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RESEARCH ARTICLE

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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 show that the effects of fiscal stimulus are higher in advanced economies compared to emerging markets, while monetary policy is found to have more homogeneous effects on GDP. We quantify the policy contribution on GDP growth in the decade that followed the global financial crisis 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.

KEYWORDS

conditional forecast, fiscal policy, monetary policy, panel VAR

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 2009G20 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 & Zabai, 2018); and the long-term consequences of the policy response (IMF, 2017a).

In recent years, however, at least prior to the arrival of the COVID-19 pandemic, priorities had gradually changed. Growth in global activity had revived over the past years as the cyclical upswing had gathered strength. Spare capacity across many economies narrowed substantially and policymakers had turned their attention towards policy normalization. Albeit gradually, the 'long decade' of policy accommodation appeared to draw to a

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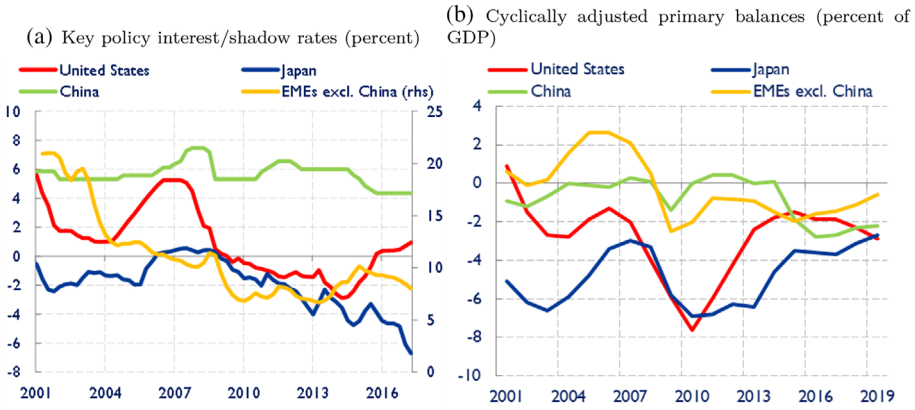


FIGURE 1 Policy intervention. Stylised facts [Colour figure can be viewed at wileyonlinelibrary.com]

close. Yet, policymakers edged at different speeds towards the stages of policy withdrawal, and it is crucial for them and us to understand the extent to which the global economy is still dependent on policy support.

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 Vector Autoregressive (VAR) models with hierarchical structure in the spirit of Jarociński (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.

We estimate separate models for the two groups of advanced and emerging economies and, following Jarociński (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. In particular, for emerging market economies (EMEs) for which time series are relatively short, this methodology 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.

The contribution of our work to the literature is twofold. First, we provide new evidence on the effects of both monetary and fiscal policy across a range of advanced and EMEs. We estimate structural panel VARs for a set of large advanced and emerging economies (United States, euro area, United Kingdom, Japan, Brazil, China, India and Russia), which together represent over half of global GDP (at purchasing power parity). Consistent with previous studies we find that GDP response to government spending shocks is mostly higher in advanced economies compared to EMEs. In contrast, we see a less strong reaction of monetary policy to fiscal policy shocks in EMEs.

Second, to discern the effect of fiscal and monetary policy on GDP growth we propose the use of 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. It should be emphasised that this is different from a historical decomposition analysis in which is estimated the contribution of actual policy shocks to GDP growth. In effect, we aim to provide an answer to the following question: what would have happened to the economy without the observed policy easing? Kapetanios et al. (2012) and Lenza et al. (2010) conduct similar exercises to ours in examining the role of monetary policy in the United Kingdom and the United States, euro area and United Kingdom respectively. However, both approaches rely on the reduced-form model to inform the conditional scenarios used. Our counterfactual exercise relies instead on the structural form of the model, attributing outcomes for policy specifically to the relevant monetary and fiscal shocks identified in our model.

Using structural conditional forecasts, our estimates account for the variability across countries in both the policy efficacy (e.g., in our framework a large policy contribution may reflect a high fiscal multiplier) and in the conduct of the policy (for example reflected in a higher or lower fiscal stimulus or monetary easing); we capture the policy efficacy through the identification of the GDP response to policy shocks, while the heterogeneity in the conduct of the policy is obtained by conditioning on the actual policy measure for each country.

The conditional scenarios results can be summarised thus. 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

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improvement in global activity in that period although it also emphasises 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 to reach the same macroeconomic outcomes. 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.

