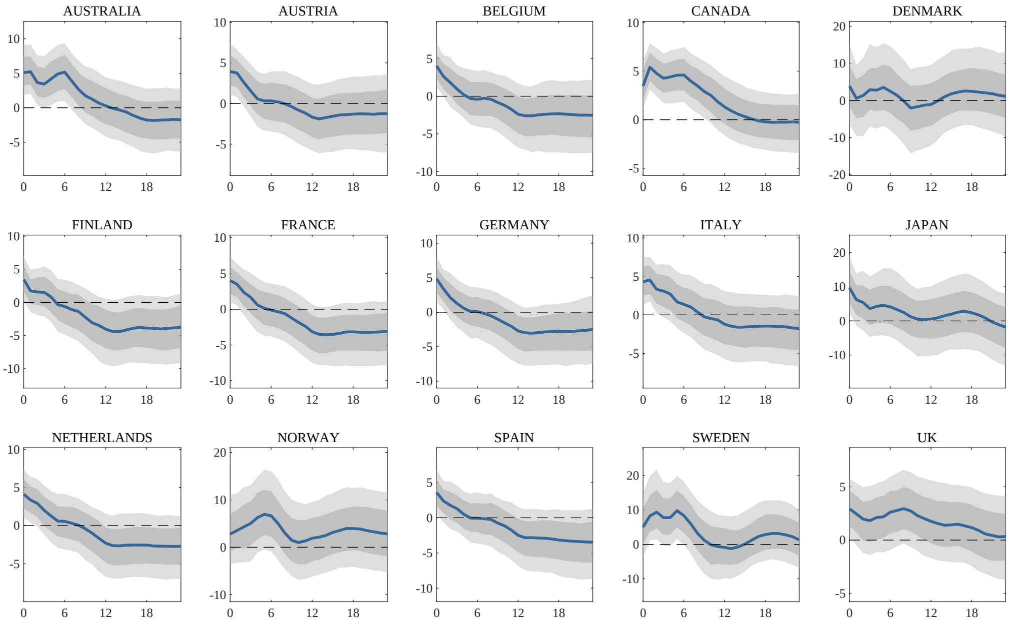
E Additional Charts

Figure E.1: NIW v. Asymmetric Prior comparison, US



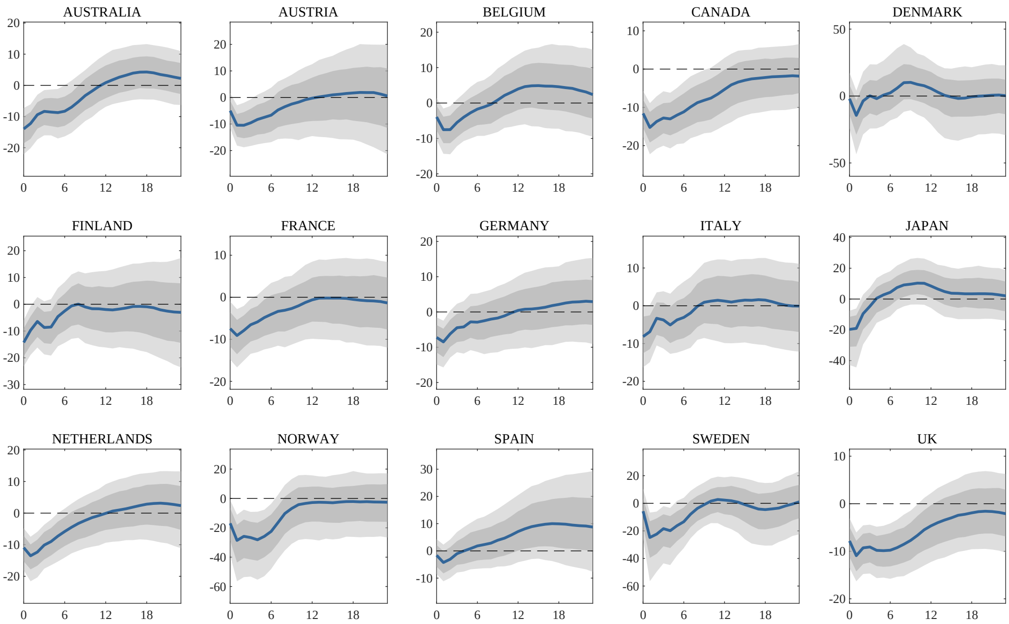
Note: Responses for US indicators from the bilateral US-Global system presented in Section 4 of the main text. Solid orange line – BVAR(12) with standard Normal Inverse Wishart prior. Dashed blue line – BVAR(12) with asymmetric conjugate prior. The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample 1990:01 – 2018:09. Shaded areas are 90% posterior coverage bands.

Figure E.2: Advanced Economies, Nominal exchange rate



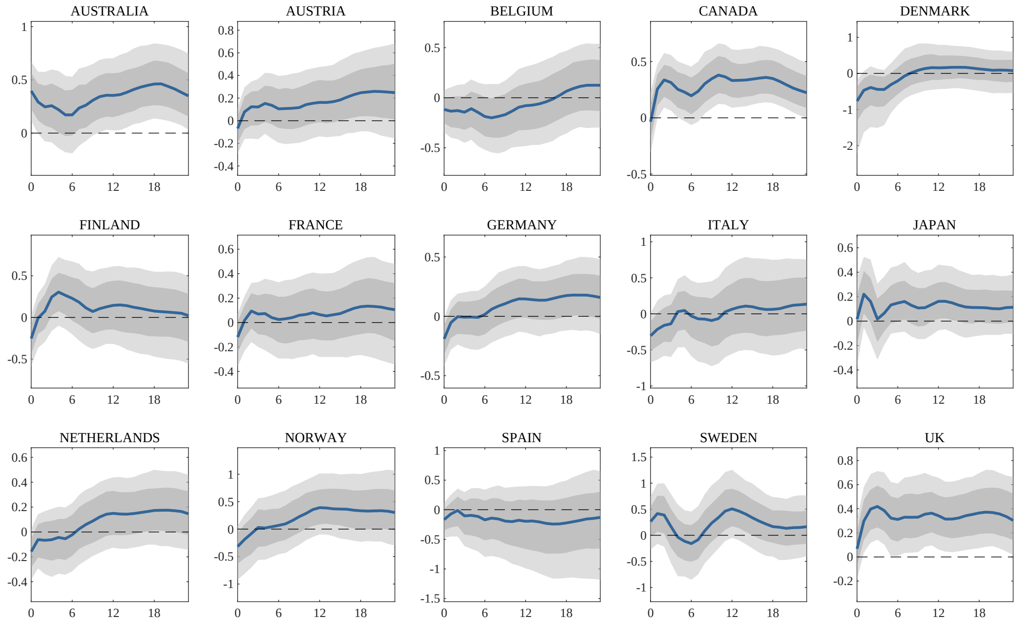
Note: Responses of nominal exchange rate (local currency/USD) in 15 advanced economies to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1 (in the main text). BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands.

