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Contents

Introduction

This thesis comprises two self-contained chapters in macroeconomics. The two macroeconomic tools that are designed to achieve the macroeconomic goals of any economy are fiscal and monetary policies. However, the VAR methodology has long been applied to the analysis of monetary policy and only recently applied to the analysis of fiscal policy. In this regard, literature has witnessed that both fiscal and monetary policies affect macroeconomic variables either individually or jointly. Moreover, most of the empirical literature on the effect of monetary policy as focused mainly on its effects on the domestic economy and the analysis of the international spillover has been growing only over the recent periods. In line with this, there is strong evidence that the world economy becomes more integrated globally, witnessed by the co-movement of most macroeconomic variables such as inflation, output, employment, interest rates, exchange rates, and trade balance following different international shocks. Hence, both domestic effects and the transmission of international spillovers are analyzed in detail in this thesis. In particular, while the first chapter focuses on the effects and contributions of both monetary and fiscal policies on the domestic economy, the second chapter is devoted to the transmission of international spillover to the domestic economy.

The first chapter, “Explaining Macroeconomic Fluctuations in Ethiopia: The Role of Monetary and Fiscal Policies”, examines the role of monetary and fiscal policies in explaining macroeconomic fluctuations in Ethiopia. To explore the roles played by monetary and fiscal policies, the Structural Vector Autoregressive (SVAR) model is estimated by appealing mainly to the Blanchard and Perotti (2002) and Perotti (2004, 2005) methodology and then impulse responses and historical contributions of each shock are generated. For this purpose, quarterly data over the sample period 1997/1998:1 to 2016/17:4 are used. In order to ensure the robustness of the baseline results, alternative identification strategies and alternative specifications are also considered in the paper.

The impulse responses show that an increase in government spending has an expansionary effect on output, while an increase in tax revenue is contractionary, with spending multipliers larger than net tax revenue multipliers. On the other hand, contractionary monetary policy is associated with a fall in output. Moreover, the contributions of fiscal policy shocks are larger than that of monetary policy shocks in explaining movements in output, with roughly equivalent contributions coming from shocks in fiscal policy components. The results also support the view predicted by Rossi and Zubairy (2011) that failing to incorporate both monetary and fiscal policies simultaneously might incorrectly attribute to the wrong conclusions about the effects of monetary and fiscal policies in explaining macroeconomic fluctuations. This chapter is forthcoming in the Journal of Policy Modelling.

The second chapter, " Does it matter where monetary expansion originates for international spillovers? ", explores the international monetary policy spillovers from the U.S., the Euro Area, Japan, and China to 17 Emerging Market Economies (EMEs). To examine the transmission of international spillovers to these emerging economies, the Structural Vector Error Correction (SVEC), Structural Factor Augmented Vector Error Correction (SFAVEC) and Structural Factor Augmented Vector Autoregressive (SFAVAR) Models are estimated. The estimation of the three alternative models is mainly to confirm the sensitivity of the baseline results. The empirical results are based on the monthly data from January 1999 to December 2018, where the starting date is determined by the introduction of the Euro Area and the availability of monthly data for some Emerging Market Economies.

Results show that, after expansionary monetary policy in these four big economies, industrial production increases in typical emerging markets. These results are robust to most countries considered in the analysis over the sample period. The short-term interest rates also fall in the typical emerging market economies regardless of where the shock is originated. However, the response of the real trade-weighted exchange rates in the typical emerging market economies is strong and short-lived after monetary expansion in the Euro Area, but persistent after monetary expansion from the U.S, Japan, and China. There is also a substantial cross-country heterogeneity in the responses of the macroeconomic aggregates in the emerging markets, where the size of the spillovers vary with the country-specific characteristics. Countries with higher trade openness and higher financial integration display stronger spillover in production as compared to other counterparts after the U.S. and the Japanese M3 innovations. Moreover, the degree of debt burden matters for the transmission of the U.S, the Euro Area, and Japan's monetary policy shocks and does not seem to matter for monetary expansions in China.

1 Explaining Macroeconomic Fluctuations in Ethiopia: The Role of Monetary and Fiscal Policies.

Abstract

The aim of this paper is to examine the role of monetary and fiscal policies in explaining macroeconomic fluctuations in Ethiopia using a structural VAR approach, over the period 1997/1998:1 to 2016/17:4. Its mains results can be presented as follows: first, an increase in government spending has an expansionary effect on output, while an increase in tax revenue has contractionary effect, with spending multipliers larger than net tax revenue multipliers; second, contractionary monetary policy is associated with fall in output; third, monetary policy contributes to a very small fluctuations in output and it is one of the responsible sources of the high and persistence inflation in the country; fourth, the contributions of fiscal policy shocks are larger than that of monetary policy shocks in explaining movements in output, with roughly equivalent contributions coming from shocks in fiscal policy components. Furthermore, the effects of fiscal and monetary policy shocks on output and inflation have improved qualitatively and quantitatively when both policy variables are jointly examined than estimating a separate model; suggesting the role of a joint analysis of fiscal and monetary policy shocks.

Key Words: Fiscal Policy, Monetary Policy, Fluctuations, SVAR

1.1 Introduction.

This paper examines the impact and the relative importance of monetary and fiscal policies in explaining Ethiopia's macroeconomic fluctuations using a structural VAR model. Ethiopia is an interesting case study for two reasons. First, its economic growth has attracted international attention in recent years. Ethiopia is among the fastest-growing economies in the world since 2003/04 (World Bank Group, 2017; Zerihun et al., 2016; Priewe, 2016). Moreover, inflation has been high and persistent exceeding double digits, reaching unprecedented figures and the center of policy debate since 2002/03. These high and persistent inflation has been one of the policy challenges in sustaining high economic growth in the country. Different explanations, for high growth and inflation dynamics, have been forwarded at the individual and institutional level, though there is a lack of empirical evidence that explicitly shows the relative importance of monetary and fiscal policy in explaining macroeconomic fluctuations in the country. The first argument is that Ethiopia's growth has been driven by large and persistent public spending in pro-poor and growth-enhancing sectors.[1] Moreover, high and persistent inflation in the country has been mainly due to, among others, expansionary monetary policy (Priewe, 2016; Zerihun et al., 2016; Minyahil et al., 2016).

Secondly, it has been shown in the literature that fiscal multipliers in low-income countries, though scarce, are generally smaller than in middle income and advanced economies. The difference in fiscal multipliers between these groups of countries is attributed to the country-specific features such as, among others, the low marginal efficiency of public spending, low degree of home bias in trade and a high degree of indebtedness (Ilzetzki et al., 2013; Shen et al., 2018). According to Dabla-Norris et al. (2012) and Shen et al. (2018), the government spending efficiency, as measured by the public investment management index (PIMI), has been low in low-income countries, which lies between 0.5 in the Congo Republic and 2.4 in Bolivia.[2] The figure for Ethiopia is 1.65 and very close to the index for Sub-Saharan African countries (1.56), which constitute a larger share of low-income countries. Similarly, most low-income countries are characterized by a lower degree of a home bias (reflected by a high import intensity) and a high degree of debt to GDP ratio. Ethiopia is not an exception from these features and hence exploring fiscal multipliers in Ethiopia best characterizes fiscal multipliers in low-income countries in general and in Sub-Saharan African countries in particular.

Evidence on the impacts of monetary and fiscal policies fueled ongoing debates in the literature. Though more focuses have been devoted to the study of monetary policy than fiscal policy until the 2008 financial crisis (Perotti, 2002; Ramey, 2011a; da Silva and Vieira, 2017), the results obtained so far are far from conclusive for both policy options (Coibion, 2012; Barakchian and Crowe, 2013; Cloyne and Hurtgen, 2016; Rafiq and Mallick, 2008).[3] Regarding monetary policy, its contribution to output and price fluctuations is either insignificant (Fetai, 2013),

[1] These sectors include agriculture and food security, roads, water and sanitation, education and health (Zerihun et al., 2016)

[2] The PIMI index in MIC and advanced economies is above the LIC average (see Dabla-Norris et al., 2012; Gupta et al., 2014).

[3] Much of these findings in the literature have been for the United States (Cloyne and Hurtgen, 2016).

very small (Christiano et al., 1999; Kim, 1999; Bernanke et al., 1997, 2005; Cloyne and Hurtgen, 2016), relatively unimportant (Leeper et al., 1996), medium (Coibion, 2012) or large and sizable (Romer and Romer, 2004; Forni and Gambetti, 2010). Despite considerable empirical evidence about the efficacy of monetary policy, there remains disagreement about its effect on the macroeconomy (Cloyne and Hurtgen, 2016). Empirical studies also fail to find evidence supporting theoretical predictions, showing the positive response of output (real GDP) and inflation to contractionary monetary policy (Mojon and Peersman, 2001; Rafiq and Mallick, 2008; Castelnuovo and Surico, 2010; Barakchian and Crowe, 2013; Cloyne and Hurtgen, 2016).

In a similar token, the effects and contributions of fiscal policy are also mixed in the current literature, especially for tax revenue shocks.[4] While some evidence find negative and significant effects of net tax shocks on output and price dynamics (Blanchard and Perotti, 2002; Favero and Giavazzi, 2007; Mountford and Uhlig, 2009), others find a rise in output following positive net tax shocks (Dungey and Fry, 2009). Perotti (2002) also shows mixed evidence for range of OECD countries and U.S. The majority of above findings are obtained from estimating monetary or fiscal policies separately, suggesting that evidence using both monetary and fiscal policies simultaneously are very limited (Dungey and Fry, 2009; Rossi and Zubairy, 2011; Fetai, 2013). However, failing to incorporate both monetary and fiscal policies simultaneously might incorrectly attribute to the wrong conclusions about the effects of monetary and fiscal policies in explaining macroeconomic fluctuations (Rossi and Zubairy, 2011; Fetai, 2013). The empirical exercises in this paper also confirm this argument where the size of the response of the output has improved significantly when both monetary and fiscal variables are jointly analyzed in a single SVAR model.[5] Hence, it is crucial to model both fiscal and monetary policies simultaneously to show the impact and relative contribution of each shocks to fluctuations in output and inflation.

The key results from the structural VAR model are as follows. First, an increase in government spending has an expansionary effect on output, while an increase in net tax has a contractionary effect, with spending multipliers larger than that of net tax multipliers. Second, contractionary monetary policy is associated with a fall in output. Third, monetary policy contributed to very small fluctuations in output and it is one of the responsible sources of the high and persistent inflation in the country. Fourth, the contributions of the fiscal policy components are roughly equivalent in explaining output fluctuations. Fifth, the contributions of fiscal policy shocks are larger than monetary policy shocks in explaining movements in output.

The remainder of the paper is organized as follows. The second section presents the related literature in the area. Section three discusses the model used in the paper along with the specification and identification of shocks, preliminary data analysis, and VAR diagnostics. The fourth section presents empirical results based on impulse responses, fiscal multipliers, and

[4]While different identification schemes yield very similar results for government spending shocks, these results are mixed for net tax revenue shocks (Caldara and Kamps, 2008).

[5]The response of the output to net tax shocks has improved both qualitatively and quantitatively when monetary shocks are included in the fiscal SVAR model. In particular, unlike in the case of joint fiscal and monetary shocks SVAR model, the response of output to net tax shocks is muted and is statistically insignificant when only the fiscal SVAR model is estimated. Similarly, the sizes of the responses of output to monetary shocks are increased when fiscal shocks are included in the monetary SVAR.

historical decomposition. Section five is devoted to some sensitivity analysis. The sixth section presents the main conclusions.

1.2 Related Literature.

1.2.1 Theoretical Literature.

1.2.1.1 Introduction.

Attainment of macroeconomic goals such as sustainable economic development, stable prices, higher output growth, stable exchange rates, maintenance of the balance of payment equilibrium, and promotion of employment are the important components of the macroeconomic stabilization policy of every economy. The realization of these macroeconomic policies is not automatic but requires policy guidance, which also represents the objectives of economic policy (Musa et al., 2014). The two main alternative policy options in national macroeconomic stabilization agendas are monetary and fiscal policies (Mobolaji and Adefeso, 2010).

Monetary policy is defined as a policy employed by the central bank in controlling the money supply as an instrument for achieving the objectives of economic policy. It is, therefore, a combination of the measures designed to regulate the value, supply and cost of money in the economy in consonance with the expected level of economic activities. On the other hand, fiscal policy is a measure employed by governments to stabilize the economy, specifically by adjusting the levels and allocations of taxes and government spending (Kareem et al., 2013). There is a consensus among economists that monetary and fiscal policies affect various macroeconomic variables either jointly or individually, but the degree and relative dynamic impacts of these policies have been the subject of debates and controversies between the Keynesians and the Monetarists (Folorunso and Ajisafe, 2002 and Mobolaji and Adefeso, 2010). In the following sections, different views about the relative efficacy of monetary and fiscal policies are discussed in terms of two broad schools of thought: the classical (Monetarist view) and Keynesian view, whose main propositions are based on the concept of IS-LM curves.

1.2.1.2 The Classical View.

The Classical school of thought is based on the existence of perfectly operating markets. According to this school's view, both labour and product markets clear through adjustment of the price of labour (wage rate) and the price of goods and services, respectively. As a result, the value of real variables in the model are determined independent of the value of the nominal money stock and, thus, government control of the money stock leads to the variations in only nominal variables (Hillier, 1991). This further gives a very little role for government in macroeconomic management of the economy, with the only role of ensuring that laws designed are respected. Furthermore, as long as all markets clear and there is full employment, any form of unemployment in the economy is due to some form of rigidity in the economy. The central argument of the Classical view is based on the Quantity Theory of Money which states that the nominal GDP (price times real output) depends only on the quantity of money. Symbolically, this is given by:

$$MV = PY$$

where M =Money stock, V = Velocity of money, P =Average price, Y =Quantity of goods and services produced. Given that P and V are constants, then M equals Y in that the level of nominal income is determined solely by the quantity of money. Most importantly, the LM curve is vertical in the case of classical school so that a change in the quantity of money has a maximum effect on the level of income.