Our results are robust to a number of alternative assumptions. The robustness checks undertaken in this paper include changing the assumptions relating to the prior of the parameter governing the model heterogeneity, the ordering of the variables in the VAR, the lag length of the variables, the measure of the shadow interest rate as well as alternative fiscal variables. None of these changes materially affect the reported impulse response functions and thus the overall conclusions of the paper.

We believe our paper addresses an important topic for both academic research and policymakers. 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. 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 because EMEs rebounded more quickly in the immediate aftermath of the global recession, the policy response differed. As such, a deeper understanding of how policy contributed across both groups would benefit both policymakers and academics.

An important policy implication can be drawn from our findings: monetary and fiscal policies cannot act in isolation. Instead, each policy needs to consider the effect of the other policy on the macroeconomic outlook as well as the possible constraints faced by the other policy. For example, the lower bound on nominal interest rates may constrain the ability of monetary policy to achieve price stability, with fiscal policy having a more important role to play in such a situation. At the same time, monetary policy can support the economy during periods where fiscal consolidation is necessary, for example to ensure that the country retains a sound fiscal position. Regular interactions between policymakers responsible for fiscal and monetary policies are thus desirable, including some policy coordination (see Debrun et al., 2021 for an in-depth assessment of monetary-fiscal policy interactions in the euro area).

1.1 | Literature review

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, Jarociński (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. Mallick and Sousa (2012) analyse responses in large emerging markets. Pérez et al. (2015) compares the transmission of monetary policy shocks in Latin America using a hierarchical panel VAR.

On the fiscal side, Burriel et al. (2010) 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. It is worth noticing that studies using VARs tend to examine fiscal and monetary policies in isolation. The Christiano et al. (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

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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.

Our paper is also linked to the literature analysing the interaction and interdependency of the two branches of macroeconomic policy over the past decade. A number of recent papers (Bianchi & Ilut, 2017; Bianchi & Melosi, 2017; Corsetti et al., 2019; Jarociński & Maćkowiak, 2018) emphasise the relevance of analysing 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 accommodating? In asking these questions, we aim to provide an understanding of the interdependencies of policies and the effect on activity over the past decade.

The paper is organised 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:

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

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

where i denotes the group of countries (advanced vs. emerging economies), $c = 1, 2, ...M$, where M is the number of countries in each group and $t = 1,2,...T$ is the sample size. For estimation purposes, we rely on a hierarchical panel VAR framework in the spirit of Jarociński (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, consumer price index, tax and a monetary policy instrument. Government spending measures real government consumption and investment—that is, it excludes the elements such as transfers (e.g., unemployment benefits) which would depend on the business cycle; we also exclude interest payments.[i] Government revenues are measured as taxes less transfers and (where possible) interest payments. The monetary policy instrument is the policy interest rate.[ii] 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 (Lemke & Vladu, 2016; Wu & Xia, 2016). One concern that might arise is that the ZLB regime could imply a change in the model parameters. However, several studies that analyse 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; Hachula et al., 2020; Wu & Xia, 2016).

To account for global developments, we add Z_t, a $T \times 5$ matrix of global variables common to all countries. This matrix contains VIX index of equity volatility, world GDP, non-oil commodity prices, oil prices and a constant. The global variables 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. Even though our empirical framework does not explicitly model spillover effects, by including global variables we control for the effects of potential global shocks or shocks hitting the economies that transmit via global factors or variables. For example, monetary and fiscal policy in China will certainly affect the business cycle in Japan, the euro area and the United States. Likewise, fiscal support packages in the United States have cross-border effects. Including key global variables helps to control for fluctuations in global demand, risk sentiment and commodity markets and limits the distortion of the estimated domestic effects due to omitted global shocks and channels.

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 (United States, euro area, Japan and United Kingdom) 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.[iii] We relegate to the Appendix S1 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

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section heterogeneity. 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:

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

where $\overline{\beta}_i$ are cross sectional average coefficients of group i, updated during the sampling procedure. Ω_i is a Minnesota type variance which reflects the scale of the variables and adjusts the relative size of coefficient[iv]. 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 $\overline{\beta}_i$ 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 centred 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 specific 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 $\overline{\beta}_i$ to obtain the estimates. This allows the comparison of the GDP response to policy shocks in advanced versus emerging economies as a group. Moreover, $\overline{\beta}_i$ 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 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 and estimation

Following the approach suggested in Dieppe et al. (2016), standard diffuse priors are assumed for $\overline{\beta}_i$ 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 $v_0/2$. Jarociński (2010) and Gelman et al. (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.

