If the Fed sneezes, who catches a cold?

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Abstract

We look at the global effects of US monetary policy shocks using a two stage approach. We first estimate a large Bayesian VAR and identify US monetary policy shocks using sign restrictions, and then analyse their effects on a number of real and financial variables in countries other than the US. We find that a surprise US monetary tightening leads to a dollar appreciation vis-á-vis most countries in our sample. Moreover, in most countries industrial production and real GDP fall, unemployment rises, and inflation declines. We find significant heterogeneity across countries, and emerging economies tend to experience larger effects. At the same time, we do not find any systematic relation between the country responses and the most likely relevant country characteristics, such as income level, exchange rate regime, financial openness, trade openness vs. the US, and dollar exposure.

Keywords: monetary policy shocks, international transmission, exchange rate regime, capital mobility.

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1 Introduction

This paper offers a re-examination of the international transmission of U.S. monetary policy shocks. Does a monetary contraction in the U.S. lead to recessions or booms in other countries? Does a monetary contraction improve or worsen financial conditions in these countries? Does it lead to capital inflows or outflows? Are these effects different across advanced and emerging economies, or across countries pegging their exchange rate to the dollar and those retaining monetary autonomy? These questions have long been studied and discussed, but empirical answers remain controversial, as recently argued by the former chairman of the Federal Reserve (Bernanke (2015)). A source of this lack of consensus is that most studies have tended to focus either on a limited set of countries (e.g. G7 countries, as in Kim (2001)) or on a limited set of variables (e.g. industrial production, inflation, short-term rates and the exchange rate as in Miniane and Rogers (2008)). In turn, the heterogeneity in the scope of the investigations has made comparability of spillovers from different estimates difficult.

In this paper we contribute to this debate by documenting the effects of US monetary policy shocks on a broad set of macroeconomic and financial variables in 18 advanced and 18 emerging economies. We expand on previous work mainly in two dimensions. First, we identify US monetary policy shocks in a way that is different from previous literature and allows to model the effects of these shocks on a range of interest rates and asset prices. Second, and most importantly, we expand the list of the variables in countries other than the US, in particular financial variables such as credit and asset prices, in order to better understand the international transmission of monetary policy. Indeed, unlike previous studies we include variables ranging from industrial production, real GDP and unemployment, to consumer and asset prices, from interest rates to domestic credit and portfolio and bank capital flows. This allows us to better document the trade-offs in terms of macroeconomic and financial stability for other countries brought about by a US monetary policy shock.

Our main findings are the following. First, we find that a surprise US monetary tightening leads to a dollar appreciation vis-á-vis most countries in our sample. In a large majority of countries industrial production and real GDP fall, and unemployment rises; however, the trade balance improves. Inflation (GDP deflator and CPI) also tends to fall in a majority of countries, although the effects are less statistically significant. Emerging economies experience more volatile macroeconomic effects. At the same time, and this our second finding, the responses of financial variables are less clear cut and quite heterogeneous across countries. While many countries see their bond yields increase relative to the US, real equity and housing prices drop in about half the countries. Likewise, many countries experience opposite effects on real credit and capital flows, including borrowing from foreign banks. Finally, we do not find any of systematic relations between the most likely country characteristics (income level, exchange rate regime, financial openness, trade openness vs. the US, and dollar exposure) and the distribution of cross-country responses to US monetary policy shocks. While a dollar peg at least seems to mute the responses of the nominal and real exchange rate, asset prices and capital flows do not seem to react differently between more and less financially open countries.[1]

We proceed in two steps. First, we obtain estimates of US monetary policy shocks in a structural VAR identified with sign restrictions consistent with recent results in the literature on the effects of these shocks. We then regress third country variables on these shocks. We are effectively asking the question: What are the consequences on the rest of world of a US monetary policy shock, conditional on this shock having the assumed effects on the US economy? Thus, we take for granted that these shocks have "textbook" effects on the US economy, such as that a tightening should reduce economic activity, and operationally rely on the literature to spell them out in detail.[2]

In particular, in our first step we impose sign restrictions derived from the impulse responses estimated by Gertler and Karadi (2015). There are two key advantages in building on their results. First, they estimate the responses to a monetary policy shock of several asset prices and interest rate spreads, eschewing any contemporaneous exclusion restrictions, which would require taking a stand on the systematic reaction of monetary policy to movements in asset prices. This is an attractive feature for us, given our focus on the propagation of US monetary policy to international asset prices and interest rates. Second, their identification and results are robust to the presence of the lower bound on short-term interest rates in the aftermath of the Great Recession. This is so as their

[1] A caveat is that the spillovers from US monetary policy shocks are much less precisely estimated if we end our sample in the half of 2008.

[2] Thus a more precise title of the paper would be: "If the Fed makes the US sneeze, who catches the cold?"

monetary policy shocks include also new information (forward guidance) on both current and future interest rate policy. As we explain in more detail below, this means that by deriving our restrictions from their impulse responses we can also hope to make our results robust over a period that includes the global financial crisis. However, to sharpen our identification, we also require that shocks also satisfy two further restrictions.[3] First, we impose that on impact the US effective nominal exchange rate appreciates following a US tightening. Second, that an aggregate of short-term rates in other major currencies react less than one-to-one to US rates. This ensures that we focus on those US monetary policy shocks which are not too positively correlated with any monetary policy shocks in other major countries. This is especially crucial in the aftermath of the recent financial crisis, when short-term rates in most advanced economies have been close to their lower bound, and more or less contemporaneously very expansionary conventional (and unconventional) monetary policies have been deployed. We find that under our identification assumptions, estimated impulse responses in the VAR are indeed robust to the inclusion of the 5 years from January 2009 to December 2013.[4]

In our second step, armed with the (distribution of) estimated monetary policy shocks from the posterior of our Bayesian VAR, we turn to the estimation of their effects on our sample of countries. Similarly to other papers such as Romer and Romer (2004), we regress a host of variables for each country both at monthly and quarterly frequency on the estimated shocks. We then aggregate these estimates across countries on the basis of several structural characteristics. These aggregations are obtained by taking simple averages across countries.[5] We aggregate countries on the basis of the following characteristics: a) income levels — advanced and emerging economies; b) exchange rate regime — floaters and dollar pegs according to the de facto classification in Klein and Shambaugh (2010); c) financial openness according to the de facto classification in Chinn and Ito (2006); d) financial dollar exposure based on the currency composition of gross

[3] Mainly for this reason we do not use the shocks by Gertler and Karadi (2014) directly.

[4] In particular, the effects of US monetary policy shocks, particularly on exchange rates, global (aggregates of) output and stock prices, are broadly similar, independently of the inclusion of these last 5 years of data. As we show below, this is not the case when we do not include the interest rate differential in our VAR.

[5] This is consistent with the Pesaran-Smith Mean Group Estimator in heterogeneous panels. In some cases, detailed below and especially in the data appendix, we omit countries with extremely large responses, e.g. Brazil in the case of short-term interest rates and inflation, because of hyperinflationary episodes included in our sample.

assets and liabilities in Benetrix et al. (2015). Therefore, similar to Klein and Shambaugh (2010), we look at the role of receiving countries' structural characteristics and choice of policy regime in influencing the degree to which US monetary policy may impose (positive or negative) externalities abroad.[6]

Of course, our work is quite closely related to previous contributions in the literature on the transmission of U.S. monetary policy shocks. A large body of evidence has shown that in the post-Bretton Woods period interest rates are more closely linked in countries that peg and in countries with open capital markets compared with countries that do not peg or impose capital restrictions.[7] Shambaugh (2004) finds that pegs follow base country interest rates more than nonpegs, even when controlling for financial openness. Di Giovanni and Shambaugh (2008) look at the effect of foreign interest rates on domestic growth in a large group of countries, finding that the effect is stronger in countries with fixed exchange rate regimes, mainly on account of the stronger impact of foreign interest rates on domestic interest rates. Among VAR studies, Canova (2005) and Mackowiak (2007) also use sign restrictions to study the effects of US monetary policy on some emerging economies. Canova (2005) finds that among Latin American countries, floaters and pegs display similar output but different inflation and interest rate responses. Mackowiak (2007) finds that output and the price level respond by more than their US counterparts, with the price level increasing after a US tightening. Miniane and Rogers (2007) look at whether capital controls insulate countries from US monetary shocks, in particular whether interest rates and exchange rates are less affected, finding no evidence that capital controls are effective. More in line with our results, they find that the exchange rate regime does not matter much for the macroeconomic transmission of US shocks, with countries having a fixed exchange rate regime being similarly affected in terms of output and inflation as floaters. Georgiadis (2015) shows, among other findings, that a floating exchange rate reduces the output spill-over from US monetary policy shocks (the more

[6]We assume that a country belongs to a given group over the whole sample for which these characteristics are computed. However, to the extent that countries characteristics have not been very stable in our sample, this approach can bias our results toward finding less stark differences across countries groupings.

[7]See e.g. Klein and Shambaugh (2010). However, Rose (2011) finds that the macroeconomic and financial consequences of exchange rate regime choices are surprisingly inconsequential. Business cycles, capital flows, and other phenomena for peggers have been similar to those for inflation targeters during the Global Financial Crisis and its aftermath.

so, the more trade and financially open the receiving countries). Most if not all of these papers do not consider, however, the potential financial dimension of spillovers, as we do in this paper. Recently Rey (2013) has shown that capital flows and stock prices in most countries, regardless of their dollar exchange rate regime, display strong comovements with the global cycle. The latter in turn is affected by US monetary policy.[8] Monetary autonomy from the US is either not granted by a float or not sufficiently used. In this view, the real choice confronting many countries is therefore a dilemma, rather than a trilemma, between monetary policy autonomy and capital controls.[9]

The paper is organized as follows. We describe the empirical approach in Section 2, and present the data in Section 3. The baseline results for all countries and for the subgroups are in Section 4. Section 5 concludes.

2 Empirical approach

We proceed in two steps. First, we estimate US monetary policy shocks using a large Bayesian VAR including several monthly US and global variables. We identify these shocks imposing sign restrictions based on the findings in the empirical literature on the effects of monetary policy shocks, in particular Gertler and Karadi (2015) — henceforth GK. Second, following the literature (e.g. Romer and Romer (2004)), we obtain impulse responses by estimating, for each realization of the series of shocks, simple autoregressive models for each variable in each country, including also contemporaneous and lagged values of the shocks. We then aggregate the resulting impulse responses across countries according to the latter characteristics. A way to view our approach is the following. Conditional on recovering US monetary policy shocks that have empirically plausible "textbook" domestic effects, we want to investigate the consequences of these shocks for the rest of world. Thus, we take for granted that these shocks have domestic effects on

[8]Agrippino-Miranda and Rey (2014) provide further evidence along the same lines. Using a large Bayesian VAR Agrippino and Rey identify a global factor explaining the variance of a large cross section of returns on risky assets. They also show that US monetary policy is a driver of this global factor. In this paper we go beyond asset returns by also documenting the effects of US monetary policy shocks on a broad range of macroeconomic and financial variables in a host of countries.

[9]Ostry and Ghosh (2014) point out that there may be a need for policy coordination if US monetary policy creates trade-offs for the receiving countries that they cannot (costlessly) undo with their own macroeconomic policy. Nevertheless, Woodford (2007) shows that globalisation does not, in general, imply a loss of monetary control in a model with frictionless international asset markets.

the US economy, such as that an interest rate hike (cut) should reduce (boost) economic activity and at some point also inflation. We rely on the empirical literature to spell these effects out in an empirically plausible way in our priors, so that we can estimate the underlying monetary policy shocks.

2.1 The BVAR Model

The empirical model used to estimate US monetary policy shocks is a BVAR with 13 variables. We need to include many US and global variables for two reasons. First, we want to identify the monetary policy shocks by imposing sign restrictions in the spirit of the findings in the VAR literature, particularly GK, for as many of their variables as possible. This implies that we need to include several relevant interest rates and spreads in our VAR for which these authors find an effect of monetary policy. Second, given the open-economy focus of our study, in addition to including the US nominal effective exchange rate, we also need to control for global drivers of economic and financial fluctuations, especially in the case of countries other than the USA. This is key to assume that estimated shocks are exogenous also to developments in countries other that the US. Therefore, we include in the VAR global aggregates of stock prices, output and commodity prices, as well as an aggregate of short-term interest rates of major currencies floating against the US dollar.

Large Bayesian VARs have been introduced by Banbura, Giannone and Reichlin (2010) as a tool to handle systems of many variables avoiding the issue of over-fitting, building on the seminal contributions by Litterman (1986) and Sims and Zha (1998). This is possible through the application of Bayesian shrinkage which amounts at increasing the tightness of the priors as more variables are added. The rationale behind this approach is that by using informative priors it is possible to shrink the likely over-parametrized VAR model towards a more parsimonious model represented by the prior distributions. Therefore, the choice of the informativeness of the priors is crucial. In this work we follow the approach of Giannone, Lenza and Primiceri (2015), i.e. the appropriate degree of shrinkage is automatically selected treating hyper-parameters as any other unknown parameter and producing inference on them.

More in detail, the reduced form VAR model for n variables,

$$Y_t = BY_{t-1} + \varepsilon_t, \varepsilon_t \sim N(0, \Sigma)$$

is conceived as a hierarchical model, where hyper-parameters are assigned diffuse hyper-priors so that maximizing their posterior simply amounts at maximizing the marginal likelihood with respect to them. As regards priors, a Normal - Inverse-Wishart distribution is used for the coefficients and the variance-covariance matrix, namely

$$\begin{aligned} \Sigma &\sim IW\left(\psi I_n; n+2\right) \\ vec\left(B\right) &\mid \Sigma \sim N\left(b, \Sigma \otimes \Omega, \right) \end{aligned}$$

where $b\left(\gamma\right)$ and $\Omega\left(\gamma\right)$ are functions of a small vector of hyper-parameters γ; the scale parameter $\psi \sim IG\left(0.02^2, 0.02^2\right)$ is also a hyper-parameter with a very diffuse prior and mode roughly at 0.02^2. Bayesian shrinkage is achieved through the combination of Minnesota, sum-of-coefficients and dummy-initial-observation priors for the VAR coefficients. The Minnesota prior assumes that the limiting form of each VAR equation is a random walk with drift. The sum-of-coefficients prior and the dummy-initial-observation prior are necessary to account for unit root and cointegration. Because the posterior does not admit analytical characterization, even under gaussianity of the likelihood function, an MCMC algorithm is used for inference, based on a Metropolis step to draw the vector of hyper-parameters and on a standard Gibbs sampler to draw the model's parameters conditional on the former. From the conditional posterior distribution we extract 20000 draws, of which the first 10000 are discarded and the last 10000 are used for inference on monetary policy shocks. Further details on the prior specification and estimation procedure can be found in Giannone, Lenza, Primiceri (2015).

This framework allows to estimate the VAR in levels, with variables expressed in annualized terms. Specifically, our model consists of $n = 13$ monthly variables, both US-specific and international variables. The US economy is described by an industrial production index, the CPI, the Federal Funds rate, a 1-year government bond yield index, the S&P500 index, the nominal effective exchange rate against 20 trading partners[10], the corporate bond spread, the mortgage spread and the commercial paper spread. The last three variables are the same as in Gertler and Karadi (2015). The global variables consist of the CRB commodity price index, a world industrial production index (excluding construction) calculated by the OECD, a world stock prices index and the difference

[10] The nominal effective exchange rate is calculated against the following 20 trading partners: Australia, Belgium, Brazil, Canada, China, France, Germany, India, Ireland, Italy, Japan, Korea, Malaysia, Mexico, Netherlands, Singapore, Spain, Switzerland, Thailand, UK.

between the G-7 ex-US short-term interest rate and the US 3-month T-bill rate. The former rate is computed as an average of the short term rates of the four major currency areas (Canada, Euro Area, Japan, UK).[11] As variables are monthly and enter the VAR in levels, the model is estimated with $p = 13$ lags.

2.2 Identification

We find it convenient to impose priors to identify US monetary policy shocks through sign restrictions on the impulse response functions following the methods pioneered by Faust (1998), Uhlig (2005) and Canova and de Nicolo' (2002). We impose restrictions on the effects of US monetary policy consistent with those estimated by GK. These authors use external instruments, based on high-frequency financial data (see also e.g. Gurkaynak et al. (2005)), to identify monetary policy shocks, including the period over which US short-term interest rates have been at their lower bound.

There are two key advantages in their estimates that make them an appealing source of priors for our purposes. First, as they estimated the responses to a monetary policy shock of several US asset prices and spreads, this allows us to model the contemporaneous responses of these variables. This is an attractive feature for us, given our focus on the financial transmission through international asset prices, among other things.

Second, GK identify monetary policy shocks whose effects are reasonably robust to the presence of the lower bound on short-term interest rates. Thus, by drawing on their results we can also hope to identify similarly robust shocks, including over the period that encompasses the recent financial crisis. While we will look at results both including or excluding this most recent period after 2008, the latter could be important to identify the transmission of US monetary policy shocks. On the one hand, to the extent that the systematic reaction of monetary policy has been constrained by the lower bound on short-term rates, this has effectively resulted in a series of contractionary monetary shocks. This intuition is borne out by standard New Keynesian models in which systematic monetary policy follows a rule for the short-term interest rate and is constrained by the lower bound (see e.g. Eggertsson and Woodford (2003)). On the other hand, when the lower bound binds, the current level of the short-term rate may not be a good gauge of the stance of

[11] The 3-month T-bill rate is used for UK, the call money rate for Japan, the 3-month Euribor for the Euro area and a general T-bill rate for Canada as calculated by the IMF.

monetary policy by itself, if the central bank is able to credibly rely on forward guidance and thus still affect longer-dated interest rates. Neglecting this aspect may then result in an overestimation of the size of contractionary shocks over this period. However, our identification in this respect possesses a key safeguard as we require that a contractionary shock not only increases the short-term rate (relative to its normal level in line with macroeconomic conditions), but that also the 1-year rate and a series of interest rate spreads go up. Therefore, any lack of accommodation in short-term rates over the more recent period will be interpreted as a contractionary shock only if associated with increases in all these other longer-dated interest rates (and as we discuss below also with an increase in the US interest differential with other major currencies and dollar appreciation).

