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Ursel Baumann, David Lodge, Mirela S. Miescu

Global growth on life support? The contributions of fiscal and monetary policy since the global financial crisis

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Abstract

This paper compares the role of monetary and fiscal policy shocks in advanced and emerging economies. Using a model with a hierarchical structure we capture the variability of GDP response to policy shocks both between and within the groups of advanced and emerging countries. Our results provide evidence that fiscal policy effects are heterogeneous across countries, with higher multipliers in advanced economies compared to emerging markets, while monetary policy is found to have more homogeneous effects on GDP. We then quantify the policy contribution on GDP growth in the last decade by means of a structural counterfactual analysis based on conditional forecasts. We find that global GDP growth benefited from substantial policy support during the global financial crisis but policy tightening thereafter, particularly fiscal consolidation, acted as a significant drag on the subsequent global recovery. In addition we show that the role of policy has differed across countries. Specifically, in advanced economies, highly accommodative monetary policy has been counteracted by strong fiscal consolidation. By contrast, in emerging economies, monetary policy has been less accommodative since the global recession.

JEL Classification: C32, E42, E52

Keywords: fiscal policy, monetary policy, panel VAR, conditional forecast.

Non-technical summary

Strong policy support was necessary to reignite the economic recovery from the 2008 global financial crisis. In part reflecting different economic conditions and challenges, the policy response across advanced and emerging market economies (EMEs) was somewhat heterogeneous. Up to now, very little attention has been paid to analyzing the differences (or similarities) in the role played by policy support in advanced economies and EMEs. A deeper understanding of how policy contributed across both groups of countries would benefit both policymakers and academics.

Our paper provides a contribution to this end by analyzing the combined role of fiscal and monetary policies in shaping global growth since the global financial crisis. We estimate panel VARs at quarterly frequency with Bayesian methods, using so-called hierarchical priors for two different groups (advanced economies and EMEs), to evaluate and compare the effect of policy on real GDP growth. The group of advanced economies includes the United States, euro area, United Kingdom and Japan and covers the period 1998 to 2016, while the EME group is composed of Brazil, China, India and Russia, covering the period 2000 to 2016. To discern the effect of fiscal and monetary policy on GDP growth, we use counterfactual scenarios in a structural setting. In addition, we study the interaction and interdependency of the two branches of macroeconomic policy over the past decade.

Our main findings are summarized as follows. Consistent with previous studies we find that fiscal multipliers are mostly higher in advanced economies compared to EMEs. Meanwhile, activity in emerging economies is affected somewhat more strongly than in advanced economies following a contractionary monetary shock. In addition, the response of GDP to fiscal shocks is more heterogeneous (between and within groups) than the response of GDP to monetary policy shocks.

Turning to the conditional scenarios, our results suggest that GDP growth in our sample of countries benefited from substantial policy support during the global financial crisis. But policy tightened thereafter as fiscal consolidation in advanced economies acted as a significant drag on the subsequent global recovery. Moreover, the role of policy has differed across countries. Specifically, in advanced economies, highly accommodative monetary policy has been counteracted by strong fiscal consolidation.

By contrast, in EMEs, monetary policy has been less accommodative since the global recession. From 2016, global policies have become more supportive overall, consistent with the observed improvement in global activity in that period. However, the reliance of the global recovery on policy support underscores the need for a gradual and calibrated withdrawal of policy accommodation.

Finally, our results emphasize an important interdependence between monetary and fiscal policies. Counterfactual scenarios undertaken for the United States suggest that without the fiscal policy reaction, monetary policy would have needed to be significantly more accommodative during the financial crisis. Thereafter, however, fiscal consolidation has required monetary policy accommodation for longer. Indeed, without the fiscal consolidation undertaken after 2011, interest rates could have risen above the zero lower bound already in 2013. This also implies that without monetary policy support the strong fiscal consolidation would not have been possible without causing a significant slowdown in US growth.

1 Introduction

In the aftermath of the 2008 global financial crisis, the design of an effective policy response became the main priority around the world. Spurred by policy commitments at the 2009 G20 London Summit, central bank and government interventions addressed macroeconomic instability and slumping demand with substantial policy support including (standard and non-standard) monetary policies and fiscal stimulus (Figure 1). Since then, debate has raged over the efficacy, efficiency and appropriateness of the response. To name but a few, the topics have covered the role of the mix between fiscal and monetary policies (Krugman, 2015); the benefits of unconventional monetary policies (Borio and Zabai, 2016); and the long-term consequences of the policy response (IMF, 2017a).

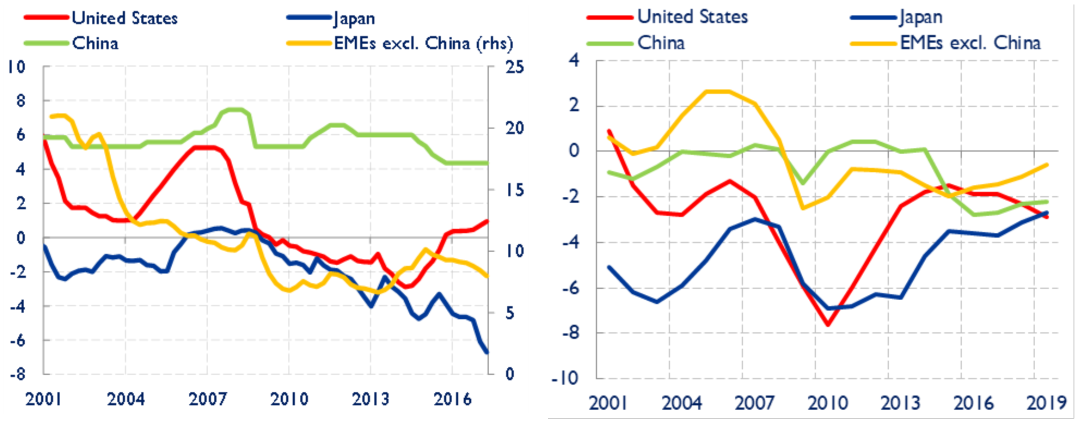
In recent years, however, priorities have gradually changed. Growth in global activity has revived over the past two years as the cyclical upswing gathers strength (IMF, 2017b). Spare capacity across many economies has narrowed substantially and policymakers have turned their attention towards policy normalisation. Albeit gradually, the 'long decade' of policy accommodation is apparently drawing to a close. Yet, as policymakers edge at different speeds towards the stages of policy withdrawal, it is crucial for them and us to understand the extent to which the global economy is still dependent on policy support. Too quick a withdrawal could force the economy into a sharp reversal; too slow could store up future troubles. This paper aims to understand the role of policies in supporting activity over the past decade.

Up to now, very little attention has been paid to analysing the differences (or similarities) in the role played by policy support in advanced and emerging economies. This is an important topic for research and policymakers. The global financial crisis affected advanced and emerging economies differently and required tailored policy responses. Facing a severe turmoil in their financial markets many advanced economies confronted a deep and long-lasting slowdown in activity. Some faced the challenges of operating monetary policy at the zero lower bound; in subsequent years, others were confronted with market-driven or politically necessitated fiscal consolidation. By contrast, partly be-

Figure 1: Policy intervention. Stylized facts.

(a) Key policy interest rates (percent)

(b) Cyclically adjusted primary balances (percent of GDP)



cause emerging market economies rebounded more quickly in the immediate aftermath of the global recession, the policy response differed (ECB, 2016). A deeper understanding of how policy contributed across both groups would benefit both policymakers and academics.

This paper aims to contribute to this growing area of research by exploring the heterogeneity in policy effects across groups of countries. Using structural panel VARs in the spirit of Jarocinski (2010) we examine the joint role of fiscal and monetary policies in shaping global growth since the global financial crisis in both advanced and emerging economies. As Caldara and Kamps (2008) note, vector autoregressive (VAR) models have become a key econometric tool to assess the effects of monetary and fiscal policy shocks. Our paper is therefore related to the wide literature on the identification of monetary and fiscal policy shocks, which are well summarized in Ramey (2016).

The contribution of our work to the literature is fourfold. First, we estimate and compare the effects of policy across a range of advanced and emerging market economies (EMEs). We estimate structural panel VARs for a set of large advanced and emerging economies (US, euro area, UK, Japan, Brazil, China, India and Russia), which together represent over half of global GDP (at purchasing power parity).

While the literature on the effects of either monetary or fiscal policy in individual countries is vast (see Ramey, 2016), fewer papers have provided comparisons of policy transmission across countries. For monetary policy, Jarocinski (2010) compares the responses of monetary policy shocks in the east and west of Europe, while Mandler et al. (2016) examine the heterogeneity across countries within the European Monetary Union. There has been more limited investigation into the effects of monetary policy in EMEs. Mallik and Sousa (2012) analyze responses in large emerging markets. Perez-Forero (2015) compares the transmission of monetary policy shocks in Latin America using a hierarchical panel VAR. On the fiscal side, Burriel et al. (2009) compare the responses of the United States and euro area to fiscal shocks. Ilzetzki et al. (2013) find that the output effect of an increase in government consumption is larger in industrial than in developing countries.

Second, we look at effects of fiscal and monetary policy in combination. Particularly for studies using VARs, the literature has tended to examine fiscal and monetary policies in isolation. The Christiano, Eichenbaum and Evans (1999), Handbook of Macroeconomics chapter, for example, concentrates on the identification of monetary policy shocks, while Ramey (2016) devotes separate sub-sections to the topics of fiscal and monetary shock identification. Other leading types of externally identified monetary policy shocks such as the Romer and Romer (2004) narrative method, or the high frequency identification of Gertler and Karadi (2015) also focus narrowly on the question of understanding monetary policy effects. The picture is similar for fiscal policy: for example, Blanchard and Perotti (2002) focus only on the role of government spending and tax shocks. In examining the role of fiscal shocks in the United States, Caldara and Kamps (2008) include interest rate variables within the VAR specification but report only the economic responses to government spending and tax shocks under a variety of identification approaches. The policy response to the global crisis required monetary and fiscal action in an effort to boost the demand. Separating monetary and fiscal policy overlooks the potential policy interactions. Our study aims to understand the combined role of both forms of policy.

Third, to discern the effect of fiscal and monetary policy on GDP growth we use counterfactual scenarios in a structural setting. We compare model forecasts conditioned on actual policy developments with forecasts conditioned on a counterfactual policy path. We judge the impact of policy on activity by assessing the difference in projected paths for GDP growth in the two scenarios across our sample of countries. In effect, we ask: what would have happened to the economy without the observed policy easing? Kapetanios et al. (2012) and Lenza et al. (2010) conduct similar exercises in examining the role of monetary policy in the UK and the US, euro area and UK respectively. However, both approaches rely on the reduced-form model to inform the conditional scenarios used. Our counterfactual exercise takes a different approach by relying on the structural form of the model, attributing outcomes for policy specifically to the relevant monetary and fiscal shocks identified in our model. A particular advantage of our approach, in using structural conditional forecasts, is that it captures the variability in the GDP response to shocks (through identification of shocks).