A Gibbs sampler is used to draw from the marginal posterior of the parameters. The algorithm is based on Jarociński (2010) and Dieppe et al. (2016). A detailed description of the Algorithm is available in the Appendix S1.

2.3 | 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 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 is the most exogenous variable in the system and is not affected contemporaneously by developments in the remaining variables[v]; 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. We control for developments in government revenues, but 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 GDP, making the identification of such shock problematic in a recursive framework.

In spite of the limitations of the recursive identification compared to alternative approaches (e.g., the narrative approach and high frequency approach),[vi] its simplicity is particularly attractive for our analysis. The Cholesky scheme is easily applicable to both advanced and emerging countries allowing for a direct comparison of the country and group specific estimates.

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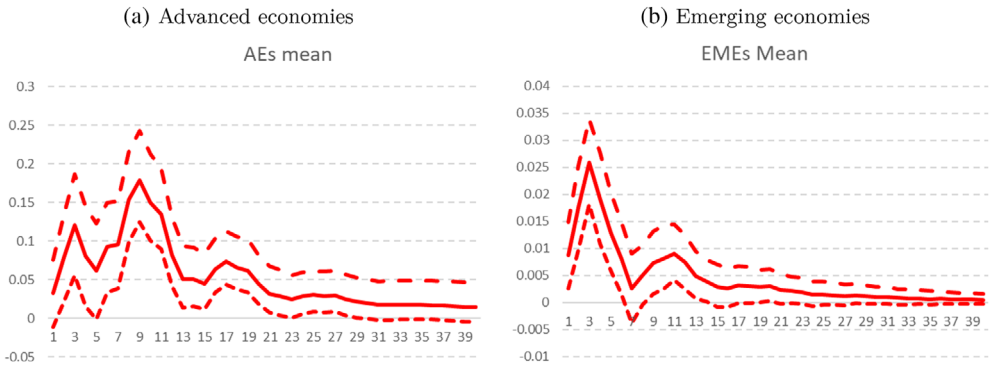


FIGURE 2 Impulse responses to government spending shocks. Mean model results. Response of year-on-year GDP growth to a 1 pp increase in the government spending rate. Bands are 68 HPDI [Colour figure can be viewed at wileyonlinelibrary.com]

3 | RESULTS

3.1 | Model evaluation

We first check the reliability of the estimated panel model by considering the model properties. The focus is on the response of GDP growth to shocks in both fiscal and monetary policy variables. We report the elasticity of GDP growth to government spending and monetary policy shocks from the mean model for both groups of AEs and EMEs, while the individual country estimates are available in the Appendix (Figures S12, S13 and S15). 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.

Figure 2 presents the mean model estimates for the government spending shock. Median across saved draws together with the 68 highest probability density intervals (HPDIs) are reported. The results suggest that the elasticity of GDP to fiscal shocks is substantially higher in AEs compared to EMEs with a GDP peak response of 0.17% in AEs versus 0.025% in EMEs.[vii] This finding is consistent with previous studies such as Ilzetzki et al. (2013) and Kraay (2012), which suggest that the effects of fiscal stimulus in EMEs are smaller than in advanced economies. Regarding the country specific estimates, reported in Figures S12 and S13, the GDP growth response to government spending shocks has the expected sign, though differing across countries. In the AEs group, we find that in the United Kingdom and the Euro Area, the GDP response to fiscal shocks is positive but slightly smaller than the one corresponding to Japan and the United States. Regarding the EMEs group, with the exception of Brazil for which we observe a peak response of around 0.4%, the effects of spending shocks on GDP growth in China, India and Russia are positive and close to the mean model estimates of the group. The high magnitude of the GDP response to fiscal shocks in Brazil has been attested in previous studies as well (see Matheson & Pereira, 2016; Oreng, 2012). Potential explanations for this result have been attributed to some characteristics of the Brazilian economy such as low import propensity, low propensity to save, high liquidity constraints and wage rigidity, which tend to magnify the effectiveness of its fiscal policy. For China, the modest impact of government spending, may reflect (i) the limited social safety net in the country; and (ii) the limitations of data which allow us to capture only central government spending while in recent years, much of China's fiscal stimulus has been generated through local government infrastructure spending.