Figure E.3: Advanced Economies, Stock prices



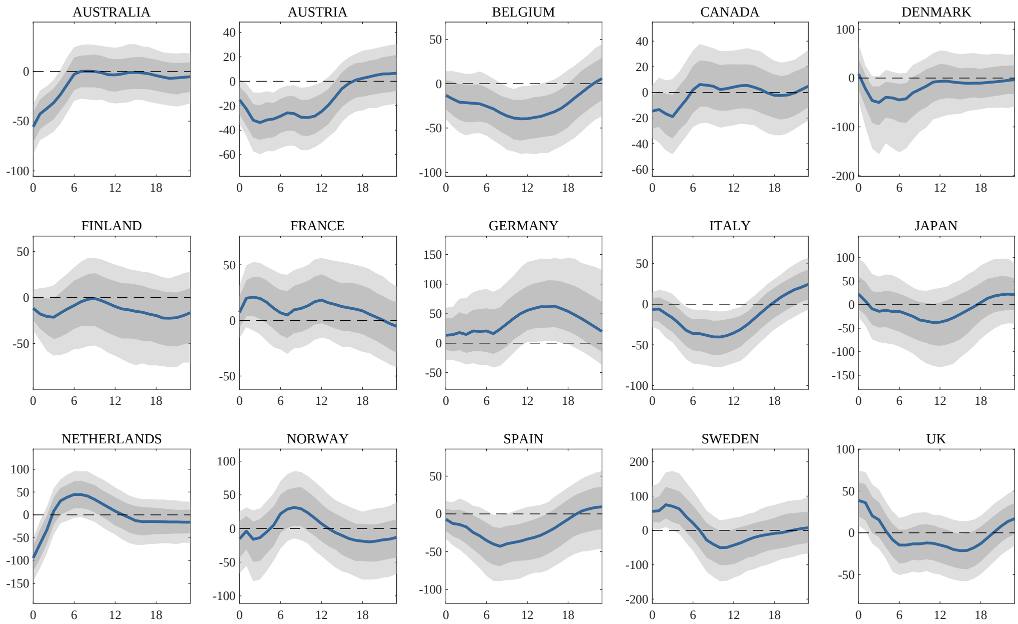
Note: Responses of stock price indices in 15 advanced economies to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1 (in the main text). BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands.

Figure E.4: Advanced Economies, Long-term rates



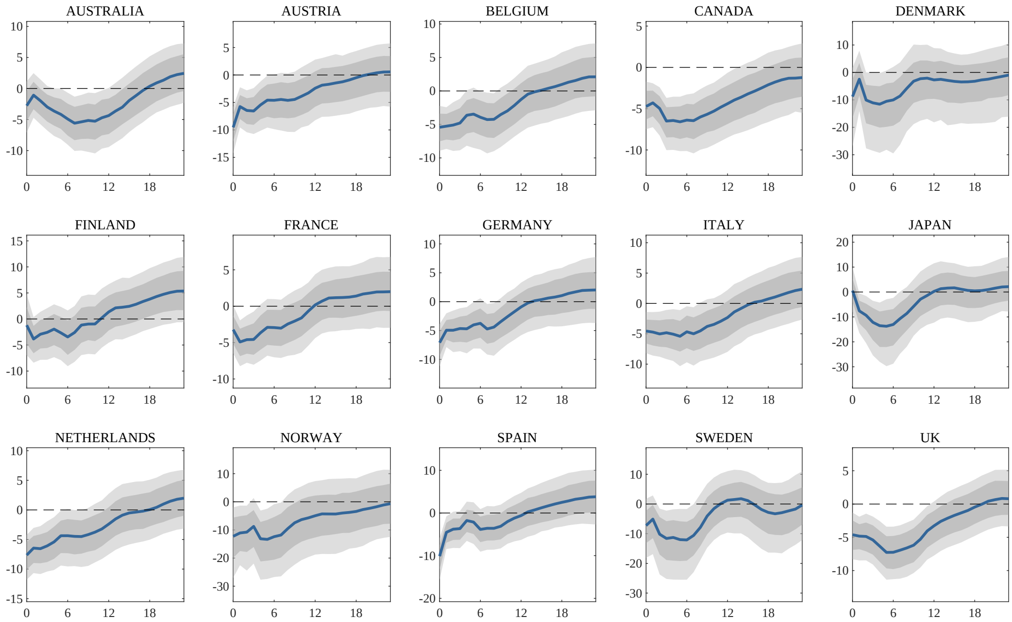
Note: Responses of long-term government bond yields in 15 advanced economies to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1 (in the main text). BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands.

Figure E.5: Advanced Economies, Cross-border flows



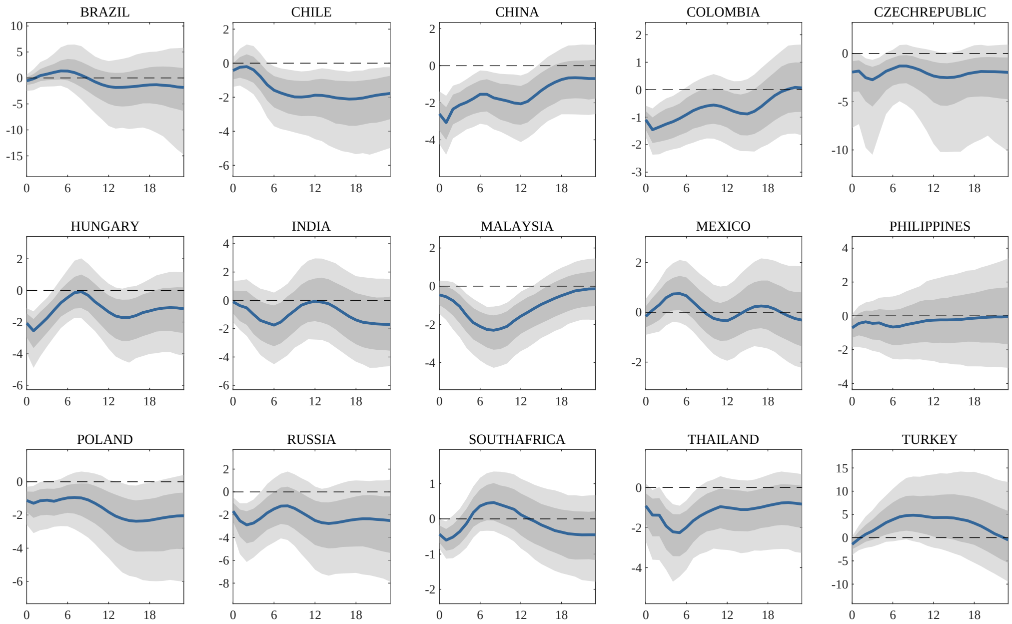
Note: Responses of cross-border flows in 15 advanced economies to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1 (in the main text). BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands.