Finally, we study the interaction and interdependency of the two branches of macroeconomic policy over the past decade. A number of recent papers (Bianchi and Ilut, 2017; Bianchi and Melosi, 2017; Corsetti et al, 2016; Jarociński and Maćkowiak, 2018) emphasize the relevance of analyzing the policy mix for economic outcomes. Our contribution is to use counterfactual scenarios to understand the role of different policies in the recent period, asking the questions: how might monetary policy have behaved if fiscal policy had been conducted differently?; and how strong would fiscal support have needed to be, had monetary policy been less accommodative? In asking these questions we aim to provide an understanding of the interdependencies of policies and the effect on activity over the past decade.

In analysing monetary and fiscal transmission across countries, we employ an econometric technique that allows us to analyze countries jointly within panel models. We estimate separate models for the two groups of advanced and emerging economies and, following Jarocinski (2010), use Bayesian estimation. The approach employs so-called hierarchical priors which have the assumption that parameters are drawn from a common mean across each group, but allow for heterogeneity in the coefficients via the hierarchical prior which is endogenously determined and governs the degree of heterogeneity across individuals. In doing so, it makes efficient use of available data. In particular, for EMEs for which time series are relatively short, this is a considerable advantage. A further benefit is that the approach can reveal heterogeneity in the propagation mechanism within each group and also between different policy tools.

Our main results can be summarised thus. Consistent with previous studies we find that fiscal multipliers are mostly higher in advanced economies compared to EMEs. We also show that in the last two decades AEs have conducted an active monetary policy which has tended to offset the effects of expansionary government spending measures. In contrast we see less strong reaction of monetary policy to fiscal policy shocks in EMEs. The response of GDP in EMEs to monetary policy shocks is also broadly in line with the literature, with activity in emerging economies affected somewhat more strongly than in advanced economies following a contractionary monetary shock. Moreover, we find that the GDP response to fiscal shocks is more heterogeneous (between and within groups) than the response of GDP to monetary policy shocks.

Turning to the conditional scenarios, we find that GDP growth in our sample of countries benefited from substantial policy support during the global financial crisis but policy tightened thereafter, particularly as fiscal consolidation in advanced economies acted as a significant drag on the subsequent global recovery. Since 2016, policies have become more supportive overall. That is consistent with the observed improvement in global activity in that period although it also emphasizes that the global recovery has been reliant on policy support and underscores the need for a gradual and calibrated withdrawal of policy accommodation. In addition we show that the role of policy has differed across countries. Specifically, in advanced economies, highly accommodative monetary policy has been counteracted by strong fiscal consolidation since 2011. By contrast, in EMEs, monetary policy has been less accommodative since the global recession.

Finally, our results emphasise an important interdependence between monetary and fiscal policies. Counterfactual scenarios undertaken for the United States suggest that without the fiscal policy reaction, monetary policy would have needed to be significantly more accommodative during the financial crisis. Thereafter, however fiscal consolidation has required monetary policy accommodation for longer. Indeed, without the fiscal consolidation undertaken after 2011, interest rates could have risen above the zero lower bound already in 2013. This also implies that without monetary policy support the strong fiscal consolidation would not have been possible without causing a significant slowdown in US growth. .

The paper is organized as follows. Section 2 introduces the methodology and the data. Section 3 reports the results. Additional robustness checks are conducted in section 4 while section 5 concludes.

2 Methodology and data

This section introduces the empirical model, the data and the identification strategy.

2.1 Empirical model and the data

We estimated the following reduced form VAR model for country c:

$$Y_{tci} = \sum_{p=1}^{l} Y_{t-p,ci}\beta_{ci}^{p} + Z_t\Phi_t + u_{tci} \tag{1}$$

$$u_{tci} \sim N(0, \Omega_{ci}) \tag{2}$$

where i denotes the group of countries (advanced vs. emerging economies), c= 1,2,...M is the number of countries in each group and t=1,2,...T is the sample size. For the estimation purpose we rely on a hierarchical panel VAR framework in the spirit of Jarocinski (2010); a separate model is estimated for each group using Bayesian Methods.

Y_c is a $T \times 5$ matrix of endogenous variables for country c and includes a proxy for government spending, GDP, inflation, tax and a monetary policy instrument. Government spending measures real government consumption and investment – i.e it excludes the elements such as transfers (e.g. unemployment benefits) which would depend on the business cycle; we also exclude interest payments.[1] Government revenues are measured as taxes less transfers and (where possible) interest payments. The monetary policy instrument is the policy interest rate.[2] For the advanced economies we address the additional restrictions caused by the zero lower bound (ZLB) using a shadow interest rate for the period from the end of 2008 (Wu and Xia, 2014 and Lemke et al. 2017). One concern that might arise is that the ZLB regime could imply a change in the model parameters. However, several studies that analyze the effects of unconventional monetary policy seem to suggest that model parameters have remained broadly stable despite the introduction of unconventional measures (Gambacorta et al. 2014; Wu and Xia, 2016; Hachula et al. 2016).

To account for the world developments, we add Z_t, a $T \times 5$ matrix of exogenous variables common to all countries containing the VIX index of equity volatility, world GDP, non-oil commodity prices, oil prices and a constant. It is worth noting that the exogenous variables in Z enter the model at time t while all the other regressors represented by a $T \times 5 \times l$ matrix are lagged values of the endogenous variables Y_c. All variables are transformed in year on year growth rates, with the exception of the monetary policy instrument. The data we use is at quarterly frequency and runs from 1998 to 2016 for AEs (US, euro area, Japan and UK) and from 2000 to 2016 for EMEs (China, Brazil, India, Russia). The lag length l is set to 5 for AEs and 6 for EMEs [3]. We relegate to the Appendix a detailed description of the data.

A key feature of this model is that it allows the β coefficients to vary across individual countries as opposed to the standard pooled estimator which ignores cross section hetero-

[1] For EMEs group, due to the lack of data on government investment we rely on government consumption to proxy the government spending.

[2] For the EMEs group, where the conduct of monetary policy has changed over time we add also the monetary aggregate M2. This helps alleviate the price puzzle. A sensitivity analysis shows that this adjustment has a rather limited impact on GDP response to policy shocks.

[3] Both the marginal Likelihood and Deviance Information Criteria (see Table S3) estimated separately for each country prefer models with a number of lags greater than 4. We adopted 6 lags for EMEs since it alleviates the price puzzle. For AEs the model with both 5 and 6 lags provides IRFs with correct sign and similar magnitude but in the model with 6 lags GDP response to monetary policy shock display some persistence which might have undesired effects on the counterfactual scenario. As such for AEs we prefer a model with 5 lags. The sensitivity section addresses the robustness of results to the lag length.

geneity. The unit specific coefficients are obtained by imposing a hierarchical structure to the model. Specifically, it is assumed that the prior distribution for the VAR coefficients β_c is defined as follows:

$$p(\beta_{ci} \mid \bar{\beta}_i, \lambda) \sim N(\bar{\beta}_i, \lambda \Omega_i) \tag{3}$$

where $\bar{\beta}_i$ are cross sectional average coefficients updated during the sampling procedure. Ω_i is a Minnesota type variance which reflects the scale of the variables and adjusts for the relative size of coefficient[4]. The crucial parameter in this setting is λ which controls the degree of heterogeneity in the model. As $\lambda \to \infty$ the coefficients collapse to the country specific VAR values while for $\lambda = 0$ the model is equivalent to the pooled estimator. Ideally, λ should reflect a good balance between individual and pooled estimates. In a standard Bayesian framework $\bar{\beta}_i$ and λ are calibrated parameters while in the current context they are treated as random variables and have their own distribution.

In brief, equation (3) reveals the prior knowledge that country coefficients are assumed to be drawn from a common distribution centered around the cross sectional mean but are allowed to deviate from this mean at a higher or lower degree dictated by the value of the endogenously determined parameter λ which is common across units. Therefore, the posterior of β_c is a weighted average of the country OLS estimates and the prior mean defined in (3).

The hierarchical structure of the model offers two key advantages that are relevant to our study. First the group specific average impulse response function can be computed using the mean model coefficients $\bar{\beta}_i$ to obtain the estimates. This allows the comparison of the GDP response to policy shocks in advanced versus emerging economies as a group. Moreover, $\bar{\beta}_i$ contains information from the whole panel (and not only one country time-series) and is updated during the sampling procedure; these features are likely to improve the estimation precision. In addition, the hierarchical prior tends to shrink the country

[4] As per Litterman 1986, what matters for the size of a coefficient is the relative size of unexpected change in the variable.

specific coefficients towards the common mean leading to a more efficient use of the data and more precise estimates of the unit specific coefficients.

2.2 Priors

Following the approach suggested in Dieppe et al. (2017), standard diffuse priors are assumed for $\bar{\beta}_i$ and Σ_{ci} while Ω_{ci} is designed in a Minnesota type fashion. Regarding λ, a traditional choice for the prior distribution is an inverse Gamma distribution with shape parameter $s_0/2$ and scale $v_0/2$. Jarocinski (2010) and Gelman (2006) show that results can be sensitive to the choice of the values for s_0 and v_0. As such, they suggest the use of a uniform prior with s_0 = -1 and $v_0 = 0$ for models where the number of units is greater than 5; or to make the prior weakly informative by using low values for s_0 and v_0 (less than 0.001) which is the strategy adopted in this paper. A sensitivity analysis shows that results are little affected by the use of a uniform prior for λ instead.

2.3 Gibbs sampler

We rely on a Gibbs sampler to draw from the marginal posterior of the parameters. The algorithm is based on Jarocinski (2010) and Dieppe et al. (2017) and it draws from the following conditional posterior distributions:

- At iteration i draw $\bar{\beta}^i$ from a multivariate normal distribution:

$N(\beta_m^{i-1}, \mathrm{N}^{-1}\Sigma_b^i)$ with:

$\beta_m^i = \mathrm{N}^{-1}\sum_{c=1}^{N}\beta_c^{i-1}$

$\Sigma_b^i = \left(\lambda^i \otimes I_q\right)\Omega$ where q is the number of coefficients to be estimated for each unit.

- At iteration i, draw λ^i from an inverse Gamma distribution :

$\lambda^i \sim \mathrm{IG}(\frac{\bar{s}}{2}, \frac{\bar{v}}{2})$ with:

$\bar{s}$=h $+s_0$ where h is the number of coefficients to be estimated for all units.