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 3 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.[viii] The contractionary measure has the expected negative effect on GDP growth for all countries. In advanced economies, the peak impact is reached after around four quarters, but the effect exhibits some persistence in the first 3 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 S10). Overall, this 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 inflation rise temporarily after a contractionary monetary policy shock.

The GDP response to fiscal shocks displays more heterogeneity (between and within group) compared to the

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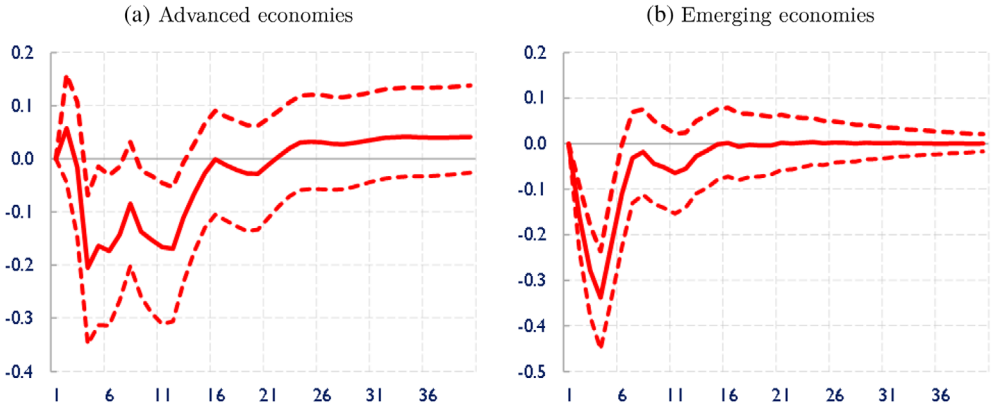


FIGURE 3 Impulse responses to monetary policy shocks. Mean model results. Response of year-on-year GDP growth to a 1 pp increase in the monetary policy interest rate. Bands are 68 HPDI [Colour figure can be viewed at wileyonlinelibrary.com]

GDP response to monetary policy shocks.[ix] Regarding the monetary policy finding, our results are in line with Jarociński (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 and Rich (2001) and Mihov (2001) find asymmetries in monetary transmission among countries.

On the other side, the variability of the effects of fiscal shocks is not new in the literature. Several studies suggest that such effects depend on the economic conditions or on the specific sample analysed. In particular, Ilzetzki et al. (2013) claim that the effects of fiscal shocks 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 effects 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 GDP response to spending shocks. 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) point out that: (i) the effects of fiscal shocks are lower under more active monetary policy, which offsets the effects of the fiscal policy measures, stabilising the economy; and that (ii) more credible and/or longer lasting measures usually imply greater effect on output.

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. In effect, we use the model to understand the path GDP would have taken had interest rates and government spending instead remained at sample averages from 2008 onwards. 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 country specific actual realisations of policy variables.
2. In the *counterfactual policy* scenario, the actual values of the policy variables are replaced by their country specific sample averages over the estimation period.

Following Bernanke et al. (1997), the counterfactual path assumes that monetary and fiscal authorities do not react to fluctuations in other macroeconomic state variables (such as output and inflation) and instead keep monetary and fiscal policy tools fixed at sample averages. To assess the contributions of policy to economic developments, we then compare the median outcomes of the two scenarios—that is, we subtract the conditional path for GDP growth in the actual policy scenario from the conditional path in the counterfactual constant policy scenario. Even though we restrict structural shocks rather than the policy rules, the comparisons we perform are somewhat extreme, particularly since the counterfactual scenarios are considered over an extended period—that is, one decade—and in that sense, they may be subject to the Lucas critique. According to Leeper and Zha (2003) and Kilian and Lewis (2011), using very big shocks to construct the counterfactuals can be problematic; the common assumption behind counterfactual exercises using Structural (S)VARs is that policy changes contemplated are small enough not to affect the structure of the economy materially. To preclude that our counterfactual scenarios are triggered by implausibly large policy