Figure E.6: Advanced Economies, Trade volume



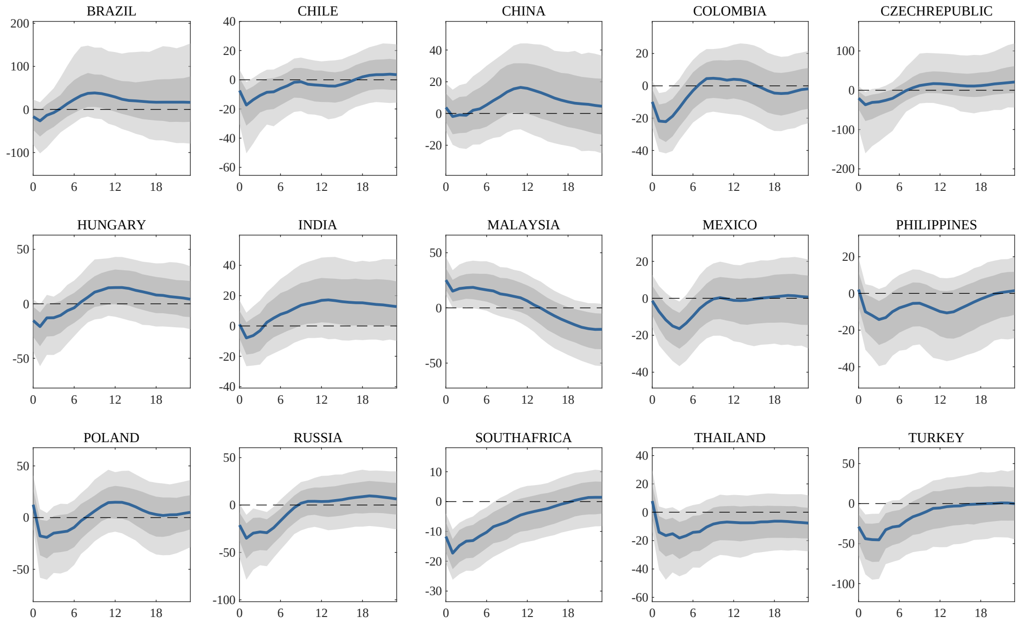
Note: Responses of trade volume in 15 advanced economies to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1 (in the main text). BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands.

Figure E.7: Emerging Markets, CPI



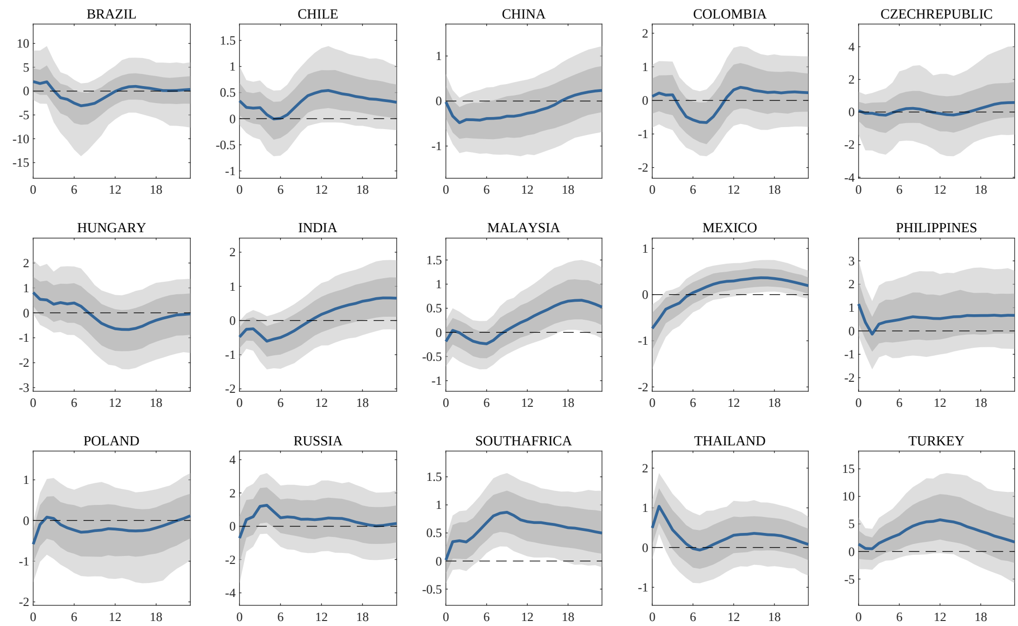
Note: Responses of CPI in 15 emerging economies to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1 (in the main text). BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands.

Figure E.8: Emerging Markets, Stock prices



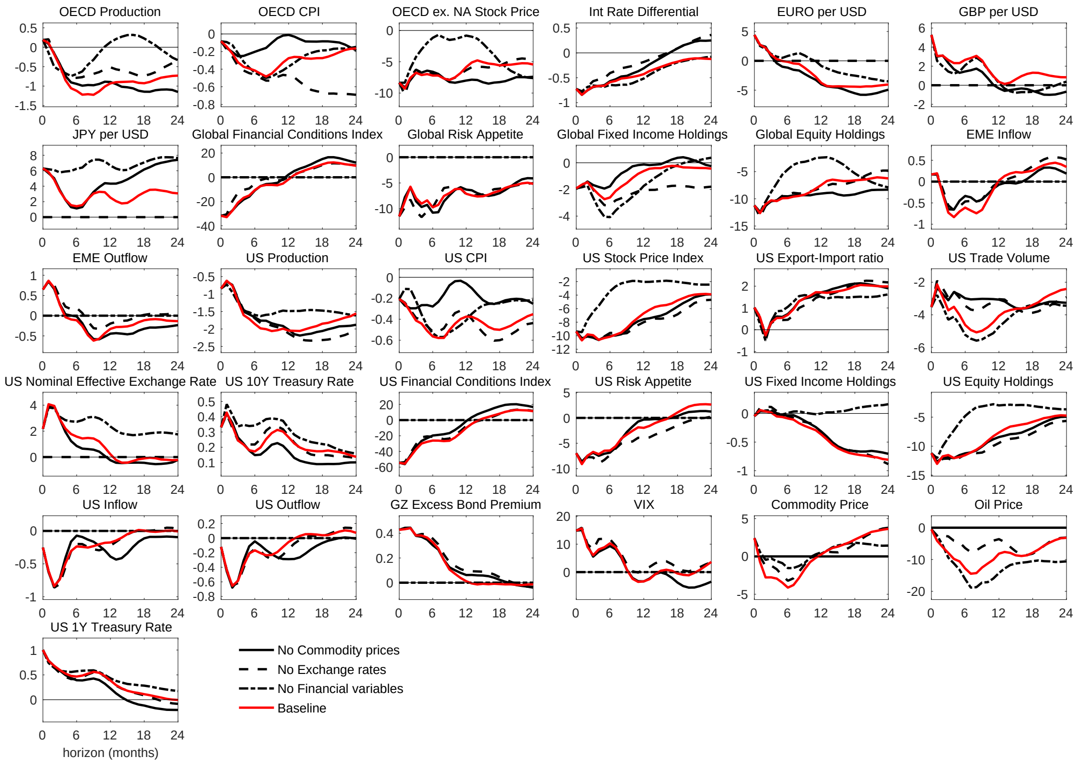
Note: Responses of stock price indices in 15 emerging economies to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1 (in the main text). BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands.