$\bar{v} = v_0 + \sum_{c=1}^{N}\left\{\left(\beta_c^{i-1} - \bar{\beta}^i\right)'\left(\Sigma_c^{-1}\right)\left(\beta_c^{i-1} - \bar{\beta}^i\right)\right\}$

Draw $\Sigma_b^i = \left(\lambda^i \otimes I_q\right) \Omega$

- At iteration i, draw β_c^i for each country c from a multivariate normal distribution:

$\beta_c^i \sim N(M, V)$ with:

$M = \mathrm{V}\left[\left(\left(\Sigma_c^{i-1}\right)^{-1}\right) y_i + \left(\Sigma_b^i\right)^{-1} \bar{\beta}^i\right]$

$V = \left[\left(\Sigma_c^{i-1}\right)^{-1} \otimes X_i' X_i + \left(\Sigma_b^i\right)^{-1}\right]^{-1}$

- At iteration i, draw Σ_c^i for each country c from the inverse Wishart distribution:

$\Sigma_c^i \sim IW(S_c, T)$ with:

$S_c = \left(Y_c - X_c \beta_c^i\right)' \left(Y_c - X_c \beta_c^i\right)$

We use 15000 replications as burn in sample and we save 10000 draws for inference, discarding 99 draws for each one saved draw. [5]

2.4 Identification strategy

We base our empirical results on the identification of two structural shocks, namely a government spending shock and a monetary policy shock. The identification strategy follows Blanchard and Perotti (2002) and Caldara and Kamps (2008) and it relies on the recursive identification approach which implies timing restrictions on the contemporaneous impact across variables. The simplicity of this approach is particularly attractive for our analysis since it is easily applicable to both advanced and emerging countries.

The variables enter the model in the following order: government spending, GDP, inflation, tax and the monetary policy instrument. As such, in line with Blanchard and Perotti (2002) it is assumed that government spending decisions are not affected

[5] The estimation is conducted using a modified version of the BEAR toolbox of Dieppe et al. (2017) which accomodates for mean model results estimation and convergence diagnostic test using inefficiency factors.

contemporaneously by domestic business cycle developments[6]; therefore reduced form innovations to the first equation coincide with our identified government spending shock. Turning to the monetary policy shocks, to achieve identification we order the monetary policy instrument last and we allow for a contemporaneous reaction of the central bank to fluctuations in the other variables; this choice can be justified on the grounds of a central bank following a Taylor rule in determining the interest rate. Although we control for developments in government revenues, we do not aim at identifying a tax shock. If scholars seem to agree on the exogeneity of the government spending decisions, there is less consensus on whether the tax variable should be ordered before or after the GDP, making the identification of such shock problematic in a recursive framework.

3 Results

3.1 Model evaluation

To assess the reliability of the estimated panel model, we first consider the model properties. The focus is on the response of GDP growth to innovations in both fiscal and monetary policy variables. We report the fiscal multipliers from both the mean model and the individual country estimates while for the monetary policy we show the mean model IRFs in the main text and the country results in the Appendix (Figure S11). The mean model results allow for the comparison of the IRFs in the two groups of countries, while the single unit estimates tell us something more on the heterogeneity within group of GDP response to policy shocks.

For government spending we convert the impulse response functions into fiscal multipliers to be able to compare them to the literature. Fiscal multipliers measure the average change in real GDP from one unit (measured in national currency) increase in government spending. Specifically, we follow Blanchard and Perotti (2002) and we define multipliers as the ratio of the output response at a particular horizon to the impact

[6] We do, however, control for the contemporaneous developments at world level through the exogenous variables.

effect of the shock on the government spending. However, different countries reach the peak response at different horizons, therefore in order to obtain comparable results across countries we consider the average GDP response over the first three years. Since data is in growth rates, we first convert the growth rates impulse responses to log-levels IRFs; we then calculate multipliers by multiplying the log-level IRFs by the average ratio of government spending over the sample period. Table 1 reports the fiscal multipliers, averaged over the first three years, derived from the IRFs.

The mean model results suggest that fiscal multipliers are higher in AEs compared to EMEs. This finding is consistent with previous studies such as Ilzetzki et al. 2013 and Kraay, 2012 who suggest that the degree of development is a critical determinant of the size of the fiscal multiplier. They show that in developing countries, the response of output to government consumption is often negative on impact and not statistically different from zero.

Regarding the country specific estimates, the government spending multipliers have the expected sign, though differing across countries. In the United States, the spending multiplier is 1.3, in line with findings from the literature. For example, Blanchard and Perotti (2002) report a US spending multiplier in the range 0.9 and 1.3, while Ramey (2011a and 2011b) points to a value between 0.6 and 1.2. In Japan, the government spending multiplier is within the ranges reported by Auerbach and Gorodnichenko (2014). The government spending multiplier for the euro area is found to be quite small[7]. In comparison, estimates of fiscal multipliers provided by Kilponen et al (2015) derived from a large number of simulated structural models suggest a spending multiplier in the euro area close to, but below 1. Turning to the United Kingdom, our spending multiplier is higher that the findings of Glocker et al (2017) who report an average (two-year cumulative) government spending multiplier of 0.4, with, however, a significant variation over time.

The literature provides fewer insights on fiscal multipliers in EMEs. The limited em-

[7]The low multiplier for euro area is driven by the initial (counterintuitive) negative response of GDP to a spending shock.

Table 1: Government spending multipliers in the first three years (average)

US	**Japan**	**UK**	**EA**	**AEs**	**China**	**Brasil**	**India**	**Russia**	**EMEs**
1.3	1.1	0.8	0.4	0.8	0.4	1.2	0.1	0.2	0.2

pirical literature suggests that fiscal multipliers in EMEs are smaller than in advanced economies and often are not significant or even negative on impact (Ilzetzki et al. 2013, Kraay, 2012). This finding is confirmed also by our results with the exception of Brazil where the spending multiplier is 1.2. One potential explanation for this finding is that Brazil's economy is relatively closed, which tends to magnify the effectiveness of its fiscal policy. Finally, for China, it is worth noting that our measures may miss important aspects of China's fiscal policy. In particular, data do not allow us to capture off-balance sheet spending by local governments which was a very important component of government spending after the global financial crisis.

Turning to the response of GDP growth to monetary policy shocks, the impulse responses for monetary policy are also broadly in line with the literature. Figure 2 shows the mean model IRFs for advanced and emerging countries to a 100 basis points increase in the monetary policy interest rate in each country[8]. The contractionary measure has the expected negative effect on GDP growth for all countries. In advanced economies, the peak impact is reached after around 4 quarters, but the effect exhibits some persistence in the first three years. In emerging economies, the peak impact is slightly larger than for advanced economies, but the response is less persistent. Note, however, that our model may not fully capture monetary policies in all EMEs. For example, during the sample period China used a combination of quantity and price tools to enact monetary policy. In particular, the use of window guidance to bolster credit growth following the global financial crisis, would not be captured.

Contrary to some of the literature for small-scale VARs (see Ramey, 2016), we do not find evidence of a 'price puzzle' for advanced economies, as the response of inflation to a monetary policy shock is negative (see Figure S9 in the Appendix). Overall, this

[8]The country specific IRFs for monetary policy are similar to the mean model estimates and are not reported in the main text for ease of exposition. They are available in the Technical Appendix.

provides some comfort that our monetary policy shocks are correctly identified in our VAR. By contrast, for EMEs, there is evidence of a mild, short-lived price puzzle which sees the inflation rise temporarily after a contractionary monetary policy shock.

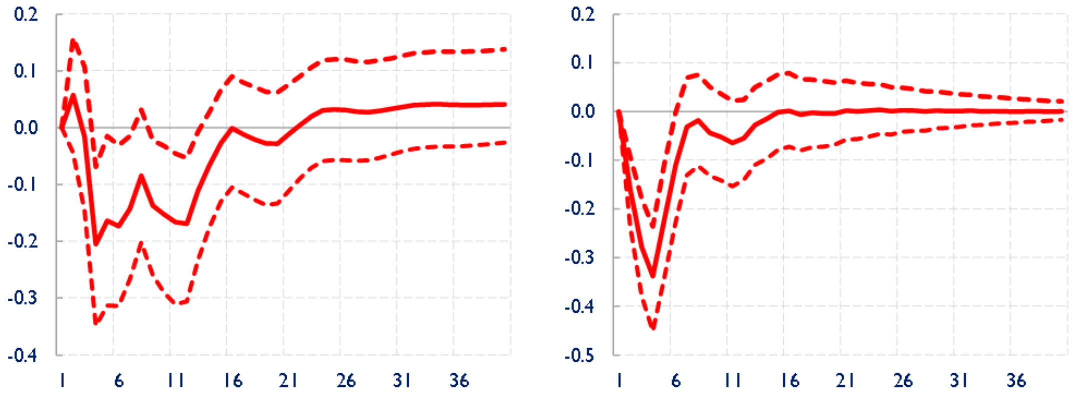
It is worth noting that GDP response to fiscal shocks displays more heterogeneity (between and within group) compared to the GDP response to monetary policy shocks[9]. Regarding the monetary policy finding, our results are in line with Jarocinski (2010) and Mojon and Peersman (2001) who show that the effects of monetary policy tend to be even across groups with substantial structural differences. In contrast, other studies such as Cecchetti (1999) and Mihov (2001) find asymmetries in monetary transmission among countries.

On the other side, the variability of fiscal multipliers is not new in the literature. Several studies suggest that fiscal multipliers depend on the economic conditions or on the specific sample analyzed. In particular, Ilzetzki et al. (2013) claim that fiscal multipliers depend on the degree of openness of a country, on the level of debt, the exchange rate regime and on the level of development. Corsetti et al. (2012) highlight important differences in the transmission of spending shocks across countries conditional on the exchange rate regime, the health of public finances and the occurrence of financial crisis. They find higher multipliers during financial crises and in countries with fixed exchange rate regimes, while the weakness of public finances is shown to have a negative impact on spending multipliers. Nickel and Tudyka (2014) focusing on a sample of 17 European countries show that spending multipliers vary considerably with the debt-to-GDP ratios, and can even turn negative at higher levels of debt. Gechert and Rannenberg (2014) reveal increasingly smaller effects of fiscal shocks as the economy is further above its potential (as fiscal measures tend, in these circumstances, to crowd-out rather than crowd-in the private sector). Whalen and Reichling (2015) distinguish specific multiplier ranges for when the economy has an active monetary policy. They point out that: (i) multiplier values are lower under more active monetary policy, which offsets the effects

[9] We refer to heterogeneity of one policy relative to the other since the parameter λ governing the model heterogeneity is common across units of the same group

Figure 2: Impulse responses to monetary policy shocks. Mean model results. Response of year-on-year GDP growth to a 1pp increase in the monetary policy interest rate

(a) Advanced economies (b) Emerging economies



of the fiscal policy measures, stabilising the economy; and that (ii) more credible and/or longer lasting measures usually imply greater effect on output. Coenen et al. (2012) corroborate some of these findings in a structural model with an accommodative monetary policy. Finally, studies focusing on non-linearities such as Auerbach and Gorodnichenko (2012a) and Mumtaz and Sunder-Plassmann (2017) report higher multipliers in recession compared to boom.