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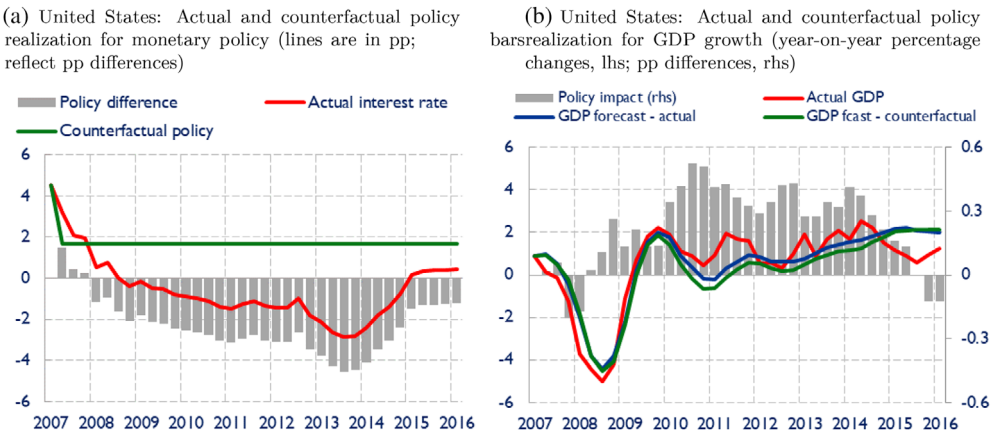


FIGURE 4 United States: Counterfactual scenario for monetary policy [Colour figure can be viewed at wileyonlinelibrary.com]

shocks, we show that the policy shocks necessary to generate the constant policy counterfactuals for the United States are within the bounds of actual historical experience (see Figure S22), hence they should not limit the usefulness of the scenarios.

We first compare the combined impact of fiscal and monetary policies—that is, we conduct a counterfactual policy scenario in which 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 4. 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 GDP 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 (pp) differences of GDP growth, are shown by the grey bars and aim to capture the policy impact of monetary policy in that period.

Note that we deliberately compare two conditional forecast scenarios—that is, 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 realisations of GDP (i.e., the green line with the red line in Figure 4). 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 policy. Lenza et al. (2010) and Kapetanios et al. (2012) use a similar approach to analyse 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 Dieppe et al., 2016; Doan et al., 1984; Waggoner & Zha, 1999); no restrictions are placed on the other shocks which are drawn from their own distribution.[x] We are not the first ones to work with structural SVAR models to perform policy counterfactual scenarios. Bernanke et al. (1997), Hamilton and Herrera (2004), Baumeister and Kilian (2014) and Kilian and Lewis (2011) use structural counterfactual scenarios to examine the various aspects of oil shocks and their interaction with monetary policy. We have also recently become aware of the methodological contribution provided by Antolin-Diaz et al. (2021) who propose a novel and flexible Bayesian algorithm to perform structural conditional forecasts. Their approach accommodates for both 'hard conditions' that always hold exactly, as in our analysis, as well as for 'soft conditions' in which the researcher wants to obtain a distribution centred at the condition value, with some variability allowed around these values, in line with the relative entropy approach proposed by Robertson et al. (2005).

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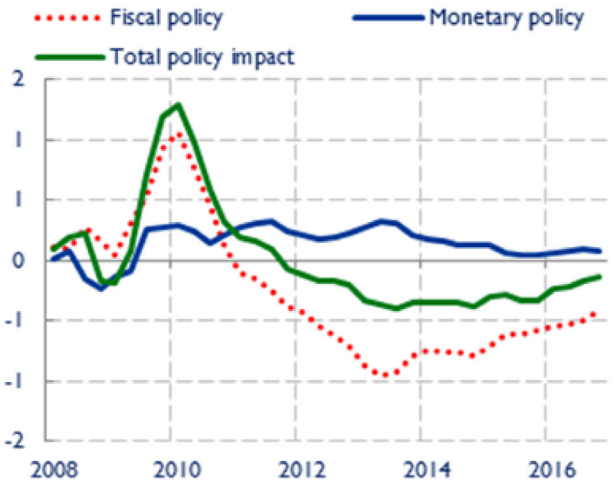


FIGURE 5 Policy contributions to aggregate GDP for eight countries (percentage point difference in year-on-year GDP growth between actual policy and counterfactual policy scenarios). The lines show the differences year-on-year GDP growth between actual policy and counterfactual policy scenarios (see 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 eight countries in the sample. [Colour figure can be viewed at wileyonlinelibrary.com]

The main advantage of the structural approach in conducting the counterfactual analysis is that it captures the heterogeneity (across countries) of the policy contribution to 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 S1.