As to the fiscal policy, as long as the LM curve is vertical, then the demand for money is not sensitive to the interest rate. Hence, the fiscal multiplier is zero (fiscal policy has no impact) as interest is not responsive so that the fiscal policy is ineffective while the monetary policy is effective (Levacic and Rebmann, 1991). For instance, expansionary fiscal policy (increase in government spending or reduction in taxes) raises the interest rate and reduces private investment. Without monetary accommodations, an increase in interest rate will end up at increasing the general price level. Hence, the general conclusion of this school of thought is that monetary policy has had a more powerful role than fiscal policy in achieving various macroeconomic goals (Cyrus and Elias, 2014; Musa et al., 2014).

1.2.1.3 The Keynesian View.

Macroeconomic reality during the periods of the Great Depression motivated professionals to think over the effectiveness of monetary policy and leads to the conclusion that fiscal policy was more effective. Keynes's (1936) general theory of employment, interest, and money provides basic theoretical ground for active fiscal policy. Keynes argues that classical economic thinking failed to explain the incidence because it was based on bold assumptions, among others, flexible prices. Instead, the government can help to counteract the downturn and stabilize the economy through demand management policies, such as fiscal policy. During this time, governments around the world began to view economic stabilization as a primary responsibility (Mankiw, 2001).

This school of thought argues that money is exogenously determined by the central authority and the economy can never operate at full employment equilibrium, in contrast to the Classical View. The concept of liquidity trap in which real interest rates cannot be reduced by any action of the monetary authorities has played a key role in the resurgence of the Keynesian economists, making the monetary policy ineffective in stimulating the economy. Expansionary fiscal policy enhances demand and productivity in the economy either directly, through larger government spendings, or indirectly, through a tax cut that could encourage private spending and investment (Mahmood and Sial, 2012). Because of this, they argue that fiscal policy is more effective than monetary policy in stimulating the macroeconomy.

The Keynesian view of fiscal policy as an effective macroeconomic management tool was strong during the 1940s and up until its effectiveness was re-dominated by the monetary policy as a main macroeconomic tool in the mid-1970s (Levacic and Rebmann, 1991). There was a strong shift from the Keynesian macroeconomic policies by several western governments in the late 1970s and early 1980s (Hillier, 1991). During this period the focus has been given to the importance and the effectiveness of the monetary policy. However, the recent international financial crisis has motivated policymakers to think over the efficacy of monetary policy once again and then induced policymakers to use fiscal stimuli as a macroeconomic stabilization tool. Blanchard et al. (2010) argue that fiscal policy should be rethought back to the center of discussion as an important macroeconomic policy tool. Nowadays, it is believed that both policy options are perceived to affect various macroeconomic aggregates. In sum, even if different schools of thought have different conclusions about the two macroeconomic management tools, the empirical evidence so far show that neither monetary nor fiscal policy alone is more effective in stimulating the economic growth and in stabilizing price, where both fiscal and monetary policies are assumed to affect macroeconomic variables depending on the structure of the economy and level of development. Hence, the following section gives due attention to the review of the empirical literature on the efficacy of fiscal policy, monetary policy and/or both.

1.2.2 Empirical Literature.

1.2.2.1 Introduction.

The focus of this section is to review the empirical literature on the impact of fiscal and monetary policies. The monetary policy literature has dominated that of fiscal policy effects (Perotti, 2002; Ramey, 2011a; da Silva and Vieira, 2017). The main reason that could explain why fiscal policy has been overlooked in the earlier periods is the issue of fiscal stabilization during the 1970s where the failure of stabilization policies, in general, fell most heavily on fiscal policy. Moreover, it was argued that fiscal policy is less flexible to change on a timely basis, has a small temporary effect (especially the temporary tax changes) and is used for political reasons (Meyer et al., 2002). Another reason is the difficulty in assembling high-frequency data over sufficiently lengthy periods (Perotti, 2002). However, there has been growing literature on the effects of fiscal policy recently. The incidence of the 2008 financial crisis has played an influential role in the recent developments on the effects of fiscal policy literature (da Silva and Vieira, 2017). The economic effects of fiscal policy have attracted both policymakers and empirical researchers. In this regard, Blanchard et al. (2010) argued that fiscal policy should be rethought back to the center of discussion as an important macroeconomic policy tool.[6] In what follows, the empirical literature on the impacts of monetary policy followed by that of fiscal policy and the relative effectiveness of both policy options are presented.

[6] The potential justification for favouring fiscal policy over monetary policy are: first, when monetary policy has reached zero lower bond, policymakers must rely on fiscal stimulus as an important policy tool; second, when recession is expected to last long, fiscal policy could be beneficial, in spite of its implementation lags (da Silva and Vieira, 2017).

1.2.2.2 Effects of Monetary Policy.

In reviewing the empirical literature on the impact of fiscal and monetary policy options, the focus is given to the VAR literature in accordance with the interest of the paper. VAR methodology has long been applied to the analysis of monetary policy, and only recently applied to the analysis of fiscal policy. Christiano et al. (1999) summarized the earlier empirical evidence on the effects of monetary policy shocks as follows: (1) short term interest rates rise, (2) output, employment, and various monetary aggregates fall and (3) inflation responds very slowly.[7] They also show that monetary policy shocks account for only smallest proportion of fluctuations in output and inflation. In fact, the majority of previous evidence is based on the recursive identification approach. However, it is has been documented that such a recursive identification scheme is more likely to produces results that are against theoretical predictions. Because of these, empirical researchers abstract from pure recursive identification approach and use alternative identification approaches such as narrative approach (Romer and Romer, 2004; Cloyne and Hurtgen, 2016), sign restrictions (Rafiq and Mallick, 2008; Mountford and Uhlig, 2009) and block exogneity approach (Dungey and Pagan, 2000; Maćkowiak, 2007; Buckle et al., 2007).

Employing the Romer-Romer narrative identification approach, Cloyne and Hurtgen (2016) show that an increase in the short-term interest rate reduces output and inflation after 2 to 3 years in the United Kingdom. They also stressed that their result is in line with other empirical findings in that the contribution of monetary policy shocks to output fluctuations is rather small. Barakchian and Crowe (2013) construct new shocks measure from Fed funds future and enter this new shocks in monthly VAR, like in Romer and Romer (2004) narrative identification approach, and show that a contractionary monetary policy shock have a statistically significant negative effect on output.[8] They, however, stressed that the finding is very sensitive to the period used for the analysis. When they attempt to identify the effects of monetary policy shocks for the period since the 1980s using the same methodologies, they obtain quite different results- contractionary monetary policy shocks appear to have a small positive effect on output and there is also small price puzzle. Maćkowiak (2007) examine the relative effects of external shocks and U.S. monetary policy shocks to macroeconomic fluctuations in emerging markets using block exogeneity approach. They obtain that external shocks are an important source of macroeconomic fluctuations in emerging markets. Moreover, price level and real output in emerging markets respond to U.S. monetary policy shocks by more than the price level and real output in the U.S. itself.

The empirical evidence from standard VAR literature, in general, suggest that the impact of contractionary monetary policy on output and inflation is very small in terms of impulse response and variance decomposition (see for example Christiano et al. 1999; Leeper et al. 1996;

[7]Christiano et al. (2005) point out that, after expansionary monetary policy shocks, output and inflation respond in a hump-shaped fashion, peaking after about $1\frac{1}{2}$ and 2 years respectively; and the interest rate falls for roughly one year. Eichenbaum and Evans (1995), on the other hand, find a persistent and significant appreciation in nominal and real exchange rates after a contractionary shock for the U.S.

[8]The contractionary monetary policy is also found to have a negative and statistically significant effect on Nigeria's real output (Nwoko et al., 2016).

Bernanke et al. 1997, 2005; Cloyne and Hurtgen 2016, among others). However, there is some evidence which suggests that the impact of contractionary monetary policy on macroeconomic variables are either medium or large. Romer and Romer (2004) construct a historical series of interest rate changes based on Federal Open Market Committee (FOMC) meetings and then isolate the innovations to these policy changes that are orthogonal to the Federal Reserve (Fed)'s information set. Then using their narrative identification approach, they document much larger effects of monetary shocks on output and inflation, both for impulse responses and historical decomposition. However, Coibion (2012), finds medium-size effects of monetary policy shocks on macroeconomic fluctuations. He provided three factors that are responsible for the differences between standard VAR and Romer and Romer (2004) results. First, contractionary monetary policy shocks from the VAR model are associated with smaller and less persistent increases in interest rates than monetary policy shocks used in Romer and Romer (2004) approach. Second, while lag lengths used in the standard VAR literature are robust to the estimated peak effects of monetary policy shocks, the estimated peak effects of policy shocks in Romer and Romer monotonically increases with the lag length of the shocks. Third, the period of reserves targeting plays a disproportionate role in driving the estimated peak effects of policy shocks.

In addition to lack of consensus about the size of impulse responses following monetary policy shocks, enormous empirical evidence also predict evidence that are against the theoretical predictions regardless of the methodology used; suggesting that there are puzzles (such as exchange rate, price, and output puzzles). Rafiq and Mallick (2008) examine the effects of contractionary monetary policy on output, prices and exchange rates for three largest Euro Area countries such as Germany, France, and Italy and obtained the different impact of such policy rate on output, prices, and exchange rate. Specifically, they show that while contractionary monetary policy leads to large fall in output in Germany, output in Italy responds positively. Similarly, they find that the response of exchange rate to contractionary monetary policy in Germany differs from that of France and Italy (while Germany experience exchange rate depreciation, exchange rate in France and Italy appreciates following a rise in short term interest rate), again suggesting lack of homogeneity in responses. They conclude that monetary policy shocks have not been a significant driver of business cycle fluctuations based on the impulse response and historical decomposition. Consistent with their findings, evidence elsewhere also find price puzzle (Sims and Zha, 1999; Christiano et al., 1999; Bernanke et al., 2005; Castelnuovo and Surico, 2010; Forni and Gambetti, 2010; Barakchian and Crowe, 2013; Cloyne and Hurtgen, 2016), exchange rate puzzle (Rafiq and Mallick, 2008; Coric et al., 2015) and output puzzle (Rafiq and Mallick, 2008; Thapar, 2008; Kamaan, 2014; Petrevski et al., 2016).

Various methods have been proposed in the literature to resolve the problem of price puzzles. The major ones are expanding the VAR with oil prices, exchange rate and commodity prices (Sims, 1992; Christiano et al., 1999), controlling for inflation expectations (Castelnuovo and Surico, 2010), using output gap instead of output or industrial production (Giordani, 2004), opting for alternative identification approaches and methodology such as sign restrictions, narrative approach or using FAVARs (Romer and Romer, 2004; Mountford and Uhlig, 2009; Forni and Gambetti, 2010; Soares, 2013). However, the solutions proposed do not guarantee any of the above-proposed solutions for resolving the price puzzle, rather the applicability of the proposed approaches is subject to the sample periods used and the country under consideration. For instance, Bernanke et al. (2005); Cloyne and Hurtgen (2016) and Barakchian and Crowe (2013) find a price puzzle even after controlling for commodity prices, oil prices and exchange rates. Barakchian and Crowe (2013) extract a measure of policy surprises from Fed funds futures in a factor model approach and obtained a price puzzle. Forni and Gambetti (2010) show that prices react positively to contractionary monetary policy shocks in the FAVAR model. Similarly, Castelnuovo and Surico (2010) argued that relaxing recursive approach to sign restrictions amplifies the price puzzle in that the inflation response now becomes positive rather than resolving it. The massage we may take from these findings is that there is no guaranteed approach to solve price puzzle and interested researchers may try one or the combinations of the above-proposed approaches.

1.2.2.3 Effects of Fiscal Policy.

The empirical evidence showing the economic effects of fiscal policy on different macroeconomic variables have emerged only recently (Perotti, 2002; Afonso and Sousa, 2011; Petrevski et al., 2016; Ramey, 2011b). Particularly in the countries with underdeveloped financial systems, little attention has been devoted to the macroeconomic effect of fiscal policy, even though these countries are interesting in their variety of types of economic growth (Fetai, 2013). Blanchard and Perotti (2002) use a Structural VAR (SVAR) approach to assess the impact of fiscal policy shocks on output using U.S. quarterly data. They use institutional information to identify the government spending and tax shocks and to distinguish automatic fiscal policy changes in response to an output from discretionary fiscal policy changes. Their result supports the Keynesian view that an exogenous increase in government spending leads to an increase in U.S. output whereas an exogenous increase in revenue has a contractionary effect on output. Similar results are obtained using the same methodology by Favero and Giavazzi (2007) who also conclude that an exogenous increase in public spending has an expansionary effect on output, while an exogenous increase in revenues is contractionary on U.S. economy. Favero and Giavazzi (2007) also find that fiscal shocks are consistently shown to have no significant effect on inflation.

Ilzetzki et al. (2013) examine the macroeconomic effects of fiscal policy shocks for developed and developing economies using the SVAR approach. They show that the output effect of an increase in government consumption is larger in advanced than in developing countries. Ilzetzki et al. (2013)'s findings support earlier evidence on the economic effects of fiscal policy by Kraay and Severn (2008) who show that the expansionary effect of fiscal policy tends to be much smaller in developing countries than in developed ones. They further warn that it is difficult to take lessons from implementing counter-cyclical fiscal policy in the latter to make policy recommendations for the former. Jooste et al. (2013) also find that increases in government spending have a positive impact on GDP, with positive and insignificant effects in the long run; while increases in taxes decrease GDP over the short run, with an immaterial impact over longer horizons. The expansionary and contractionary effects of government spending and net taxes on output, respectively, are also documented in Argentina and Peru (Cerdeiro et al., 2010).

Corsetti et al. (2012) indicate that the size of fiscal multipliers are larger under fixed than under flexible exchange rates, lower when debt is high, and larger during financial crises. Ilzetzki et al. (2013) also find similar results and argue that the fiscal multipliers are larger in economies with predetermined exchange rate regimes than in countries with flexible exchange rates, suggesting the role of monetary accommodation to fiscal shocks and, thus, the importance of fiscal-monetary interactions for the effects of fiscal policy on output. Auerbach and Gorodnichenko (2012, 2013) compared the size of fiscal multipliers in recession and expansion using structural VARs for a panel of advanced countries. They show that fiscal multipliers are larger in recessions than in expansions. Similarly, Figueres (2016) examine monetary policy in determining the size of the fiscal spending multiplier in recessions and expansions as for the U.S. economy. He suggests that the fiscal multiplier in recessions is larger than one and statistically different from that corresponding to expansions.