Figure E.9: Emerging Markets, Long-term rates



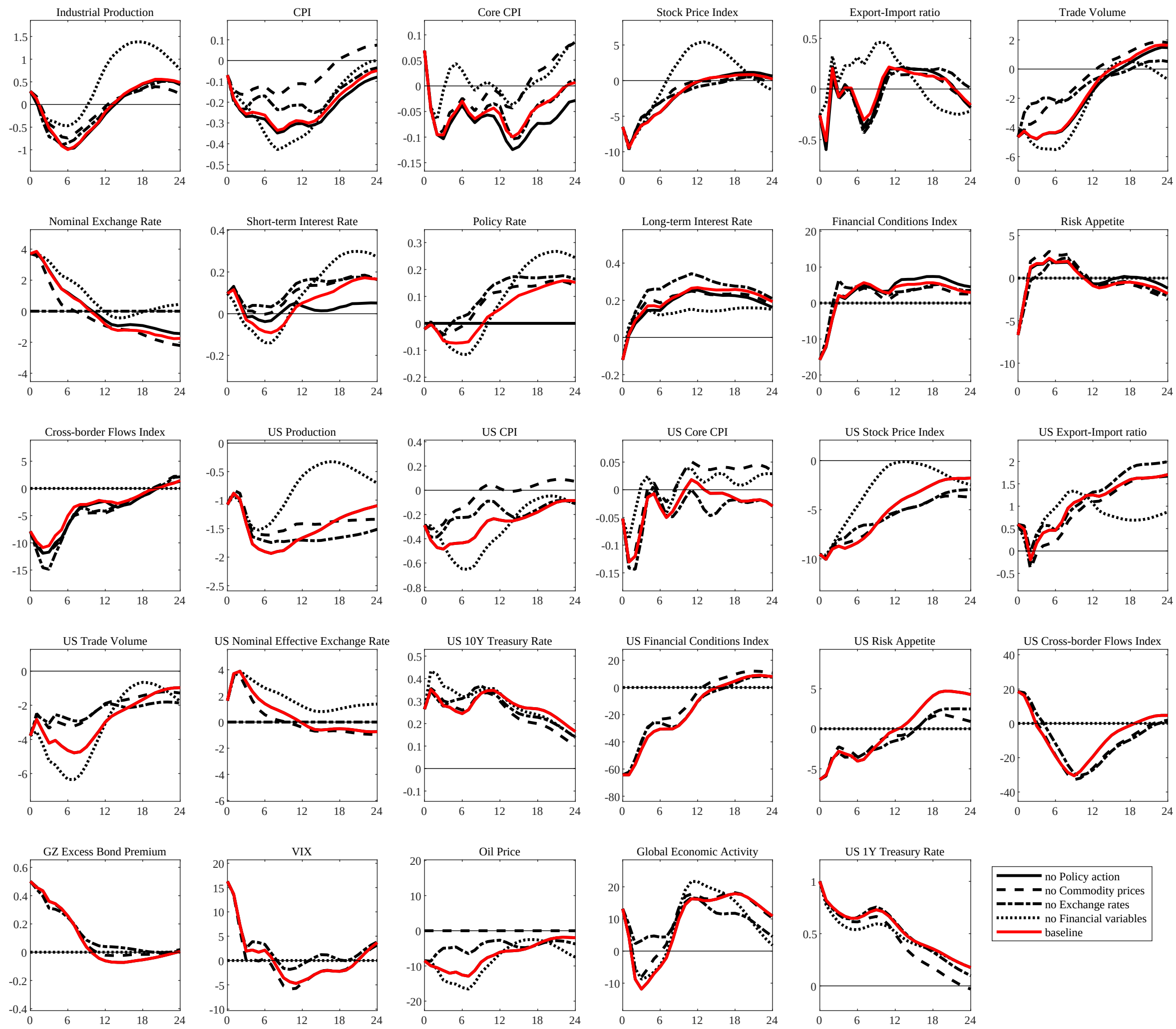
Note: Responses of long-term government bond yields in 15 emerging economies to a contractionary US monetary policy shock, normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1 (in the main text). BVAR(12) with asymmetric conjugate priors. Shaded areas are 68% and 90% posterior coverage bands.