In principle, we could have used the same external instruments as in GK to identify US monetary policy shocks with our reduced form VAR residuals.[12] A first reason is that we obtain a longer series of monetary policy shocks as we impose our restrictions on the whole sample starting in 1980, rather than the shorter one for which their external instruments are available. There is consensus that US monetary policy has been relatively stable since the early 1980s. Moreover, while drawing from their results to model the effects of monetary policy on the US economy, we also want to focus on US monetary policy shocks which should not be too positively correlated with monetary policy shocks in other major countries. This is especially a concern in the aftermath of the recent financial crisis, when short-term interest rates in most advanced economies have been at their lower bound, as more or less contemporaneously very expansionary conventional (and unconventional) monetary policies have been deployed. The inclusion of this interest rate differential is also likely to make our results more robust to the risk of giving too much weight to contractionary shocks during the more recent period. This is similar to the argument above regarding other longer-dated interest rates. Any deviation of the US short-term rate over this period from its estimated systematic relation with the underlying state of the economy is going to be mapped into a discretionary lack of accommodation and thus a contractionary monetary policy shock only if associated with a higher interest rate than

[12] Indeed, we could use their instruments directly in IV estimates of regressions of third-countries variables on US interest rates. However, in this respect a source of concern are the results in Ramey (2015), showing that the GK instruments and shocks may be rather weak and lead to inconclusive results in a single equation setting, even when using US data. Indeed, we find that they result in an increase in US industrial production in a regression like (4).This is a further reason for us to seek potentially sharper instruments with our approach.

in the other major economies.

We thus recover shocks that, while informed by GK findings for many US variables, also satisfy, at least on impact, the following requirements. First, a measure of short term rates in other major currencies should react less than one-to-one to US rates; second, the US effective exchange rate appreciates.

In more details, we impose the following restrictions:

$$\begin{aligned}
FFR &> 0 \quad \text{for} \quad t = 1, \ldots, 6 \\
IP_{US} &< 0 \quad \text{for} \quad t = 2, \ldots, 6 \\
CPI_{US} &\leq 0 \quad \text{for} \quad t = 4 \\
1Y : GBY_{US} &> 0 \quad \text{for} \quad t = 1, \ldots, 4 \\
MS_{US} &> 0 \quad \text{for} \quad t = 2 \\
CPS_{US} &> 0 \quad \text{for} \quad t = 1, 2, 3 \\
SP_{US} &< 0 \quad \text{for} \quad t = 1 \\
NEER_{US} &> 0 \quad \text{for} \quad t = 1 \\
DiffIR &< 0 \quad \text{for} \quad t = 1
\end{aligned}$$

Here FFR is the Fed Funds rate, IP_{US} is the US industrial production, CPI_{US} is the US consumer price index, $1Y : GBY_{US}$ are 1-year government bond yields, MS_{US} is the mortgage spread, CPS_{US} is the commercial paper spread, SP_{US} is the S&P500 index, $NEER_{US}$ is the nominal effective exchange rate and $DiffIR$ is the difference between the global interest rate and the US short-term rate. The first six restrictions are broadly in line with the results in GK as reported in their Figures 2-8. However, a persistent contraction in industrial production is a fairly widespread finding in the literature on the effects of US monetary policy shocks. Similarly, we impose that inflation be negative after four months, striking a compromise between studies imposing a fall on impact (e.g. Uhlig 2005) and the evidence of a delayed response. We also impose that US stock prices fall on impact and the US effective nominal exchange rate appreciates, while $DiffIR < 0$. As discussed above, the last two restrictions in the table help in ensuring the identification of a US-specific monetary policy shock. The fall in the interest differential does not require interest rates in other major currencies to fall, but only that they increase by less than their US counterparts on impact. Observe that these assumptions are conservative for our purposes, as we are constraining interest rates in major currencies to increase by less than US rates and thus to be more accommodative, other things equal. This can then result in an attenuation of the effects of US monetary policy on the rest of the world.

Finally, the impulse response functions of the remaining four variables we include are left unrestricted. Namely, the US corporate bond spread, commodity prices, world industrial production, and world stock prices are free to react to the shock according to the data. These last three variables then will provide initial unrestricted evidence of the aggregate effects of US monetary policy shocks on the rest of the world.

The algorithm to estimate the posterior distribution of impulse response functions and of monetary policy shocks is standard. As discussed above, we obtain 10000 draws from the conditional posterior distributions of the reduced-form coefficients and variance-covariance matrix. For each draw, following the procedure in Uhlig (2005), 5000 random orthogonalizations of the variance-covariance matrix are evaluated, discarding those that do not satisfy the sign restrictions. The algorithm always finds at least one suitable orthogonalization for more than 99% of the draws from the conditional posterior distributions. This check implies that our restrictions do not implausibly constrain the reduced form VAR posterior.

We conclude this subsection by discussing the priors on impulse responses elicited by our procedure (readers not interested in these aspects can jump directly to the next section). Recently, Baumeister and Hamilton (2015) have argued that sign restrictions can unduly constrain impulse response posteriors, so it is important to have some sense of how much the latter differ from implicit priors. First, recall that any candidate contemporaneous response to the vector of structural shocks can be calculated as

$$H = PQ,$$

for P the Choleski factor of the variance matrix of the reduced form innovations, $\Sigma = PP'$, and Q an orthogonal matrix obtained from the following decomposition

$$X = QR,$$

where X is a matrix of independent $N(0,1)$. Since we are interested in recovering just one shock as in Uhlig (2005), say v_{jt}, where $\varepsilon_t = Hv_{jt}$, we can focus on the first column of Q which is simply the first column of X normalized to have unit length:

$$\begin{bmatrix} q_{11} \\ \vdots \\ q_{n1} \end{bmatrix} = \begin{bmatrix} \frac{x_{11}}{\sqrt{x_{11}^2+..+x_{n1}^2}} \\ \vdots \\ \frac{x_{n1}}{\sqrt{x_{11}^2+..+x_{n1}^2}} \end{bmatrix}.$$

Results in Section 3 of Baumeister and Hamilton (2015) show that the implicit prior on the impact effect of this shock on variable i, $h_{ij} = \partial y_{it}/\partial v_{jt} =$ is then given by:

$$p\left(h_{ij} \mid \Sigma\right) = \begin{cases} \frac{\Gamma(n/2)}{\Gamma((n-1)/2)\sqrt{\pi}} \frac{1}{\sqrt{\sigma_{ii}}} \left(1 - h_{ij}^2/\sigma_{ii}\right)^{\frac{n-3}{2}} & \text{if } h_{ij} \in \left[-\sqrt{\sigma_{ii}}, \sqrt{\sigma_{ii}}\right] \\ 0 & \text{otherwise} \end{cases}, \tag{1}$$

where σ_{ii} is the corresponding element of the diagonal of Σ. This distribution is symmetric around zero and for $n > 3$, puts most of its mass on values close to zero (its mode obtains for $h_{ij} = 0$), so it is more informative than a uniform, but actually it assigns less probability to large effects of the shock. Concretely, this implies that we can view our conditional prior that a monetary shock increases the short term interest rate on impact as given by

$$p\left(h_{FFR,MP} \geq 0 \mid \sigma_{FFR}\right) = \begin{cases} 2\frac{\Gamma(n/2)}{\Gamma((n-1)/2)\sqrt{\pi}} \frac{1}{\sqrt{\sigma_{FRR}}} \left(1 - h_{FFR,MP}^2/\sigma_{FFR}\right)^{\frac{n-3}{2}} & \text{if } h_{FFR,MP} \in (0, \sqrt{\sigma_{FFR}} \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

where this prior is just the truncated version of the unrestricted one. Therefore, it is more diffuse the larger the value of the variance of the VAR innovation to the FFR equation, σ_{FFR}. Recall that our prior on Σ is the same as in Giannone et al. (2015) — namely we assume $\Sigma|\psi \sim IW\left(\psi I_n; n+2\right), \psi \sim IG\left(0.02^2, 0.02^2\right)$. Despite having its mode roughly at $\psi = 0.02^2$, the latter Inverse Gamma is very diffuse, with first quartile $\psi \simeq 1500$. It follows that prior draws of σ_{FFR} conditional on ψ are in general very large. Thus, the marginal prior on the impact response of the FFR is very diffuse on the positive real line. As a result, to the extent that the posterior distribution of Σ is different from its prior and informative, the posterior for h_{ij} will be different as well, allowing to draw new information from the data and making the impulse response posterior informative.[13]

[13] Nevertheless, it is true that asymptotically when Σ converges to its (pseudo)-true value, the posterior will be proportional to this prior, as now σ_{ii} is fixed at its "population" value. In this sense, Baumeister and Hamilton (2015) show that the effects of this prior, similarly to all priors on impulse responses in under-identified VARs, do not vanish asymptotically.

What about the responses of other variables? In general, we can express the impact response of the $l-th$ variable (dropping now the shock subscript) as the inner product between the $l-th$ row of the Choleski matrix P and the vector q as follows:

$$h_l = \sum p_{li} q_{i1}.$$

Therefore, if all the off-diagonal elements of the $l-th$ row are zero, the implicit conditional prior will be the same as before,

$$p\left(h_l \mid \Sigma\right) = \begin{cases} \frac{\Gamma(n/2)}{\Gamma((n-1)/2)\sqrt{\pi}} \frac{1}{\sqrt{\sigma_{ll}}} \left(1 - h_l^2/\sigma_{ll}\right)^{\frac{n-3}{2}} & \text{if } h_l \in \left[-\sqrt{\sigma_{ll}}, \sqrt{\sigma_{ll}}\right] \\ 0 & \text{otherwise} \end{cases},$$

appropriately truncated to reflect any sign restriction. For instance, this is the prior conditional on the mean of the IW prior, given by $\sigma_{ll} = \psi$ (or at the mode $\psi/\left(2n+3\right)$) and $\sigma_{li} = 0$. The same considerations as before would apply in this case too, namely that the difference between the prior and the posterior is entirely driven by the posterior for σ_{ll}, if $\sigma_{li} \mid Y = 0$.

In the more general case with non-zero p_{li} elements, h_l would be equal to the sum of the dependent random variables q_{i1}. Thus, we cannot use the marginal distribution for q_{i1} in Baumeister and Hamilton (2015). However, these authors show that if we scale the response h_l with the response of the FFR, h_{FFR}, thus obtaining the elasticity to a unit monetary shock, we can easily compute the conditional distribution of this scaled impact response, h_l^*. Assuming without loss of generality that the FFR is ordered first in the VAR, we have that:

$$h_l^* = \sum_{i=1}^{n} \frac{p_{li}}{\sigma_{FFR}} \frac{q_{i1}}{q_{11}} = \frac{p_{l1}}{\sigma_{FFR}} + \sum_{i=2}^{n} \frac{\frac{p_{li}}{\sigma_{FFR}} x_{i1}}{x_{11}},$$

where the last term is just the ratio of independent normals with mean zero. This ratio is thus distributed as a Cauchy with median $\frac{p_{l1}}{\sigma_{FFR}}$ and scale parameter $\sqrt{\sum_{i=2}^{n}\left(\frac{p_{li}}{\sigma_{FFR}}\right)^2} > 0:$

$$p\left(h_l^* \mid \Sigma\right) = \frac{\sqrt{\sum_{i=2}^{n}\left(\frac{p_{li}}{\sigma_{FFR}}\right)^2}}{\pi\left[\sum_{i=2}^{n}\left(\frac{p_{li}}{\sigma_{FFR}}\right)^2 + \left(h_l^* - \frac{p_{l1}}{\sigma_{FFR}}\right)^2\right]}.$$

First, when h_l is unconstrained and can be either positive or negative, the posterior inference on the impulse response will depend on whether the posterior for $\frac{p_{l1}}{\sigma_{FRR}}$ is concentrated on positive or negative values. Second, when h_l obeys a sign restriction, this Cauchy distribution is again appropriately truncated. Therefore, it is important to keep in mind that a lot of the data-driven information in our estimated impulse responses will depend on the posterior distribution of the correlation of the reduced form residuals (as they determine the p_{li} elements). To sharpen understanding about our results, we will report the whole impact posteriors for our impulse responses, to contrast them with the implicit priors as captured by (1) and (2). Nevertheless, it is important to stress that the BVAR mainly serves the purpose of providing us with monetary policy shocks that have plausible US domestic effects and are reasonably exogenous to other countries, rather than providing new evidence on what these effects may be, in order to update our priors about the latter.

2.3 Estimation of the impact on countries other than the US

The above procedure, in addition to impulse response functions in the BVAR, allows us to obtain an estimate of the posterior distribution of our US monetary policy shocks. Armed with these shocks, for each variable y in country i, y_i, we compute a vector of impulse responses at horizon h

$$IRF_{y,i,h} = \frac{\partial y_{i,t+h}}{\partial \varepsilon^{MP}_{US,t}} \tag{3}$$

for all the countries in our sample other than the US. Following the literature (e.g. Romer and Romer (2004)), we obtain the impulse response coefficients by estimating, for a given realization of the series of shocks $\varepsilon^{MP}_{US,t}$, the following distributed lag model for each variable:

$$y_{it} = \alpha_{i,j} + \phi_i (L) y_{i,t-1} + \beta_i (L) \varepsilon^{MP}_{US,t} + \varepsilon_{it}, \tag{4}$$

where we also include monthly or quarterly dummies and a time trend. Variables are transformed as in the BVAR. Observe that $\varepsilon^{MP}_{US,t} = 1$ amounts to a one-standard deviation structural shock, as in the BVAR impulses responses.

We characterize uncertainty of our estimates by reporting their distributions over the realizations of the estimated shocks to take into account that $\varepsilon^{MP}_{US,t}$ are generated regressors. In particular, we assume that conditional on $y_{i,t-1}$ and a given realization of the series of monetary policy shocks $\varepsilon^{MP}_{US,t}$, the error term in (4) is Gaussian $N(0, \sigma^2)$. Together with a conjugate (Normal-IG) prior on the vector of coefficients $\Gamma = (\alpha_{i,j}, \phi_i, \beta_i)$ and on σ^2, this implies that the posterior for these coefficients is also a standard Normal-IG. Therefore, we can easily draw from it to simulate the posterior of the impulse responses, conditional on the given series of shocks. Repeating this procedure for a number of realized time series of the monetary shocks allows to simulate the posterior distribution of the impulse responses taking into account also uncertainty about the shocks.

In practice, we proceed as follows. We extract 10000 time series of the US monetary policy shocks, and for each of them 10 draws from the parameters conditional (Normal-IG) posterior.[14] We pick the prior hyper-parameters in the following way. First, similarly to the BVAR, we set $\sigma^2 \sim IG\left(\nu = 3, 0.02^2\right)$; the variance of the Normal prior is set to $\sigma^2 I$. We then set the mean $\overline{\Gamma}$ of the Normal prior on the coefficients of (4) equal to their OLS estimates which are obtained by using the time series of the cross-sectional median values of the estimated monetary policy shocks. As we document below (see *Figure 7*), this prior makes the BVAR posterior distribution of the impulse responses of US variables (such as industrial production, CPI, equity prices, the exchange rate and interest rates) similar to the posteriors computed for the same variables by using the above procedure based on (4). We view this as an important consistency property of our approach, as there is no guarantee that in a small sample like ours, impulse responses for the same variables obtained from the BVAR and from (4) would be similar.[15]

The flexibility of this approach represents a key advantage given our quite heterogenous panel of data. It allows us to consider variables at both monthly and quarterly frequency for each country i, as discussed in the next section, also using samples shorter than those for which we estimate our shocks. Moreover, in addition to yielding results country by country for each variable, it makes it convenient also to aggregate them across countries on the basis of several characteristics. These aggregations are obtained by taking simple averages across countries.[16] Note that we take averages across countries and we do not pool the data, due to significant heterogeneity in country results (which we document later on in Section 4.2), which could give rise to an aggregation bias. This approach is similar to the mean group estimators advocated by Pesaran and Smith (1995) in the

[14] Using 100 draws instead of 10 does not materially alter our results but greatly increases the computational time.

[15] See e.g. Kilian and Kim (2011).

[16] In some cases, detailed below and especially in the data appendix, we omit countries with extremely large responses, e.g. Brazil in the case of short-term interest rates and inflation, because of hyperinflationary episodes included in our sample.

presence of parameter heterogeneity in rich autoregressive models like ours.[17]

We aggregate countries on the basis of the following characteristics: a) income levels — advanced and emerging economies; b) exchange rate regime; c) financial and trade openness; d) dollar financial exposure, the details of which are described below in Section 3.

3 Data description

The tables in the appendix describe in detail all variables used in the empirical analysis. The Bayesian VAR model to identify US monetary policy shocks consists of 13 monthly variables which were discussed above. Table **??** lists all the variables used in the BVAR with their sources.

In order to study the international effects of US monetary policy, a large number of country-specific variables are regressed on the estimated monetary policy shocks and the impulse response functions are computed. Our sample consist of 36 countries, namely: Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, India, Italy, Japan, Korea, Latvia, Lithuania, Malaysia, Mexico, Netherlands, Norway, Philippines, Poland, Portugal, Russia, South Africa, Spain, Sweden, Thailand, Turkey and UK. We consider euro area countries individually for all variables but short term rates and bilateral US dollar exchange rates. These series refer only to euro area aggregates after 1999 (or the date of euro adoption).

For each country we consider both monthly and quarterly variables. *Monthly variables* include: (i) the bilateral dollar exchange rate;[18] (ii) the real effective exchange rate; (iii) the short-term interest rate differential with the US; (iv) CPI; (v) industrial production; (vi) real stock prices (deflated with the CPI); the nominal trade balance (scaled by the average of the sum of import and export over the whole sample); (viii) the differential of

[17] A further reason preventing us to use panel techniques relates to computational difficulties inherent in our Bayesian approach to deal with the randomness in shock estimates. Bayesian panel data analysis requires at least the use of Gibbs sampling (if not full MCMC) to simulate the posterior distribution conditional on a given monetary shock time series. But this is hardly feasible given the large number of draws we need to extract from the empirical distribution of our shocks.