It is also documented in the empirical literature that fiscal multipliers are generally larger in advanced economies than in low-income and low-income countries (Ilzetzki, 2011; Kraay, 2012; Estevão and Samaké, 2013; Ilzetzki et al., 2013). Evidence-based on DSGE simulations and SVAR models suggest that fiscal multipliers for advanced economies generally lies between 0 and 1 in normal times. In terms of fiscal policy components, government spending and revenue multipliers are 0.75 and 0.25 respectively in advanced economies (Batini et al., 2014). On the other hand, fiscal multipliers for low-income economies are either very small or negative. Government spending multipliers range from 0.1 to 0.4, while the revenue multipliers range from 0.2 to 0.4 in low-income economies (Ilzetzki, 2011). Cerdeiro et al. (2010) find that both government spending and net tax multipliers are zero in Argentina and Peru. Government spending and net tax multipliers in South Africa are found to be 0.3 and 0.7 (Jooste et al., 2013).

Like the economic effects of monetary policy, the responses of macroeconomic variables to fiscal policy shocks are mixed regardless of the methodology used and the level of development, particularly for the economic effects of taxation shocks. For instance, Afonso and Sousa (2011) analyse the macroeconomic effects of fiscal policy in Portugal using a Bayesian Structural Autoregression model. The results show that positive government spending shocks have a negative effect on real GDP; lead to "crowding-out" effects of private consumption and investment; have a persistent and positive effect on the price level. While some evidence point to negative and significant effects of taxation shocks on output and price dynamics (Blanchard and Perotti, 2002; Favero and Giavazzi, 2007; Mountford and Uhlig, 2009), others find a rise in output following positive taxation shocks (Dungey and Fry, 2009). Perotti (2002) also find mixed evidence for ranges of OECD countries and the U.S. The response of the exchange rate following shocks to fiscal policy is also mixed in the economic literature. Ilzetzki et al. (2013) compared the response of exchange rate to government consumption in developed and developing countries and document that while the real exchange rate is barely affected on impact by the shocks to government consumption in the former and shows a depreciation in the long run, it appreciates by a statistically significant margin in latter on impact. Their findings are similar to results in

Ravn et al. (2007); Kim and Roubini (2008) and Monacelli and Perotti (2008) who also find a depreciation in the real exchange rate in response to government consumption shocks developed countries.

In sum, the empirical evidence on the economic effects of fiscal policy is mixed. Perotti (2002) confirmed this mixed results using the extended version of Blanchard and Perotti (2002) approach for five OECD countries: the U.S., Germany, the U.K., Canada, and Australia. He shows that the effect of fiscal policy on real GDP and its components have become weaker over the last 20 years, with the U.S. being an outlier in this regard and mixed. The reason for this, he argues, is increased openness of economies and possible changes in monetary policy regimes.

1.2.2.4 Effects based on Joint Analysis of Fiscal and Monetary Policy.

In recent years, there have been growing attempts to jointly examine the macroeconomic responses of the monetary and fiscal policies, rather than separate analysis of each policy variables. It has been shown that failing to recognize that both monetary and fiscal policy simultaneously affect macroeconomic variables might incorrectly attribute the fluctuations to the wrong source (Rossi and Zubairy, 2011). Many authors also document the importance of including both monetary and fiscal policy simultaneously (Blanchard and Watson, 1986; Perotti, 2002; Dungey and Fry, 2009; Fetai, 2013; Coric et al., 2015; Petrevski et al., 2016; da Silva and Vieira, 2017; Ilzetzki et al., 2013). In this regard, Sims (2005) argued that proper coordination between monetary and fiscal policies means that the conduct of monetary policy without a sound fiscal policy can be counterproductive.

Blanchard and Watson (1986) used structural VAR to jointly analyze the effect of monetary and fiscal policy. They conclude that both fiscal and monetary policies are important in explaining fluctuations in output and prices. In contrast, Christiano et al. (1996), using the SVAR model, shows that monetary policy has small effects on real GDP and on prices. They also stressed the importance of fiscal policy determining the size of the response of real GDP and prices to monetary policy shocks. On the other extreme, the size of the responses of real GDP and prices to monetary shocks are not significantly reduced when fiscal shocks are included in the monetary SVAR model (Fetai, 2013). Mountford and Uhlig (2009) jointly examined both fiscal and monetary variables in their model using a sign restricted-SVAR approach. They show that fiscal spending shocks have a negative effect on real GDP. They also conclude that deficit-financed tax cuts work best in improving real GDP.

In the recent study, Rossi and Zubairy (2011) examine the importance of monetary and fiscal policy shocks in explaining output fluctuation in the U.S. They show that fiscal shocks are relatively more important in explaining medium cycle fluctuations whereas monetary policy shocks are relatively more important in explaining business cycle fluctuations. Dungey and Fry (2009) used the SVAR approach to examine the importance of fiscal and monetary policy on New Zealand economy. They show that while monetary policy shocks have a relatively long-lived effect in New Zealand output, government spending shocks are approximately countercyclical with taxation shocks generally contributing negatively to output. The reason for such a persistent effect of monetary policy shocks on output, as opposed to results from other models so far, they claim, is the imposition of the Pagan and Pesaran (2008) distinction between temporary and permanent shocks.

Coric et al. (2015) analyse the role of monetary and fiscal policies in price stability and economic growth in Croatia using a structural vector autoregression (VAR) model. Their findings are twofold: first, both monetary and fiscal policy shocks have positive effects on economic activity. Second, while fiscal expansion leads to nominal exchange rate appreciation, monetary policy shocks have depreciation effects on the nominal exchange rate. A recent paper by da Silva and Vieira (2017) evaluates the role of monetary and fiscal policies for a panel of advanced and developing countries, for the period prior to the beginning of the financial crisis (2001-2008) and for the period after the crisis (2009-2012) using system GMM dynamic panel data models. They conclude that monetary policy seems to be countercyclical only for advanced economies in the period prior to the international financial crisis and fiscal policy, however, behaves in a procyclical way only in the pre-crisis period. Cyrus and Elias (2014) examine the relative effectiveness of the fiscal and monetary policies on real output in Kenya using a recursive vector autoregressive (VAR) framework. They show that fiscal policy has a significant positive impact on real output growth in Kenya while monetary policy shocks are completely insignificant.

Overall, the reviewed literature indicates that a handful of empirical studies have been undertaken regarding the efficacy of the monetary and fiscal policies, especially for the developed world. An important issue is that although there exist the vast majority of studies examining the effect of monetary and fiscal policies, the empirical findings of these studies are mixed and inconclusive both in developed and developing countries. It, thus, suggests the difficulty of generalizing the finding of one country for other countries. In other words, it requires country-specific findings based on the respective country's data and its economic environment. The above findings also suggest that empirical evidence is biased towards developed countries, especially the U.S. economy and very limited studies are available for developing countries. Thus, in this study, a SVAR model is employed to track the role of monetary and fiscal policies in explaining macroeconomic fluctuations in Ethiopia.

1.3 Data and Model.

The model used in this paper is a structural vector autoregression (SVAR) model. This section describes data and methodology employed to assess shocks from monetary policy, fiscal policy and other sources affecting the economy. It also describes the identification techniques used in this study. Finally, some preliminary statistics and diagnostic tests are also presented.

1.3.1 Data.

Quarterly data for the VAR model are considered over the sample period 1997/98:1-2016/17:4. Narrow Money (M_1), Broad Money (M_2), Interest Rate (r_t), Consumer Price Index (π_t), Value of Import (m_t) and Exchange Rate (e_t) data are obtained from National Bank of Ethiopia

(NBE). On the other hand, Real Output (y_t), Private Consumption (c_t), Net Taxes (t_t), Government Spending (g_t), Direct Taxes (DT_t), Indirect Domestic Taxes (IDT_t) and Indirect Custom Taxes (ICD_t) data are collected from Ministry of Finance and Economic Cooperation (MoFEC). While Interest Rate (r_t), Consumer Price Index (π_t), Real Output (y_t), Net Taxes (t_t), Government Spending (g_t) and Exchange Rate (e_t) are variables included in the empirical VAR model, data on Private Consumption (c_t), Direct Taxes (DT_t), Indirect Domestic Taxes (IDT_t), Value of Import (m_t) and Indirect Custom Taxes (ICD_t) are considered for identification of fiscal shocks in Blanchard and Perotti (2002) approach. The monetary aggregates are used as an alternative measures for monetary policy. See appendix A for detailed descriptions and definitions of data used in this study. All variables, except interest rate, are expressed into natural logarithm. Moreover, Consumer Price Index (π_t), Net Taxes (t_t), Narrow Money (M_1), Broad Money (M_2), and Government Spending (g_t) are seasonally adjusted. The starting date for the sample period is determined by the availability of quarterly data for fiscal variables.

1.3.2 The Empirical Model.

The SVAR model with p lags and no constant terms can be written as:[9]

$$A(L)Y_t = u_t \tag{1.1}$$

with $E(u) = 0$, $cov(u_t) = \Sigma_u$(diagonal matrix), where $A(L)$ is p^{th} order lagged polynomial of the coefficient matrices given by $A(L) = A_0 - A_1L - A_2L^2 - ... - A_pL^p$; $Y_t = (y_t, \pi_t, e_t, r_t, g_t, t_t)$ is the vector of endogenous variables viz. Real Output (y_t), Consumer Price Index(π_t), Exchange Rate (e_t), Interest Rate(r_t), Government Spending(g_t), and Net Tax (t_t). A_0 is a k-dimensional square matrix of contemporaneous coefficients; $u_t = (u_t^y, u_t^\pi, u_t^e, u_t^r, u_t^g, u_t^t)$ is k dimensional vector of structural innovations, with $u_t \sim (0, \Sigma_u)$, $\Sigma_u$is a variance-covariance matrix.

The reduced form VAR model with p lags , which is a system of reduced-form equations, can be derived by pre-multiplying equation equation (1.1) by (kxk) polynomial inverse matrix in A(L) as:

$$B(L)Y_t = \varepsilon_t \tag{1.2}$$

The (kx1) vector $\varepsilon_t = (\varepsilon_t^y, \varepsilon_t^\pi, \varepsilon_t^e, \varepsilon_t^r, \varepsilon_t^g, \varepsilon_t^t)$ consists of reduced form residuals ordered with their corresponding observed endogenous variables in vector Y_t. The variance-covariance matrix of

[9]See lag length selection section for specific lag length (p) used in the empirical VAR model.

the above reduced form model is given by Λ. The relationship between parameters of the structural form model in equation 1.1 and the reduced form model in equation 1.2 are given by:

$$B(L) = A_0^{-1}A(L) = I - B_1L - B_2L^2 - ... - B_pL^p \tag{1.3}$$

The reduced-form VAR residuals in equation 1.2 are generally be correlated and can, therefore, not necessarily be interpreted as purely structural innovations. To overcome this problem, Sims (1980) proposed SVAR approach that relates the vector Y_t to a vector of structural innovations.[10] The relationship between structural disturbances, u_t and residual disturbances, ε_t is given by

$$\varepsilon_t = A_0^{-1}u_t. \tag{1.4}$$

This shows that the reduced form residuals ε_t are assumed to be a linear combination of the structural innovations, u_t. Using equation 1.3 and equation 1.4, the parameters in the SVAR model and in the reduced form model are related by:

$$B(L) = I - A_0^{-1}(A_1L + A_2L^2 + .. + A_pL^p) \tag{1.5}$$

and

$$V = A_0^{-1}\Sigma A_0^{-1'} \tag{1.6}$$

The parameters of the SVAR model are estimated by choosing $A_0^{-1}$and Σ to maximize the log-likelihood function for sample of $t = 1, 2, ...T$ observations presented in equation 1.7

$$logL = \sum_{t=1}^{T} \Gamma \tag{1.7}$$

with the corresponding likelihood function given by

$$\Gamma = -\frac{1}{2}ln(2\pi) - \frac{1}{2}|lnA_0^{-1}\Sigma A_0^{-1'}| - \frac{1}{2}\varepsilon_t'(A_0^{-1}\Sigma A_0^{-1'})^{-1}\varepsilon_t \tag{1.8}$$

[10] The correlations between reduced form shocks arise due to absence of contemporaneous relations between endogenous variables. Because such contemporaneous correlations exist in the SVAR, structural shocks can now be taken to be uncorrelated and can be interpreted as structural innovations (Sims, 1980; Ouliaris et al., 2016).

where ε_t is the reduced form residual and Σ is the diagonal variance-covariance matrix. Up on the estimation of the SVAR model, the analytical tool for structural impulse response function can be obtained by solving the equation 1.1 for Y_t in structural moving-average representation, whose coefficients are, indeed, the structural impulse response functions:

$$Y = \Omega(L)u_t \tag{1.9}$$

where $\Omega(L) = [A_0 - A_1L - A_2L^2 - ... - A_pL^p]^{-1} = [A(L)]^{-1}$.

1.3.2.1 Identification of shocks.

Identification of shocks is one of the challenges in the SVAR literature. Different identification schemes have been used in existing studies. However, there is no universally agreed identification approach so far. The structural shocks in the current work are identified using traditional SVAR restrictions and Blanchard and Perotti (2002) approach.[11] Moreover, alternative identification following the approach in Sims and Zha (1998) and Kim and Roubini (2000) is also used to identify the structural shocks. In the following section, the focus will be given to Blanchard and Perotti (2002) and Perotti (2002, 2005) identification approach and traditional SVAR restrictions. To identify exactly a VAR model of n endogenous variables, $2n^2 - \frac{1}{2}n(n+1)$ identifying restrictions must be imposed in A and B matrices. Since α_{gy}, $\alpha_{g\pi}$, α_{gr}, α_{ge}, α_{ty}, $\alpha_{t\pi}$, α_{tr}, and α_{te} are identified following Blanchard and Perotti (2002) and Perotti (2002, 2005) approach (see below), there are only 21 parameters to be estimated after full identification. Given that there are 21 elements in the variance-covariance matrix of the reduced form VAR, the model is exactly identified.