Figure E.10: Channels of Transmission, Global Economy



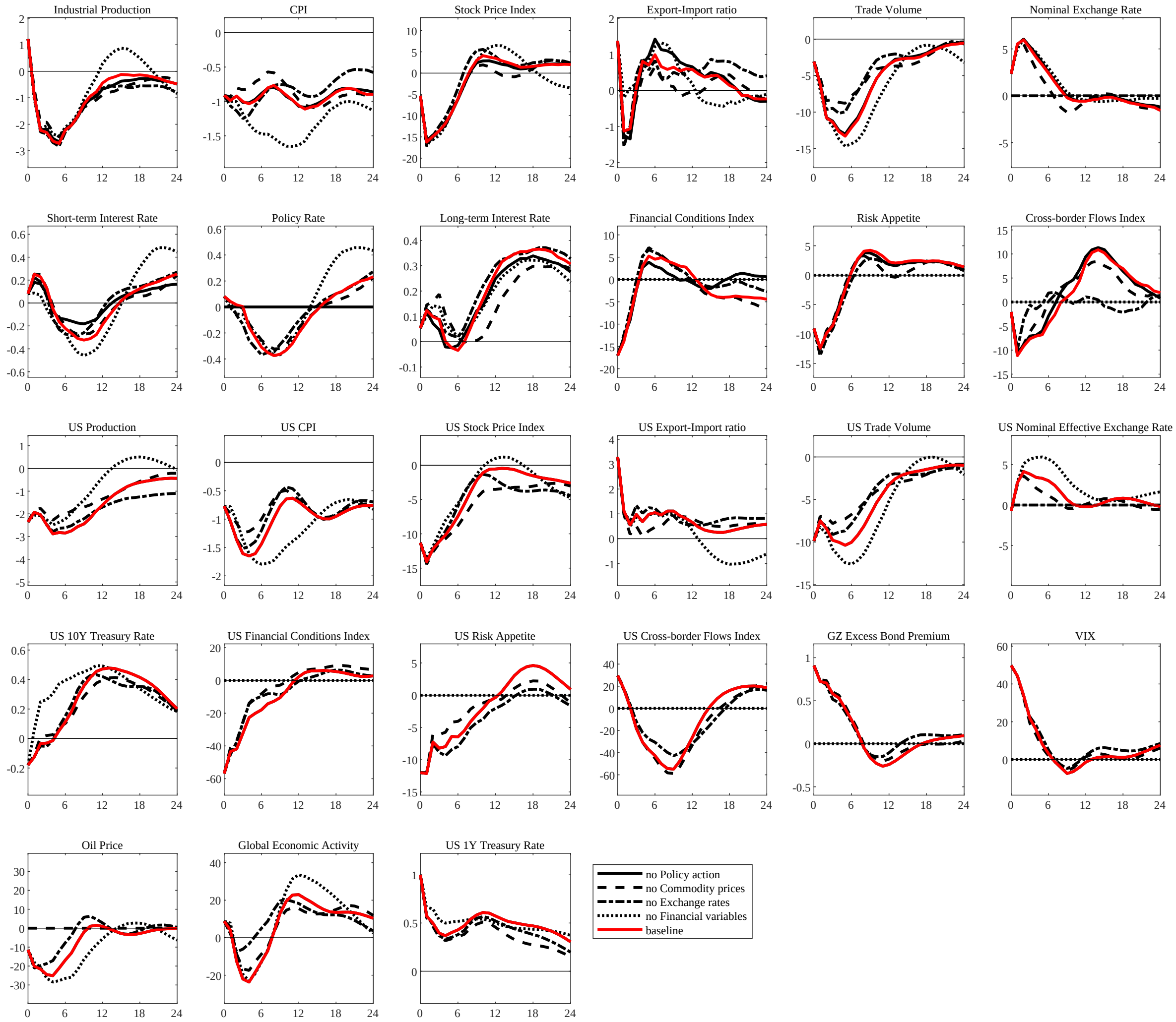
Note: Lines correspond to impulse responses obtained with the baseline specification (solid red); assuming the Brent crude and commodity prices do not react (solid black); assuming the nominal exchange rates do not react (dashed black); finally, assuming financial conditions, risk appetite cross-border flows, the excess bond premium, and VIX do not react (dash-dotted black). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample 1990:01 - 2018:09. BVAR(12) with asymmetric conjugate priors.

Figure E.11: Channels of Transmission, Advanced Economies



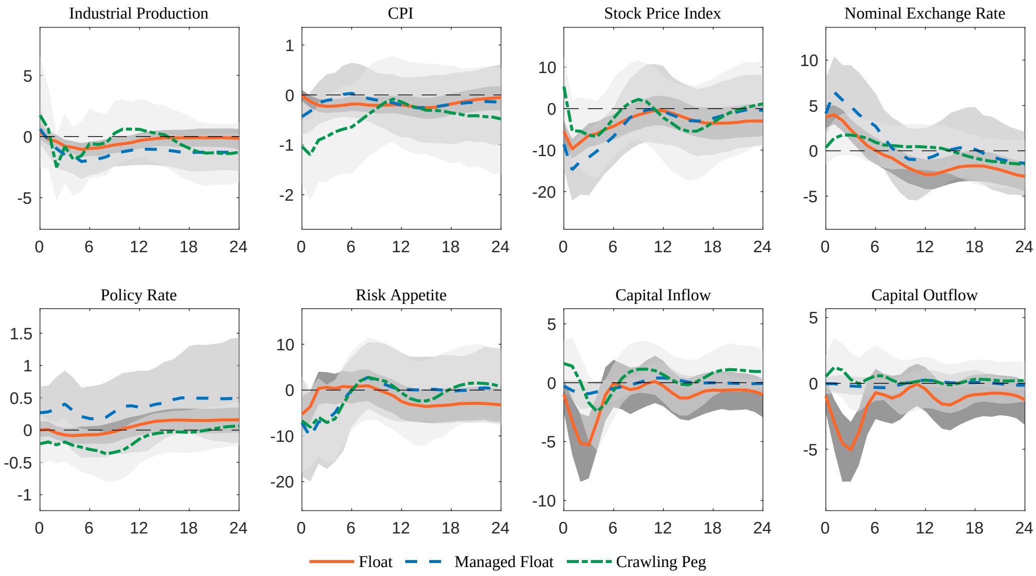
Note: Lines correspond to impulse responses obtained with the baseline specification (solid red); assuming the policy rate does not react (solid black); the Brent crude and commodity prices do not react (dashed black); exchange rates do not react (dashed-dotted black); financial conditions, risk appetite, cross-border flows, the excess bond premium, and VIX do not react (dotted black). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1 (in the main text). BVAR(12) with asymmetric conjugate priors.