[18] It is defined as the amount of local currency needed for 1$ so that an increase in the exchange rate represents an appreciation of the US dollar.

long-term government bond yields vis-á-vis the US. The short term rates are defined in Table ??.

Quarterly variables include: (i) real GDP; (ii) the GDP deflator; (iii) the unemployment rate; (iv) real housing prices (deflated by CPI); (v) real domestic credit (deflated by CPI); (vi)-(vii) total portfolio inflows and outflows, and (viii) total bank inflows, all scaled by GDP. Finally, as a gauge of macroeconomic volatility we also report results for the sum of the absolute changes in unemployment and inflation (as measured by the GDP deflator) — a "misery index". Details about the source of each series are provided in Tables ?? and ??.[19]

The series of monetary policy shocks extracted from the BVAR starts in February 1981 (as we use 13 lags in the model) so that the regressions can be estimated from that date on. When coming to quarterly regressions the monetary policy shocks are aggregated taking their quarterly average. Regressions can be estimated starting from Q2 1981. As not all variables are available over the whole sample, we are forced to run some the regressions over shorter samples. The sample available for each time series is displayed in Table ?? and ??.

Country characteristics

The second step of our analysis consists of aggregating the impulse response functions of single-country variables according to some country-specific characteristics. The main distinctions is between advanced and emerging economies, countries whose exchange rate is pegged or left free to float and finally financially open or less open countries. We mostly consider sample averages for each indicator unless otherwise specified. The values of the indicators are reported in Table 3a-b.

Advanced vs. emerging economy. The classification according to advanced or emerging country is consistent with the one contained in the IMF World Economic Outlook. In this case we refer to the latest classification and do not average over the sample.

Exchange rate regime. The choice of the exchange rate regime is not a straightforward one since there is more than one meaningful classification (see Rose 2011). We mainly draw

[19] The sources of the variables we use are: Datastream, Reuters, Haver Analytics, Eurostat, Oxford Economics, the Global Financial Data database (GFD), the International Financial Statistics (IFS), Balance of Payments Statistics and Direction of Trade Statistics of the IMF, the Main Economic Indicators database of the OECD, the Bank for International Settlements and the European Central Bank. Data about total credit to private sector come from the Banking Institution database of the IMF.

from the classification of Klein and Shambaugh (2010), who also have some information on the base country. Hence we use a dollar peg dummy if countries are pegged to the USD according to Klein and Shambaugh.

Financial openness. We measure financial openness with the Chinn-Ito index, which measures de iure financial openness.

Trade openness. We consider countries' trade openness vs. the United States (exports to and imports from the US as a share of domestic GDP).

Dollar exposure. This is computed on the basis of Benetrix et al. (2015) data on the currency composition of gross foreign assets and liabilities. In this version we focus on gross rather than net exposure, although the choice is not uncontroversial.

These classifications are then combined to derive sub-samples of countries with interesting common characteristics so that we also consider advanced floaters, emerging floaters, advanced open, emerging financially open and emerging less-financially open countries.

Finally, Tables **??** and **??** report the list of countries used in the respective aggregations. Unless differently specified (e.g. in the case of the exchange rate regime), countries are split in two different groups depending on whether the value of their indicators fall above or below the median value over the whole sample for which these characteristics are computed. This is in line with the approach in e.g. Miniane and Rogers (2007), in which point impulse response estimates are directly regressed on average characteristics such as the intensity of capital controls. However, to the extent that countries characteristics have not been very stable in our sample, this approach can bias our results toward finding less stark differences across countries groupings. Unfortunately, for many countries we simply don't have the degrees of freedom to consider time-varying characteristics in the individual regressions (4), as this would imply a proliferation of interactions of the regressors with a time-varying index for the different country characteristics. This approach would make more sense using panel techniques; however, as already explained above, panel techniques raise computational difficulties if we want to take into account the model uncertainty in our estimates of the US monetary policy shocks.[20]

[20] An alternative could be to use informative priors on the time variation, obviously at the risk of unduly constraining any posterior inference.

4 The domestic effects of US monetary policy shocks

We begin by presenting our results for a contractionary US monetary policy shock in the BVAR in *Figure 1* over the full sample period, until the end of 2013. As it is customary, the figure reports the 16th, 50th (median) and 84th percentiles of the point by point distribution of the estimated impulse responses (the dotted red lines) in response to a one-standard deviation structural shock, as well as the mean. It is clear from the figure that the typical shock is estimated to have larger and more persistent effects than we impose. The federal fund rate and the 1-year rate rise persistently, with the median effect peaking around 10 basis points. These responses are significant (i.e. the 16th percentile is above zero) for almost 12 months. This interest rate hike is associated with a shorter-lived widening in the mortgage spread, the commercial paper spread and the corporate bond spread, where only the latter's response (which we leave unrestricted) is not significant even on impact. As a result, the US price level, industrial production and stock prices drop significantly on impact and in later periods, with the effects dissipating after one year to 4 years. The trough effects are smaller for the CP (around -0.1%), and larger for stock prices (-1%); the peak decline in industrial production is around -0.25%.

Finally, most international variables respond as would be expected according to standard textbook predictions. The persistent fall in the interest differential closely mirrors the hike in US rates, and is thus consistent with interest rates in other major currencies barely responding to the shock, while the dollar effective exchange rate strongly appreciates, by around 0.5%. This appreciation however becomes insignificant after 6 months, as the 16th percentile returns below zero. Turning to the unconstrained variables, despite the dollar appreciation, industrial production and stock prices fall in the rest of the world, while the large median decrease in commodity prices is always bracketed between a positive 16th percentile and negative 68th percentile. The contraction in world industrial production and stock prices is similar in magnitude to that in their US counterparts, albeit somehow less persistent. These responses are consistent with a transmission involving strong complementarity between US and foreign manufacturing goods or a limited degree of exchange rate pass-through — see e.g. Corsetti, Dedola and Leduc (2010).

The impulse responses estimated excluding the most recent period after 2008 are broadly similar to those in Figure 1 A-B, qualitatively and in most cases quantitatively

— see *Figure 2*. The only notable exception concerns the response of the mortgage spread and the commercial paper spread, which is now much smaller than when the financial crisis period is included. Conversely, the corporate bond spread increases significantly.

How are these effects different from what is implied by our sign-restriction priors? To answer this question *Figure 3* reports the impact response posterior distribution estimated over the whole sample until 2013 (the red lines report the fitted empirical density). Recall from Section 2.1 that under the assumption that the reduced form residuals are uncorrelated (entailed by our prior mode over the matrix Σ), sign restrictions imply a prior on the impact responses of unconstrained variables given by (1), appropriately truncated when a positive (or negative) sign is assumed as in (2). A shape similar to this truncated prior, with a substantial share of its mass very close to zero, characterizes only the responses of US stock prices and the exchange rate, among the constrained variables. As the reduced form residuals of these variables are evidently not very correlated with those of other variables, the posterior is basically proportional to the prior. Conversely, the other constrained (such as the FFR and the 1 year rate) and unconstrained variables (such as global IP and stock prices) tend to display densities with little mass at zero, and thus markedly different from the priors.

We conclude this section by reporting on a few exercises we carried out to provide further corroboration of our results. First, we re-estimated the BVAR impulse responses by dropping the interest rate differential from it (not shown here to save on space). We find that these impulse responses are similar to those in Figure 1, but there are some differences. In particular, the responses of interest rates are now much more persistent, with the 16th percentile staying positive for more than 40 months. Moreover, the responses of many variables are somehow larger than in Figure 1, especially those of the international variables. When we reestimate the VAR over the sample ending in 2008 again omitting the interest rate differential, instead results are very similar to those in Figure 2. As discussed above, this difference underscores the importance of including the short-term interest rate differential in our analysis to make results more robust to the inclusion of the most recent period with interest rates at their lower bound. Indeed, this interest rate differential has been as stable over this period as US short-term rates.

Second, we computed the responses of the US stock prices, the nominal and real effective exchange rate and the interest rate differential to the series of shocks estimated by GK, using the same specification as in (4). Point estimates and the 16th and 84th percentiles are presented in *Figure 4* for the sample until 2013.[21] They verify that the identifying restrictions we impose on these three variables are not patently inconsistent with the effects of the monetary policy shocks estimated by these authors. Namely, the interest rate differential and stock prices drop, while the nominal effective exchange rate (and the real effective one) appreciates.[22] Moreover, *Figure 5* reports the distribution of correlations of our shocks with the (point estimates of the) GK shocks and also the extended series of the Romer and Romer (2004) shocks as computed by Barakchian and Crowe (2013). The correlation is mostly positive in both cases. As shown in Table 2, median values range between 0.12 and 0.21, depending on the shocks and the samples. These values are similar to that of the correlation between the GK and RR shocks, equal to 0.19.

Third, we computed impulse responses of the monthly US VIX index to our identified shocks, again using a specification like (4).[23] We could not include the VIX directly in the BVAR because it is available only after the early 1990s. This could be an important omission in light of the results in Rey (2013), where the VIX, taken as a proxy for the "global financial cycle", is shown to be correlated with capital flows and asset prices across countries and to increase in response to a US monetary policy tightening. *Figure 6* reports the impulse responses of the VIX to our monetary policy shocks, estimated again over both samples. Similarly to the other impulses responses, the (blue) dotted lines represent the point-by-point 16th, 50th and 84th percentiles. It is clear that an unexpected monetary tightening in the US, as measured by our shocks, results in a substantial (around 7% on impact in response to a one-standard deviation structural monetary policy shock) and fairly persistent increase in the VIX, in line with the results in Rey (2013). The responses are also broadly similar across the 1990-2008 and 1990-2013 samples. This finding, together with our result that US and global stock prices fall in response to a US interest rate hike, shows that our estimated monetary policy shocks are consistent with salient features of the effect of US monetary policy on key global financial variables as

[21]In this case we use a wild bootstrap procedure, as e.g. in Ramey (2015), to characterize estimation uncertainty.

[22]The original GK shocks are not scaled to have a unitary variance like ours, so the scale of these IRF is not directly comparable with that in our BVAR.

[23]These results are broadly insensitive to the prior we use.

documented by Miranda-Agrippina and Rey (2015).

To summarize, these exercises together lend support to our benchmark identification and the effects of the resulting monetary policy shocks.

Comparing priors and posteriors for individual regressions of US variables Before turning to the discussion of the results for countries other than the US, we document the difference between the impulse responses obtained under the priors and posteriors of (4), when the procedure outlined in Section 2.3 is applied to the following US monthly variables: (i) the nominal effective dollar exchange rate (NER); (ii) the real effective exchange rate (REER); (iii) the 3-month interest rate (3mIR); (iv) CPI inflation; (v) industrial production (IP); (vi) (real) stock prices (SP); (vii) the nominal trade balance scaled by total trade (TB); (viii) the 1-year interest rate (GBY1).

Comparing the top and bottom panels in Figure 7, the posterior distributions of impulses responses appear substantially different from their priors. First, for those variables whose prior is relatively tight, the overlap with the posterior is minimal. This occurs for the exchange rates, interest rates and stock prices. When priors are relatively uninformative, the posteriors tend to show less dispersion, as is the case of IP, CPI and especially the trade balance. The fact that the posterior is quite different from the prior is especially reassuring for the two variables which are not included in the BVAR, namely the real effective exchange rate and the trade balance (stock prices enter in nominal terms in the BVAR).

Second, posterior distributions in the bottom panel of Figure 7 are broadly consistent with the BVAR posteriors in Figure 1. However, impulse responses are somehow less persistent, especially for IP and the 3-month and 12-month interest rates. The latter's are also slightly smaller. Importantly, these results depend on the prior. When we experimented with less informative priors, either by increasing the variance of the normal prior for the coefficients Γ, or even setting the mean of latter to zero, we found that the implied posteriors were now fairly different from those in Figure 1.[24] We conclude from this exercise that this prior choice strikes a balance between making the US estimates based on (4) close to their BVAR counterparts, and imposing too tight a constraint on the posterior inference.

[24] These results are available upon request.

5 Evidence on the global transmission of US monetary policy shocks

In the next subsection we provide a broad overview of the country specific responses to the US monetary policy shocks. In Section 5.2 we explore whether these responses have any commonality that can be attributed to shared country characteristics. Before going into the details of the results, it is useful to give an overview of the key findings. First, we find that a surprise US monetary tightening leads to a dollar appreciation vis-á-vis most countries in our sample. In a large majority of countries industrial production and real GDP fall, and unemployment rises; however the trade balance improves. Inflation (GDP deflator and CPI) also falls in a majority of countries, although the effects are less statistically significant. Emerging economies tend to experience more volatile effects. At the same time, and this is our second finding, the responses of financial variables are more heterogeneous and muted: while most countries see their bond yields increase relative to the US, real equity and housing prices drop in about half the countries. Likewise, many countries experience opposite effects on real credit and capital flows, including borrowing from foreign banks. Finally, in Section 5.2 we do not find any of systematic relations between the most likely country characteristics (income level, exchange rate regime, financial openness, trade openness vs. the US, and dollar exposure) and the distribution of cross-country responses to US monetary policy shocks. While a dollar peg at least mutes the effects on the nominal and real exchange rate, asset prices and capital flows do not seem to react differently between more and less financially open countries.

5.1 The cross-country distribution of the effects of US monetary policy shocks

We summarize the effects across countries of US monetary policy shocks in *Figure 8.* For each variable the figure reports a chart with the maximum absolute value over an horizon of 5 years of the median responses to a one-standard deviation monetary shock, country by country. The responses in advanced economies are depicted in blue bars, those of emerging economies in red bars. The peak impulse response for the euro area is reported in green, and the overall country average in black to the far right-hand side of each chart. Recall that euro area countries are not included individually in the case of the bilateral dollar exchange rate and of short term rates. The top panel shows the maximum responses of monthly variables, while the bottom panel shows the maximum responses for quarterly variables. Monthly variables include: (i) the bilateral dollar exchange rate; (ii) the real effective exchange rate; (iii) the short-term interest rate differential with the US; (iv) CPI inflation; (v) industrial production; (vi) real stock prices; (vii) the nominal trade balance; (viii) the differential of long-term government bond yields vis-á-vis the US. Quarterly variables include: (i) real GDP; (ii) the GDP deflator; (iii) the unemployment rate; (iv) real housing prices; (v) real domestic credit; (vi)-(vii) total portfolio inflows and outflows, and (viii) total borrowing from foreign banks, all scaled by GDP; (ix) "the misery index" of macroeconomic volatility.

Starting with the top panel in Figure 8, it is apparent that virtually all countries experience a nominal bilateral depreciation (a positive value) with the US dollar.[25] The largest significant depreciation, almost 1.4%, occurs in Hungary. The response is not significant for a few currencies, in particular for countries managing their exchange rate vis-á-vis the US dollar, such as China. However, the euro depreciation too, while showing a large median peak of 1.3%, is not significant. The widespread bilateral dollar depreciation transpires into a broad based real depreciation (a negative value) in more than half of the countries, mostly advanced ones; recall from Figure 7 that the US dollar appreciates in real terms by 0.5%. However, only in a few countries the responses are now statistically significant.[26] Sweden experiences the largest significant depreciation, -0.5%; the largest significant real appreciation, 0.5%, takes place in China.

The cross-country heterogeneity of the responses of other asset prices is larger. Short-term interest rates tend to moderately fall relative to the US in advanced countries; e.g. the peak differential is -11 basis points in the euro area. They increase, sometimes by a lot, in emerging ones, such as Chile, where the peak differential is 62 basis points. The responses of longer-term yields differentials are more similar across countries, displaying a generalized small increase (Greek bonds experience the largest significant positive differential, 56 basis points). However the differential turns negative in a few emerging

[25]The exception is Estonia, whose appreciation however is not significant as it is bracketed between the 16th and 84th percentile. Brazil's responses for the dollar exchange rate, the CPI and the short-term differential are not shown as they are very large and imprecisely estimated.

[26]The real effective exchange rate is now reported for all members for the euro area separately. On aggregate, the euro depreciates in real terms but not significantly.

economies (the largest relative fall, -80 basis points, occurs in Turkey). Finally, against the background of a 1% drop in the US, stock prices decline in most emerging markets and several advanced economies; some countries however experience significant increases.[27]

Conversely, the sign of the responses of macroeconomic variables is quite similar across economies. Industrial production and the CPI drop in most countries, while the trade balance improves. The decline in industrial production is fairly significant in a majority of countries, the largest in Lithuania at -1.2%, and among advanced economies, -0.8% in Japan. Euro area IP also significantly contracts, by -0.5%. These declines are bigger than the US own response. In contrast, the few increases are nowhere significant. The CPI displays a similar, generalized fall. For instance, nominal prices significantly decline in the euro area, by -0.1% (Malaysian CPI decreases the most, by -0.2%). The trade balance improves in most countries, both advanced and emerging; however countries like Norway and Russia experience large significant deteriorations (by -.8% and -1% respectively).[28]

Turning to the bottom panel of Figure 8, we also find that the effects on macroeconomic variables such as the real GDP and its deflator, and unemployment, do not greatly differ in sign across countries. The real GDP contraction is statistically significant in a majority of countries, including the euro area, where the peak effect is -0.5%. Unemployment rises in around half of the countries (the largest responses of these variable, -1.75% and 1%, occur in Lithuania). The fall in the GDP deflator is also less widespread than the real GDP, and more muted (Malaysia, whose CPI also falls significantly, experiences the largest drop, -1.4%). Both variables are barely affected in the euro area, the latter despite the significant decline in the CPI reported above.

We find a lot more heterogeneity across countries in the responses of financial variables and capital flows. Real housing prices decline in many emerging economies, but are large and significant especially in the Baltic countries. Advanced economies tend to experience small but generally little significant increases, including the euro area. The response of real private credit varies a great deal across countries, falling in several emerging economies, although with little statistical significance, but also in advanced economies like Belgium,

[27] Lithuanian stock prices fall significantly the most, -2.8% (Norwegian stocks by -1.3% the most among advanced countries); the largest significant increase occurs in China, almost 4%; the euro area increase is not significant.