3.2 Conditional forecasts to evaluate the role of policy support

To discern the effect of fiscal and monetary policy on GDP growth, we compare model forecasts conditioned on actual policy developments with forecasts conditioned on a counterfactual policy path. The exercise consists of construction of conditional forecast for GDP growth under two counterfactual scenarios: an actual policy scenario and a counterfactual policy scenario:

1. Under the *actual policy* scenario we produce a path for GDP conditional on the actual realizations of policy variables.

2. In the *counterfactual policy* scenario, the actual values of the policy variables are replaced by their sample averages over the estimation period.

To assess the contributions of policy to economic developments, we then compare the median outcomes of the two scenarios – i.e. we subtract the conditional path for GDP growth in the *actual policy scenario* from the conditional path in the *counterfactual policy* scenario.

We first compare the combined impact of fiscal and monetary policies - i.e. we conduct a counterfactual policy scenario in both the (shadow) interest rate and government spending variables are constrained to their sample averages over the estimation period. We then look at the contributions of fiscal and monetary policies separately. To examine the contributions of monetary policy, we restrict only the path of the interest rate in the counterfactual policy scenario. To examine the contribution of fiscal policy, we restrict only the path of government spending.

The approach is illustrated for the United States in Figure 3. The left-hand side chart shows the actual path of the (shadow) interest rate and the counterfactual policy path (set to the sample average for the interest rate in the United States). The right-hand side chart then shows the GDP conditional forecast based of the actual policy rate (blue line) and the GDP path conditional on counterfactual policy (green line). Both scenarios imply a deep decline in 2008 and 2009 which reflects the effects of the global factors captured by the exogenous variables in the VAR. However, gradually differences in the path of (year-on-year) GDP growth emerge. Those differences (measured in the percentage point differences of GDP growth) are shown by the gray bars and aim to capture the policy impact of monetary policy in that period.

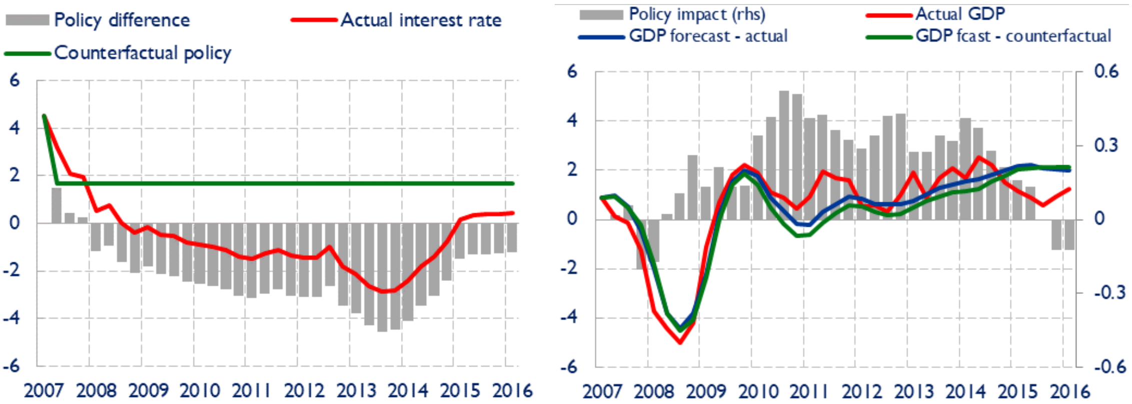
Note that we deliberately compare two conditional forecast scenarios – i.e. we compare the counterfactual policy scenario with another conditional forecast for GDP based on the actual realisations of policy variables. Another option would have been to compare the counterfactual policy scenario with the actual realizations of GDP (i.e. the green line with the red line in Figure 3). But this strategy would have mixed the effects of policy with other factors that generated fluctuations in real activity over this period. Our method aims to isolate the policy contributions.

Note also that we employ a structural approach to understanding the contributions of

Figure 3: United States: Counterfactual scenario for monetary policy

(a) United States: Actual and counterfactual policy realisation for monetary policy (lines – percent; bars – percentage point differences)

(b) United States: Actual and counterfactual policy realisation for GDP growth (year-on-year percentage changes, lhs; percentage point differences, rhs)

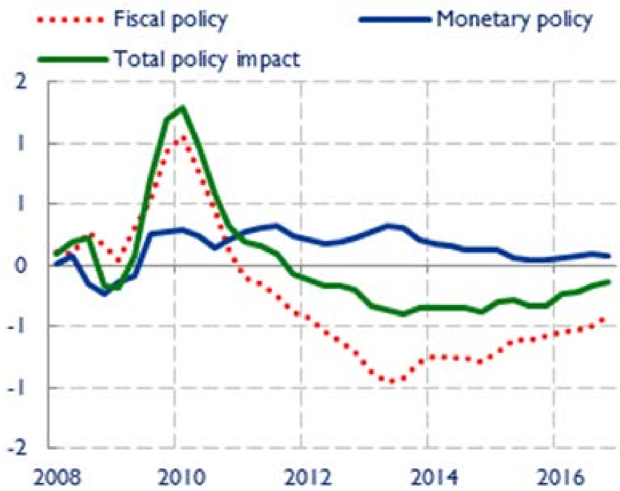


policy. Lenza et al. (2010) and Kapetanios et al. (2012) use a similar approach to analyze the effects of quantitative easing in the euro area and UK respectively. However, they use a reduced form approach in which the path of the restricted variable is obtained through the contribution of all shocks. By contrast, we employ a strategy in which restrictions on specific structural shocks generate the fixed path of the conditioned variable. For example, in order to obtain the GDP forecast with the federal fund rate fixed at a predetermined value, we restrict (only) the monetary policy structural shock in such a way that it generates the desired fixed path for the monetary instrument (see Doan et al. 1983 and Waggoner and Zha 1999, Dieppe et al. 2017); no restrictions are placed on the other shocks which are drawn from their own distribution.[10] The main advantage of the structural approach in conducting the counterfactual analysis is that it captures the heterogeneity (across countries) of the policy contribution on GDP by taking into account the variability in the response of GDP to policy shocks as well as in the design of the specific policy measure. A detailed example of the counterfactual scenario is presented in the appendix.

The estimated overall support from government spending and monetary policy is

[10] For example, in case of a recursive identification, an unrestricted shock is drawn from a N(0,1) distribution. See Dieppe et al. 2017 for details.

Figure 4: Policy contributions to aggregate GDP for eight countries (Percentage point difference in year-on-year GDP growth between actual policy and counterfactual policy scenarios)



Notes: the lines show the differences year-on-year GDP growth between actual policy and counterfactual policy scenarios (see section 3.2 for explanation). Green line shows the impact of fiscal and monetary policies combined; red dotted line shows impact of fiscal policy only; blue shows the impact of monetary policy. GDP growth is a PPP-weighted average of the 8 countries in the sample

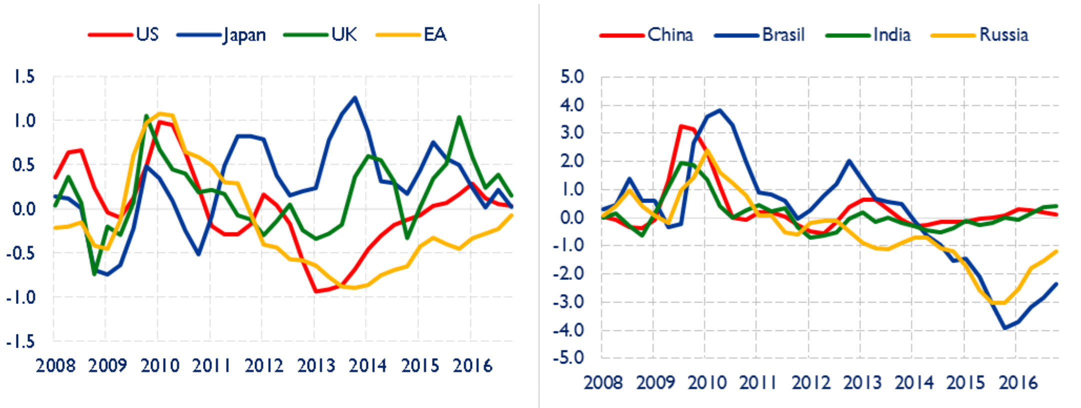
shown in Figure 4 for the aggregate GDP of the countries in the sample, and at country level in Figure 5.[11] The results suggest that global activity benefited from substantial policy support in the aftermath of the global financial crisis, as policymakers loosened both fiscal and monetary policy to combat the sharp downturn in economic activity. Moreover, the policy support faded quickly, and by 2011, policy acted as a drag on global activity. The shift was mostly driven by fiscal policies: while monetary policy remained accommodative, particularly in advanced economies, efforts towards consolidation provided a significant headwind to the global expansion. More recently, macroeconomic policies have become more supportive for global activity. The drag from fiscal policies consolidation has gradually lessened, particularly in advanced economies. With monetary policies remaining highly accommodative in advanced economies and some monetary easing in large EMEs, the overall contribution of policy to growth has shifted and become less

[11]For ease of exposition we limit our attention to the differences in the medians across the two scenarios. Figures S17 and S18 in the appendix report the full posteriors for both scenarios for the case of overall policy contribution.

Figure 5: Policy contributions to GDP growth for advanced and emerging economies (Percentage point difference in year-on-year GDP growth between actual policy and counterfactual policy scenarios)

(a) Advanced economies

(b) Emerging economies



Notes: the lines show the differences year-on-year GDP growth between actual policy and counterfactual policy scenarios (see section 3.2 for explanation).

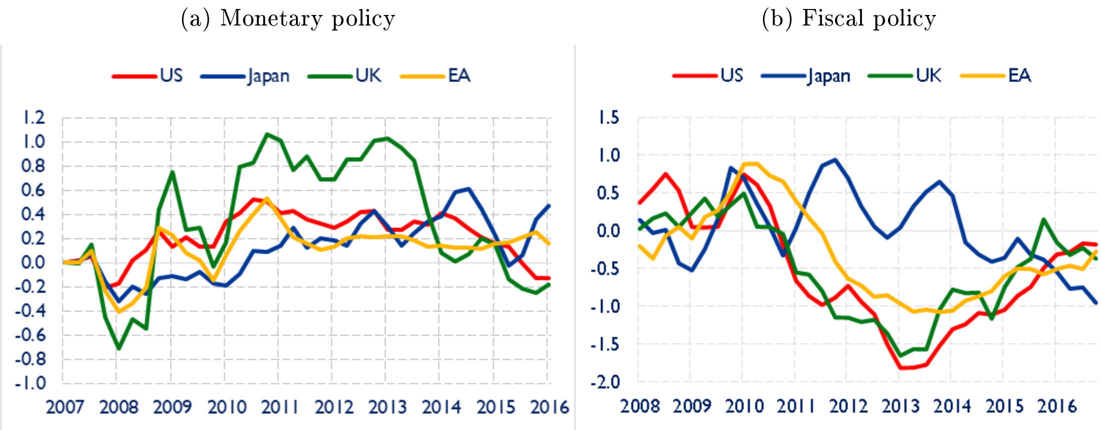
negative.