Figure E.12: Channels of Transmission, Emerging Markets



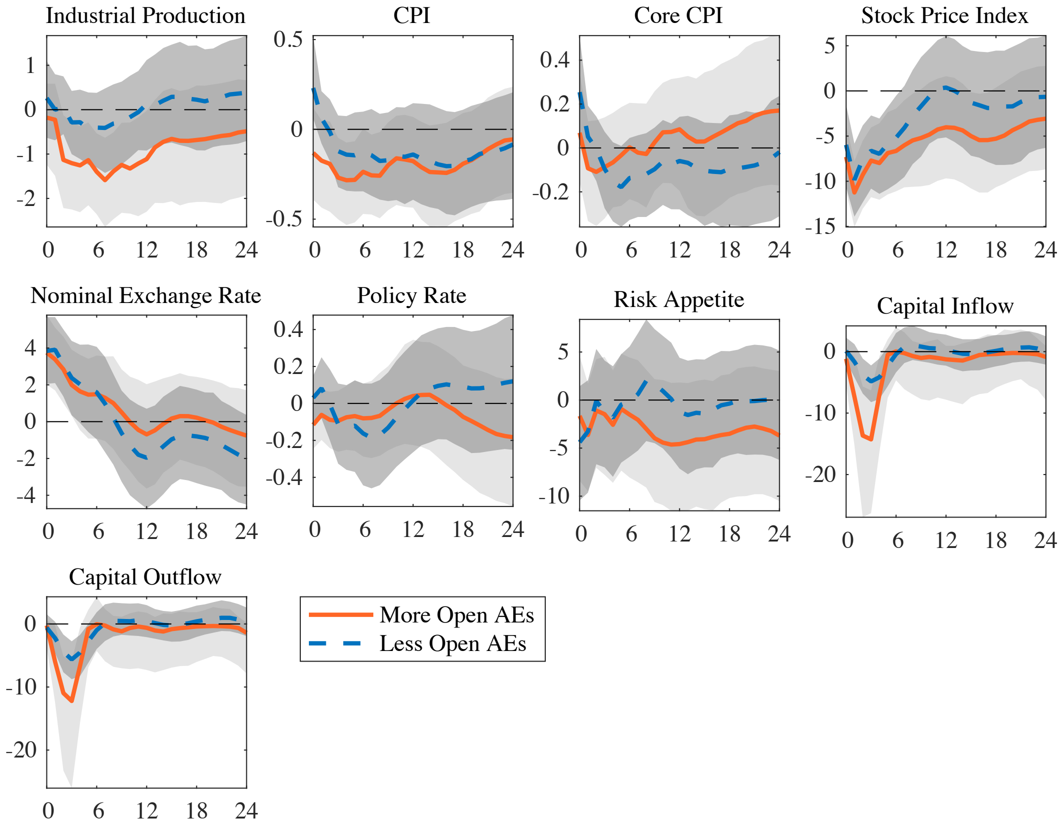
Note: Lines correspond to impulse responses obtained with the baseline specification (solid red); assuming the policy rate does not react (solid black); the Brent crude and commodity prices do not react (dashed black); exchange rates do not react (dashed-dotted black); financial conditions, risk appetite, cross-border flows, the excess bond premium, and VIX do not react (dotted black). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1 (in the main text). BVAR(12) with asymmetric conjugate priors.

Figure E.13: Exchange Rate Regimes, Inflows and Outflows



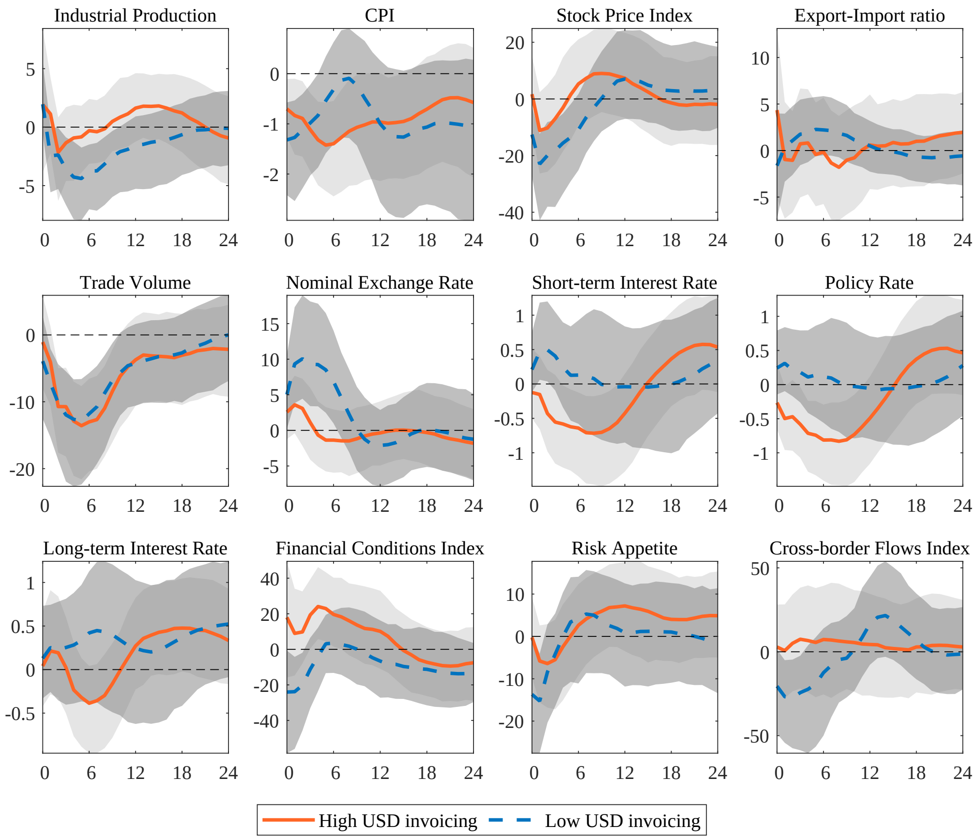
Note: Orange line – median responses of 17 floaters (15 advanced economies except Canada, plus Czech Republic, Hungary, and Poland); Dotted blue line – median responses of 7 managed floaters (Brazil, Canada, Chile, Colombia, Mexico, South Africa, and Turkey); Green dash-dotted line – median responses of 6 crawling peggers (China, India, Malaysia, Philippines, Russia, and Thailand). Data on exchange rate regimes are from Ilzetzki et al. (2019). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

Figure E.14: AEs by Openness to Capital, Inflows and Outflows



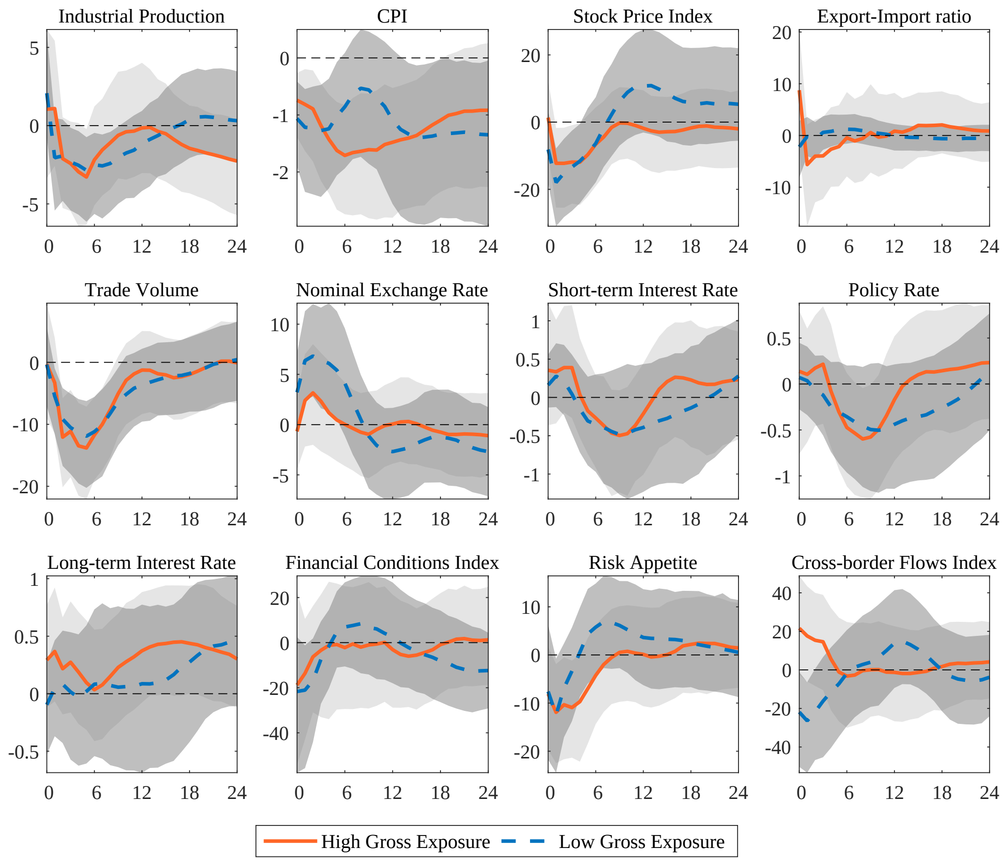
Note: Orange line – median responses of 5 AEs (Canada, Denmark, Germany, Netherlands, and UK), whose overall degree of capital openness corresponds to the bottom 1/3 among 15 advanced economies. Dotted blue line – median responses of 6 AEs (Australia, France, Italy, Norway, Spain, and Sweden), whose overall degree of capital openness corresponds to the top 1/3. Data on capital flow management are from Chinn and Ito (2006). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