[28] The largest significant improvement, 2.4%, takes place in Turkey; among advanced economies in Greece, by 1.4%.

where it declines by a significant -0.6%. However, the generally positive responses in advanced economies are also rather muted. Finally, capital flows, including borrowing from foreign banks (all scaled by nominal GDP), display quite different effects in sign and size. Cumulated portfolio inflows by foreign residents but also outflows by domestics decline in around half of the countries, including many advanced economies. For instance, even the euro area experiences a significant decline in portfolio inflows of around -1%. The decline in outflows, though also large at over -2.5%, is not significant. Total borrowing from foreign banks also displays many positive and negative responses across both advanced and emerging countries. However positive responses tend to be significant in a majority of the former, negative responses in a majority of the latter.[29] For instance, borrowing from foreign banks significantly soars in Denmark by 11% and drops by -4.7% in Turkey.

To summarize, a US surprise tightening brings about a widespread dollar appreciation and a fall in broad macroeconomic activity, with an improvement in trade balances in nominal terms. Inflation also tends to fall in most countries, although less sharply. Emerging economies experience more volatile macroeconomic effects, as summarized by the "misery index". Among financial variables, the increase in long-term government bond differentials and, in a more limited fashion, the drop in equity prices are also fairly generalized. Conversely, the response of short-term rates differentials and housing prices is more heterogenous. By the same token, many countries experience opposite effects on real private credit and capital flows, including borrowing from foreign banks.

5.2 Country characteristics and the effects of US monetary policy shocks

In the following, we find is convenient to organize the results for both monthly and quarterly regressions by country groupings. Therefore, for each figure panel A will show impulse responses aggregated from monthly regressions, while Panel B will depict impulse responses aggregated from quarterly regressions. As before, the (red) dotted lines represent the point-by-point 16th, 50th and 84th percentiles, while the (black) solid line is the average response. Country groupings used in this subsection are reported in *Table 4*.

Advanced vs. emerging countries. We start by presenting results by splitting

[29] Lithuania displays the very large negative response in the chart, which is however not significant. We do not report the huge Chinese negative response.

countries on the basis of their income levels (see first and second column in Table 4b), displayed in Figure 9. The percentiles of distributions of the average responses of the 18 AEs are shown in the solid (red) lines, while those of the 18 EMEs are shown in dotted (blue) lines. These responses confirm and extend our previous results that a US monetary policy shock has substantial cross-border effects. Panel A shows that in the average country in the rest of the world, an unexpected interest rate tightening is associated with depreciation both nominally against the US dollar and on a real trade-weighted basis — where a fall again indicates depreciation. Industrial production declines across the board, as well as do stock prices — though significantly only in EMEs. Both variables seem to react similarly to their BVAR counterparts, though in a less persistent fashion. The responses of other variables are also very similar across AEs and EMEs. The trade balance and long-term interest differentials significantly increase in both groups. The decline in the CPI and short term interest differentials are significant only in AEs; the median response of the latter in EMEs is even positive.

The responses of quarterly variables displayed in Panel B confirm and further sharpen these results. In the average AE and EME, the contraction in industrial production is also associated with a fall in broad-based output as measured by real GDP, and an increase in unemployment. The fall in the GDP deflator is never significant, however, in either group. The increase in real credit is marginally significant only in EMEs. But some quantitative differences emerge from the responses of other financial variables. While housing prices, borrowing from foreign banks and portfolio inflows are barely affected in advanced countries, they significantly decline in emerging economies in response to a US surprise monetary tightening.[30]

A first important result then is that the consequences of a US monetary policy shock for economic activity are qualitatively and quantitatively similar across advanced and emerging economies, since a US tightening brings about a recession and an increase in unemployment in both groups. Inflation and interest rate dynamics are also broadly similar, but with higher dispersion and volatility among EMEs than among AEs. As a result macroeconomic volatility as captured by the sum of absolute changes in inflation and unemployment (the "misery index"), is significantly higher for EMEs than for AEs. On the other hand, some negative financial repercussions are estimated more sharply for

[30] The drop in housing prices is to a large extent driven by the Baltic countries.

EMEs, especially concerning asset prices and capital outflows.

Other country characteristics: Currency regime, financial openness, and US trade and dollar exposure. We turn next to the analysis of the effects of other country-specific dimensions on the transmission of US monetary policy shocks, such the exchange rate regime (*Figure 10*), the degree of capital mobility[31] (*Figure 11*), trade openness towards the US (*Figure 12*) and US dollar exposure (*Figure 13*) also among emerging markets, with a view of exploring some of the possible reasons behind the asymmetric response across countries. Quite surprisingly, we find that none of the chosen characteristics appears to explain country heterogeneity.[32] Although impulse responses are sometimes different between groups, they always overlap so that their difference is never statistically significant. This also includes the exchange rate vs. the US dollar, which as expected reacts less in dollar pegs than in other countries, but the difference is not large and indeed not statistically significant. Also the interest rate reaction does not significantly differ between pegs and floats, different from previous results in the literature (e.g., Shambaugh 2004). This however may reflect the fact that some of the countries we classify as dollar pegs over the whole sample, in reality have had also spells of floating rates. This is the case of India and Mexico, for instance.

6 Conclusions

This paper investigates the global effects of US monetary policy shocks using a two stage approach. First, estimates of US monetary policy shocks are obtained by using an identification scheme based sign restrictions in line with the results in Gertler and Karadi (2015). This allows modeling the response of a range of interest rates and spreads to a US monetary policy shock. A number of real and financial variables at monthly and quarterly frequency are then regressed on the estimated shocks to compute impulse responses in 18 advanced and 18 emerging economies. Countries are grouped on the basis of characteristics like their dollar exchange rate regime or the openness of their capital accounts.

[31] We focus on emerging markets because financial openness tends to be uniformly higher in advanced countries. AEs are also all classified as floating relative to the dollar according to the Klein-Shambaugh metric.

[32] Results do not change for these last two characteristics when we look at different degrees of exposure among all ountries, or among advanced economies only.

We find that a surprise US monetary tightening leads to a dollar appreciation vis-á-vis most countries in our sample. In most countries industrial production and real GDP fall, and unemployment rises; however, the trade balance improves. Inflation (GDP deflator and CPI) also tend to fall in a majority of countries. Emerging economies tend to experience larger effects. Responses of financial variables are more heterogeneous and muted: bond yields increase relative to the US yields in most countries, while real equity and housing prices drop in about half the countries. Finally and most notably, we do not find any of systematic relations between the most likely relevant country characteristics (income level, exchange rate regime, financial openness, trade openness vs. the US, and dollar exposure) and the distribution of cross-country responses to US monetary policy shocks. While a dollar peg at least mutes the effects on the nominal and real exchange rate, asset prices and capital flows do not seem to react differently between more and less financially open countries.

A main implication of this finding is that, conditional on monetary policy shock, neither the exchange rate regime nor financial openness, at least the way we measure them, appear to matter for the international transmission of monetary policy. In particular, in line with Miniane and Rogers (2007), we do not find that capital controls may provide an effective protection against monetary spill-overs. At the same time, we find evidence of significant country heterogeneity, which suggests that spill-overs are indeed asymmetric - though the asymmetry is not well explained by the most likely country characteristics we have so far explored.

References

[1] Agrippino-Miranda, S. and H. Rey (2015): "World asset markets and the global financial cycle", mimeo.

[2] Ahmed, S. and A. Zlate (2014): "Capital flows to emerging market economies: A brave new world?", Journal of International Money and Finance, 48, pp. 221-248.

[3] Aizenman, J., Chinn, M. D. and H. Ito (2015): “Monetary policy spillovers and the trilemma in the new normal: Periphery country sensitivity to core country conditions”, NBER Working Paper 21128.

[4] Banbura, M., Giannone, D. and L. Reichlin (2010): "Large Bayesian vector autoregressions", Journal of Applied Econometrics, 25, 1, pp. 71-92.

[5] Barakchian and Crowe (2013): "Monetary policy matters: Evidence from new shocks data," Journal of Monetary Economics, Vol. 60, pp. 950-966.

[6] Benetrix, A. S., Shambaugh, J. C. and P. R. Lane (2015): "International Currency Exposures, Valuation Effects and the Global Financial Crisis", Journal of International Economics, 96, 98-109.

[7] Boivin, J. and M. P. Giannoni (2009): "Global forces and monetary policy effectiveness", in J. Gali and M. Gertler (eds.), *International Dimensions of Monetary Policy*, NBER.

[8] Canova, F. and G. De Nicolo’ (2002): "Monetary Disturbances Matter for Business Cycle Fluctuations in the G-7 ", Journal of Monetary Economics, 49, 1131-59.

[9] Chinn, M. and H. Ito (2006): "What matters for financial development? Capital controls, institutions, and interactions." Journal of Development Economics 81, 163-192.

[10] Corsetti, G., L. Dedola and S. Leduc (2010). "Optimal Monetary Policy in Open Economies". Handbook of Monetary Economics.

[11] Davis, S. and I. Presno (2014): "Capital controls as an instrument of monetary policy", Federal Reserve Bank of Dallas, Globalization and Monetary Policy Institute Working Paper 171.

[12] Di Giovanni, J. and J. C. Shambaugh (2008): "The impact of foreign interest rates on the economy: The role of the exchange rate regime", Journal of International Economics, 74, pp. 341-361.

[13] Eichengreen, B. and P. Gupta (2013): "Tapering talk: The impact of expectations of reduced Federal Reserve security purchases on emerging markets", World Bank Working Paper.

[14] Faust, J. (1998): "The robustness of identified VAR conclusions about money", Carnegie Rochester Series on Public Policy, 49, pp. 207-244.

[15] Fernández, A., Klein, M. W., Rebucci, A., Schindler, M. and M. Uribe (2015): "Capital Control Measures: A New Dataset." NBER WP No. 20970.

[16] Gertler, M. and P. Karadi (2015): "Monetary policy surprises, credit costs and economic activity", American Economic Journal: Macroeconomics, 7, 1.

[17] Georgiadis, G. (2015): "Determinants of Global Spillovers from US Monetary Policy", Journal of International Money and Finance, forthcoming.

[18] Giannone, D., Lenza, M. and G. Primiceri (2015): "Prior selection for vector autoregressions", Review of Economics and Statistics.

[19] Goldberg, L. S. (2013). "Banking globalisation, transmission, and monetary policy autonomy", Federal Reserve Bank of New York Staff Reports No. 640.

[20] Kalemli-Özcan, S. (2015). "Capital flows and spillovers," CIGI Working Paper No. 8, March 2015.

[21] Kilian L., and YJ Kim (2011). "How Reliable Are Local Projection Estimators of Impulse Responses?" Review of Economics and Statistics.

[22] Klein, M. W. and J. C. Shambaugh (2010): *Exchange rate regimes in the modern era*, Boston: The MIT Press.

[23] Lane, P. and J. C. Shambaugh (2010): "Financial exchange rates and international currency exposures", American Economic Review, 100, 1, pp. 518-540.

[24] Litterman, R. B. (1986), Forecasting with bayesian vector autoregressions - five years of experience, Journal of Business & Economic Statistics 4, 25-38.

[25] Mackowiack, B. (2007): "External shocks, U.S. monetary policy and macroeconomic fluctuations in emerging markets", Journal of Monetary Economics, 54, pp. 2512-2520.

[26] Magud, N., Reinhart, C. and K. Rogoff (2011): "Capital inflows, exchange rate flexibility, and credit booms", NBER Working Paper No. 17670.

[27] Miniane, J. and J. Rogers (2007): "Capital controls and the international transmission of U. S. money shocks", Journal of Money, Credit and Banking, 39, 5, pp. 1003-1035.

[28] Mohan, R., Debabrata Patra, M. and M. Kapur (2013): "The international monetary system: Where are we and where do we need to go?", IMF Working Paper No. 13/224.

[29] Ostry, J. D. and A. R. Ghosh (2013): "Obstacles to international policy coordination and how to overcome them", Journal of International Money and Finance, forthcoming.

[30] Pesaran, M. H. and R. Smith (1995): "Estimating Long-Run Relationships from Dynamic Heterogeneous Panels", Journal of Econometrics, 68, 1, pp. 79–113.

[31] Reinhart, C. M., and K. S. Rogoff (2004): "The Modern History of Exchange Rate Arrangements: A Reinterpretation", Quarterly Journal of Economics, 119, 1, pp. 1–48.

[32] Rey, H. (2013): "Dilemma not trilemma: The global financial cycle and monetary policy independence", paper presented at the Federal Reserve Bank of Kansas City Economic Policy Symposium, Jackson Hole.

[33] Romer, C. D. and D. H. Romer (2004): "A New Measure of Monetary Shocks: Derivation and Implications", American Economic Review, 94: 1055-1084.

[34] Rose, A. K. (2011): "Exchange Rate Regimes in the Modern Era: Fixed, Floating, and Flaky", Journal of Economic Literature, 49, 3, pp. 652-72.

[35] Shambaugh, J. C. (2004): "The effect of fixed exchange rates on monetary policy", Quarterly Journal of Economics, 119, 1, pp. 301-352.

[36] Sims, C. A. and Zha, T. (1998), 'Bayesian methods for dynamic multivariate models', International Econom Review 39, 949-968.

[37] Uhlig, H. (2005): "What are the effects of monetary policy on output?Results from an agnostic identification procedure", Journal of Monetary Economics, 52, pp. 381-419.

[38] Woodford, M. (2007): "Globalisation and monetary control", NBER Working Paper No. 13329.