The estimated overall support from government spending and monetary policy is shown in Figure 5 for the aggregate GDP of the countries in the sample, and at country level in Figure 6.[xi] 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 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 7), 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 2012–2013, 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 which necessitated emergency spending. Monetary policy by the Bank of Japan through its quantitative easing programme 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 8), 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 (2017b) estimates a significantly larger fiscal deficit than reported by official figures, suggesting substantially bigger fiscal support. Among 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

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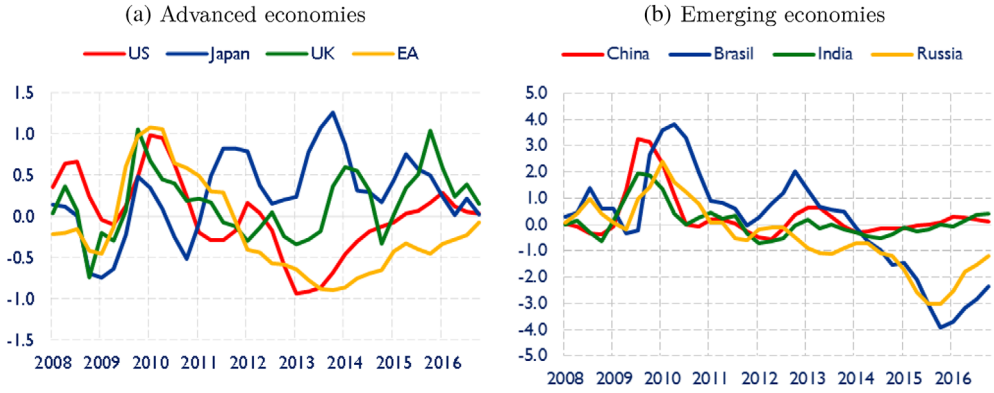


FIGURE 6 Policy contributions to GDP growth for advanced and emerging economies (pp difference in year-on-year GDP growth between actual policy and counterfactual policy scenarios). The lines show the differences year-on-year GDP growth between actual policy and counterfactual policy scenarios (see section 3.2 for explanation). [Colour figure can be viewed at wileyonlinelibrary.com]

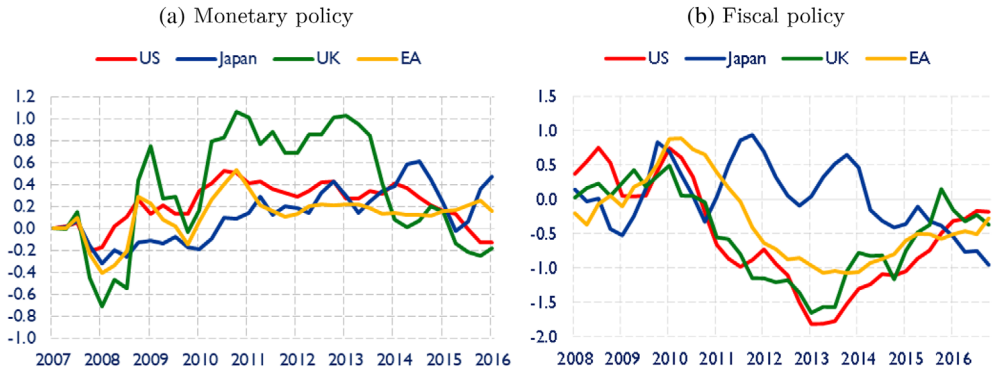


FIGURE 7 Policy contributions to GDP growth for advanced economies from monetary and fiscal policies (pp difference in year-on-year GDP growth between actual policy and counterfactual policy scenarios). The left-hand side chart shows the differences in year-on-year GDP growth between actual policy and 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. [Colour figure can be viewed at wileyonlinelibrary.com]

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 analysing the interaction and interdependencies of monetary and fiscal policies. In this section, we ask two questions: (i) how strong would the monetary easing have needed to be to attain the observed levels of macro variables if fiscal policy (FP) had been conducted differently? and (ii) how strong would fiscal support have needed to be to reach the same paths of output and inflation, had monetary policy been less accommodative? We illustrate the interactions between monetary and fiscal policies using the US economy as an example, being one of the largest economies in our sample.