Blanchard and Perotti Approach.

Blanchard and Perotti's approach is based on institutional information about taxes and spending. Given the reduced form VAR in equation 1.2, according to SVAR model in Blanchard and Perotti (2002) and the one extended by (Perotti, 2002, 2005), the reduced form residuals of the g_t and t_t equations, ε_t^g and ε_t^t, contain three components: (i) the automatic response of taxes and government spending to changes in macroeconomic variables, such as output, prices, interest rates, and exchange rate; (ii) the discretionary response of policymakers to macroeconomic shocks; and (iii) exogenous shift in government spending and taxes, which are shocks of the interest to be identified.[12]

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[11] Perotti (2002, 2005) extended the original 3 variables Blanchard and Perotti (2002) identification approach to five variables SVAR for US and OECD countries.

[12] Ramey (2011b) argued that SVAR shocks might have been forecasted by the private sector. However, this is less likely to be the case in developing countries. The reasons for these are (i) government spending is very volatile on a quarter-to-quarter basis. (ii) quarterly fiscal variables are subject to revisions, making fiscal planning not credible by the private sector. It is, therefore, unlikely that the public will have foreseen many

As pointed out in Blanchard and Perotti (2002) and Perotti (2002, 2005), reduced form residuals to government spending and net taxes can, thus, be written as:

$$\varepsilon_t^g = \alpha_{gy}\varepsilon_t^y + \alpha_{g\pi}\varepsilon_t^\pi + \alpha_{gr}\varepsilon_t^r + \alpha_{ge}\varepsilon_t^e + \beta_{gt}u_t^t + u_t^g \tag{1.10}$$

$$\varepsilon_t^t = \alpha_{ty}\varepsilon_t^y + \alpha_{t\pi}\varepsilon_t^\pi + \alpha_{tr}\varepsilon_t^r + \alpha_{te}\varepsilon_t^e + \beta_{tg}u_t^g + u_t^t \tag{1.11}$$

The coefficients $\alpha'_{jk}s$ contain both the automatic and the discretionary changes in fiscal policy components in response to unexpected movements in the other macroeconomic variables.[13] On the other hand, the $\beta'_{jk}s$ coefficients measure the response of fiscal variables to a structural shocks in the system. Obviously, provided that the structural shocks, u_t^g and u_t^t, are correlated with the reduced form residuals ε_t^g and ε_t^t, equations 1.10 and 1.11 cannot be estimated using OLS. To obtain them, the approach here is based on works in Blanchard and Perotti (2002) and Perotti (2002, 2005). Since it takes more than a quarter for discretionary fiscal policy to respond to macroeconomic shocks, the systematic discretionary response is absent in quarterly data, implying that the coefficients $\alpha'_{jk}s$ in 1.10 and 1.11 capture only the automatic response of government spending and net taxes to output, prices, interest rates and exchange rate (Perotti, 2005).

Then, external information on the elasticity of net taxes and spending to output, prices, interest rates and exchange rate can be used to assign the appropriate values of the coefficients $\alpha'_{jk}s$ (see section 3.3); and hence, construct the cyclically adjusted residuals of the net taxes and spending shocks as follows:

$$\varepsilon_t^{g,CA} = \varepsilon_t^g - (\alpha_{gy}\varepsilon_t^y + \alpha_{g\pi}\varepsilon_t^\pi + \alpha_{gr}\varepsilon_t^r + \alpha_{ge}\varepsilon_t^e) = \beta_{gt}u_t^t + u_t^g \tag{1.12}$$

of the SVAR shocks identified as fiscal policy innovations, and even less likely that their exact timing at a quarterly frequency will have been known in advance. These makes the SVAR approach more effective at identifying unanticipated fiscal shocks in developing countries than in high-income countries.(Ilzetzki, 2011; Mendoza et al., 2013; Ilzetzki et al., 2013).

[13] The automatic response of fiscal policy refer to the government's budget component that automatically responds to the business cycle (Ducanes et al., 2006). The discretionary fiscal policy, on the other hand, refers to the deliberate change in government spending and revenue to promote employment, price stability and economic growth. It has two structural components: while the endogenous discretionary fiscal policy component relates to the systematic response of fiscal policy to economic activity or to other macroeconomic variables, exogenous component of discretionary fiscal policy relates to the increase in public spending to finance war or a politically motivated transfer to the population usually prior to election (Beetsma et al., 2008).

$$\varepsilon_t^{t,CA} = \varepsilon_t^t - (\alpha_{ty}\varepsilon_t^y + \alpha_{t\pi}\varepsilon_t^\pi + \alpha_{tr}\varepsilon_t^r + \alpha_{te}\varepsilon_t^e) = \beta_{tg}u_t^g + u_t^t \tag{1.13}$$

To identify the two structural fiscal policy shocks, orthogonalization of fiscal shocks is key, which in fact depends on the ordering of the fiscal policy shocks. Since there is neither theoretical nor empirical guidance to put one of these shocks first, the empirical exercises in Perotti (2002, 2005); Lozano and Rodriguez (2011) and de Castro and Fernandez Caballero (2011) show that it is more plausible to assume that tax decisions comes after the spending decisions. Alternatively, the opposite assumptions can also be tested. Perotti (2005) also shows that since the correlation between the two cyclically adjusted fiscal shocks is very low in all cases, their ordering does not matter.

In this paper also the decision that spending shocks comes first before tax decisions is considered. Under this assumption, the cyclically adjusted residuals of the net taxes and spending shocks can be written as:

$$\varepsilon_t^{g,CA} = u_t^g \tag{1.14}$$

$$\varepsilon_t^{t,CA} = \beta_{tg}u_t^g + u_t^t \tag{1.15}$$

Following approach in Perotti (2002, 2005), these cyclically adjusted residuals of the net taxes and spending shocks can be used as an instrument while estimating other equations of the model.[14] Given the ordering of the variables,[15] the remaining equations are given by:

$$\varepsilon_t^y = -(\omega_{yg}\varepsilon_t^g + \omega_{yt}\varepsilon_t^t) + u_t^y \tag{1.16}$$

[14]These two structural shocks are orthogonal to the other structural shocks of the economy (Perotti, 2005)

[15]In this paper, spending is ordered first, net tax is ordered second, output is ordered third, inflation is ordered fourth, interest rate is ordered fifth and the exchange rate is ordered last. The variables are ordered so that monetary policy is allowed to respond to output and inflation contemporaneously but affect exchange rate. Fiscal variables are ordered before monetary variables due to the fact that interest rate payments are excluded from the definition of both fiscal policy components (Perotti, 2002, 2005; Caldara and Kamps, 2008; Lozano and Rodriguez, 2011). It also follows from the assumption that the monetary authority can respond more rapidly to news than fiscal decision-makers can (Ilzetzki et al., 2013).This follows much of the literature in the field. However, since there is no both theoretical as well as the empirical ground for ordering the two fiscal policy components, the baseline results are checked for the sensitivity of the result for alternative ordering. See the robustness section for more detailed discussions. Indeed, different alternative orderings of the variables included in the baseline SVAR model are also experimented for checking robustness of the main results.

$$\varepsilon_t^{\pi} = -(\omega_{\pi g}\varepsilon_t^g + \omega_{\pi t}\varepsilon_t^t + \omega_{\pi y}\varepsilon_t^y) + u_t^{\pi} \tag{1.17}$$

$$\varepsilon_t^{r} = -(\omega_{rg}\varepsilon_t^g + \omega_{rt}\varepsilon_t^t + \omega_{ry}\varepsilon_t^y + \omega_{r\pi}\varepsilon_t^{\pi}) + u_t^{r} \tag{1.18}$$

$$\varepsilon_t^{e} = -(\omega_{eg}\varepsilon_t^g + \omega_{et}\varepsilon_t^t + \omega_{ey}\varepsilon_t^y + \omega_{e\pi}\varepsilon_t^{\pi} + \omega_{er}\varepsilon_t^{r}) + u_t^{e} \tag{1.19}$$

Thus, the key to identifying fiscal shocks in Blanchard and Perotti (2002) as well as in Perotti (2002, 2005) approach is that it takes more than a quarter for discretionary fiscal policy to respond to changes in macroeconomic variables, such as output, inflation, interest rate and exchange rate; at quarterly frequency the contemporaneous discretionary response of net taxes and government spending to macroeconomic shocks can, thus, be assumed to be zero. Thus, following their approach, structural shocks to government spending and taxes can be identified by imposing a restriction on the A and B matrices using AB-model type:[16]

$$\begin{bmatrix} 1 & 0 & \alpha_{gy} & \alpha_{g\pi} & \alpha_{gr} & \alpha_{ge} \\ 0 & 1 & \alpha_{ty} & \alpha_{ty} & \alpha_{tr} & \alpha_{ty} \\ \omega_{yg} & \omega_{yt} & 1 & 0 & 0 & 0 \\ \omega_{\pi g} & \omega_{\pi t} & \omega_{\pi y} & 1 & 0 & 0 \\ \omega_{rg} & \omega_{rt} & \omega_{ry} & \omega_{r\pi} & 1 & 0 \\ \omega_{eg} & \omega_{et} & \omega_{ey} & \omega_{e\pi} & \omega_{er} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^g \\ \varepsilon_t^t \\ \varepsilon_t^y \\ \varepsilon_t^{\pi} \\ \varepsilon_t^r \\ \varepsilon_t^e \end{bmatrix} = \begin{bmatrix} \beta_{gg} & \beta_{gt} & 0 & 0 & 0 & 0 \\ \beta_{tg} & \beta_{tt} & 0 & 0 & 0 & 0 \\ 0 & 0 & \beta_{yy} & 0 & 0 & 0 \\ 0 & 0 & 0 & \beta_{\pi\pi} & 0 & 0 \\ 0 & 0 & 0 & 0 & \beta_{rr} & 0 \\ 0 & 0 & 0 & 0 & 0 & \beta_{ee} \end{bmatrix} \begin{bmatrix} u_t^g \\ u_t^t \\ u_t^y \\ u_t^{\pi} \\ u_t^r \\ u_t^e \end{bmatrix} \tag{1.20}$$

Where $\alpha'_{jk}s$ are the contemporaneous response of fiscal variables, g_t and t_t, to changes in macroeconomic shocks, in which Blanchard and Perotti (2002) and Perotti (2002, 2005) use institutional information on the elasticities of net taxes and government spending to macroeconomic variables. Discussions on elasticities of net tax and government spending to macroeconomic variables for this paper are provided in the next section. $\omega'_{jk}s$ are the contemporaneous response of macroeconomic variables to changes in fiscal and other macroeconomic shocks. Moreover, non-fiscal variables are identified by imposing traditional short-run restrictions on the bottom four rows of A and B matrices, which is, in fact, the standard approach in the literature (Christiano et al., 1999; Perotti, 2002, 2005; Uhlig, 2005; Claus et al., 2006; Favero and Giavazzi, 2007; Dungey and Fry, 2009; Coibion, 2012).

Identification of the two off-diagonal elements of the B-matrix depends on the relative ordering of the two fiscal shocks. One could assume that spending shocks come first so that $\beta_{gt} = 0$

[16] A and B matrices are derived here for six variable case following Blanchard and Perotti (2002) and Perotti (2002, 2005) approach.

and estimate β_{gt} or vice versa. In the current study, the identification assumption imposes that $\beta_{gt} = 0$ and the robustness check is experimented for the case where $\beta_{tg} = 0$.[17]

1.3.2.2 Constructing Government Spending and Net taxes Elasticities.

Identifying fiscal policy shocks requires exogenously determined elasticities of the net taxes and government spending to change in macroeconomic variables, $\alpha'_{jk}s$. These elasticities are identified based on the techniques used in Blanchard and Perotti (2002); Perotti (2002, 2005); Caldara and Kamps (2008); Lozano and Rodriguez (2011) and de Castro and de Cos (2008). The authors argue that if interest payments are excluded from government spending and net tax, the elasticity of government spending and net taxes are set to zero. In the current paper, definitions of the two fiscal variables exclude interest payment so that $\alpha_{gr} = \alpha_{tr} = 0$. The elasticity of government spending and net taxes to exchange rate is also assumed to be zero: $\alpha_{ge} = \alpha_{te} = 0$, suggesting that fiscal variables do not contemporaneously respond to exchange rate shocks within the quarter. This is also the usual approach in the literature (de Castro and Fernandez Caballero, 2011). The contemporaneous effects of output and prices on government spending and net tax are discussed in detail below.

Elasticities of Government Spending to changes in output and prices.

Consider now the output and price elasticities of government spending, α_{gy} and α_{ty}. Recall that Blanchard and Perotti exploit the fact that it takes more than one quarter to the government sector to respond to changes in output. It is hard to think of any quantitative response of government spending to output contemporaneously (Perotti, 2002), suggesting $\alpha_{gy} = 0$. However, the elasticity of government spending to the price level is less straight forward. Perotti (2002, 2005) explained this scenario in three cases: (i) wage component of government spending are not indexed to the quarterly consumer price index (CPI), with indexation occurring with a considerable lag. This assumption better reflects the situation in Ethiopia where indexation to inflation hardly exists in the country. Hence, real government spending on wages is likely to have an elasticity to the CPI of -1. (ii) the non-wage component of government spending might be fixed in nominal terms, suggesting price elasticity of spending equal to -1. (iii) spending on drugs in health services might be indexed to the price level within the quarter, implying an elasticity of 0. Exploiting these arguments, Perotti (2002) argues that the price elasticity of government spending is assumed to be -0.5, $\alpha_{g\pi} = -0.5$.[18]

[17] Blanchard and Perotti (2002); Perotti (2002, 2005); de Castro and de Cos (2008); Favero and Giavazzi (2007) and Ilzetzki (2011), among others, show that results are not sensitive to assuming $\beta_{tg} = 0$; $\beta_{gt} = 0$. Ilzetzki (2011) also show that results are insensitive to setting both to zero.