Appendix A. Figures

Figure 1: IRFs from baseline BVAR estimated over the sample 1980 - 2013

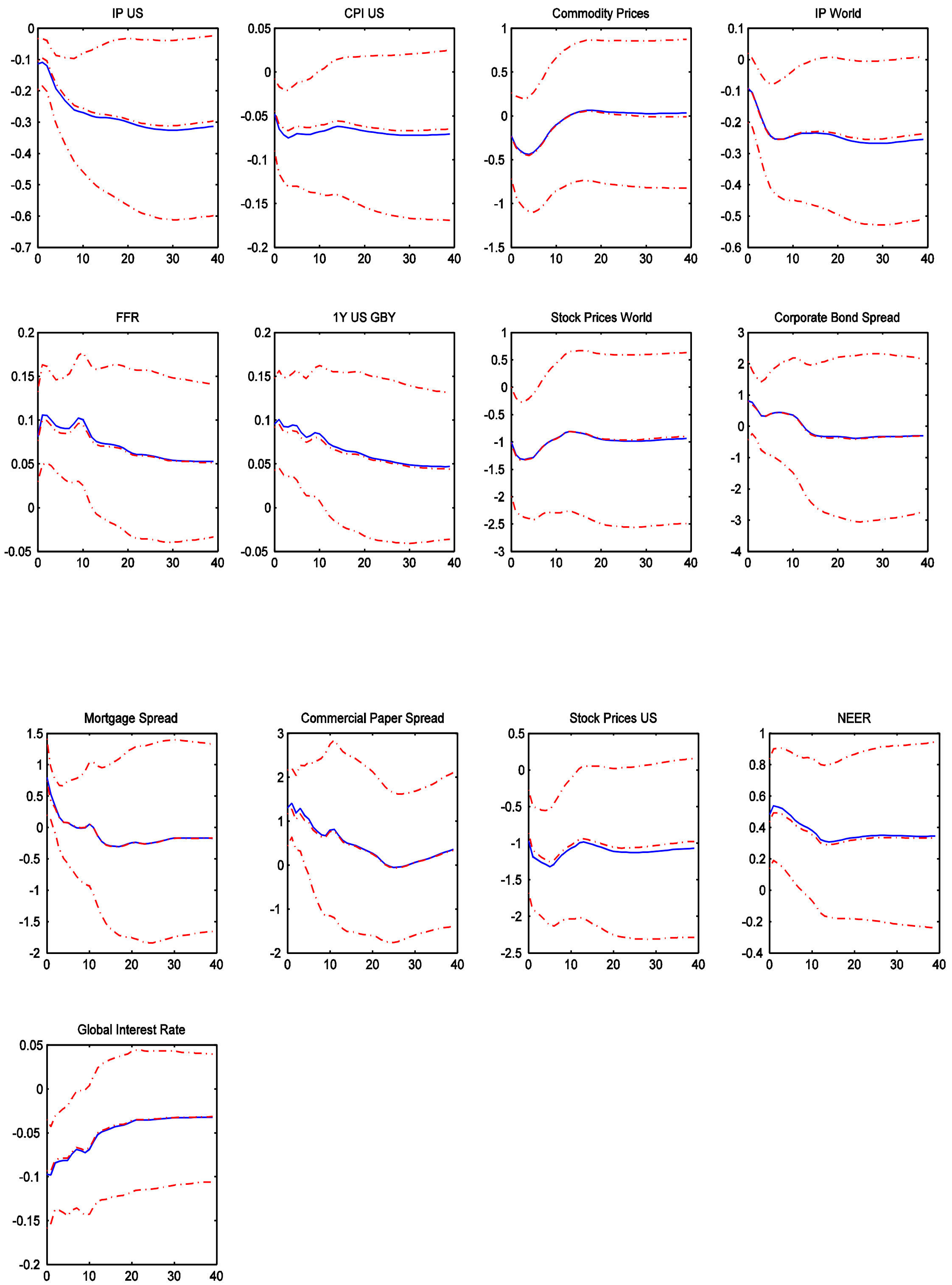


Figure 2: IRFs from baseline BVAR estimated over the sample 1980 – 2008

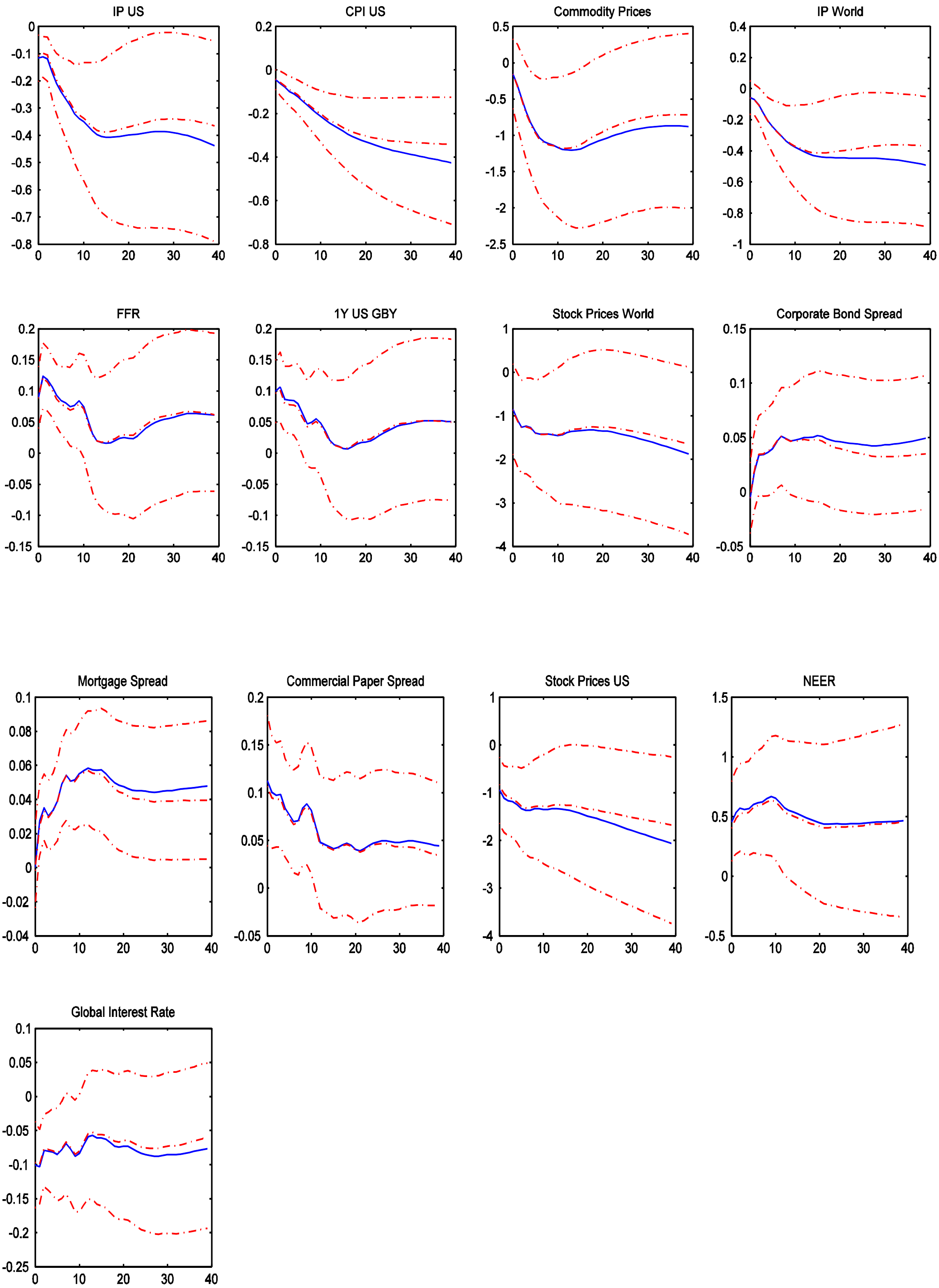
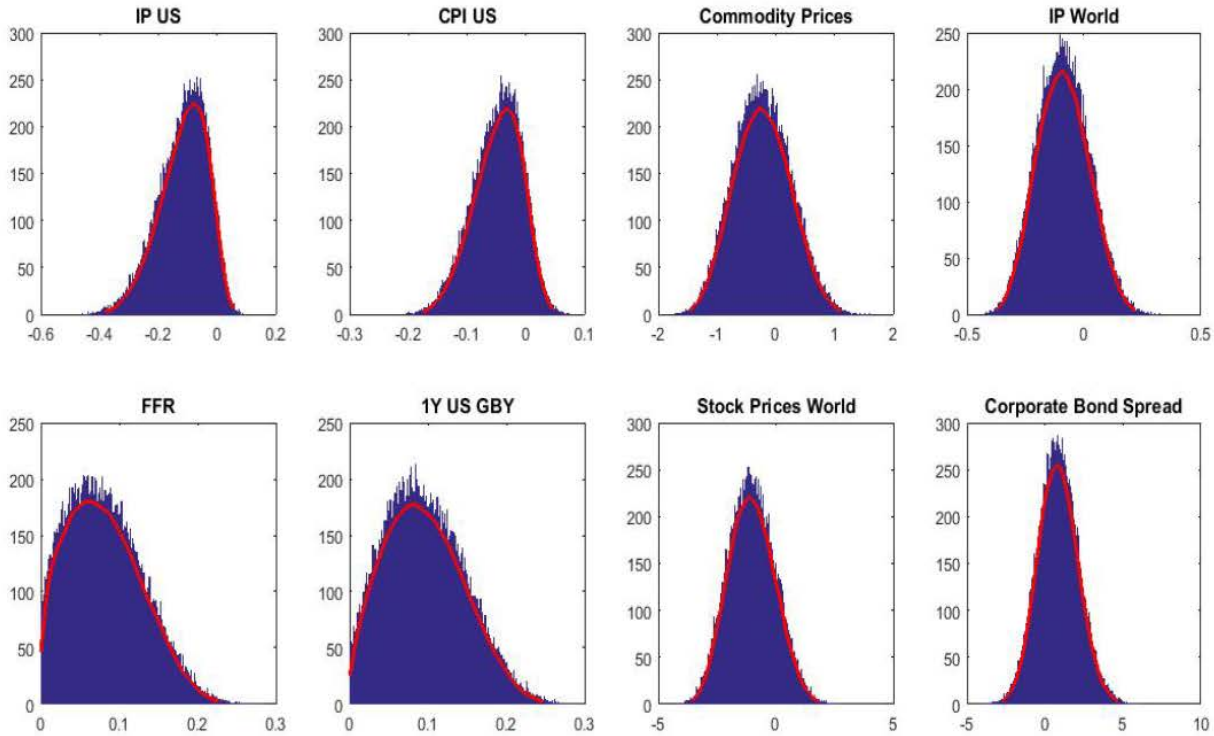


Figure 3: Posterior distributions of impact responses estimated over the sample 1980 - 2013

(a)



(b)

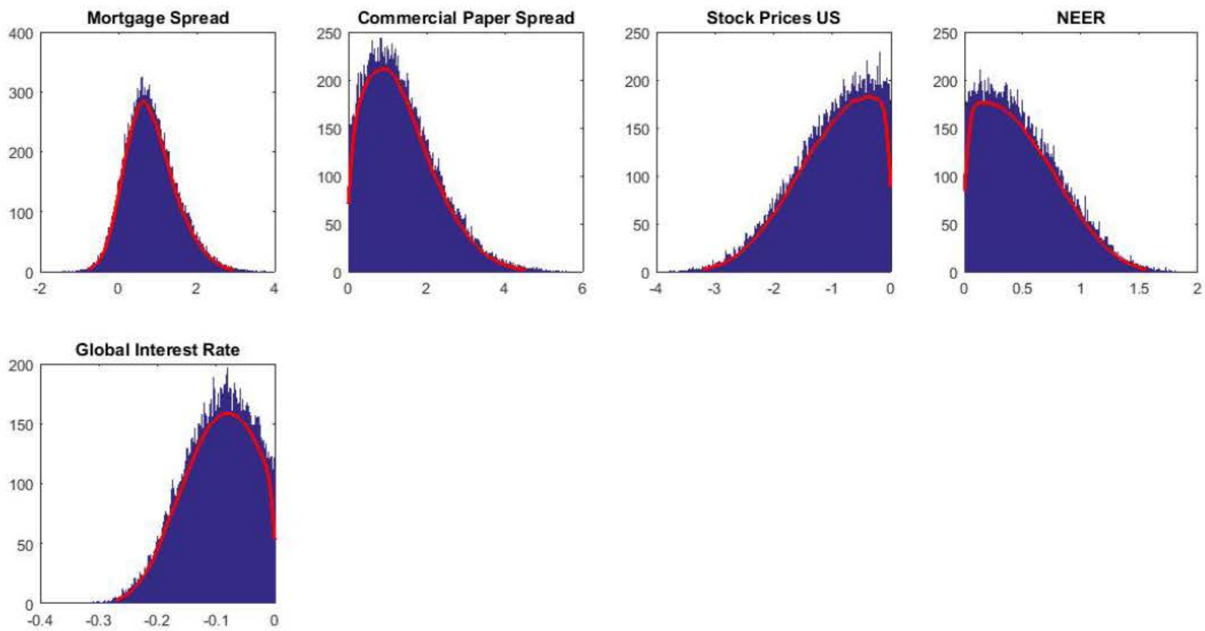


Figure 4: Response of variables in our BVAR to Gertler and Karadi (2015)'s monetary policy shocks, monthly regressions

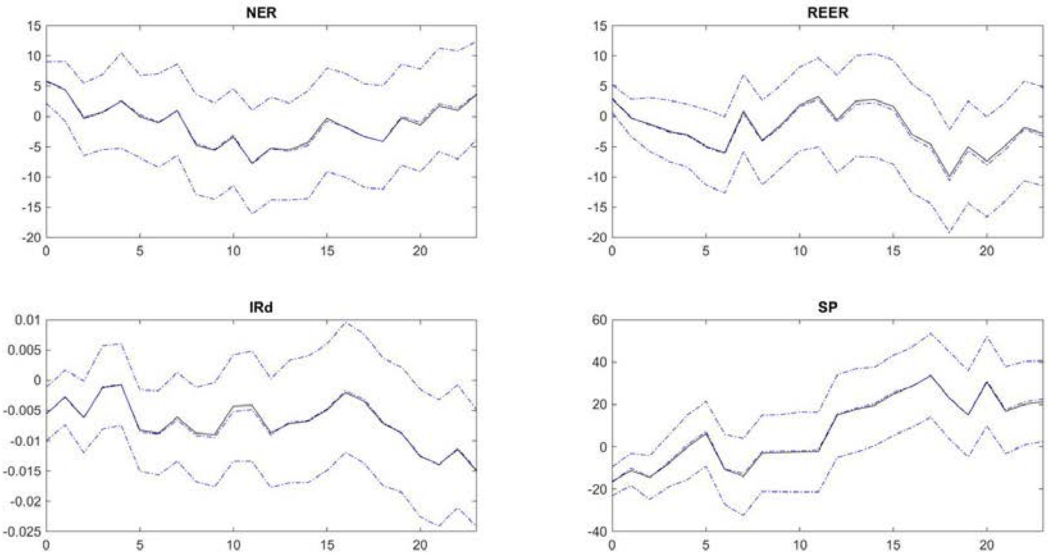


Figure 5: Correlations between our estimated shocks and (i) Gertler and Karadi (2015) shocks, and (ii) updated Romer and Romer shocks from Barakchian and Crowe (2013).

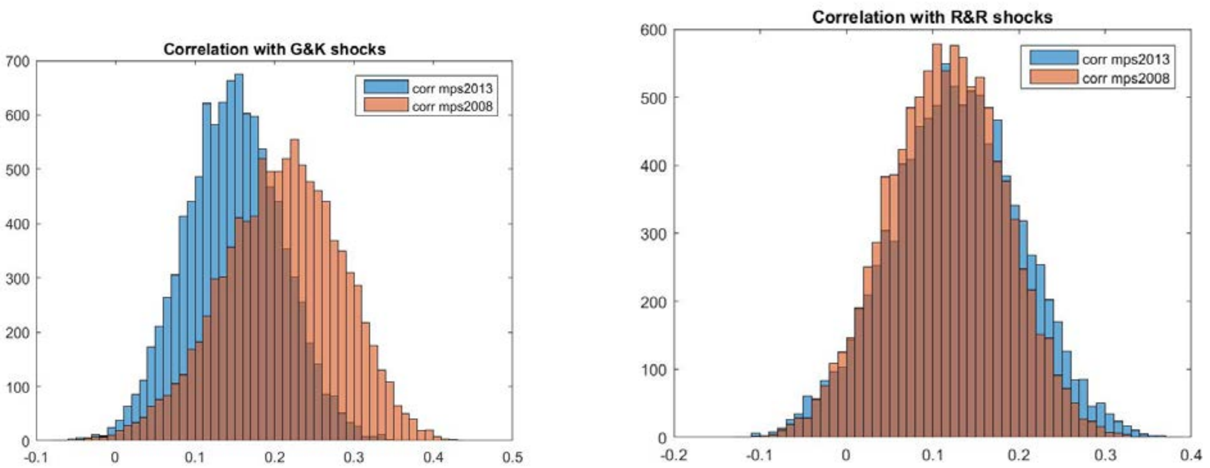
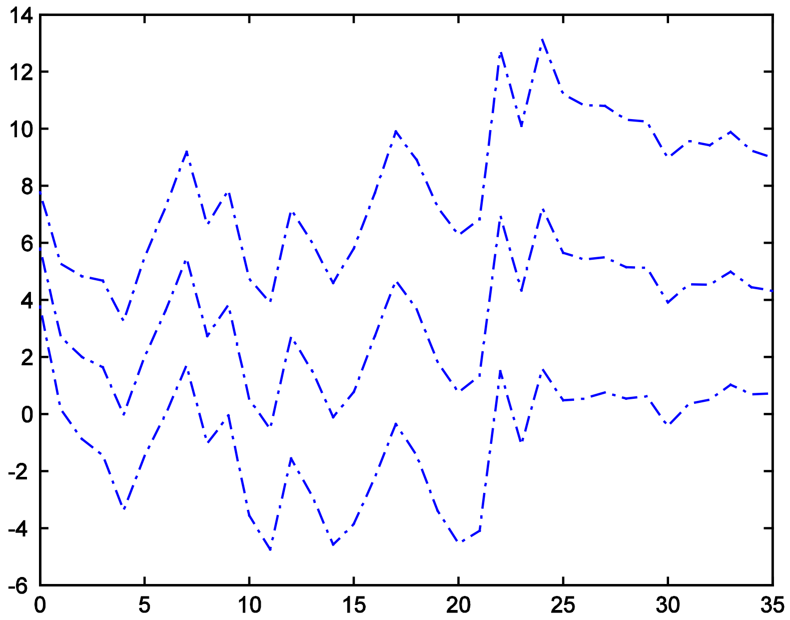


Figure 6: VIX responses to US monetary policy shocks, monthly regressions

1990:01 – 2008:06



1990:01 – 2013:12

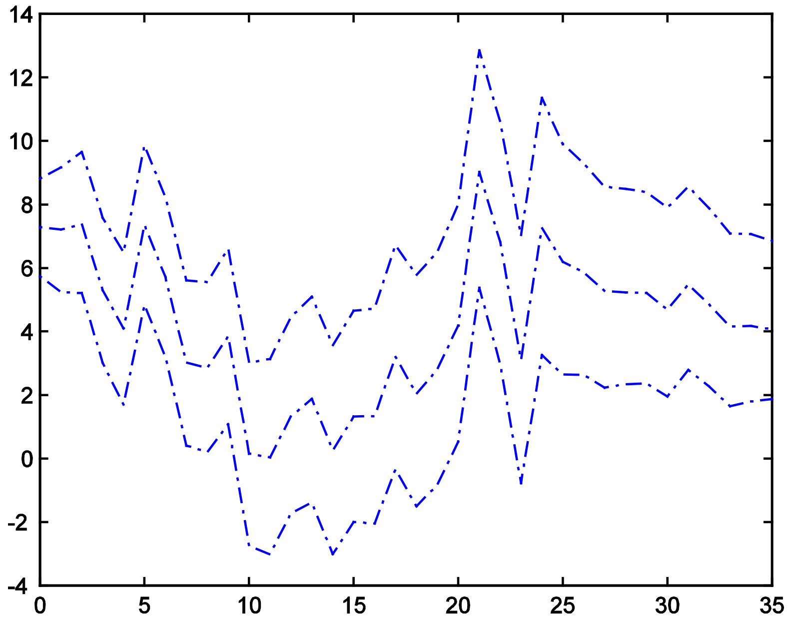
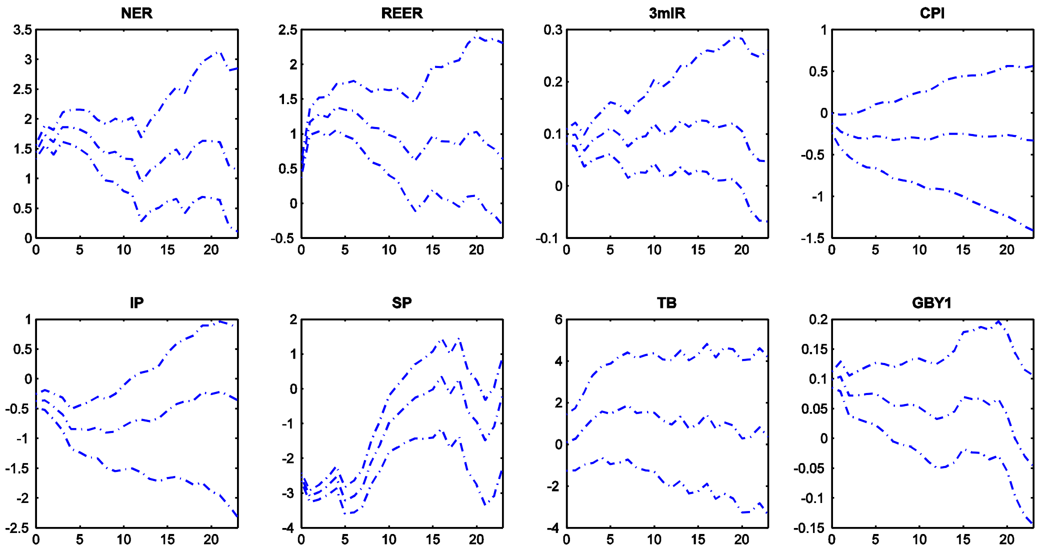