We start with (i) and assess the role of fiscal policies in shaping monetary policy since the global financial crisis. Following the methodology described in section 3.2 we compute two conditional forecasts over the sample 2008Q1-2016Q4 as follows:

- Scenario 1: Produce a forecast for the interest rate in which all the other variables (except for the interest rate)

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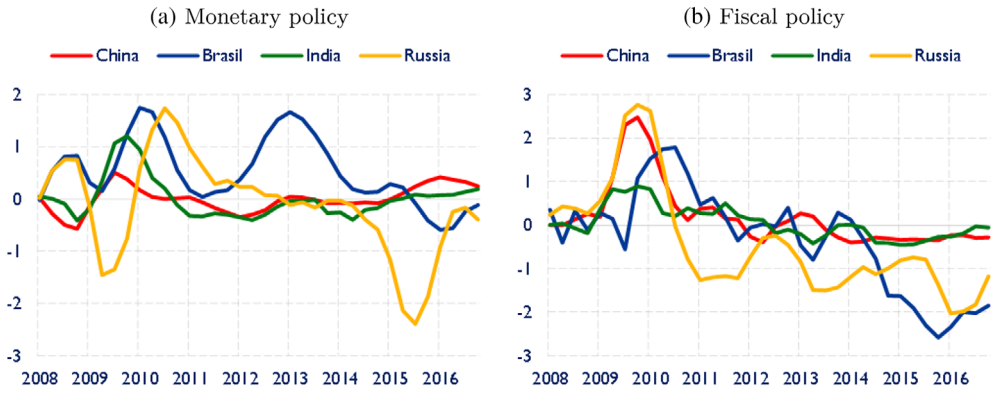


FIGURE 8 Policy contributions to GDP growth for emerging market economies from monetary and fiscal policies (pp difference in year-on-year GDP growth between actual policy and counterfactual policy scenarios). The left-hand side chart shows the differences in year-on-year GDP growth between actual policy 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. [Colour figure can be viewed at wileyonlinelibrary.com]

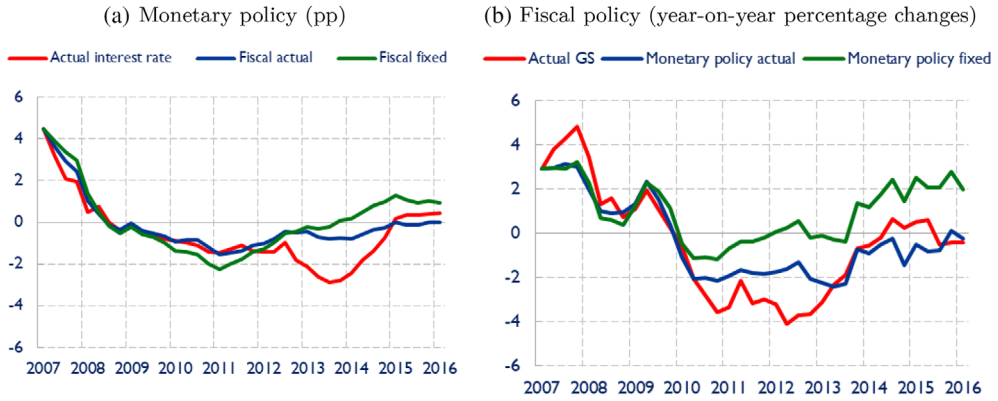


FIGURE 9 Policy interaction scenarios for the United States. The left-hand side chart shows the actual and counterfactual paths for monetary policy from 2007. The red line shows the actual (shadow) interest rate path. The blue line shows the conditional forecast for the interest rate, conditioned on 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. [Colour figure can be viewed at wileyonlinelibrary.com]

are conditioned to be at their actual value, generated by all shocks except for the monetary policy shock. This is the 'actual monetary policy scenario' (red line in Figure 9a) and it captures the short term rate behaviour necessary to achieve the actual paths of the non-policy variables, assuming that fiscal policy has an active role in the economy and is consistent with its historical records.

- Scenario 2: Produce again a forecast for the interest rate restricting all shocks except for the monetary policy one and impose that GDP, inflation and tax are at their actual values while fiscal policy (in terms of government spending) is fixed at its sample average (green line in Figure 9a). Thus, in this scenario we assume that there is no response of fiscal policy to economic developments and the action of monetary policy alone should be such that it attains the actual paths of the non-policy variables.