[18] The model is estimated taking this value and robustness check is conducted for slightly higher (-0.6) and lower (-0.4) values. The results are insensitive to these values (see Figure figure 1.13 in appendix D). Many authors used this value for estimating SVAR in the literature: Favero and Giavazzi (2007) and Caldara and Kamps (2008) for U.S, Lozano and Rodriguez (2011) for Colombia, de Castro and de Cos (2008) and de Castro and Fernandez Caballero (2011) for Spain, Claus et al. (2006) for New Zealand, Ilzetzki (2011) for range of developing and developed countries, and Burriel et al. (2010) for Euro Area. These authors, among others, also show that their results are intact due to this assumption.

Elasticities of net taxes to changes in output and prices.

To construct elasticities of net taxes with respect to output and prices, one has to calculate the elasticity of each tax category to the tax base and elasticity of the tax base to GDP (Blanchard and Perotti, 2002). Formally,

$$\alpha_{ty} = \sum_{i=1}^{n} \alpha_{tb}\alpha_{by}s_i \tag{1.21}$$

where α_{ty} is the elasticity of net tax with respect to output, α_{tb} denotes elasticity of each tax category with respect to the tax base, α_{by} denotes elasticity of the tax base to GDP and s_i denotes the weight of each tax category in the sum of taxes. Therefore, to construct of elasticity of taxes with respect to output, we need a different category of taxes and their respective tax bases.[19] In this paper, tax categories and tax bases of the Ministry of Finance and Economic Cooperation are adopted with slight modification.[20] Therefore, the three tax categories along with their respective tax bases are direct domestic taxes (with tax base Real Gross Domestic Product), Indirect domestic taxes (with tax base private consumption), and Indirect Custom taxes (with tax base value of import of goods and services). Nominal variables are converted into real values where 1998/99 is the base year. Moreover, quarterly data on private consumption is constructed by multiplying the annual share of private consumption in GDP by each quarterly value of GDP. Using the above information, the output elasticity of taxes with respect to output is 0.534 (see Table 1.1). This value is comparable with (0.56) output elasticity of net tax computed by Alemayehu and Befekadu(1998) for Ethiopia and reported in Geda (2011).

Table 1.1: Elasticity of net taxes with respect to output

Tax Category	α_{tb}	α_{by}	s_i	$\alpha_{tb}.\alpha_{by}.s_i$
Direct domestic taxes	0.87	1.00	0.34	0.299
Indirect domestic taxes	0.83	0.91	0.25	0.189
Indirect custom taxes	0.41	0.27	0.41	0.045
α_{ty}				**0.534**

Compared with the elasticity of net taxes with respect to output for other countries in the literature, the value for Ethiopia is slightly lower. For instance, Perotti (2002) constructed 1.95 for the U.S., 1.92 for Canada and 0.79 for the U.K. Similarly, Ilzetzki (2011) and Cerdeiro et al. (2010) calculated 0.78 and 0.45 respectively for Argentina, 0.48 for Australia, 0.76 for Brazil, 1.23 for Chile, 0.52 for France and 1.18 for South Africa. de Castro and de Cos (2008) also

[19] In Blanchard and Perotti (2002), there are four tax categories, viz. Personal income taxes, indirect taxes, corporate income taxes, and social security taxes.

[20] Excise and Value-added taxes are combined into indirect domestic taxes due to the fact that these tax categories have common proxy tax bases (private consumption); See Ravnik and Zinic (2011) for a similar approach.

computed 0.62 for Spain. The low elasticity of net tax to output is partly due to very low elasticity of indirect domestic taxes and indirect custom taxes to output, reflecting narrow tax base. Zerihun et al. (2016) also argue that the net tax to GDP ratio in Ethiopia is lower than the Sub-Saharan average.[21]

The price elasticity of net tax is the weighted average of the elasticity of tax type I with respect to the consumer price index (Perotti, 2002, 2005):

$$\alpha_{t\pi} = \sum_{i=1}^{n} \alpha_{t_i\pi} s_i \tag{1.22}$$

Where $\alpha_{t\pi}$ is the elasticity of net taxes with respect to the consumer price index, $\alpha_{t_i\pi}$ denotes elasticity of each tax category with respect to the consumer price index, and s_i denotes the weight of each tax category in the sum of taxes. Exploiting this approach, the elasticity of net taxes with respect to consumer price index is calculated as 0.357 (see Table 1.2).

Table 1.2: Elasticity of net taxes with respect to consumer price index

Tax Category	$\alpha_{t_i\pi}$	s_i	$\alpha_{t_i\pi}.s_i$
Direct domestic taxes	0.55	0.34	0.187
Indirect domestic taxes	0.45	0.25	0.112
Indirect custom taxes	0.14	0.41	0.057
$\alpha_{t\pi}$			**0.357**

Yet elasticity of net taxes with respect to the consumer price index is lower for Ethiopia relative to some other countries due to the low elasticity of indirect custom taxes to the consumer price index, reflecting the small open economy. Perotti (2002), for example, calculates 1.23 for the U.S., 1.09 for Canada and 1.17 for the U.K.

1.3.3 Preliminary Data Analysis and VAR Diagnostics.

In this section, results from descriptive statistics and VAR diagnostic tests are undertaken to ensure the reliability of the results.[22].

1.3.3.1 Descriptive Statistics

Fiscal and monetary policies are the major macroeconomic stabilization tool to stabilize an economy. In particular, the fiscal policy stance aims to achieve macroeconomic stability while

[21] Average net tax to GDP ratio target for sub-Saharan Africa is 18 percent.
[22] See appendix B for test results.

supporting economic growth. Application of these macroeconomic tools in Ethiopia witnessed that the government has been prioritizing public spending on pro-poor and growth-enhancing sectors and improving revenue mobilization (Mwanakatwe and Barrow, 2010). Figure 1.1 presents the pattern of government spending, revenue, monetary aggregates and their effects on the fiscal deficit since 1998/99. We observe a clear and common trend of both government spending and revenue, where the former is consistently larger than the latter in the period under consideration. This persistent gap between government spending and revenue as resulted in a persistent fiscal deficit, though fall short of small.

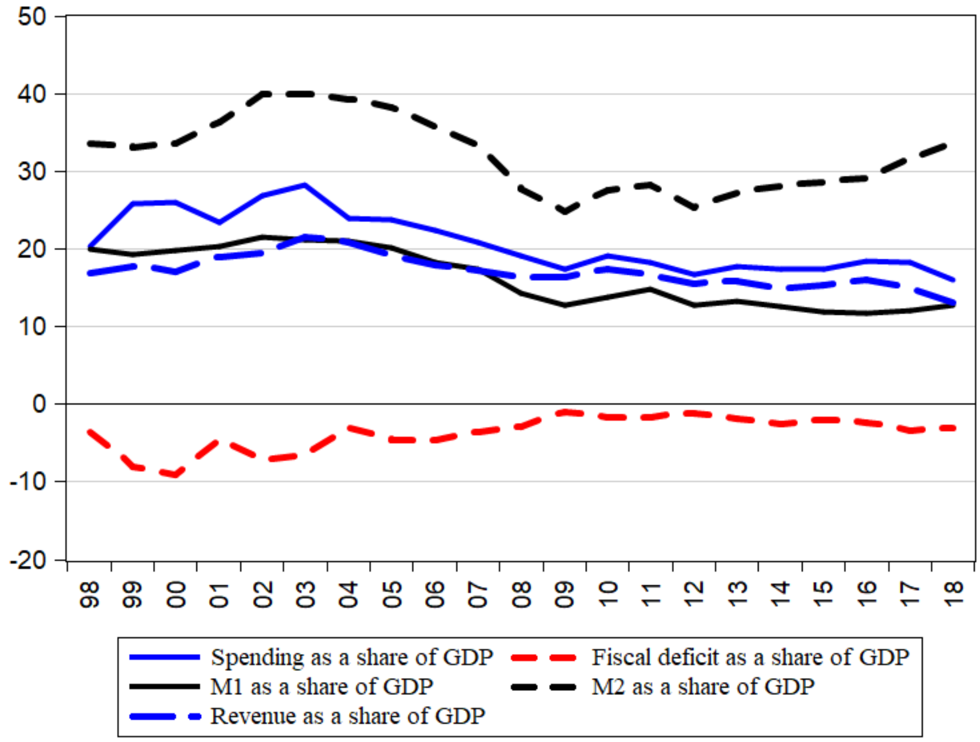


Figure 1.1: Governemnt spending, revenue, fiscal deficit and monetary aggregates (% of GDP)

Government spending as a share of GDP has shown a declining trend since 2003/04 partly because of the privatization of government enterprises and thus government withdraws from direct involvement in production and service. Secondly, even though government spending was increasing in absolute terms during these periods, the average growth rate of nominal GDP (25 percent) is higher than the average growth rate of public spending (22.5 percent)[23]. When it comes to the sources of financing government spending, the main sources of spending financing are external sources (such as grants and external borrowing) and domestic sources (such as

[23]The growth rates are calculated based on OLS regression of natural logarithm of respective variables on time (year)

domestic revenue and domestic debt financing). On the revenue side, it has been rising in parallel with government spending. Over the last sixteen years, total revenue has grown at a rate of 21 percent. Moreover, the share of tax revenue in total revenue has also increased over the same periods due to the improvements in tax collection. Despite improvements in tax collection, the fiscal deficit has been negative showing a persistent gap between government spending and revenue, though roughly stable. The highest fiscal deficit including grants was 9 percent of GDP in 1999/00 due to aggressive defense spending and it declined to 2.4 percent of GDP in 2015/16. The prudent fiscal policy stance contributed to low and stable fiscal deficits in the country (Zerihun et al., 2017).

Ethiopia's monetary policy is aimed at maintaining price and exchange rate stability and creating a conducive macroeconomic environment to promote rapid and sustainable economic growth (NBE, 2009). Figure 1.1 also shows the share of narrow money (M1) and broad money (M2) in GDP since 1998/99. The share of M1 and M2 in GDP has been following almost similar trend due to the interlinkage between the two variables. Looking at the link between these two macroeconomic management tools is crucial. One of the interlinkage between fiscal and monetary variables is the monetization of fiscal deficits which is inevitable in developing countries where growth is mostly public spending led growth. In Ethiopia, since the foreign source of finance is not equally growing with the government's commitment to building large projects and infrastructures, the government has been relying on domestic sources of financing (Abebe, 2012). This has contributed to the monetization of fiscal deficits due to increasing government spending and low revenue collection.

To see potential monetization of fiscal deficits, one may observe the relationship between trends in the share of government spending, monetary aggregates and fiscal deficit in GDP over the sample period. The period of high government spending and hence relatively high fiscal deficit is associated with a larger share of monetary aggregates in GDP, which potentially indicates that the government has been relying on domestic sources of financing fiscal deficit through printing high powered money. Figure 1.1 also indicates that the period of relatively low share of government spending and relative low fiscal deficit is associated with a low share of monetary aggregates. This, in fact, might also be one of the reasons for explaining double-digit inflation during these periods under consideration. Moreover, Minyahil et al. (2016) also documented that means of financing fiscal deficit have led to the monetization of fiscal deficit in the country. Finally, it is important to note that the importance of the external sources of financing is not overlooked as the goal here is to show the trends in components of fiscal and monetary policies in the country.

1.3.3.2 Seasonal Adjustment.

It is usual to check the seasonal variation of variables when quarterly observations are used before seasonally adjusting them. To check for the seasonality of variables included in the model, both parametric and non-parametric tests are employed. These tests include stable seasonality test, moving seasonality test, Kruskal-Wallis test (non-parametric test) and combined seasonality test. Results for each approach are summarized in Table 1.8 and 1.9 (appendix

C). The test results show that stable seasonality is evident for net taxes, inflation and government spending at a 1 percent level of significance. Similarly, the test for moving seasonality indicates evidence of moving seasonality for all variables except for net taxes. On the other hand, the non-parametric test indicates that there is no evidence of seasonality for interest rate and exchange rate. When the test results for stable seasonality and moving seasonality tests are mixed as in the above cases, the combined test provides evidence to decide whether a series needs to be seasonally adjusted. This test is based on the stable seasonality test, moving seasonality tests and Kruskal-Wallis test. The combined tests for seasonality show that there is evidence of seasonality for net tax, government spending, and inflation and these variables are, thus, seasonally adjusted.

1.3.3.3 Unit Roots Test.

A stationary series is a stochastic process for which mean, variance, and auto-covariances do not depend upon time. A series is said to be (weakly or covariance) stationary if the mean, and auto-covariances of the series are finite and independent of time (Hamilton, 1994 and Verbeek, 2004). Therefore, to check unit root for variables included in the VAR framework, the Augmented Dickey-Fuller Test (ADF) and Phillips-Perron Test (PP) are employed. The test results show that while the interest rate is stationary variable, real output, government spending, net taxes, inflation and exchange are found to be non-stationary (See Table 1.4 in appendix section §1.7).

Due to the fact that resorting to differencing non-stationary data in VAR literature introduce distortions into the model (Fanchon and Wendel, 1992) and in line with Perotti (2002, 2005); Heppke-falk et al. (2006); de Castro and de Cos (2008) and Ravnik and Zinic (2011), the benchmark model is estimated in levels, unrestricting the long-run structure. However, to check the robustness of the baseline results, alternative specifications are also estimated both with the first difference of the non-stationary variables and taking into account the long-run relationships.[24] For more details, see section 1.5.

1.3.3.4 Lag Length Selection Criteria.

Before estimating the VAR model, it is critical to choose the order of the model that yields a good model and hence precise forecast. The order of the VAR model refers to the optimal number of lags that should be included in the VAR model. The appropriate lag order (p) of the VAR can be determined using standard model selection criteria. Ivanov and Kilian (2005) compared the six lag-order selection criteria most commonly used in applied work based on the sample size and the frequency of data.[25] They conclude that for monthly VAR models, Akaike

[24] I thank Robert M. Kunst, the coordinating editor of the Journal of Empirical Economics, for suggesting this specification.