Figure 7: US responses to US monetary policy shocks: prior and posterior; 1980 – 2013, monthly regressions

Prior



Posterior

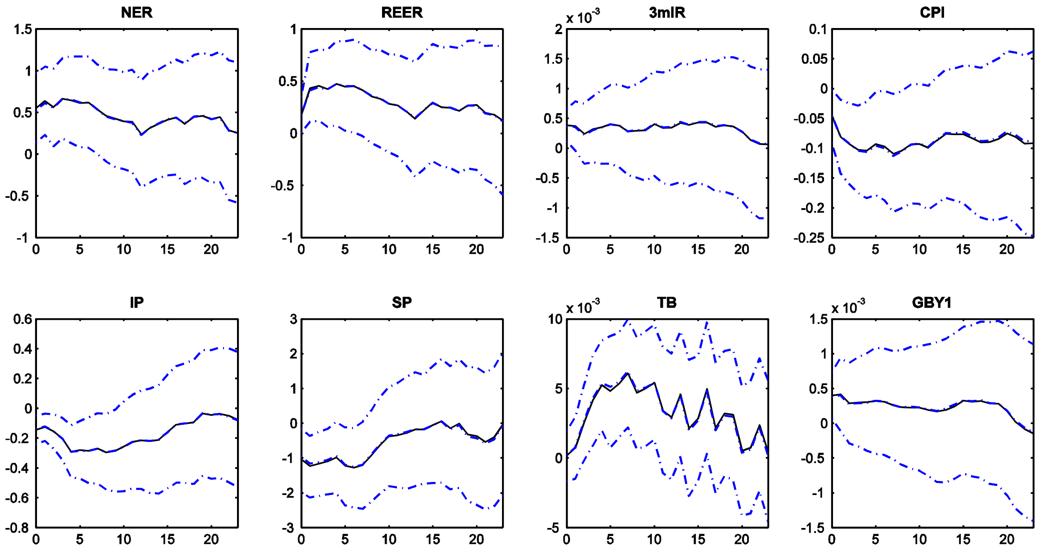
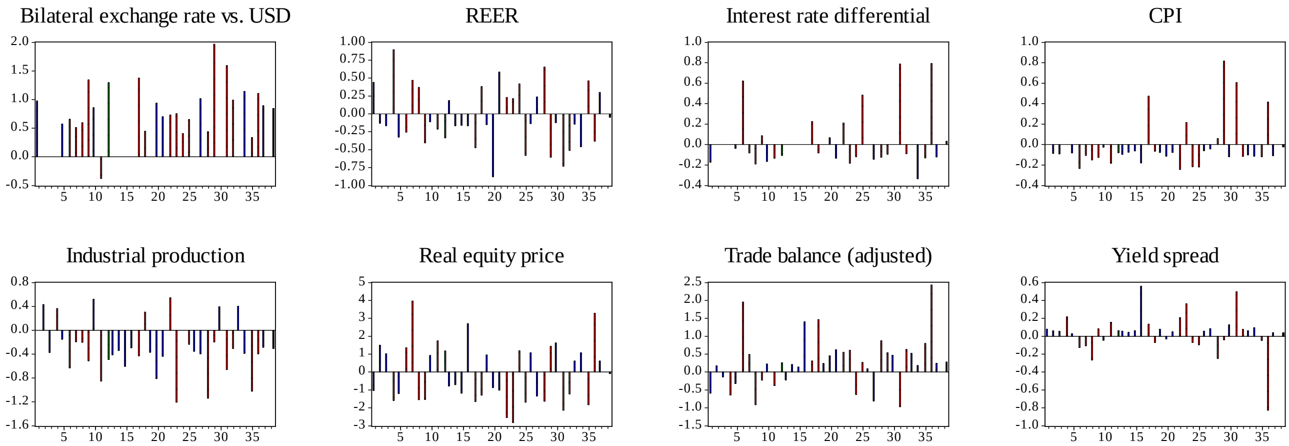
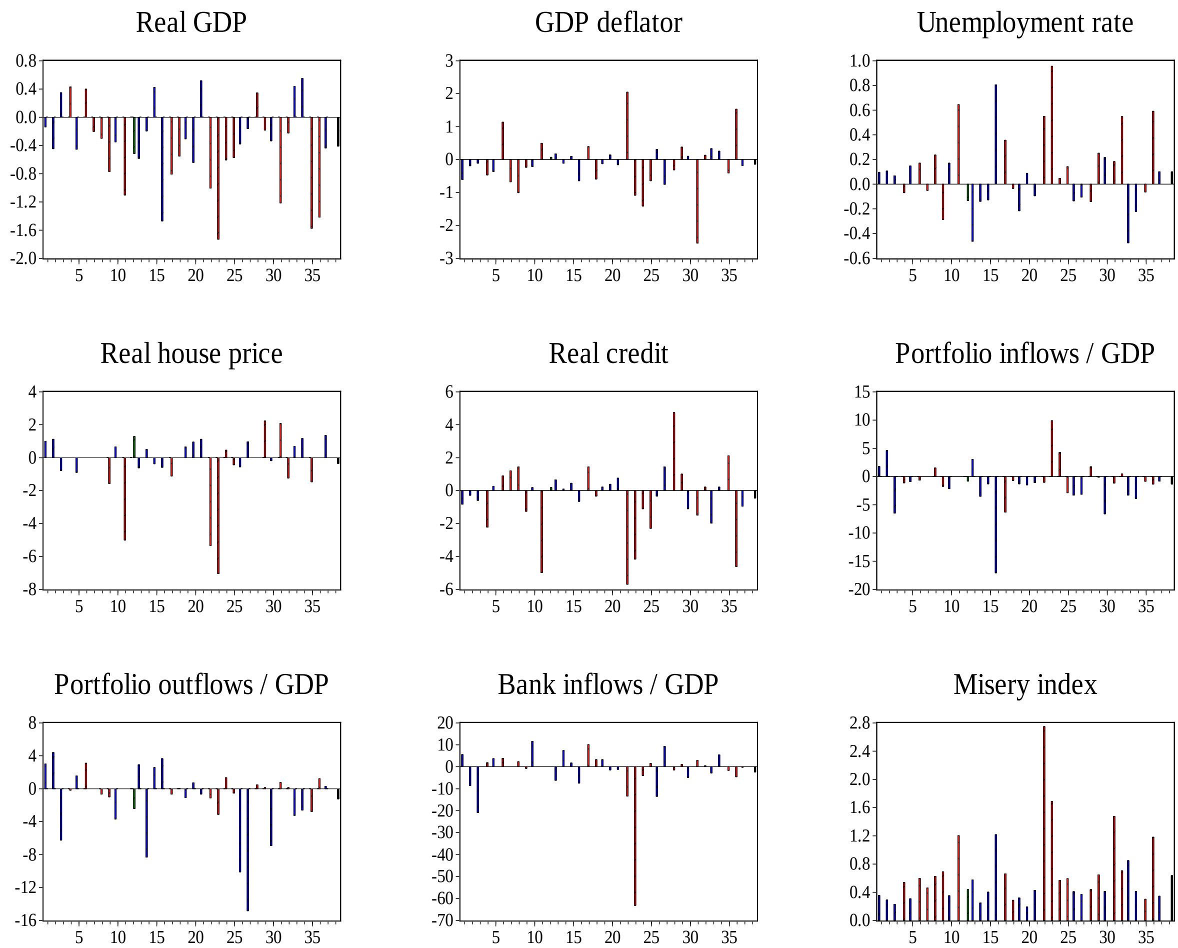


Figure 8: Country-specific median peak impulse responses to a one standard deviation contractionary US monetary policy shock

Monthly regressions



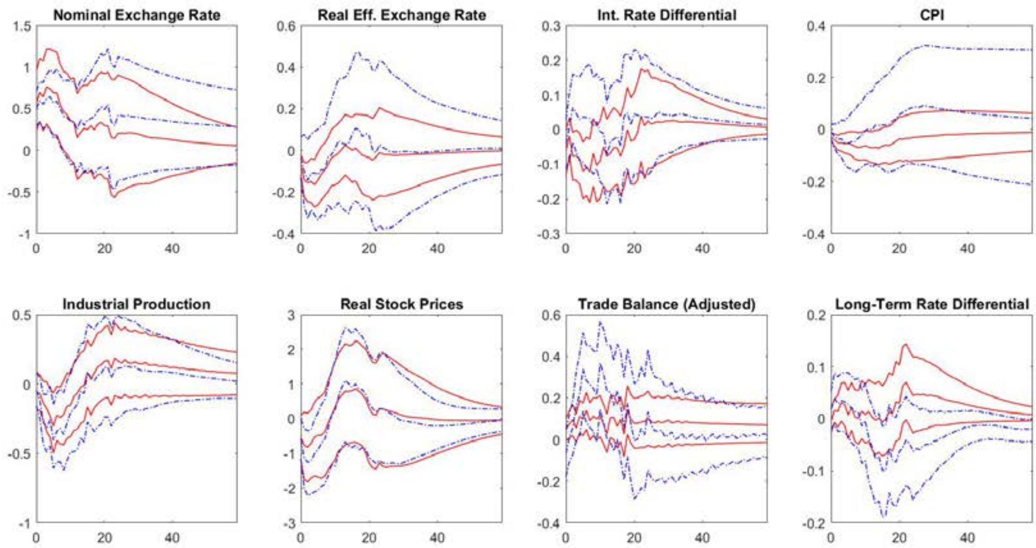
Quarterly regressions



Sample period: 1980 - 2013. Note that we exclude inflation, the nominal exchange rate and the interest rate differential in Brazil as well as bank inflows into China due to very high values. Blue bars refer to advanced countries, red bars to emerging countries. The peak impulse response for the euro area is reported in green, and the overall country average in black to the very right.

Figure 9: Responses of advanced (solid red line) and emerging economies (dotted blue line) to US monetary policy shocks.

Monthly regressions



Quarterly regressions

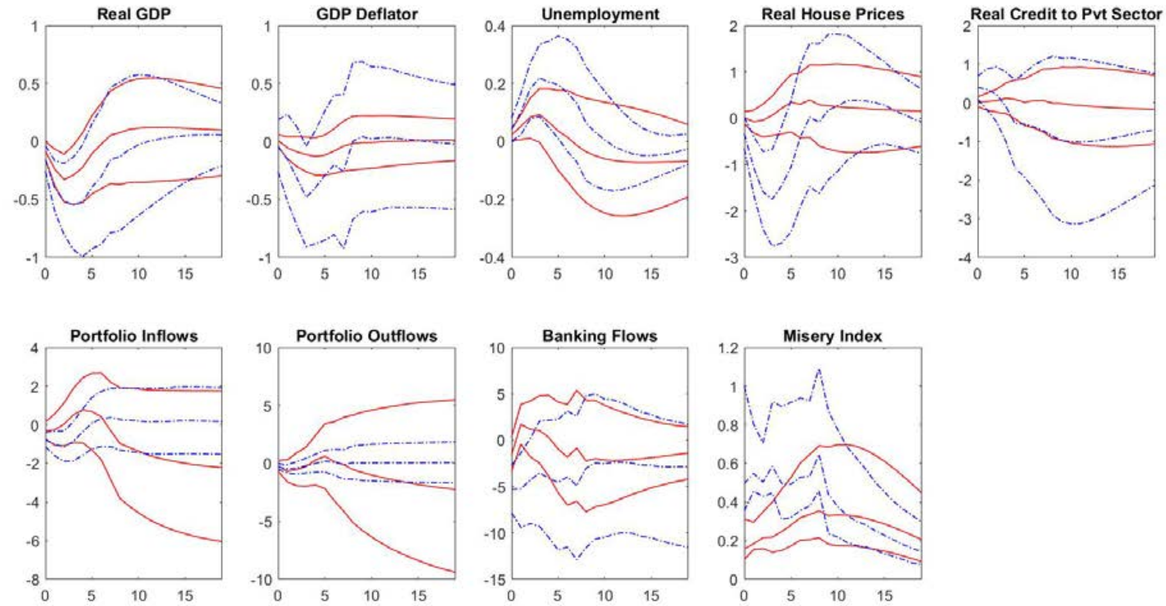
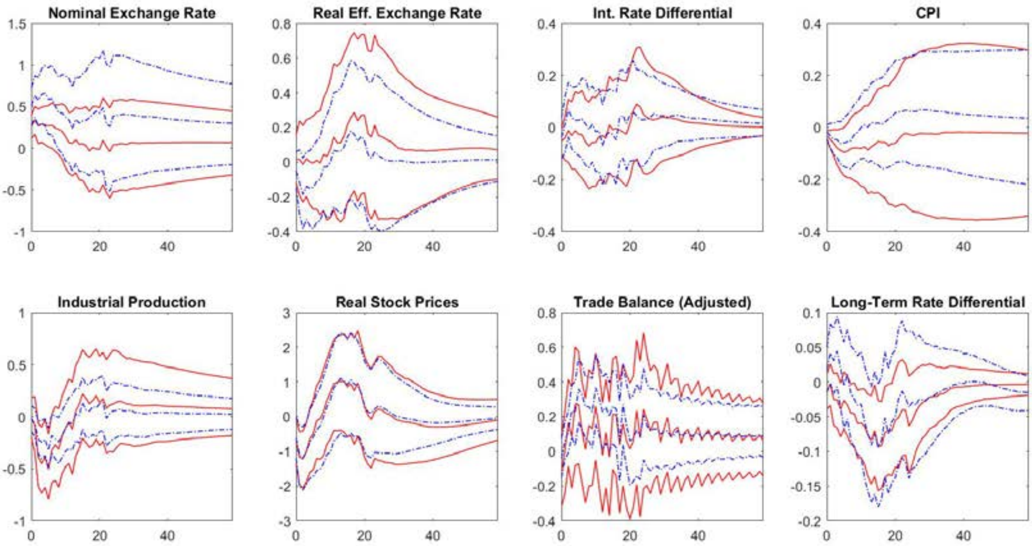


Figure 10: Responses of EMEs with dollar pegs (solid red line) and floating regime (dotted blue line) to US monetary policy shocks

Monthly regressions



Quarterly regressions

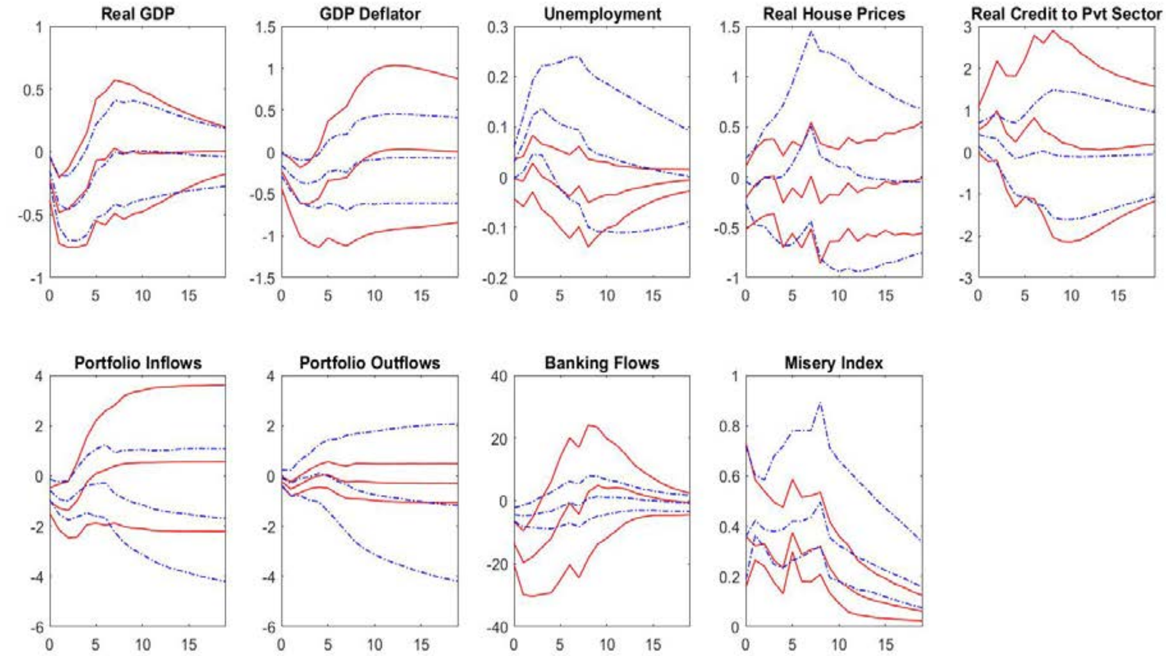
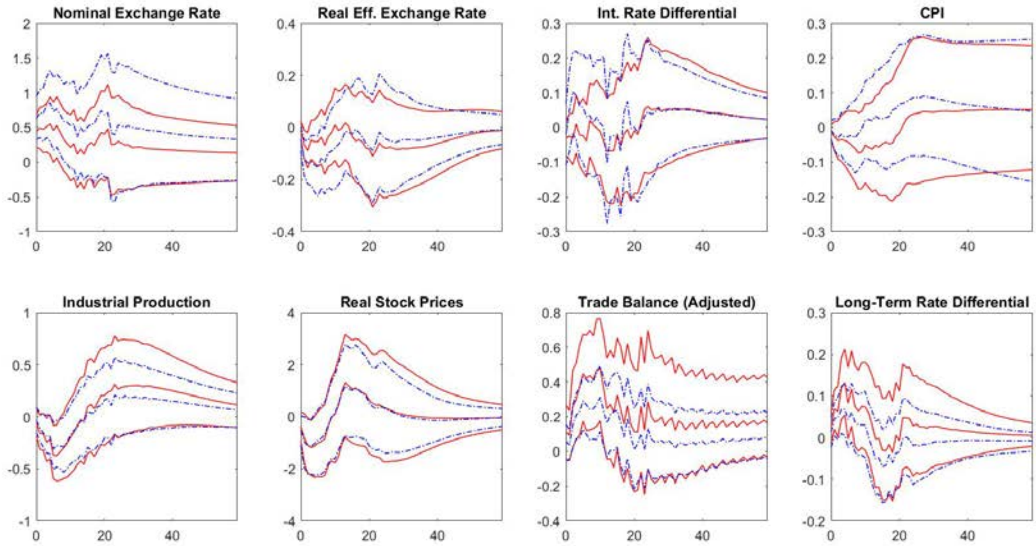