The extent of policy support has varied strongly across countries and instruments, in particular after the initial support to the global financial crisis.

Specifically, in advanced economies (Figure 6), highly accommodative monetary policy has been counteracted by strong fiscal consolidation. After the initial support provided following the Great Recession, the support from fiscal policy in advanced economies faded quite rapidly, acting as a significant drag on economic activity.

In the United States, federal spending as part of the American Recovery and Investment Act started to wane, while state and local government spending continued to diminish from 2011 onwards, reflecting the states' balanced budget rules. In 2012-13 some fiscal measures expired (including the Bush income tax cuts for high-income households, the payroll tax reduction for middle-income households; and the extended unemployment benefits). More recently, however, policy has provided a more supportive backdrop: the drag from fiscal consolidation has eased, while monetary policy remained accommodative. In Japan, fiscal consolidation was delayed by the earthquake in 2011

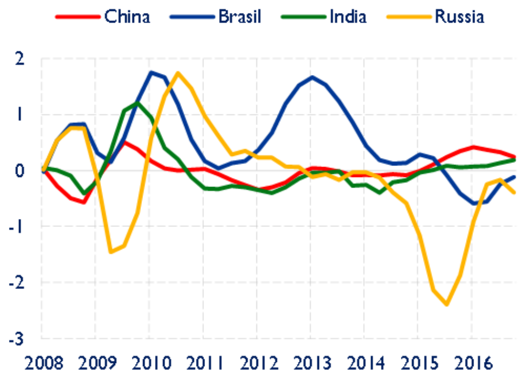
Figure 6: Policy contributions to GDP growth for advanced economies from monetary and fiscal policies (Percentage point difference in year-on-year GDP growth between actual policy and counterfactual policy scenarios)



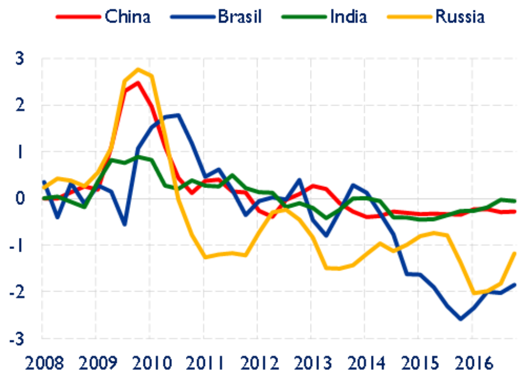
Notes: the left-hand side chart shows the differences in year-on-year GDP growth between actual policy and counterfactual policy scenarios in which only the interest rate is restricted in the counterfactual policy scenario. the right-hand side chart shows the differences in year-on-year GDP growth between actual policy and counterfactual policy scenarios in which only the path of government spending is restricted in the counterfactual policy scenario. See section 3.2 for explanation.

Figure 7: Policy contributions to GDP growth for emerging market economies from monetary and fiscal policies (Percentage point difference in year-on-year GDP growth between actual policy and counterfactual policy scenarios)

(a) Monetary policy



(b) Fiscal policy



Notes: the left-hand side chart shows the differences in year-on-year GDP growth between actual policy and counterfactual policy scenarios in which only the interest rate is restricted in the counterfactual policy scenario. The right-hand side chart shows the differences in year-on-year GDP growth between actual policy and counterfactual policy scenarios in which only the path of government spending is restricted in the counterfactual policy scenario. See section 3.2 for explanation.

which necessitated emergency spending. Monetary policy by the Bank of Japan through its quantitative easing program has increasingly supported GDP growth over the sample period. In the United Kingdom, the contribution from monetary policy has been a pillar of growth, but has become more neutral recently as the Bank of England has started to gradually remove its policy accommodation. Meanwhile fiscal policy has also become less of a drag over time after a long period of austerity. Finally, in the euro area fiscal policy was a major drag on growth. This can be explained by consolidation needs that arose due to the euro area sovereign debt crisis. However, the drag from fiscal consolidation has also diminished here. By contrast, monetary policy in the euro area has supported growth.

On the other side, in EMEs (Figure 7), monetary policy has been less accommodative since the global recession. In China, after the initial policy support during the global recession monetary policy tightened, with interest rates and reserve requirements remaining relatively high despite low inflation. Subsequently, as GDP growth slowed during 2014, lower interest rates and some fiscal support have provided for more supportive policy. However, it is likely that our model does not fully capture the role of fiscal policy in China. IMF (2017c) estimates a significantly larger fiscal deficit than reported by official figures, suggesting substantially bigger fiscal support. Amongst other EMEs, the experience of commodity exporting EMEs (Brazil and Russia) has played an important role in shaping developments. Policy in these countries was broadly supportive for activity until 2014 when sharp terms of trade shocks forced a recalibration of policies. Monetary policy tightened in both countries to combat currency depreciation and high inflation and inflation expectations. Fiscal policies were also restrained – by high debt and weak credibility in the case of Brazil; and by the need to adjust to lower oil revenues in the case of Russia. With fiscal consolidation remaining a necessity in both countries, policies continue to act as a headwind to GDP growth, although some monetary easing - as currencies have stabilised and inflation has fallen - has provided some help.

3.3 The interaction of monetary and fiscal policies

The empirical setting used in our analysis is well suited to analyzing the interaction and interdependencies of monetary and fiscal policies. In this section, we ask two questions: (i) how might monetary policy (MP) have behaved if fiscal policy (FP) had been conducted differently? and (ii) how strong would fiscal support have needed to be, had monetary policy been less accommodative? We illustrate the interactions using the US economy as an example, being one of the largest economies in our sample. We first assess the role of fiscal policies in shaping monetary policy since the global financial crisis. Following the methodology described in section 3.2 we conduct two conditional scenarios. In the first scenario we restrict shocks to government spending, tax, inflation and GDP to produce a conditional forecast for interest rates conditioned on the observed paths of GDP, inflation, tax and government spending. In the second scenario, we restrict the same shocks to obtain a path for interest rates conditioned on the actual values of GDP, inflation and tax but keeping government spending at its sample average (Figure 8 a). To compensate for the lack of the fiscal stimulus, the counterfactual paths for policy suggest a sharper reduction in (shadow) interest rates in the United States. Thereafter, however, fiscal consolidation has forced continued accommodation from monetary policy. Without the fiscal consolidation that occurred from 2011 onward, monetary policy would have begun to tighten already in the United States – indeed, our model suggests that interest rates would have been above the zero lower bound already in 2013. In other words, the results show how much of the monetary policy reaction was triggered by the additional effects on output and inflation generated by the government spending policy.

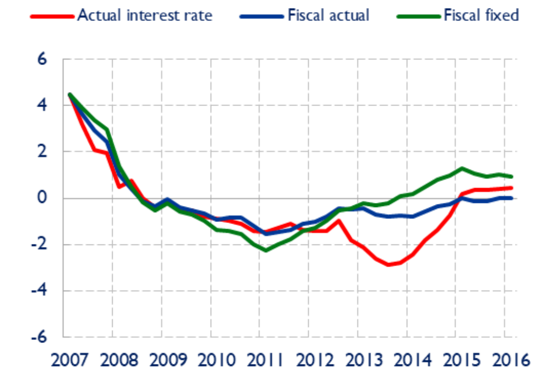
We next consider the reverse question and ask how fiscal policy might have behaved had monetary policy been different. As before, we conduct two scenarios. In the first scenario we restrict shocks to GDP, inflation, tax and interest rates to produce a conditional forecast for government spending conditioned on the observed paths of GDP, inflation, tax and interest rates (blue lines in Figure 8 b). In the second scenario, we restrict the same shocks to obtain a path for government spending conditioned on the actual values of GDP, tax and inflation but keeping interest rates at the sample averages (red lines in Figure 8 b). The counterfactual scenarios highlight the role of accommodative monetary policies in allowing fiscal consolidation in the US after the global recession. In the scenarios without considerable monetary accommodation (i.e. the red lines), the model suggests that government spending would have needed to be stronger to support activity.

4 Robustness analysis

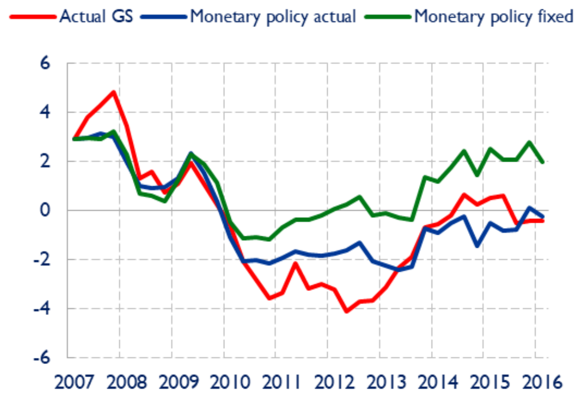
We perform additional robustness checks aiming to address some of the concerns raised by our analysis. More details on the sensitivity tests discussed in this section can be found in the appendix to the paper (Figures S12 - S16). Jarocinski (2010) and Gelman (2006) show that weekly informative prior for the parameter λ governing the model heterogeneity can have undesired effects on results, especially for panel with more than 5 units. In order to reinforce our results, we re-estimate the model using the uniform prior (with s= -1 and v=0) instead. Impulse response functions reported in Figure S12

Figure 8: Policy interaction scenarios for the United States

(a) Monetary policy (percent)



(b) Fiscal policy (year-on-year percentage changes)



Notes: the left-hand side chart shows the actual and counterfactual paths for monetary policy from 2007. The red line shows the actual (shadow) interest rate path. The blue line shows the conditional forecast for the interest rate, conditioned on the observed profiles for GDP, inflation and government spending (from 2007 onwards). The green line shows the conditional forecast for the interest rate, conditioned on the observed profiles for GDP, inflation (from 2007) and with government spending fixed at the sample average. The right-hand side chart shows the actual and counterfactual paths for government spending from 2007. The red line shows the actual path of government spending (in year-on-year percentage changes). The blue line shows the conditional forecast for the government spending, conditioned on the observed profiles for GDP, inflation and the interest rate (from 2007 onwards). The green line shows the conditional forecast for government spending, conditioned on the observed profiles for GDP, inflation (from 2007) and with the interest rate fixed at the sample average.