[25] They also compared these criteria based on the cost of not knowing true lag order, differences in accuracy across criteria and sensitivity of results to impulse response horizons. The most commonly used lag length selection criteria in empirical research are the Sequential Modified Likelihood Ratio test (LR test), Final

Information Criterion (AIC) tends to produce the most accurate impulse response estimates. For quarterly VAR models, the Hannan-Quinn Criterion (HQC) appears to be the most accurate criterion except for sample sizes smaller than 120, for which the Schwarz Information Criterion (SIC) is more accurate. In this study, the lag length test show mixed results: while the Schwarz Information Criterion (SIC) suggests one lag,[26] Hannan-Quinn Criterion (HQC) and Akaike Information Criterion (AIC) suggests four lags. In light of results in Ivanov and Kilian (2005), lag length of one is considered, though it is obvious that one lag is too small and might lead to the wrong conclusion, given the potential problem of serial correlation with too small lags. The test for serial correlation with one lag also confirms the problem of serial correlation. Given this fact, the baseline VAR model is re-estimated with two and three lags. Yet, there is evidence of serial correlation in the reduced form residuals when the VAR is estimated using two and three lags (see Table 1.5). When reduced form VAR is estimated with four lags (see Table 1.5), the problem of serial correlation and heteroscedasticity disappear.[27] Hence, the empirical model is estimated with four lags.[28] Table 1.5 in appendix B3 depicts the test results for lag length selection.

1.3.3.5 Stability of VAR Model.

To come up with valid inferences about impulse responses, the stability of the VAR is crucial for policy analysis and forecasting. Model stability test checks whether the roots of the characteristic polynomial lie inside the unit circle. The VAR model in equation 1.2 can be written in lag operator notation as:

$$B(L)Y_t = B\varepsilon_t \; where \; I_n - B_1L - B_2L^2 - ... - B_pL^p \qquad (1.23)$$

The VAR(p) is stable if the roots of $\det(I_n - B_1L - B_2L^2 - ... - B_pL^p)$ lies outside the complex unit circle. The empirical model is checked to ensure that the model is stable. Test for the stability of the VAR model shows that all roots lie inside the unit circle (see Figure 1.10 in appendix B2).

1.3.3.6 Serial Correlation and Heteroscedasticity Tests.

Residual serial correlation in the estimated VAR model is conducted to check whether the current value residual is correlated with any of its lagged values. The Brusch-Godfrey Lagrange

Prediction Error (FPE), Akaike Information Criteria (AIC), Schwarz Information Criteria (SIC) and Hannan Quinn Information Criteria (HQ) test statistics.

[26] See Castelnuovo and Surico (2010) for a similar application

[27] The reduced form VAR is also stable when the model is estimated with four lags. Lag order of 4 and 6 are upper limits when working with quarterly and monthly data in small sample respectively (Ouliaris et al., 2016).

[28] Eichenbaum and Evans (1995) selected lag length based on the robustness of inference to higher-order lags.

Multiplier test is used for this purpose. The result in Table 1.6 (appendix B4) suggests that, except at the first three lags, there is no serial correlation when VAR is estimated with four lags. The White's(1980) test for heteroscedasticity is performed on the residuals. The result in Table 1.7 (appendix B4) shows that VAR residuals are homoscedastic with the given information.

1.4 Empirical Findings.

1.4.1 Impulse Response functions.

1.4.1.1 Fiscal Policy shocks.

Previous sections focus on the empirical model used and their diagnostic tests. This section presents empirical results from the SVAR model and checks their robustness to different specifications. The SVAR model is interpreted with the help of impulse response functions (IRF), multipliers and historical decomposition (HD). The impulse response functions show the response of each variable in the system to shocks from other variables. Hall (1995) argued that the most important means of examining results from structural VAR is through the impulse responses of the system. Therefore, the effect of policy variables is interpreted using impulse response functions for monetary and fiscal policy variables. Based on the impulse responses for fiscal variables, short-term and cumulative multipliers are computed for each component of the fiscal policy. Due attentions are also given to the relative contribution of each shock in the VAR system on the policy target variables, inflation, and output. Finally, the relative importance of monetary and fiscal policy shocks are also analyzed by generating aggregated contributions of each policy shocks, viz. monetary policy effect and fiscal policy effect. As is commonplace in the SVAR literature, the impulse response functions have been estimated for a sixty-eight percent confidence band.[29]

The impulse responses emanating from shocks in government spending, net taxes, and interest rate are discussed below. Figure 1.2 shows impulse responses for up to 20 quarters after the shocks for each shock. It can be seen that increased government spending is reflected in higher real output, which is consistent with, among others, results in Fatas and Mihov (2001); Blanchard and Perotti (2002); Perotti (2002, 2005); Heppke-falk et al. (2006); Claus et al. (2006); Giordano et al. (2007); de Castro and de Cos (2008); Dungey and Fry (2009) and Mountford and Uhlig (2009). However, the size and persistence of output response to government spending shocks vary significantly across studies. In the current paper, for instance, the impact of government spending on real output is small (see fiscal multipliers). Perotti (2002, 2005) also find, for a range of OECD countries and the U.S., that the impact of spending shocks is small.

[29]The choice of the confidence interval width is very standard in this kind of SVAR literature and follows, among others, Edelberg et al. (1999); Fatas and Mihov (2001); Joiner (2001); Blanchard and Perotti (2002); Perotti (2004); Claus et al. (2006); Heppke-falk et al. (2006); Chung and Leeper (2007); Kim and Roubini (2000, 2008); Caldara and Kamps (2008); Cloyne and Hurtgen (2016); Buckle et al. (2007); Ramey (2011b) and Fisher et al. (2016), who also choose 68% confidence band to discuss their results.

Inflation rises following increased government spending, though it remains statistically insignificant one-year aftershock.[30] The response of interest rate to government spending shocks is inline with the standard results, where interest rises following expansionary spending shocks (not shown here). The spending shocks are shown to have no significant effect on the exchange rate despite a positive (appreciating) effects in terms of the sign of the response.

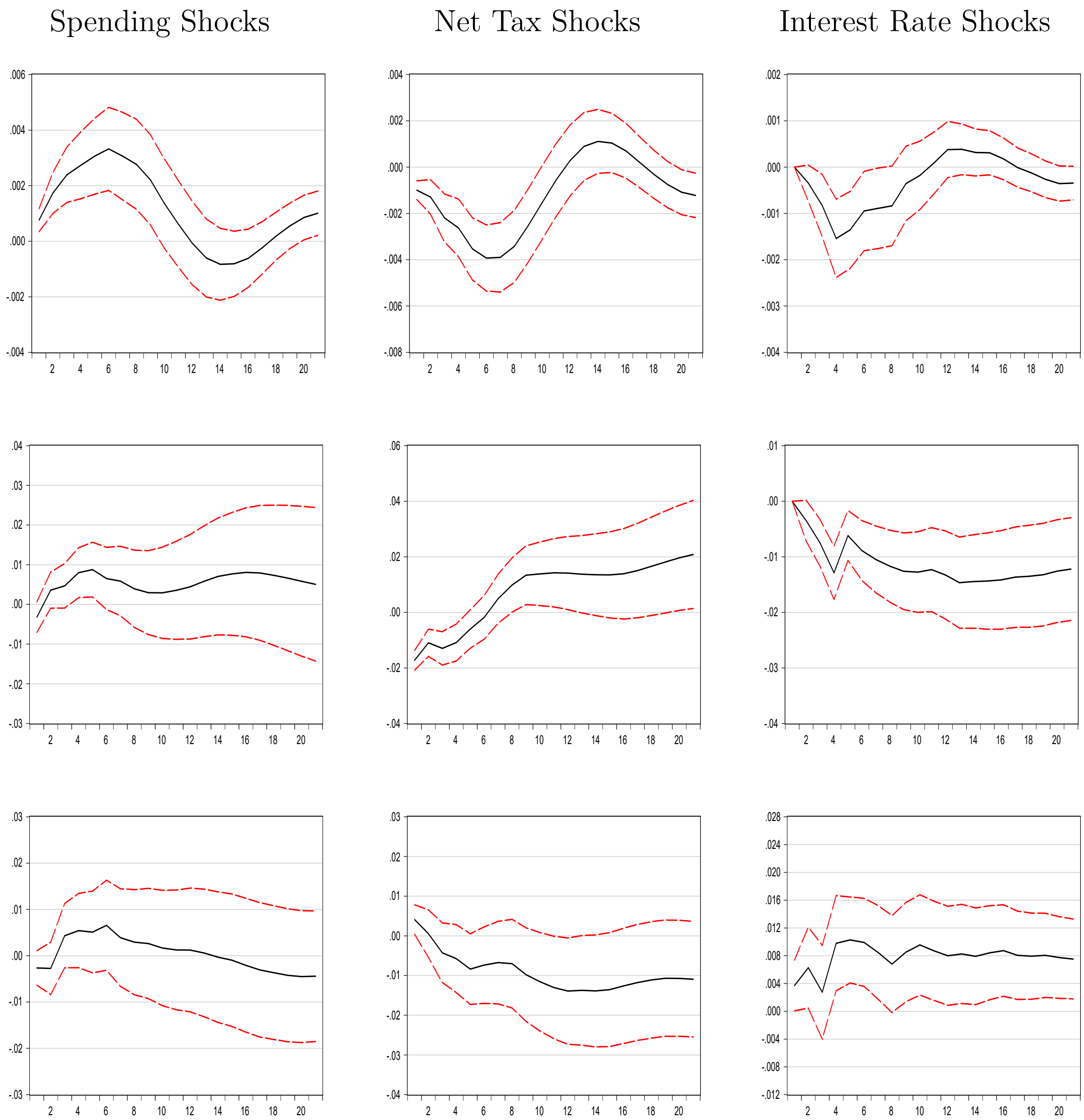


Figure 1.2: Impulse responses to a fiscal and monetary policy shocks. The rows show the responses of real output, inflation and exchange rate to shocks in government spending, net taxes and interest rate, presented in first, second and third columns , respectively.

[30]Favero and Giavazzi (2007) show that spending shocks have no significant effect on inflation. Canova and Paustian (2011) find that inflation rises in response to government spending shocks.

The response of real output to net tax shocks is mixed in the literature.[31] Mountford and Uhlig (2009); Blanchard and Perotti (2002) and Favero and Giavazzi (2007) find a fall in output following positive net tax shocks. Dungey and Fry (2009), on the other hand, find a rise in real output in response to increased net tax shocks. Perotti (2002, 2005) also find mixed results for the range OECD countries and the U.S. In the present paper, an exogenous increase in net tax has resulted in a fall in output as expected which is also standard results.

The impact of net tax shocks on inflation is also one where mixed results found in the literature. Net tax shocks are associated with lower inflation and higher inflation after the first year, though its effect is statistically insignificant after the second year, consistent with Mountford and Uhlig (2009). Favero and Giavazzi (2007) find a fall in inflation in response to positive net tax shocks. The interest rate quickly falls in response to net tax shocks in the current model (also not reported here).[32] See Dungey and Fry (2009) for similar results following positive net tax shocks. The response to the exchange rate shows that the exchange rates do not appear to respond significantly to net tax shocks.

However, to consider policy advice and design, it is important to calculate the fiscal multipliers. Fiscal multipliers measure the short-term effects of fiscal policy on output.[33] They are the change in output to an exogenous a one-unit change in the fiscal variable (Ilzetzki et al., 2013; Batini et al., 2014). Literature suggests that multipliers may vary across different horizons. The focus here, therefore, is given to two types of fiscal policy multipliers: short-term impact multiplier and the cumulative multiplier.[34] The short-term impact multiplier (SM) given by:

$$SM = \frac{\triangle y_t}{\triangle g_t} \tag{1.24}$$

measures the ratio of the change in output to a change in government spending at the time in which the impulse to government spending occurs (Ilzetzki, 2011), where both $\triangle y_t$ and $\triangle g_t$ are extracted from their respective impulse-response functions of output and government spending. In order to examine the impact of fiscal policy shocks at longer horizons, the cumulative multiplier (CM) at time T is also used in as defined by:

$$CM = \frac{\sum_{t=0}^{T}(1+i)^{-t}\triangle y_t}{\sum_{t=0}^{T}(1+i)^{-t}\triangle g_t} \tag{1.25}$$

[31] Different identification methods used in the literature yield very similar results for government spending shocks. However, these results are mixed for net tax shocks (Caldara and Kamps, 2008).

[32] Mountford and Uhlig (2009) find that interest rate rises following positive government revenue shocks.

[33] Short-term fiscal multipliers provide little guidance about the medium- to long-term effects and are silent on other important variables, such as employment, social outcomes, and income distribution (Batini et al., 2014).

[34] See Ilzetzki (2011) and Ilzetzki et al. (2013) for a similar way of defining multipliers. Since the analytical definitions of fiscal multipliers here are presented for government spending, the short term impact and cumulative multipliers for net taxes can be defined following the definitions for government spending.

where i is the median interest rate in the sample. Based on the impulse responses due to spending and net tax shocks, it is possible to calculate spending and net tax multipliers, respectively. Thus, the above impulse responses for fiscal shocks are scaled to derive the effect of a one-unit increase in net tax or government spending on economic activity. The cumulative multiplier at a given quarter is obtained as the ratio of the cumulative response of GDP or output and the cumulative response of fiscal variables at that quarter (De Castro and de Cos, 2008; De Castro and Garrote, 2015). Then, to facilitate interpretation of fiscal multipliers, the cumulative response of output to each of spending and net tax shocks are computed by adding the first four, eight, twelve, sixteenth and twentieth lagged quarter responses, which is the traditional approach in the literature. Accordingly, the short-term multipliers and cumulative multipliers for the spending and net tax shocks are shown in Figure 1.3.