Figure 11: Responses of EMEs with lower (solid red line) and higher capital mobility (dotted blue line) to US monetary policy shocks

Monthly regressions



Quarterly regressions

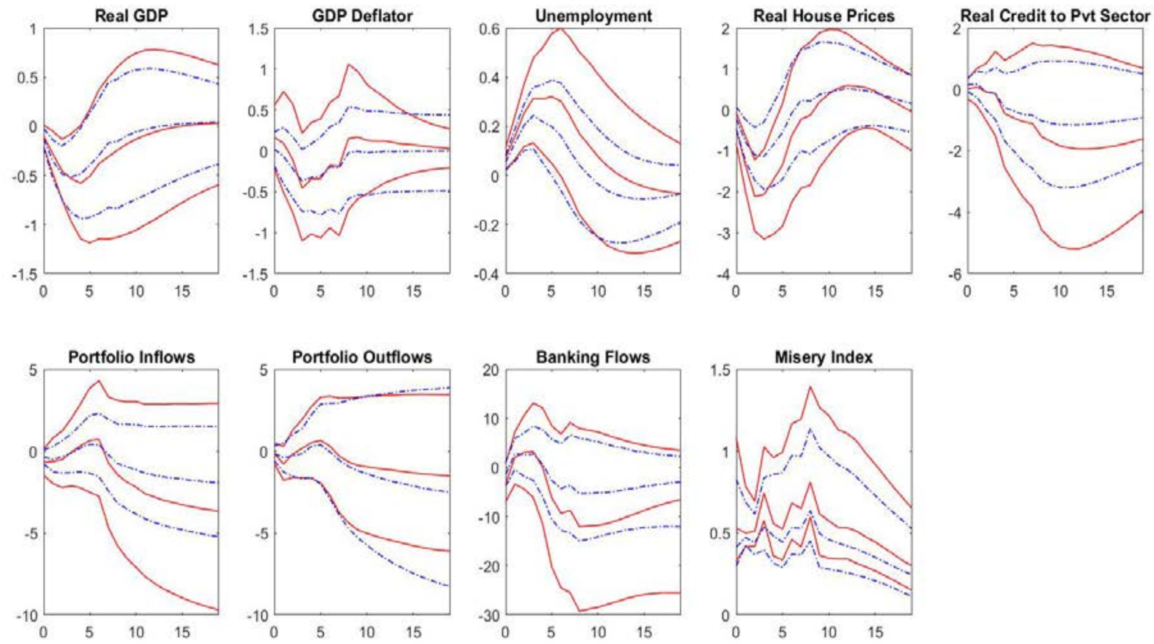
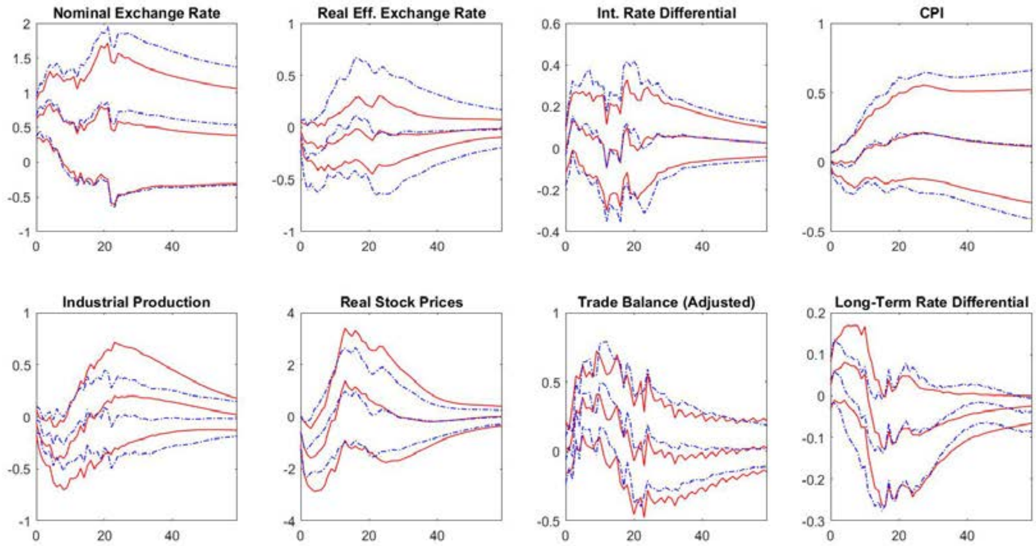


Figure 12: Response of EMEs with high (solid red line) and low US trade exposure (dotted blue line) to US monetary policy shocks

Monthly regressions



Quarterly regressions

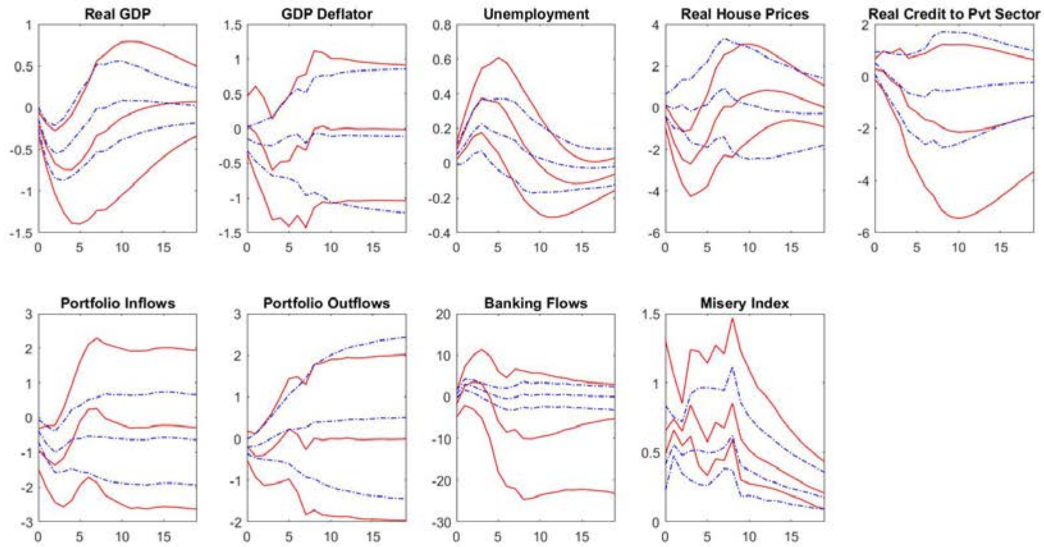
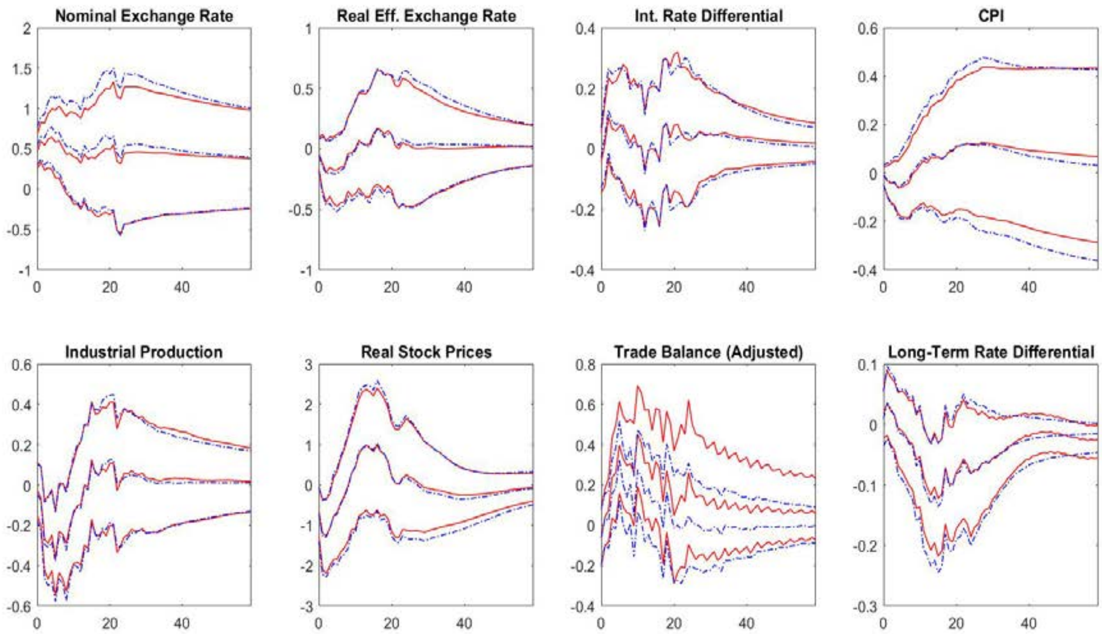
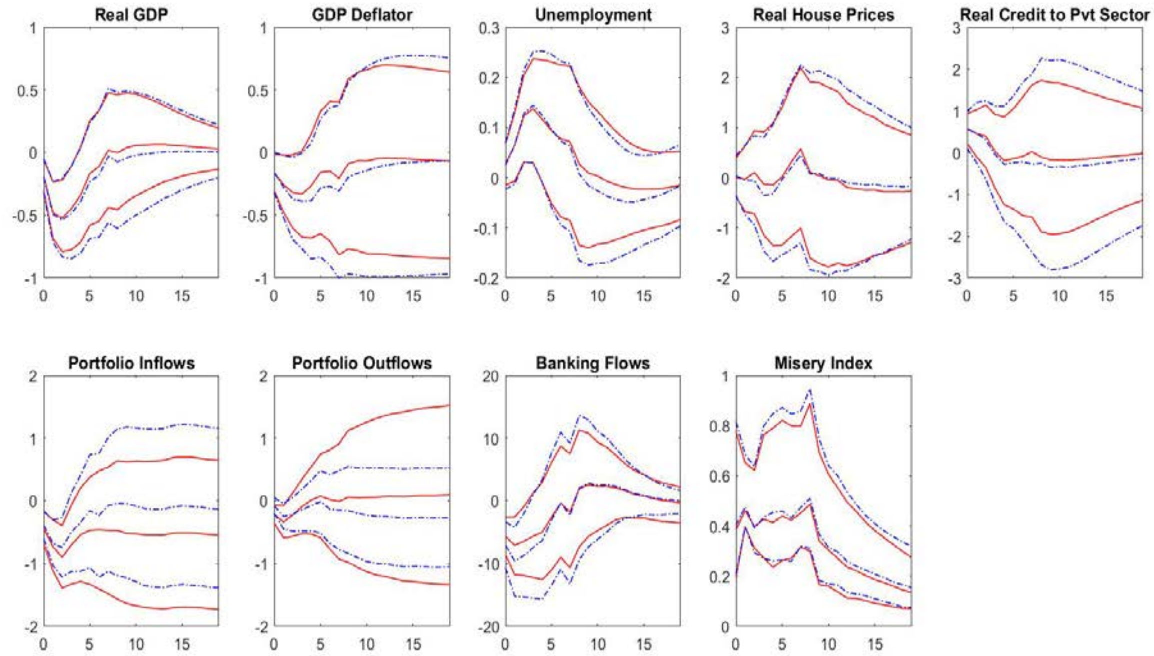


Figure 13: Response of EMEs with high (solid red line) and low dollar financial exposure (dotted blue line) to US monetary policy shocks

A. Monthly regressions



B. Quarterly regressions



Appendix B. Tables

Table 1: Variables used in the BVAR Model

VARIABLE	SOURCE
Federal Funds Rate - US	IMF (IFS)
CPI - US	Haver Analytics
Industrial Production - US	Haver Analytics
Stock Price Index - US (S&P500)	Haver Analytics
Nominal Eff. Exchange Rate - US	Haver Analytics
Corporate Bond Spread - US	Gertler, Karadi (2015)
Mortgage Spread - US	Gertler, Karadi (2015)
Commercial Paper Spread - US	Gertler, Karadi (2015)
1-year Gov.t Bond Yield - US	Haver Analytics
Commodity Prices (TR/J CRB Index)	Haver Analytics
Industrial Production - OECD countries	OECD (MEI)
Stock Price Index - Developed World	Datastream
Short-Term Rate - US (3-month T-bill rate)	IMF (IFS)
Short-Term Rate - Canada (T-bill rate)	IMF (IFS)
Short-Term Rate - Euro Area (3-month Euribor)	ECB and GFD
Short-Term Rate - Japan (Call money rate)	IMF (IFS)
Short-Term Rate - UK (3-month T-bill rate)	IMF (IFS)

Table 2: Correlations between Romer and Romer*'s, Gertler and Karadi (2015)'s and our shocks

Shocks	Mean	Median	Max	Min
R&R with MPS 2013	0,13	0,13	0,39	-0,13
R&R with MPS 2008	0,12	0,12	0,34	-0,12
G&K with MPS 2013	0,15	0,15	0,38	-0,07
G&K with MPS 2008	0,21	0,21	0,43	-0,06
G&K with R&R	0,19			

*The Romer and Romer's shocks are the updated series from Barakchian and Crowe (2013).

Table 3: Short-Term Rate Definition

COUNTRY	**SHORT-TERM RATE**
Australia	Money Market Rate
Brazil	Money Market Rate
Canada	T-bill Rate
Chile	Lending Rate
China	Call Money Rate
Colombia	Discount Rate
Czech Republic	Money Market Rate
Denmark	Call Money Rate
Estonia	Deposit Rate
Euro Area	Euribor (3 months)
Hungary	Deposit Rate
India	Call Money Rate
Japan	Call Money Rate
Korea	Money Market Rate
Latvia	Money Market Rate
Lithuania	Money Market Rate
Malaysia	Money Market Rate
Mexico	Average Cost of Funds
Norway	Interbank Rate (3 months)
Philippines	Lending Rate
Poland	Money Market Rate
Russia	Money Market Rate
South Africa	Money Market Rate
Sweden	Call Money Rate
Thailand	Money Market Rate
Turkey	Deposit Rate
UK	T-bill Rate (3 months)

Table 4: Countries Classifications*

INCOME LEVEL		EXCHANGE RATE REGIME		CAPITAL OPENNESS		INFLOW RESTRICTIONS		DOLLAR EXPOSURE		TRADE OPENNESS	
ADVANCED	**EMERGING**	**FLOATERS**	**DOLLAR PEGS**	**MORE**	**LESS**	**MORE**	**LESS**	**MORE**	**LESS**	**MORE**	**LESS**
Australia	Brazil	Australia	China	Australia	Brazil	Australia	Austria	Belgium	Australia	Australia	Austria
Austria	Chile	Austria	India	Austria	Chile	Brazil	Belgium	Canada	Austria	Belgium	Czech Republic
Belgium	China	Belgium	Malaysia	Belgium	China	Chile	Canada	Chile	Brazil	Brazil	Denmark
Canada	Colombia	Brazil	Mexico	Canada	Colombia	China	Czech Republic	China	Colombia	Canada	Estonia
Denmark	Czech Republic	Canada	Philippines	Czech Republic	Greece	Colombia	Denmark	Czech Republic	Estonia	Chile	Finland
Finland	Estonia	Chile	Thailand	Denmark	Hungary	Finland	France	Denmark	Finland	China	France
France	Hungary	Colombia		Estonia	India	Hungary	Germany	France	Greece	Colombia	Greece
Germany	India	Czech Republic		Finland	Korea	India	Greece	Germany	Hungary	Germany	Hungary
Greece	Latvia	Denmark		France	Malaysia	Korea	Italy	Japan	India	Japan	India
Italy	Lithuania	Estonia		Germany	Mexico	Mexico	Japan	Korea	Italy	Korea	Italy
Japan	Malaysia	Finland		Italy	Norway	Philippines	Latvia	Malaysia	Latvia	Malaysia	Latvia
Korea	Mexico	France		Japan	Philippines	Poland	Netherlands	Netherlands	Lithuania	Mexico	Lithuania
Netherlands	Philippines	Germany		Latvia	Poland	Russia	Norway	Norway	Mexico	Netherlands	Norway
Norway	Poland	Greece		Lithuania	Portugal	South Africa	Portugal	Russia	Philippines	Philippines	Poland
Portugal	Russia	Hungary		Netherlands	Russia	Thailand	Spain	South Africa	Poland	South Africa	Portugal
Spain	South Africa	Italy		Spain	South Africa	Turkey	Sweden	Spain	Portugal	Sweden	Russia
Sweden	Thailand	Japan		Sweden	Thailand		UK	Sweden	Thailand	Thailand	Spain
UK	Turkey	Korea		UK	Turkey			UK	Turkey	UK	Turkey
		Latvia									
		Lithuania									
		Netherlands									
		Norway									
		Poland									
		Portugal									
		Russia									
		South Africa									
		Spain									
		Sweden									
		Turkey									
		UK									

*The sources and references for our classifications are the following:
- Income levels: it is consistent with the one contained in the IMF World Economic Outlook
- Exchange rate regime: based on Klein and Shambaugh (2010)
- Capital openness: based on the de facto classification in Chinn and Ito (2006)
- Inflow restrictions: based on the kai index of Fernandez et al. (2015) (data are not available for Estonia, Lithania and Malaysia)
- Dollar exposure: based on the currency composition of gross assets and liabilities in Lane and Shambaugh (2010)
- Trade openness: based on the sum of exports to and imports from US over GDP with data coming from the IMF