Appendix are almost unaffected by this change.[12]

In choosing the lag structure for EMEs, we prefer a model with 6 lags. In addition we control for the monetary aggregate including M2 before monetary policy instrument. This model performs better in alleviating the price puzzle. However, for the AEs we adopt a 5 lag structure without M2 and there might be concerns on the validity of the statements regarding the comparison of policy effects across groups. Moreover, there is not a clear agreement in the literature on whether M2 should be placed before or after the policy rate. As such we check the effect of policy shocks on GDP in EMEs in two additional scenarios, specifically with 5 lags instead of 6 and with M2 ordered last. IRFs of GDP are mildly affected while price puzzle is a bit more pronounced in both cases. Additionally, since EMEs have to deal also with the excessive money growth rooted in the government‘s need to finance itself by seignorage (see Frankel, 2010), we perform a counterfactual check for EMEs in which monetary policy targets both the interest rate and the monetary aggregate. Results (see Figure S14) show an increase in the magnitude of the effects of monetary policy compared to the scenario of only interest rate targeting. We also test the sensitivity of our results to employing a different shadow rate for AEs in order to account for the ZLB. Figure S16 shows impulse responses of GDP for advanced economies to a monetary policy shock using the shadow rate measure proposed by Krippner. Finally, we check the convergence of the Gibbs sampler reporting the inefficiency factors for the posterior estimates of the parameters. The convergence diagnostics (Figure S19) are satisfactory with inefficiency factors values below 5 for all parameters.

5 Conclusion

We used Panel VARs with hierarchical structure to asses and compare the effects of fiscal and monetary policy to GDP growth in advanced and emerging economies. Our results suggest that the effects of monetary policy on GDP are similar across the two groups

[12]Since the counterfactual scenario is constructed from pieces of IRFs, we are comfortable to assume that stable IRFs imply stable conditional forecasts.

while the fiscal multipliers are higher in AEs compared to EMEs. We also find that fiscal policy effects display some within group variation. This effect is not verified in the case of monetary policy.

We then conducted a counterfactual analysis and we provided evidence that global GDP growth benefited from substantial policy support during the global financial crisis but policy tightening thereafter, particularly fiscal consolidation, acted as a significant drag on the subsequent global recovery. In addition we show that the role of policy has differed across countries. Specifically, in advanced economies, highly accommodative monetary policy has been counteracted by strong fiscal consolidation. By contrast, in EMEs, monetary policy has been less accommodative since the global recession.

Finally, our counterfactual scenarios emphasize the important interdependence of fiscal and monetary policies in shaping each other. The scenarios provide admittedly stark contrasts but they underscore the interdependence of each branch of macroeconomic policy. In particular, in United States, we find that fiscal consolidation in the aftermath of the financial crisis has pushed continued accommodation from monetary policy.

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Conditional forecast example

Imagine the policymaker wants to answer the following question:

What is the forecast of GDP conditioned on knowing that Federal Fund rate in the next 2 periods is 1%?

Step1. Define a simple 2 variables VAR as in (4) formed by GDP (Y) and Interest rate (X).

$$\begin{pmatrix} Y_t \\ X_t \end{pmatrix} = \begin{pmatrix} c_1 \\ c_2 \end{pmatrix} + \begin{pmatrix} B_1 & B_2 \\ B_3 & B_4 \end{pmatrix} \begin{pmatrix} Y_{t-1} \\ X_{t-1} \end{pmatrix} + \begin{pmatrix} A_{11} & \\ A_{21} & A_{22} \end{pmatrix} \begin{pmatrix} e_{1t} \\ e_{2t} \end{pmatrix} \quad (4)$$

and define $z_{ij}{}^k$ as the IRF of j to K shock at horizon i and variable X is constrained to be 1 in the next two periods.

$$R = \begin{pmatrix} z_{1,2}^1 & z_{1,2}{}^2 & 0 & 0 \\ z_{2,2}^1 & z_{2,2}^2 & z_{1,2}^1 & z_{1,2}^2 \end{pmatrix} \quad (5)$$

$$r = \begin{pmatrix} 1 - \bar{X}_{t+1} \\ 1 - \bar{X}_{t+2} \end{pmatrix} \quad (6)$$

where $\bar{X}$ denotes the unconditional forecast of X and r is the difference between the desired path of the Federal Fund rate and its unconditional forecast.

Step2. Re-write the desired restriction in terms of structural shocks e and the matrix of impulse responses R

$$Re = r \quad (7)$$

As per Waggoner and Zha (1999) draw the restricted shock e from a distribution:

$$e \sim N\left(R'(RR')^{-1}r,\ I - R'(RR')^{-1}R\right) \quad (8)$$

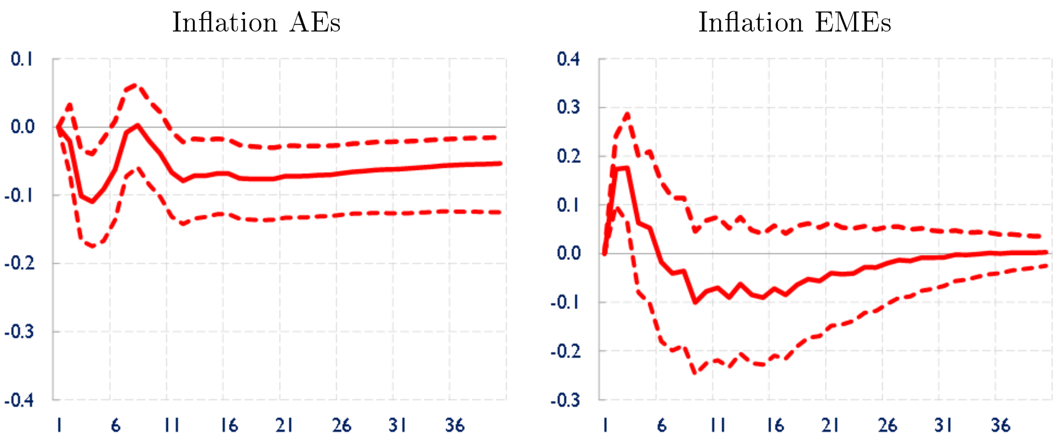
If we restrict all structural shocks in (7) we get a reduced form solution. If instead we want to attribute the desired path to a specific shock, for example the Monetary policy shock, we draw the restricted shock e_2 from (8) while the remaining shock is drawn from its own distribution which is a N(0,1) in a recursive scenario.

Data description

Data transformations:

- Government spending: Government consumption and government investment deflated by the GDP deflator - annual growth rates.
- Taxes: Current receipts minus transfers and interest payment deflated by the GDP deflator – annual growth rates.

Figure S9: Inflation response to a 1% increase in interest rate. Mean model results



- Real GDP – annual growth rates.
- Inflation – annual growth in CPI
- VIX - CBOE Market Volatility Index – levels
- Commodity Price Index: All Commodities (C001CXAP@IFS) – annual growth rates
- World: Energy Index (C001CXE@IFS) – annual growth rates
- World GDP (GDP for world, weighted by PPP) minus country GDP - annual growth rates

Table S2: Monetary and Fiscal Data description (with HAVER codes, where applicable)

Country	Monetary instrument	Government spending	Tax
US	Effective federal funds rate (FFED@USECON) Wu-Xia shadow rate (FFEDSHDW@USECON)	Government consumption nominal (GE@USNA) Government investment nominal (GI@USNA)	Government receipts nominal (GRCP@USNA) Government transfers nominal (GETFP@USNA) Government interest payments Nominal (GIPD@USNA)
Japan	Shadow Short Rate Point Estimates (N158RSSV@G10)	Government Final Consumption Expenditure, Value (Q158G@OUTLOOK)	Total Receipts, General Government Value (Q158GRF@OUTLOOK) Social Security Benefits Paid By General Government (Q158SSP@OUTLOOK) Social Security Benefits Paid By General Government (Q158SSP@OUTLOOK)
UK	Bank Rate (UNBEDR@UK) Wu-Xia shadow rate (UKSHDW@UK)	Government consumption nominal (NMRPQ@UK) Government investment nominal (RPZGQ@UK)	Total Receipts, General Government Value (ANBVQ@UK+ ANBWQ@UK) Social Security Benefits Paid By General Government (NMFXQ@UK+ GZSJQ@UK) Japan: Social Security Benefits Paid By General Government (NUGWQ@UK+GZSKQ@UK)
Euro area	Lemke et al. (2017) shadow rate	Government consumption nominal Government investment nominal	Government receipts nominal Government transfers nominal Government interest payments
Brazil	Interest Rate: Selic - Target Rate (N223RTAR@EMERGE, avg)	Government Consumption (S223NCGC@EMERGE)	Central Government Revenues: Assets Operations (N223FGR@EMERGE-N223FRAS@EMERGELA) Social Security Benefits (N223FEPS@EMERGELA)
China	Prime Lending Rate (N924FRRL@EMERGEPR) Money Supply: M2 (N924FM2@EMERGEPR)	Fixed Asset Investment funded by State Budgetary Funds (N924VUST@EMERGEPR)	Government Revenues CEIC code :4331701 (CFPAA)
India	RepoRate (N534RPV@EMERGEPR)	Central Govt expenditure (N534FGE@EMERGE)	Central Govt receipts (N534FGR@EMERGE)
Russia	Money Supply: M2 (H922FM2@EMERGECW)	Government Consumption Expenditure (H922NCGC@EMERGE)	Federal Budget Revenue (N922FGR@EMERGE)

Table S3: Marginal likelihood/ Deviance Information criteria for single country VAR. Models with higher marginal likelihood and smaller Deviance Information Criteria are preferred.