The short-term impact multiplier is 0.05 for spending shocks and is close to zero for net tax shocks. An additional Ethiopian Birr (ETB) of government spending delivers only 5 cents of additional output. This effect, while small, is statistically significant. The very small short term multiplier of taxa revenue shocks could be related to a narrow tax base, which is in fact below the even Sub-Saharan average.[35] Focusing on the short-term multiplier, however, may be misleading because fiscal stimulus packages can only be implemented over time and there may be lags in the economy's response (Ilzetzki et al., 2013). Hence, to see impacts of the fiscal policy shocks over longer horizons, the cumulative multipliers for spending and net tax shocks are computed as shown in Figure 1.3.

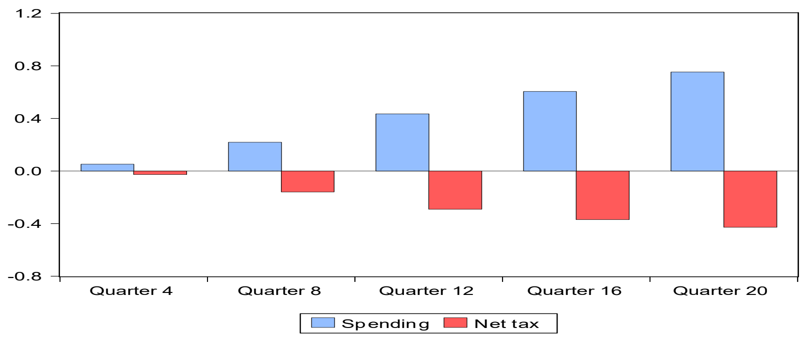


Figure 1.3: Short-term cumulative impact multipliers for spending and net tax shocks.

The cumulative multiplier for spending shocks rises to 0.22 whereas it remains relatively small and negative for net tax shocks. The small cumulative spending multiplier may reflect some crowding out of output and other related factors such as the implementation lag of public investment programs, the inefficiency of government spending, and relatively high debt status of the country (Kirchner et al., 2010; Batini et al., 2014; Ilzetzki et al., 2013).

Though small, the spending multipliers are higher than the net tax multipliers, which is one of the interesting results obtained in the majority of the empirical literature. The small size

[35] Tax revenue to GDP ratio is 18 percent in sub-Saharan Africa (Zerihun et al., 2016).

of the fiscal multiplier in Ethiopia is not surprising and comparable with the size of fiscal multipliers in other emerging and low-income countries. In many advanced countries, the fiscal multipliers can lie between less than zero to larger than one, with the average first-year multiplier of 0.75 for government spending and 0.25 for government revenue and, with higher spending multipliers than revenue multipliers (Batini et al., 2014). On the other hand, the empirical literature on fiscal multiplier in developing countries, though scarce, show that fiscal multipliers are very small (Ilzetzki, 2011; Kraay, 2012; Estevão and Samaké, 2013; Ilzetzki et al., 2013). The spending multiplier range from negative to 0.3 while revenue multiplier range from negative to 0.4. For instance, evidence using a panel of developing country show that the impact multiplier is -0.03 for spending, which basically depend on a number of factors such the degree of openness, exchange rate regime and level of indebtedness (Ilzetzki et al., 2013). For the sake of comparison, the short-term and cumulative multipliers for selected advanced and low-income countries are presented in Table 1.3. It can be seen from Table 1.3 that fiscal multipliers are higher for advanced countries and very small for low-income countries.

Table 1.3: Short-term and cumulative multipliers in high income and low income countries

High Income Countries										
Quart	**Australia**		**Canada**		**Germany**		**United Kingdom**		**United States**	
	Gov.	Tax	Gov.	Tax	Gov.	Tax	Gov.	Tax	Gov.	Tax
4 Quart	0.08	0.90	0.4	-0.37	1.29	-0.08	0.20	0.14	0.47	-0.88
12 Quart	0.31	1.02	0.43	-1.14	0.41	-3.62	0.29	0.37	0.82	-4.31
20 Quart	0.47	0.93	0.45	-1.07	0.59	-5.47	0.30	0.57	1.40	-7.75
Low Income Countries										
Quarter	**Argentina**		**Peru**		**South Africa**		**Indonesia**		**Panel of EMs**	
	Gov.	Tax	Gov.	Tax	Gov.	Tax	Gov.	Tax	Gov.	Tax
4 Quart	0.01	-0.01	0.20	-0.34	0.30	0.70	-0.3	0.4	0.2	0.3
12 Quart	0.01	-0.01	0.20	-0.90						
20 Quart	0.01	0.23	-1.90							

Source: Perotti (2002); Batini et al. (2014); Gov=Government spending, Tax=net tax, Quart=Quarters and EMs = Emerging Economies

1.4.1.2 Monetary Policy shocks.

In the literature, monetary policy shocks can be represented by either change in the short-term interest rates or changes in the narrow and broad monetary aggregates shocks. There is, in fact, a little consensus regarding the measure of the monetary policy shocks – whether to use monetary aggregate or interest rate (Leeper et al., 1996; Rafiq and Mallick, 2008).[36] While some authors preferred short-term interest rates as an indicator of monetary policy shocks (McCallum, 1983; Bernanke and Mihov, 1998; Bernanke and Blinder, 1992; Dungey and Fry, 2009; Mountford and Uhlig, 2009; Cloyne and Hurtgen, 2016); others considered monetary aggregates such as narrow money (M1), broad money (M2) or Non-borrowed reserves (Sims, 1992; Christiano et al., 1996, 2005).[37] In the baseline model, the short term interest rate is used to represent monetary policy shocks. The response of inflation, real output, and exchange rate to interest rate shocks are depicted in Figure 1.2.

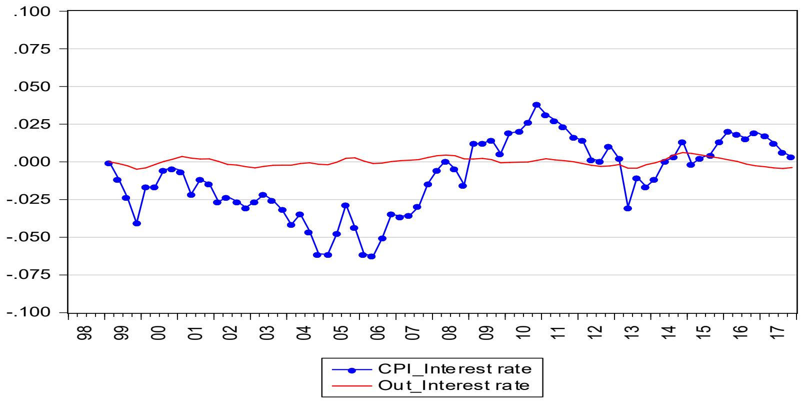


Figure 1.4: Contribution of interest rate to output and inflation

Several VAR empirical studies encountered different puzzles in response to monetary policy shocks. This paper does not encounter these puzzles as in the conventional framework. The response of output is contractionary following contractionary monetary policy. Some empirical studies have obtained a positive and significant response of output (or GDP) to a rise in short term interest rates. For example, the response of real GDP to contractionary monetary policy is positive in Rafiq and Mallick (2008) for Italy, Uhlig (2005) for the U.S and Dungey and Fry (2007) for New Zealand.[38] Similar evidence was found for Austria, Greece, Ireland and

[36] To check the sensitivity of baseline results to different alternative specifications, the model is re-estimated using alternative short-term interest rates and an alternative measure of monetary policy, monetary aggregates. Results presented in the robustness section show that they are robust to this kind of exercise.

[37] Monetary aggregates may be preferred over the short-term interest rate due to the argument that one cannot determine the influence of monetary policy by simply observing changes in interest rates and hence, price increases cannot occur without an increase in the monetary aggregates (Sims, 1992; Rafiq and Mallick, 2008; Bernanke and Mihov, 1998). In addition, short-term interest rates are a ‘polluted’ measure of the monetary policy stances (Sims, 1992; Christiano et al., 1996). In contrast, McCallum (1983); Bernanke and Blinder (1992) and Bernanke and Mihov (1998) preferred to use short-term interest rates over different measures of monetary aggregates due to the fact that the growth rates of monetary aggregates depend on a variety of non-policy influences. Moreover, the interest rate is probably less contaminated by endogenous responses to contemporaneous economic conditions than is the monetary aggregates.

[38] While the result for Uhlig (2005) and Rafiq and Mallick (2008) are from the sign restriction approach, it is from block exogeneity recursive scheme for Dungey and Fry (2007).

the Netherlands (cited in Rafiq and Mallick, 2008). In this paper, however, the contribution of contractionary monetary policy to output fluctuations is very small as compared to its contribution to inflation (see Figure 1.4). Very small effects of monetary policy on output and its larger effect on inflation could partly support the view that monetary policy largely contributes to nominal variables such as prices. Cloyne and Hurtgen (2016); Leeper et al. (1996); Bernanke et al. (2005, 1997) and Christiano et al. (1999) also show that the response of output to interest rate shocks is rather small.[39]

The well-known puzzles in the literature following contractionary monetary policy are price and exchange rate puzzles. This paper does not encounter an exchange rate puzzle in the sense that the response of the exchange rate to interest rate shocks is as in conventional framework, where the exchange rate appreciates following interest rate shocks. This is consistent with the response of the exchange rate to interest rate in Buckle et al. (2007); Forni and Gambetti (2010) and Eichenbaum and Evans (1995). Similarly, an increase in interest rate is associated with a significant fall in price, suggesting the absence of a price puzzle in the model. Some recent evidence has also shown that if the central bank does not raise interest rates sufficiently in response to inflation, structural VAR models are capable of producing price puzzles regardless of the identification of schemes used (Castelnuovo and Surico, 2006, 2010).

To shed light on the result in Castelnuovo and Surico (2006, 2010) and to check the robustness of this standard results in this paper, several specifications are re-estimated alongside with the baseline model. These include using an alternative identification scheme, an alternative measure of short term interest rate, and alternative monetary policy indicators such as narrow and broad monetary aggregate. To start with the first measures, the structural shocks are identified following the recursive identification scheme and the SVAR model is re-estimated as shown in Figure 1.14 in appendix D.

One can observe that the impulse responses to the fiscal and monetary policy shocks are similar to the one depicted in Figure 1.2. In particular, increased government spending and net taxes are associated with statistically significant expansionary and contractionary effects on the real output, respectively. Moreover, similar results are also obtained for the effect of the contractionary monetary policy shocks where we do not observe both price and exchange rate puzzles. As a third measure, the short term interest rate is substituted with the alternative measure of interest rate and an alternative measure of monetary policy indicator, such as monetary aggregates and then the SVAR model is re-estimated. The result shown in Figure 1.16 (appendix D) shows that expansionary monetary policy has an expansionary effect on output and a positive effect on inflation. These results are robust to both broad and narrow monetary aggregates[40] and using an alternative measure of short term interest rates such as deposit rates does not also change the baseline conclusion (Figure 1.15). See the robustness section for a more detailed discussion on these results.

[39]Coibion (2012) and Romer and Romer (2004) show that response of output to interest rate shocks is medium and large respectively.

[40]Both monetary aggregates are seasonally adjusted based on parametric and non-parametric seasonal adjustment tests.

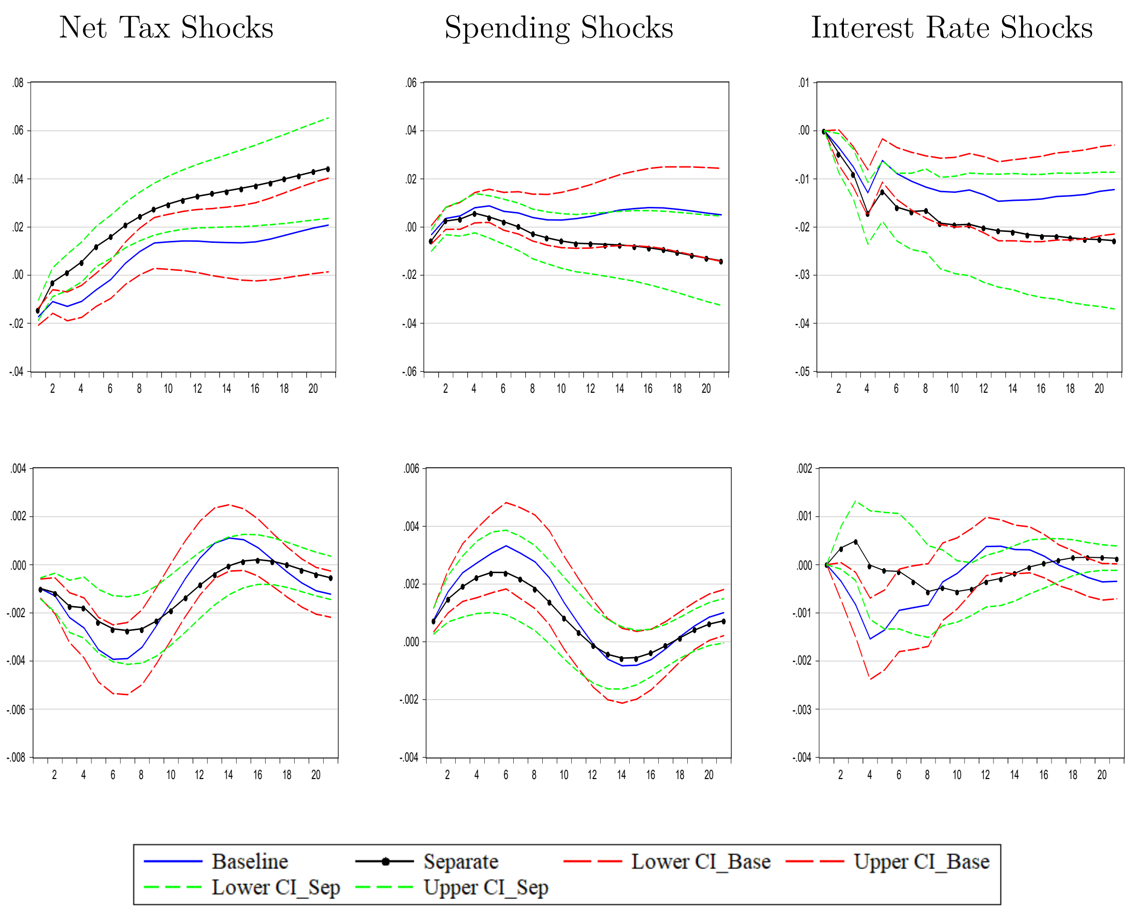


Figure 1.5: Impulse responses based on baseline model and separate models. Each row shows the responses of inflation and real output to shocks in net taxes, government spending and interest rates indicated in the first, second and third columns, respectively. The blue lines show the responses of inflation and output in the baseline model. The black lines with symbols show the responses of inflation and output from separate fiscal and monetary policy models. Underscore (_) Base and Sep represents the lower and upper confidence intervals in baseline model and separate models, respectively.