Figure E.15: EMs by USD Trade Invoicing



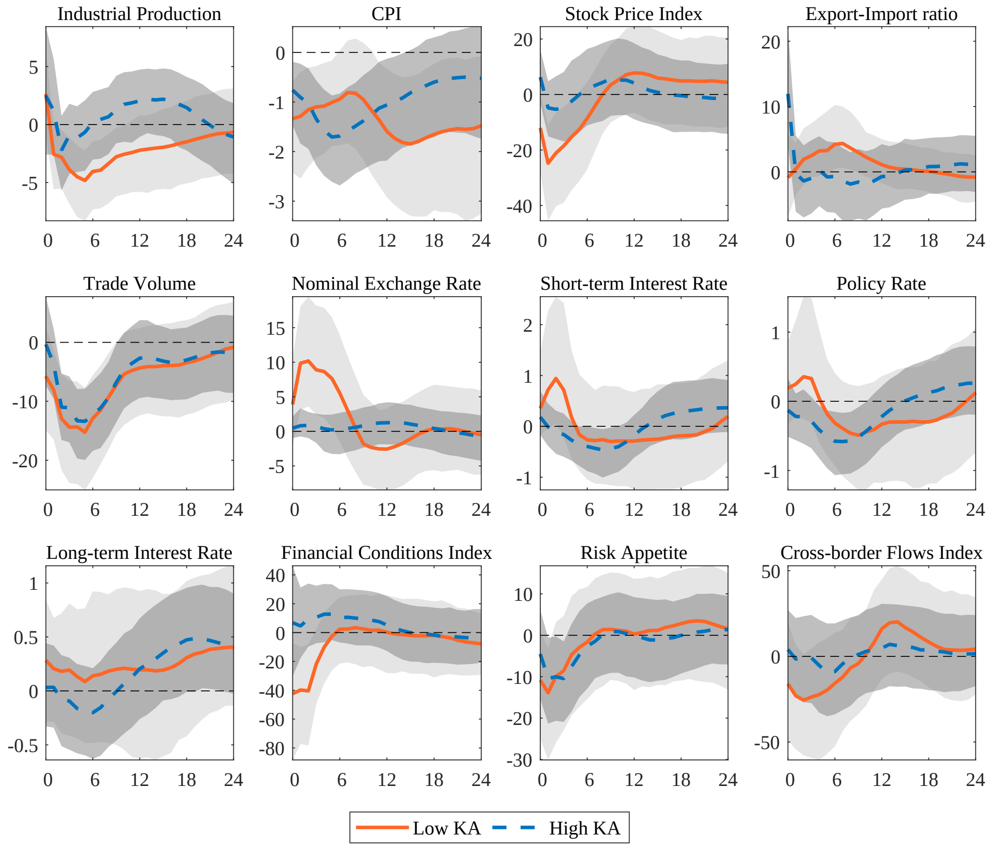
Note: Solid orange line – median responses of 5 emerging economies (Brazil, Colombia, Thailand, India, and Malaysia), whose USD trade invoicing both in terms of exports and imports corresponds to the top 1/3 among 15 EMs. Dashed blue line – median responses of 5 emerging economies (Czech Republic, Hungary, Poland, Turkey and South Africa), whose USD trade invoicing both in terms of exports and imports corresponds to the bottom 1/3. Data on trade invoice in USD are from Gopinath (2015). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

FIGURE E.16: EMs BY GROSS USD EXPOSURE



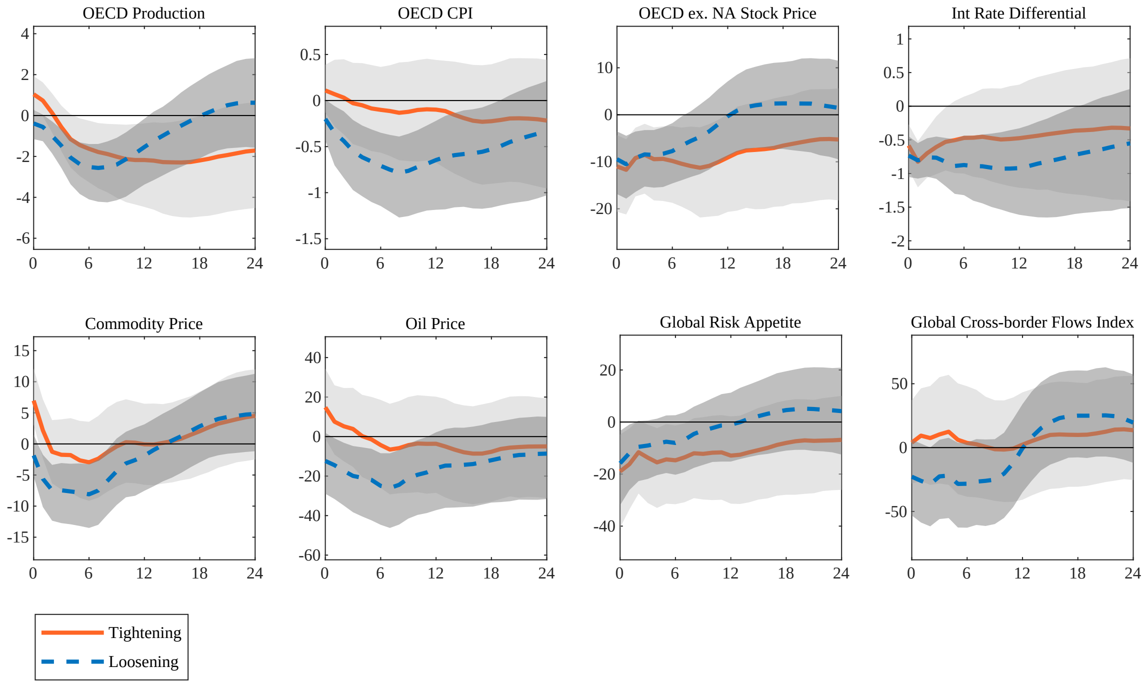
Note: Solid orange line – median responses of 5 emerging economies (Chile, Malaysia, Philippines, Russia, and Thailand), whose gross USD exposure corresponds to the top 1/3 among 15 EMs. Dashed blue line – median responses of 5 emerging economies (Czech Republic, Hungary, India, Poland, and South Africa), whose gross USD exposure corresponds to the bottom 1/3. Data on gross USD exposure are from Bénétrix et al. (2015). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