Lags	US	Jap	UK	EA	China	Brasil	India	Russia
Test	Mg Lik/DIC	Mg Lik/DIC	Mg Lik/DIC	Mg Lik/DIC	Mg Lik/DIC	Mg Lik/DIC	Mg Lik/DIC	Mg Lik/DIC
4	-145/1042	-223/926	-264/1129	-177/730	-299/1309	-316/1373	-376/1651	-405/1800
5	-239/1010	-219/907	-261/1113	-172/707	-294/1283	-311/1347	-370/1623	-398/1766
6	-235/992	-218.45/894	-257/1094	-170/699	-290/1265	-307/1325	-364/1598	-392/1738

Figure S10: Interest rate and inflation response to a 1% increase in government spending. Mean model results

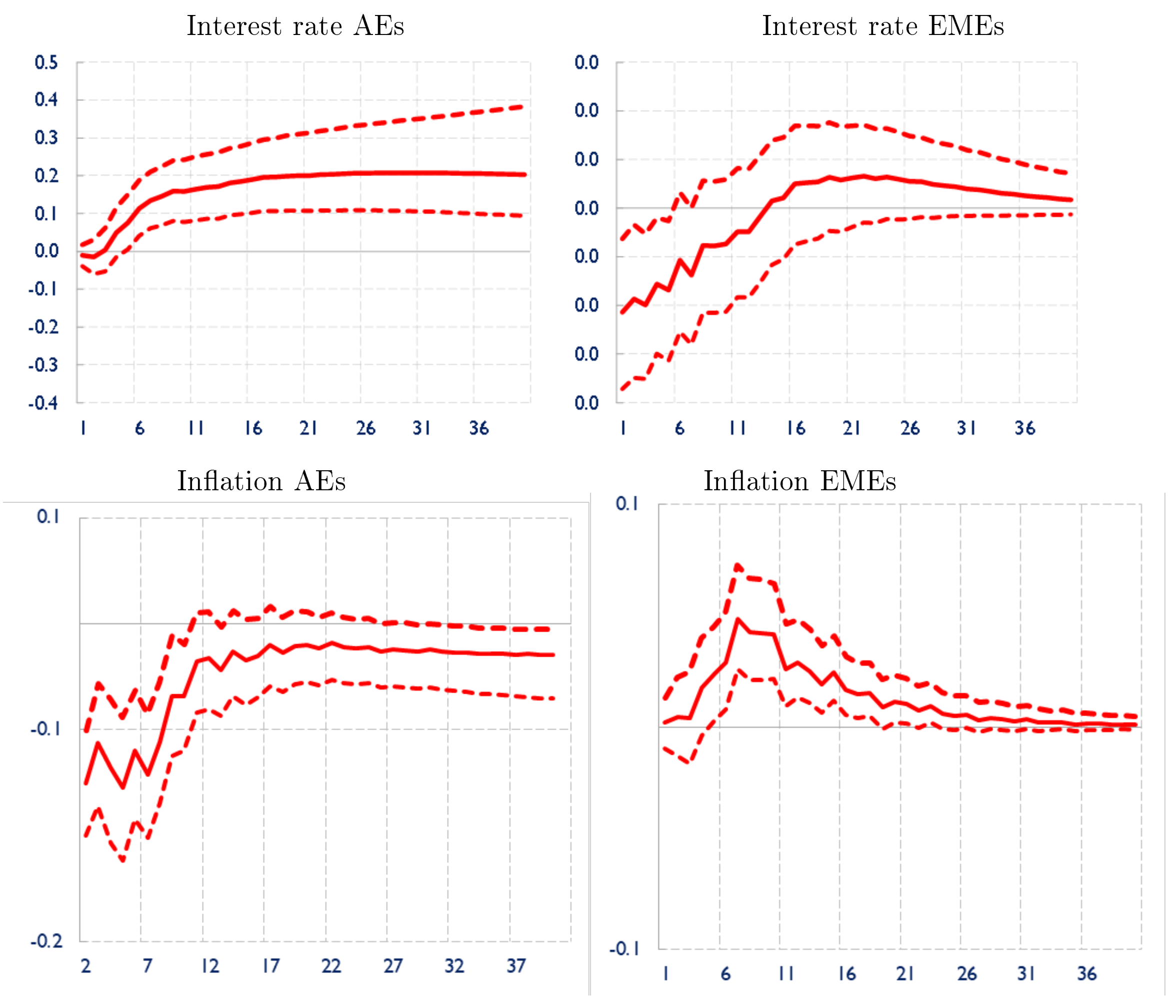


Figure S11: GDP response to fiscal and monetary shocks. Country results

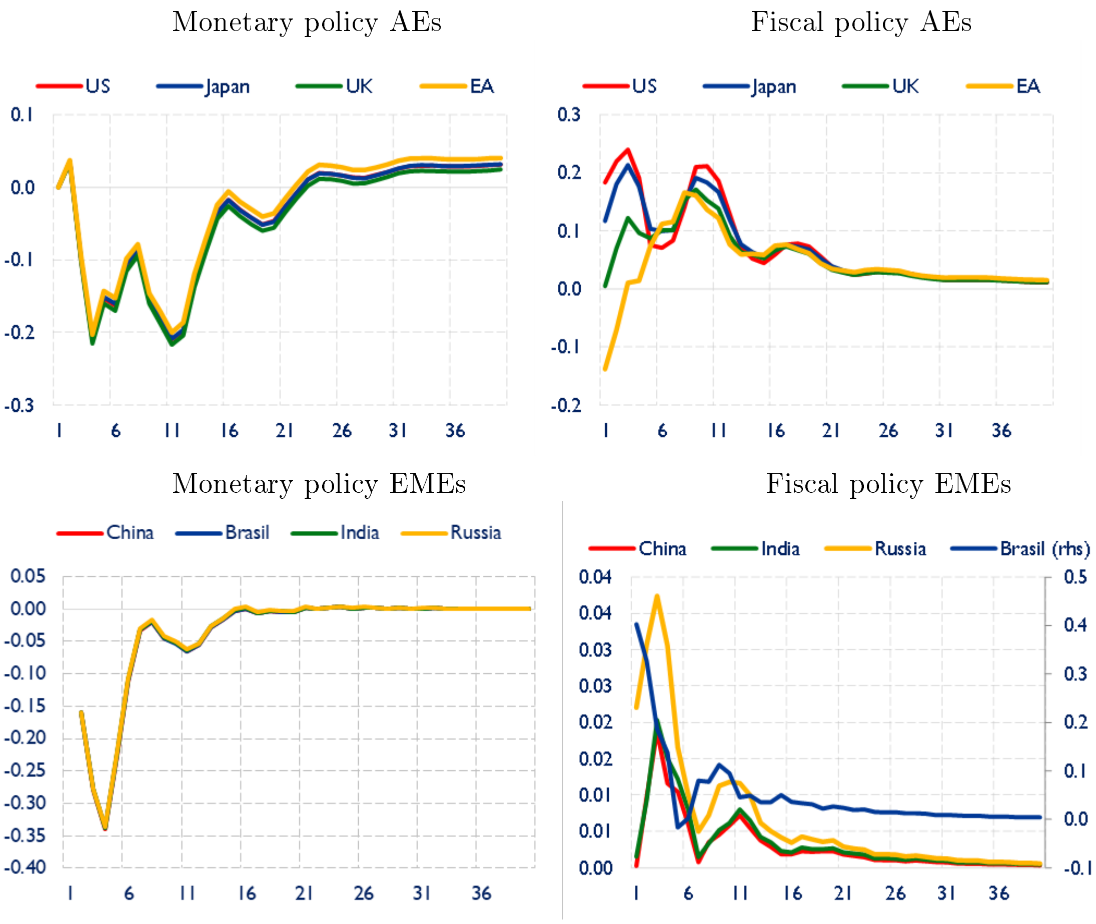


Figure S12: Sensitivity analysis to the prior on λ.

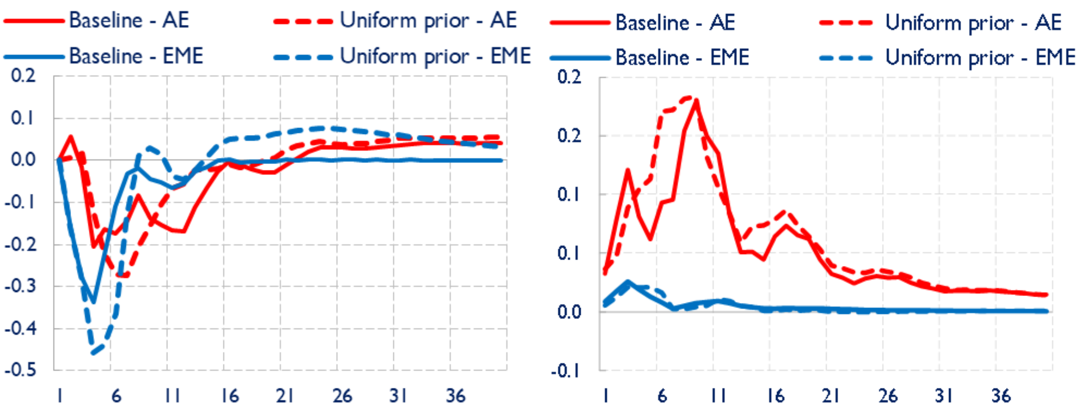


Figure S13: Sensitivity analysis to the number of lags for EMEs. Country results with 5 lags.

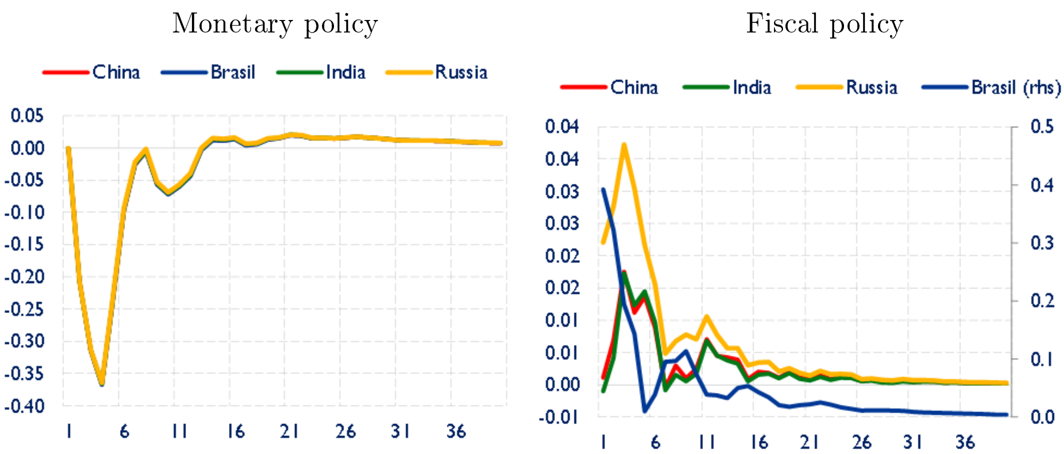


Figure S14: Monetary Policy Contribution in EMEs with M2 and R targeting

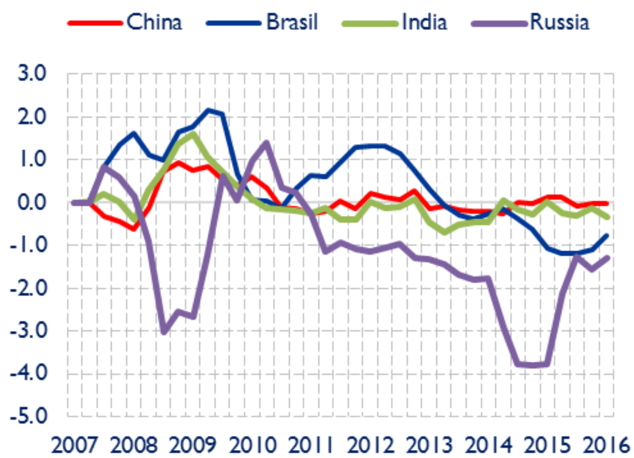


Figure S15: Sensitivity analysis to variables ordering for EMEs. Results with M2 ordered last.