Table 5: Data Samples - Monthly

COUNTRIES	NOMINAL EXCH. RATE	REAL EFF. EXCH. RATE	INT. RATE DIFFERENTIAL	CPI	IND.PRODUCTION	REAL STOCK PRICES	TRADE BALANCE ADJ	10Y GOVT BOND YIELDS
Australia	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	-	-	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Austria	-	Feb 1981 - Dec 2013	-	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Belgium	-	Feb 1981 - Dec 2013	-	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Brazil	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1991 - Dec 2013	Feb 1981 - Dec 2013	Dec 1999 - Dec 2013
Canada	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Chile	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Jan 1990 - Dec 2013	Jan 1996 - Dec 2013	Apr 2007 - Dec 2013
China	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Mar 1990 - Dec 2013	Jan 1993 - Dec 2013	Jan 1997 - Dec 2013	Jan 1993 - Dec 2013	Oct 1983 - Dec 2013	Jun 1992 - Dec 2013
Colombia	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Jan 1990 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Oct 2002 - Dec 2013
Czech Republic	Jan 1993 - Dec 2013	Jan 1990 - Dec 2013	Jan 1993 - Dec 2013	Jan 1993 - Dec 2013	Jan 1990 - Dec 2013	Jan 1994 - Dec 2013	Jan 1991 - Dec 2013	Apr 2000 - Dec 2013
Denmark	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Jan 1987 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Estonia	Jan 1994 - Dec 2013	Jan 1994 - Dec 2013	Feb 1993 - Dec 2013	Jan 1992 - Dec 2013	Jan 1998 - Dec 2013	Jun 1996 - Dec 2013	Jan 1993 - Dec 2013	Apr 1997 - Dec 2013
Euro Area	Jan 1999 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Jan 1990 - Dec 2013	Jan 1991 - Dec 2013	Jan 1990 - Dec 2013	Jan 1990 - Dec 2013	Feb 1981 - Dec 2013
Finland	-	Feb 1981 - Dec 2013	-	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
France	-	Feb 1981 - Dec 2013	-	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Germany	-	Feb 1981 - Dec 2013	-	Jan 1991 - Dec 2013	Feb 1981 - Dec 2013	Jan 1991 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Greece	-	Feb 1981 - Dec 2013	-	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Jan 1985 - Dec 2013	Feb 1981 - Dec 2013	Sep 1992 - Dec 2013
Hungary	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Jan 1985 - Dec 2013	Jan 1991 - Dec 2013	Feb 1981 - Dec 2013	Jun 1999 - Dec 2013
India	Feb 1981 - Dec 2013	Jan 1994 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Italy	-	Feb 1981 - Dec 2013	-	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Japan	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Korea	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Oct 2000 - Dec 2013
Latvia	Feb 1992 - Dec 2013	Jan 1994 - Dec 2013	Aug 1993 - Dec 2013	Jan 1992 - Dec 2013	Jan 2000 - Dec 2013	Apr 1996 - Dec 2013	Jan 1995 - Dec 2013	Dec 1998 - Dec 2013
Lithuania	Jan 1992 - Dec 2013	Jan 1994 - Dec 2013	Dec 1993 - Dec 2013	May 1992 - Dec 2013	Dec 1995 - Dec 2013	Jan 2001 - Dec 2013	Jan 1994 - Dec 2013	Jan 1997 - Dec 2013
Malaysia	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	-	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Mexico	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Jul 2001 - Dec 2013
Netherlands	-	Feb 1981 - Dec 2013	-	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Norway	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Philippines	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Jan 1998 - Dec 2013	Jan 1987 - Dec 2013	Feb 1981 - Dec 2013	Feb 2001 - Dec 2013
Poland	Feb 1981 - Dec 2013	Jan 1988 - Dec 2013	Dec 1990 - Dec 2013	Jan 1988 - Dec 2013	Jan 1985 - Dec 2013	May 1991 - Dec 2013	Aug 1989 - Dec 2013	May 1999 - Dec 2013
Portugal	-	Feb 1981 - Dec 2013	-	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Jan 1988 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Russia	Jun 1992 - Dec 2013	Nov 1993 - Dec 2013	Jan 1996 - Dec 2013	Jan 1992 - Dec 2013	Jan 1993 - Dec 2013	Sep 1997 - Dec 2013	Jun 1992 - Dec 2013	Dec 1996 - Dec 2013
South Africa	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Spain	-	Feb 1981 - Dec 2013	-	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Sweden	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Thailand	Feb 1981 - Dec 2013	Jan 1994 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Jan 2000 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013
Turkey	Feb 1981 - Dec 2013	Jan 1994 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Jan 1986 - Dec 2013	May 1990 - Dec 2013	Dec 2005 - Dec 2013
UK	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013	Feb 1981 - Dec 2013

Table 6: Data Samples - Quarterly

COUNTRIES	REAL GDP	GDP DEFLATOR	UNEMPLOYMENT	HOUSE PRICES	CREDIT TO PVT SECTOR	PORTFOLIO INFLOWS / GDP$	PORTFOLIO OUTFLOWS / GDP$	BANK INFLOWS / GDP$
Australia	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1999 - Q4 2013
Austria	Q1 1988 - Q4 2013	Q2 1981 - Q4 2013	Q1 1994 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1996 - Q4 2013	Q1 1996 - Q4 2013	Q4 1999 - Q4 2013
Belgium	Q2 1981 - Q4 2013	Q1 1995 - Q4 2013	Q1 1983 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 2002 - Q4 2013	Q1 2002 - Q4 2013	Q4 1999 - Q4 2013
Brazil	Q1 1990 - Q4 2013	Q1 1994 - Q4 2013	Q4 2001 - Q4 2013	-	Q4 1989 - Q4 2013	Q3 1994 - Q4 2013	Q4 1994 - Q4 2013	Q4 1999 - Q4 2013
Canada	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1999 - Q4 2013
Chile	Q1 1992 - Q4 2013	Q1 1996 - Q4 2013	Q1 1986 - Q4 2013	-	Q2 1981 - Q4 2013	Q1 1991 - Q4 2013	Q2 1993 - Q4 2013	Q4 1999 - Q4 2013
China	Q1 1992 - Q4 2013	Q1 1992 - Q4 2013	Q1 2000 - Q4 2013	-	Q1 1991 - Q4 2013	-	-	Q4 1999 - Q4 2013
Colombia	Q1 1995 - Q4 2013	Q1 2000 - Q4 2013	Q1 2001 - Q4 2013	-	Q2 1981 - Q4 2013	Q1 1996 - Q4 2013	Q1 1996 - Q4 2013	Q4 1999 - Q4 2013
Czech Republic	Q1 1995 - Q4 2013	Q1 1996 - Q4 2013	Q1 2005 - Q4 2013	Q1 1993 - Q4 2013	Q1 1991 - Q4 2013	Q1 1995 - Q4 2013	Q3 1996- Q4 2013	Q4 1999 - Q4 2013
Denmark	Q2 1981 - Q4 2013	Q1 1991 - Q4 2013	Q1 1983 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1990 - Q4 2013	Q1 1990 - Q4 2013	Q4 1999 - Q4 2013
Estonia	Q4 1993 - Q4 2013	Q1 1993 - Q4 2013	Q1 1989 - Q4 2013	Q1 2005 - Q4 2013	Q1 1992 - Q4 2013	-	-	-
Euro Area	Q1 1995 - Q4 2013	Q1 1995 - Q4 2013	Q2 1998 - Q4 2013	Q1 1990 - Q4 2013	Q3 1997 - Q4 2013	Q1 1998 - Q4 2013	Q1 1998 - Q4 2013	-
Finland	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1988 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1999 - Q4 2013
France	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1983 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1999 - Q4 2013
Germany	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1991 - Q4 2013	Q2 1981 - Q4 2013	Q1 1991 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1999 - Q4 2013
Greece	Q1 1995 - Q4 2013	Q2 1981 - Q4 2013	Q2 1998 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1999 - Q4 2013	Q1 1999 - Q4 2013	Q4 1999 - Q4 2013
Hungary	Q1 1995 - Q4 2013	Q1 1995 - Q4 2013	Q1 2001 - Q4 2013	Q1 1991 - Q4 2013	Q4 1982 - Q4 2013	Q1 1995 - Q4 2013	Q2 1995 - Q4 2013	Q4 1999 - Q4 2013
India	Q2 1996 - Q4 2013	Q2 1996 - Q4 2013	Q2 1981 - Q4 2013	-	Q2 1981 - Q4 2013	Q2 1996 - Q4 2013	Q2 2006 - Q4 2013	Q4 1999 - Q4 2013
Italy	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1983 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1999 - Q4 2013
Japan	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1999 - Q4 2013
Korea	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q3 1982 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1988 - Q4 2013	Q4 1999 - Q4 2013
Latvia	Q1 1990 - Q4 2013	Q1 1990 - Q4 2013	Q1 1993 - Q4 2013	Q1 2006 - Q4 2013	Q3 1993 - Q4 2013	Q1 1996 - Q4 2013	Q1 1995 - Q4 2013	Q4 1999 - Q4 2013
Lithuania	Q4 1993 - Q4 2013	Q1 1995 - Q4 2013	Q1 1993 - Q4 2013	Q1 2006 - Q4 2013	Q1 1993 - Q4 2013	Q1 1995 - Q4 2013	Q1 1995 - Q4 2013	Q4 1999 - Q4 2013
Malaysia	Q1 1989 - Q4 2013	Q1 1991 - Q4 2013	Q1 1998 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1999 - Q4 2013	Q1 1999 - Q4 2013	Q4 1999 - Q4 2013
Mexico	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 2000 - Q4 2013	Q1 2005 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1999 - Q4 2013
Netherlands	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1983 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1999 - Q4 2013
Norway	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1989 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1999 - Q4 2013
Philippines	Q4 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1984 - Q4 2013	-	Q2 1981 - Q4 2013	Q2 1987 - Q4 2013	Q2 1991 - Q4 2013	Q4 1999 - Q4 2013
Poland	Q2 1995 - Q4 2013	Q3 1995 - Q4 2013	Q1 1990 - Q4 2013	Q1 1989 - Q4 2013	Q1 1992 - Q4 2013	Q1 2000 - Q4 2013	Q1 2000 - Q4 2013	Q4 1999 - Q4 2013
Portugal	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1983 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1986 - Q4 2013	Q1 1992 - Q4 2013	Q4 1999 - Q4 2013
Russia	Q1 1995 - Q4 2013	Q1 1995 - Q4 2013	Q1 1994 - Q4 2013	Q1 2000 - Q4 2013	Q4 1993 - Q4 2013	Q3 1995 - Q4 2013	Q3 1995 - Q4 2013	Q4 1999 - Q4 2013
South Africa	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 2000 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1985 - Q4 2013	Q1 1986 - Q4 2013	Q4 1999 - Q4 2013
Spain	Q2 1981 - Q4 2013	Q1 1995 - Q4 2013	Q2 1986 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1981 - Q4 2013	Q4 1999 - Q4 2013
Sweden	Q2 1981 - Q4 2013	Q1 1993 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1993 - Q4 2013	Q1 1993 - Q4 2013	Q4 1999 - Q4 2013
Thailand	Q1 1993 - Q4 2013	Q1 1993 - Q4 2013	Q1 2001 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1993 - Q4 2013	Q1 1997 - Q4 2013	Q4 1999 - Q4 2013
Turkey	Q1 1987 - Q4 2013	Q1 1987 - Q4 2013	Q1 2005 - Q4 2013	-	Q1 1986 - Q4 2013	Q1 2007 - Q4 2013	Q1 2007 - Q4 2013	Q1 2007 - Q4 2013
UK	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q1 1983 - Q4 2013	Q2 1981 - Q4 2013	Q3 1986 - Q4 2013	Q2 1981 - Q4 2013	Q2 1981 - Q4 2013	Q4 1999 - Q4 2013

Table 7: Data Sources - Monthly*

COUNTRIES	NOMINAL EXCH. RATE	REAL EFF. EXCH. RATE	INT. RATE DIFFERENTIAL	CPI	IND.PRODUCTION	REAL STOCK PRICES	TRADE BALANCE ADJ	10Y GOVT BOND YIELDS
Australia	IMF (IFS)	BIS	IMF (IFS)	-	-	IMF (IFS)[§]	OECD (MEI)	Reuters
Austria	-	IMF (IFS)	-	IMF (IFS)	IMF (IFS)	IMF (IFS)	Haver Analytics	ECB
Belgium	-	IMF (IFS)	-	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	ECB
Brazil	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	IMF (IFS)	Haver Analytics	Datastream
Canada	IMF (IFS)	BIS	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	GFD
Chile	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	OECD (MEI)	OECD (MEI)	OECD (MEI)	Datastream
China	IMF (IFS)	IMF (IFS)	OECD (MEI)	OECD (MEI)	Haver Analytics	IMF (IFS)	Haver Analytics	Datastream
Colombia	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	Haver Analytics	IMF (IFS)	Haver Analytics	Datastream
Czech Republic	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	OECD (MEI)	OECD (MEI)	Reuters
Denmark	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	BIS	IMF (IFS)	GFD
Estonia	BIS	BIS	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	GFD
Euro Area	IMF (IFS)	IMF (IFS)	ECB, GFD	ECB	Haver Analytics	OECD (MEI)	OECD (MEI)	OECD (MEI)
Finland	-	IMF (IFS)	-	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	GFD
France	-	IMF (IFS)	-	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	ECB
Germany	-	IMF (IFS)	-	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	ECB
Greece	-	IMF (IFS)	-	IMF (IFS)	OECD (MEI)	OECD (MEI)	OECD (MEI)	ECB
Hungary	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	IMF (IFS)	Reuters
India	IMF (IFS)	BIS	OECD (MEI)	IMF (IFS)	Haver Analytics	IMF (IFS)	IMF (IFS)	GFD
Italy	-	IMF (IFS)	-	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	ECB
Japan	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	ECB
Korea	IMF (IFS)	BIS	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	GFD
Latvia	IMF (IFS)	BIS	IMF (IFS)	IMF (IFS)	Haver Analytics	IMF (IFS)	Haver Analytics	GFD
Lithuania	IMF (IFS)	BIS	IMF (IFS)	IMF (IFS)	Haver Analytics	IMF (IFS)	Haver Analytics	GFD
Malaysia	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	-	BIS	IMF (IFS)	GFD
Mexico	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	GFD
Netherlands	-	IMF (IFS)	-	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	ECB
Norway	IMF (IFS)	IMF (IFS)	OECD (MEI)	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	GFD
Philippines	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	Haver Analytics[+]	BIS	IMF (IFS)	Datastream
Poland	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	OECD (MEI)	OECD (MEI)	GFD
Portugal	-	IMF (IFS)	-	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	ECB
Russia	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	IMF (IFS)	OECD (MEI)	GFD
South Africa	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	BIS	IMF (IFS)	IMF (IFS)	GFD
Spain	-	IMF (IFS)	-	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	ECB
Sweden	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	IMF (IFS)	IMF (IFS)	GFD
Thailand	IMF (IFS)	BIS	IMF (IFS)	IMF (IFS)	Haver Analytics	BIS	IMF (IFS)	IMF (IFS)
Turkey	IMF (IFS)	BIS	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	OECD (MEI)	BIS
UK	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	IMF (IFS)	GFD

* The following acronyms have been used: BIS: Bank for International Settlements; ECB: European Central Bank; GFD: Global Financial Data database; IMF (IFS) : International financial statistics database of the International Monetary Fund; OECD (MEI): Main economic indicators database of the Organization for Economic Cooperation and Development.

[+] Philippines: Industrial production of the manufacturing sector.

[§] Australia: Nominal stock prices.

Table 8: Data Sources - Quarterly*

COUNTRIES	REAL GDP	GDP DEFLATOR	NOMINAL GDP IN $	UNEMPLOYMENT	HOUSE PRICES	CREDIT TO PVT. SECTOR	PORTFOLIO INFLOWS	PORTFOLIO OUTFLOWS	BANK INFLOWS
Australia	Datastream	Datastream	Haver Analytics	Haver Analytics	Oxford Economics	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Austria	Haver Analytics	IMF (IFS)	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Belgium	GFD	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Brazil	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	-	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Canada	Haver Analytics	IMF (IFS)	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Chile	GFD	IMF (IFS)	Haver Analytics	OECD (MEI)	-	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
China	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	-	IMF (IFS)	-	-	BIS (CBS - ibb)
Colombia	GFD	Haver Analytics	Haver Analytics	Haver Analytics	-	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Czech Republic	GFD	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Denmark	GFD	Haver Analytics	Haver Analytics	Haver Analytics	BIS	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Estonia	GFD	IMF (IFS)	-	Haver Analytics	Eurostat	IMF (IFS)	-	-	-
Euro Area	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	-
Finland	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
France	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Germany	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Greece	Datastream	OECD (MEI)	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Hungary	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
India	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	-	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Italy	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Japan	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Korea	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Latvia	GFD	IMF (IFS)	Haver Analytics	Haver Analytics	Eurostat	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Lithuania	GFD	Haver Analytics	Haver Analytics	Haver Analytics	Eurostat	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Malaysia	GFD	Haver Analytics	Haver Analytics	Oxford Economics	Oxford Economics	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Mexico	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Netherlands	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Norway	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Philippines	GFD	Haver Analytics	Haver Analytics	Haver Analytics	-	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Poland	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Portugal	GFD	IMF (IFS)	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Russia	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
South Africa	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	Haver Analytics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Spain	GFD	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Sweden	GFD	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Thailand	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Oxford Economics	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
Turkey	Haver Analytics	Haver Analytics	Haver Analytics	OECD (MEI)	-	BIS (TCS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)
UK	Haver Analytics	Haver Analytics	Haver Analytics	Haver Analytics	Datastream	IMF (IFS)	IMF (BOP)	IMF (BOP)	BIS (CBS - ibb)

*The following acronyms have been used: BIS: Bank for International Settlements; BIS (CBS - ibb): Consolidated banking statistics database (on immediate borrower basis) of the Bank for International Settlements; BIS (TCS): Total credi statistics database of the Bank for International Settlements; GFD: Global Financial Data database; IMF (BOP) : Balance of payment statistics database of the International Monetary Fund; IMF (IFS) : International financial statistics database of the International Monetary Fund; OECD (MEI): Main economic indicators database of the Organization for Economic Cooperation and Development.