Figure E.17: EMs by Openness to Capital, Fernández et al. (2016)



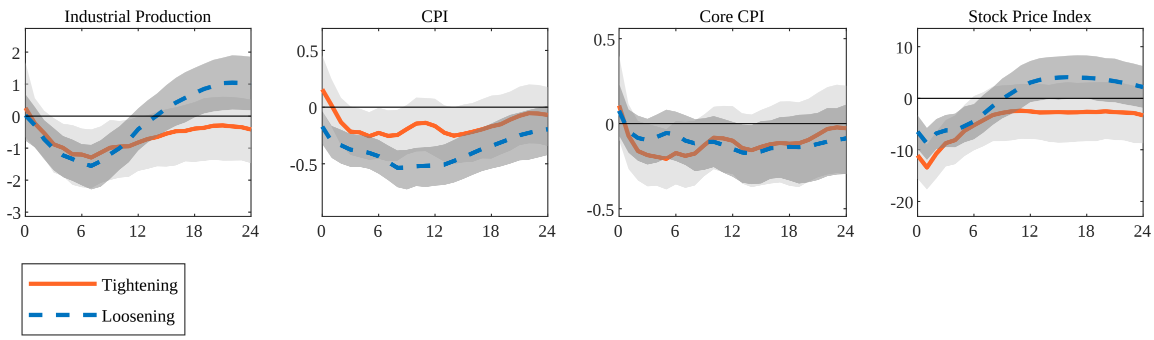
Note: Solid orange line – median responses of 5 emerging economies (Chile, Czech Republic, Hungary, Poland, and Turkey), whose overall degree of capital openness corresponds to the bottom 1/3 among 15 EMs. Dashed blue line – median responses of 5 emerging economies (China, India, Malaysia, Philippines, and Thailand), whose overall degree of capital openness corresponds to the top 1/3. Data on degree of capital openness are from Fernández et al. (2016). The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

Figure E.18: Asymmetric shocks, Global Economy



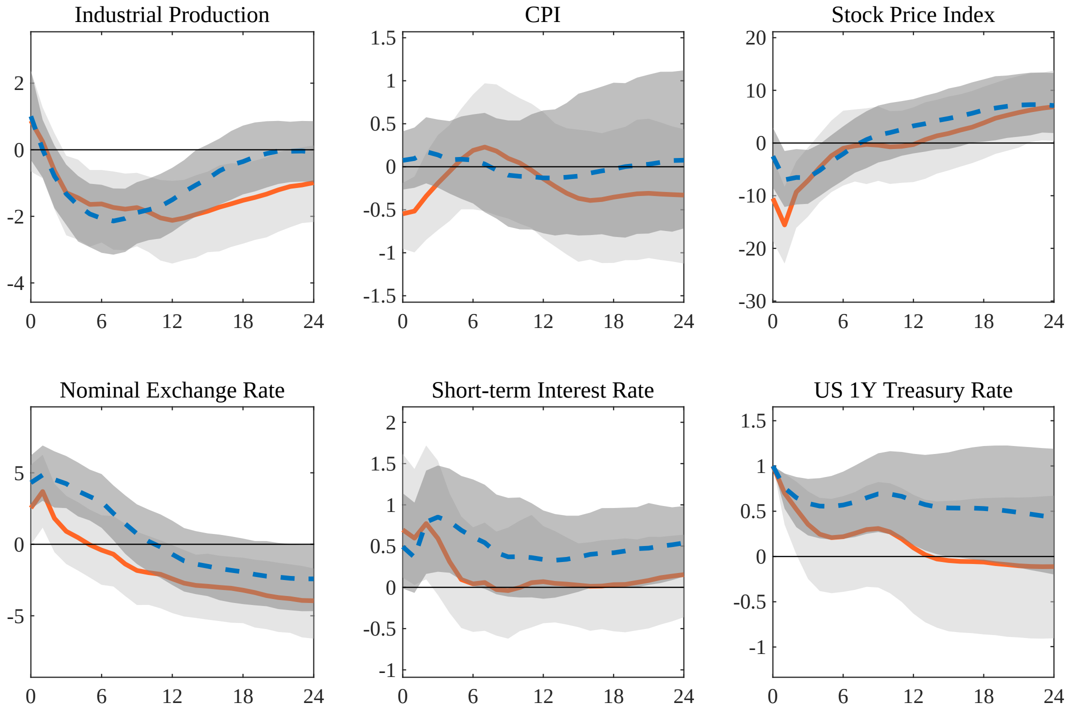
Note: Solid orange line – selected global responses to a contractionary US monetary policy shock. Dashed blue line – selected global responses to an expansionary US monetary policy shock. The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample 1990:01 – 2018:09. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands. These responses and the responses in Figure **??** are estimates jointly in the same US-Global bilateral system.

Figure E.19: Asymmetric shocks, Advanced Economies



Note: Solid orange line – selected median responses of 15 advanced economies to a contractionary US monetary policy shock. Dashed blue line – selected median responses of 15 advanced economies to an expansionary US monetary policy shock. The shock is normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table 1 (in the main text). BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

Figure E.20: Asymmetric shocks, Emerging Markets



Note: Orange line – median responses of 13 emerging economies to a contractionary US monetary policy shock. Dashed blue line – median responses of 13 emerging economies to an expansionary US monetary policy shock. Shocks are normalised to induce a 100bp increase in the US 1-year treasury constant maturity rate. Informationally robust HFI. Sample reported in Table D.14. BVAR(12) with asymmetric conjugate priors. Shaded areas are 90% posterior coverage bands.

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