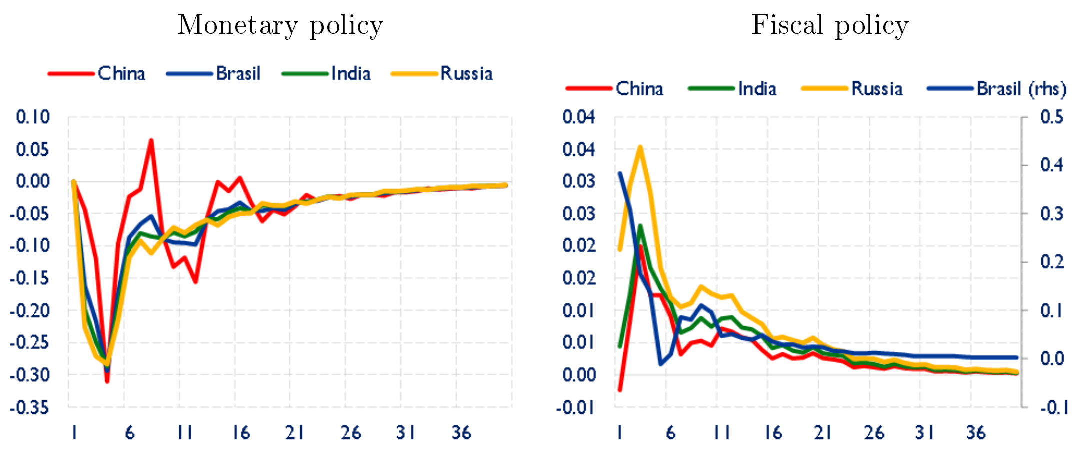


Figure S16: Sensitivity analysis to using Krippner shadow rate

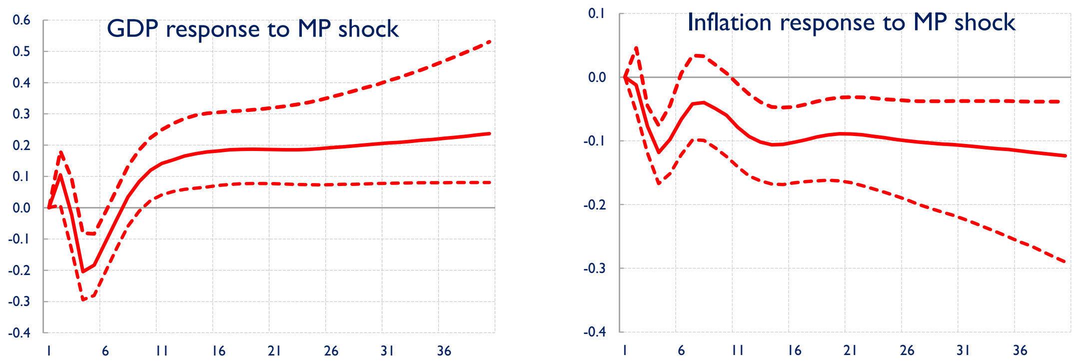


Figure S17: Conditional forecast AEs. Overall policy scenarios. Bands are 68 HPDI

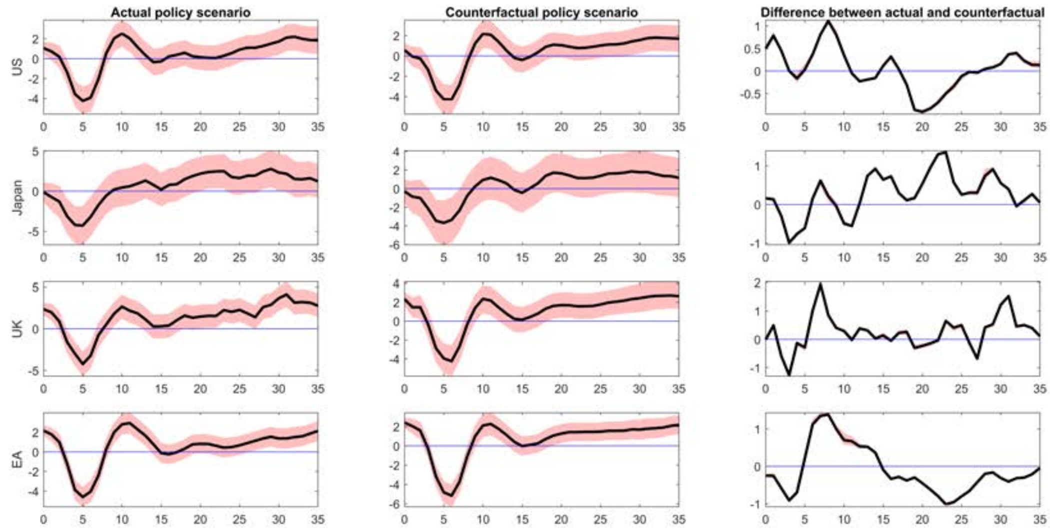


Figure S18: Conditional forecast EMEs. Overall policy scenarios. Bands are 68 HPDI

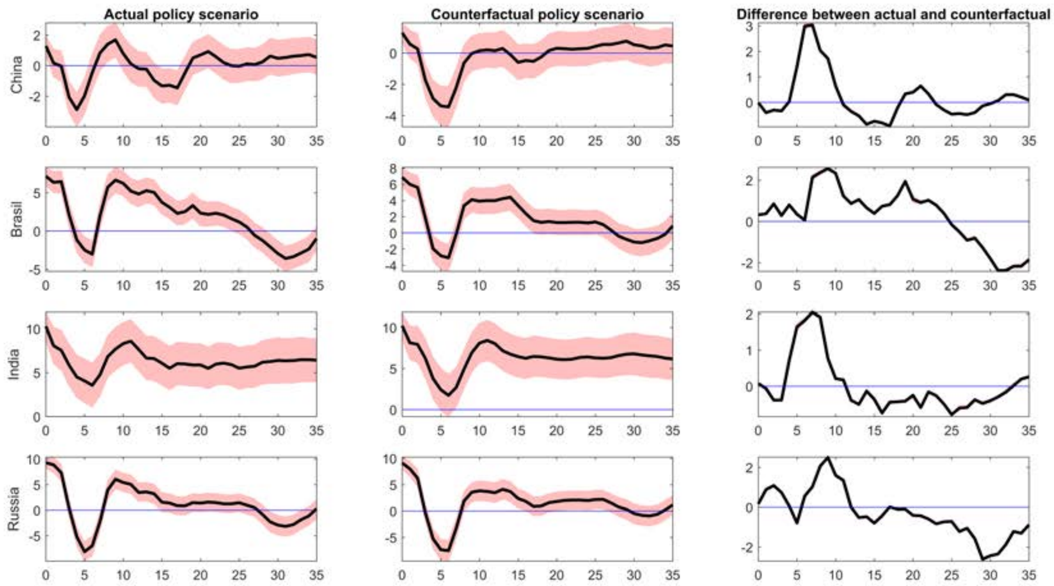
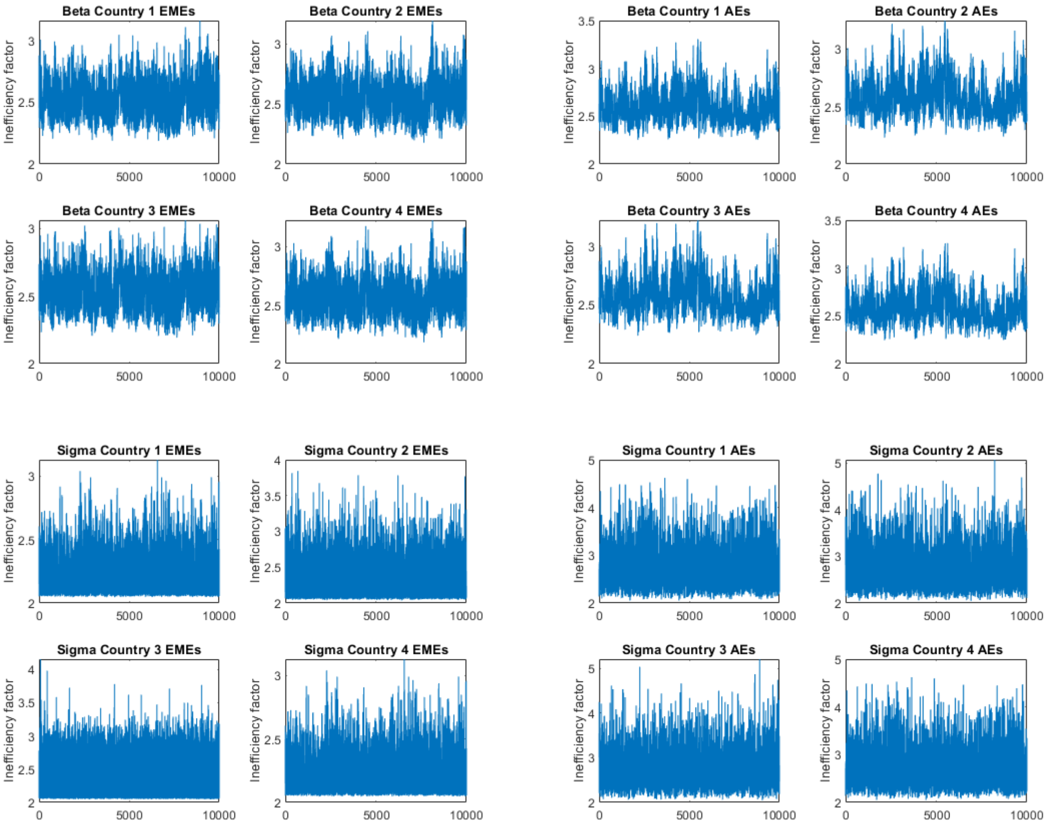


Figure S19: Inefficiency factors



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Ursel Baumann
European Central Bank, Frankfurt am Main, Germany; email: ursel.baumann@ecb.europa.eu

David Lodge
European Central Bank, Frankfurt am Main, Germany; email: david.lodge@ecb.europa.eu

Mirela S. Miescu
Queen Mary University of London, London, United Kingdom; email: m.s.miescu@qmul.ac.uk

Postal address 60640 Frankfurt am Main, Germany
Telephone +49 69 1344 0
Website www.ecb.europa.eu

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