The forecasts for interest rates in the two scenarios are reported in Figure 9a, together with the actual value of the interest rates (blue line). To compensate for the lack of the fiscal stimulus, the counterfactual paths for policy suggest a sharper reduction in (shadow) interest rates in the

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United States (green line in Figure 9a). 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, by looking at the difference in the two counterfactual scenarios we can infer 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 counterfactual scenarios along the lines of the Scenarios 1 and 2 described above. 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 9b). 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 9b). 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 green lines), the model suggests that government spending would have needed to be stronger to support economic activity.

Our results highlight the important policy implication that monetary and fiscal policies cannot act in isolation. Instead, each policy needs to consider the effect of the other policy on the macroeconomic outlook as well as the possible constraints faced by the other policy. In particular, the counterfactual simulations highlight this point: fiscal policy would have needed to be considerably more expansionary without the help of monetary accommodation. Monetary policy support therefore can help ensure economic stability during periods where fiscal consolidation is necessary and allow that a country retains a sound fiscal position. That emphasises the more general point that regular interactions between policymakers responsible for fiscal and monetary policies are thus desirable, including some policy coordination (see Debrun et al., 2021 for an in-depth assessment of monetary-fiscal policy interactions in the euro area).

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 S16–S22).

Jarociński (2010) and Gelman et al. (2006) show that weakly 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 $\nu = 0$) instead. Impulse response functions reported in Figure S16 Appendix are almost unaffected by this change.[xii]

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, 2011), we perform a counterfactual check for EMEs in which monetary policy targets both the interest rate and the monetary aggregate. Results (see Figure S18) 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 S20 shows impulse responses of GDP for advanced economies to a monetary policy shock using the shadow rate measure proposed by Krippner (2013). We also show that the estimated monetary policy shocks effects are robust to an alternative ordering of the variables in which government spending is ordered last (see Figure S21).

The government spending measure includes government consumption and government investment for the advanced economies group, while for the EMEs the data for government investment is not available. As such, there might be some concerns regarding the comparability across groups regarding the fiscal policy effects. As a test of the accuracy of our results were estimate the AEs model using only government consumption in the fiscal measure. Results reported in the Figure S14 show that the impulse responses are little affected by this change in the fiscal variable definition.

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Finally, we check the convergence of the Gibbs sampler reporting the inefficiency factors for the posterior estimates of the parameters. The convergence diagnostics (Figure S25) are satisfactory with inefficiency factors values below 5 for all parameters.

5 | CONCLUSIONS

We used Panel VARs with a hierarchical structure to asses and compare the effects of fiscal and monetary policy on GDP growth in advanced and emerging economies. Our results suggest that the effects of monetary policy on GDP are similar across the two groups while the fiscal policy effects are higher in AEs compared to EMEs. We also find that GDP growth response to government spending shocks display some within group variation. This effect is not verified in the case of monetary policy.

Using a counterfactual analysis, 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 showed 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 emphasise 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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DATA AVAILABILITY STATEMENT

The data and codes that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTES

[i] For the EMEs group, due to a lack of data on government investment, we rely on government consumption to proxy for government spending. For the euro area, the fiscal data is based on Paredes et al. (2009)

[ii] 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.

[iii] Both the marginal Likelihood and Deviance Information Criteria reported in Tables S4 and S5, 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.

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

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

[vi] The impulse responses to a government spending shock based on timing restrictions might be downward biased due to fiscal foresight as per Ramey (2011) and Ramey (2016); moreover the zero impact effect of monetary policy on output and prices can be considered restrictive in a quarterly data setting.

[vii] Since the counterfactual scenario makes use of impulse responses, we report the GDP elasticity to fiscal stimulus rather than multipliers. The cumulative present discounted value multipliers as per Mountford and Uhlig (2009) are available in the Table S3.

[viii] 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 S1.

[ix] 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

[x] For example, in case of a recursive identification, an unrestricted shock is drawn from a $N(0, 1)$ distribution. See Dieppe et al. (2016) for details.

[xi] For ease of exposition, we limit our attention to the differences in the medians across the two scenarios. Figures S23 and S24 in the appendix report the posterior median and 68 HPDI for both conditional forecast scenarios for the case of overall policy contribution. We show the statistical significance of the difference in the medians of the two scenarios performing a Wilcoxon test for each horizon of the forecast path. Results reported in Table S2 show that the null hypothesis that the two scenarios distributions are equal is rejected for most of the observations. Standard t-tests convey similar results and are available upon request.

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

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