Impulse responses based on the separate SVAR models.

To see how the size of the response of output and prices to the fiscal and monetary policy shocks are improved, separate fiscal and monetary SVAR models are estimated and the impulse responses from each model are extracted. To make the comparison meaningful, fiscal policy and monetary policy shocks are identified exactly as in the case of the baseline SVAR model.[41]

[41] Fiscal shocks are identified using Blanchard and Perotti (2002) and Perotti (2002) approach while the monetary policy shocks are identified by imposing traditional short-run restrictions. To check the robustness of these results, monetary policy shocks are identified following the approach used in Kim and Roubini (2000), and the results are qualitatively identical.

The impulse responses presented in Figure 1.5 show that the responses of the output to net tax and spending shocks have improved qualitatively and quantitatively when monetary shocks are included in the fiscal SVAR model. In particular, unlike in the case of the baseline SVAR model, the responses of output to fiscal policy shocks have been muted when monetary policy shocks are excluded from the fiscal SVAR model.

One can also observe improvements in terms of the response of the output to the monetary policy shocks when fiscal variables are included in the monetary SVAR model. Not only the sizes of the responses of output to monetary shocks are decreased when fiscal shocks are excluded from the monetary SVAR model, but also there is a clear qualitative difference in terms of the output responses. The contractionary monetary policy shocks are consistently shown to have no significant effect on output over the entire sample periods. Moreover, the response of inflation to monetary policy shocks are more persistent as compared to the baseline model. These exercises support the arguments that failing to incorporate both monetary and fiscal policies simultaneously might incorrectly attribute to the wrong conclusions about the effects of monetary and fiscal policies in explaining macroeconomic fluctuations (Rossi and Zubairy, 2011; Fetai, 2013).

1.4.2 Historical analysis of the contributions to Ethiopian Growth cycles.

Impulse response functions are helpful to see how macroeconomic variables respond and their respective dynamics in the event of particular shocks. In fact, impulse responses can also be supplemented by variance decomposition of forecast errors at various time horizons. However, the connection between variance decomposition and the feature of the growth cycle is very weak (Dungey and Pagan, 2000; Buckle et al., 2007; Pagan and Robinson, 2014). Hence, the favoured approach for analyzing the relative impact of shocks and which shocks have occurred during the sample period is using historical decomposition. In the following section, the structural VAR model is used to identify the contribution of each shock to the Ethiopian growth cycle and inflation dynamics during the past 20 years.

Traditionally, the growth cycle is represented as the percentage deviation of real gross domestic output from its trend level. The estimated structural VAR model can be used for this analysis. To identify the contribution of each shocks to the growth cycle over the sample periods, we first write the SVAR model in equation equation (1.1) in a moving average representation as follows (Dungey and Pagan, 2000; Claus et al., 2006; Buckle et al., 2007).

$$y_t = y_0 + \sum_{i=0}^{t-1} \sum_{h=1}^{6} \omega_{ih} u_{h(t-i)} \tag{1.26}$$

Where y_t represent variable of interest, which is real output, y_0 denotes initial conditions, ω_{ih} is the i^{th} impulse response associated with the h^{th} shocks for six shocks in the VAR system.[42]

[42]Buckle et al. (2002) indicates that initial conditions will contribute also to the deviations of real GDP from

Figure 1.6 shows the contribution of government spending, net taxes, interest rate and exchange rate to output deviations from the trend over the sample period. The zero lines in each Figure correspond to the point at which, for instance, real output is at the trend and the point where the respective shocks are making a zero contribution to deviations in GDP from the trend. A negative (positive) value for each shock implies that the particular shock has contributed towards moving real GDP below (above) trend line respectively. It is indeed apparent from the Figure that the relative contribution of each shock varies over time. Broadly speaking, the prominent sources of output fluctuations are government spending and net tax shocks. Moreover, both shocks were significant contributors to the 2002/03 recession of the Ethiopian economy. Though its contribution is small relative to spending and net tax shocks, interest rate shocks were also one of the contributing shocks to the 2002/03 recession. The relatively large contribution of monetary policy shocks to output fluctuations was registered at the beginning and end of the sample periods. The contribution of government spending and net tax shocks to output fluctuations has increased even in the recent sample periods. More on the relative importance of fiscal policy and monetary policy are presented in the next section.

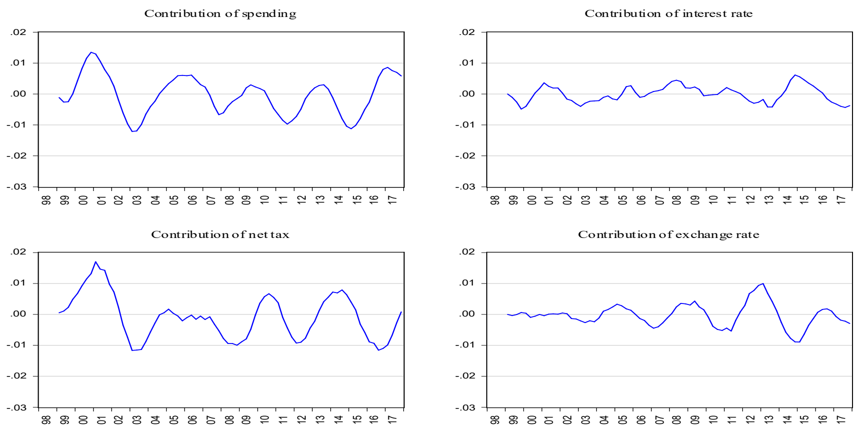


Figure 1.6: Contribution to Growth Cycles. It shows the contribution of spending, net tax, output, inflation, interest rate and exchange rate shocks to Ethiopia's business cycle fluctuations.

In contrast to the attention they receive at both individual and institutional levels, shocks from the exchange rates have not been important sources of growth cycles during the earlier periods. This might be due to the fact that movements in the exchange rate had marginal effects on foreign trade movements. While the highest and negative contribution of the exchange rate was recorded during 2014/15 as a result of a negative growth rate of value of export, its largest and positive contributions were shown in 2012/13. In general, each shock has contributed either negatively or positively during the sample periods, with spending shocks and net tax shocks taking lion shares.

trend at the beginning of the sample period. But over time the contributions from initial conditions converge toward zero.

The approach in equation 1.26 can also be to identify the contributing factors to the inflation dynamics in Ethiopia. Inflation has been the center of public debate in Ethiopia and was one of the policy challenges in sustaining the high economic growth that the country has been enjoying since 2003/04. Hence, it is important to identify the main contributing shocks to the inflation dynamics in Ethiopia.

The historical decomposition of inflation over the sample period is depicted in Figure figure 1.7 . Each panel in the Figure shows the contribution of different shocks to inflation dynamics in Ethiopia. The important sources for inflation movements are net tax shocks, exchange rates, and interest rate shocks. These shocks are also important sources of 2001/02 deflation. The contribution of the exchange rate to the inflation movement has been strong during the recent period due to the policy decision taken by the National Bank of Ethiopia and its subsequent effect on the import price as well as consumer expectations. The interest rate shocks also had a key role in reducing double-digit inflation of 2002/03 to a single digit next year. The role of government spending to inflation fluctuations was broadly small and relatively higher during the earlier periods. In the early periods of the sample, net tax shocks look lion share in explaining movement in inflation while it is the exchange rate shocks that have been dominant in explaining inflation movement. Generally speaking, while spending and net tax shocks were dominant shocks explaining output fluctuation, net tax and exchange rate shocks were major shocks explaining inflation movements.

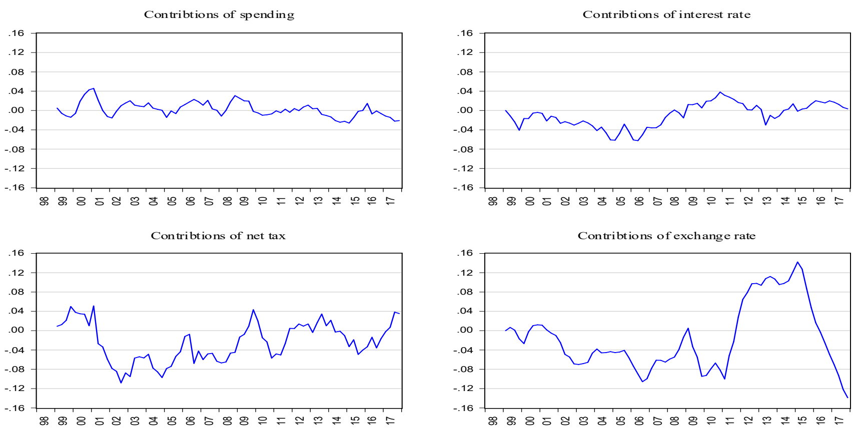


Figure 1.7: Contribution to Inflation Dynamics. It shows the contribution of spending, net tax, output, inflation, interest rate and exchange rate shocks to inflation dynamics.

1.4.2.1 Relative Importance of Policy variables.

The relative contributions of all shocks included in the SVAR model are discussed in the previous section. In this section, the focus is paid to the relative importance of policy variables in explaining movement in real output. First, the relative importance of fiscal policy components vis-a-vis government spending and net tax shocks are discussed followed by the relative importance of monetary and fiscal policies in explaining the growth cycle in Ethiopia during the sample periods. Monetary policy shocks are represented by interest rate shocks and named as monetary policy effect (MPE). On the other hand, government spending shocks and net tax shocks are aggregated to form total fiscal policy effect (FPE), as usual in the literature.

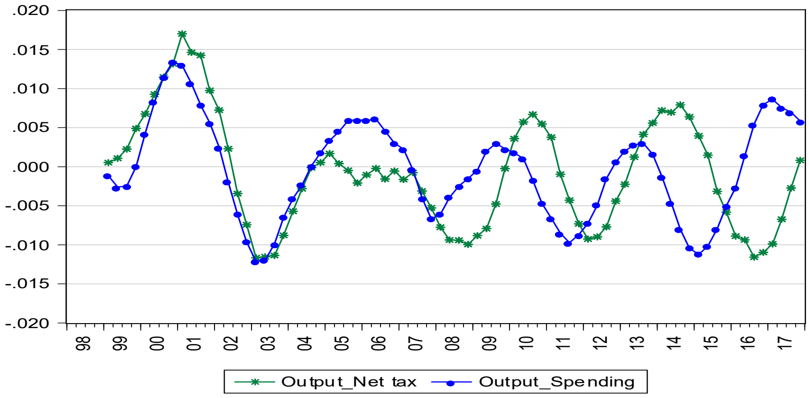


Figure 1.8: Relative importance of fiscal policy components to GDP growth cycle.

The relative importance of fiscal policy components to the growth cycle is depicted in Figure figure 1.8 . Government spending shocks are more or less pro-cyclical. They contributed negatively to output during the 2002/03 recession and during the slowdown of 2008/09. They also contributed positively to the high growth of 2000/01 and 2006/07. In fact, it does not always act in a pro-cyclical manner, where its contribution was negative during the high growth of 2014/15.

The contribution of net tax shocks was also pro-cyclical during early periods, particularly up until the first quarter of 2004/05. It also contributed negatively to the 2002/03 recession. Indeed, net tax shocks generally contributed negatively to output for the majority of sample periods, with positive and highest contribution registered in most early and recent periods. In general, as in Claus et al. (2006) and Dungey and Fry (2009), the contribution of net tax shocks and government spending shocks to real GDP growth cycle are roughly equivalent, with both shocks contributing more or less in opposite direction to the other shocks after late 2012/13. Moreover, the highest and positive contributions of both shocks are recorded during the high growth of 2000/01.

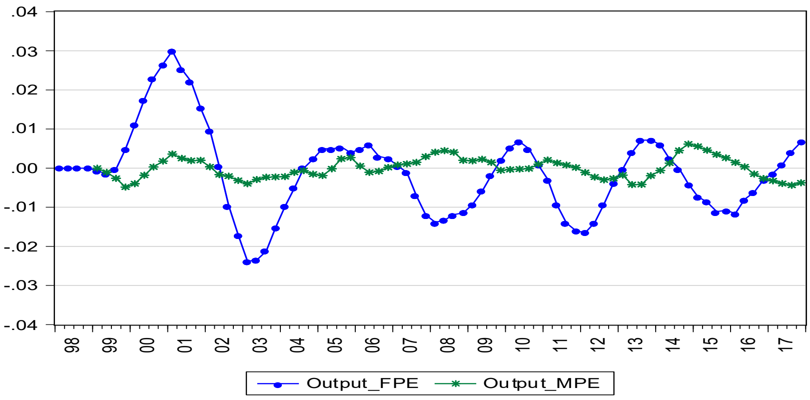


Figure 1.9: Relative importance of fiscal policy and monetary policy to GDP growth cycle. Monetary policy is represented by interest rate shocks. Effects of government spending and net tax shocks are aggregated to form total fiscal policy effect.

The contributions of monetary policy and fiscal policy to real output over the sample period are depicted as the Monetary Policy Effect (MPE) and Fiscal Policy Effect (FPE) in Figure 1.9. Fiscal policy has been acting in a pro-cyclical manner for the majority of the sample periods. During the slowdown associated with the drought in 2002/03, 2007/08 and 2015/16, fiscal policy was broadly contractionary and act as expansionary during the high growth of late 2006/07, 2009/10 and 2013/14, in a pro-cyclical manner. This pro-cyclical behavior of fiscal policy is a standard result for developing countries in the literature. Alesina et al. (2008); Ilzetzki and Végh (2008) and Petrevski et al. (2016) also find similar results. Monetary policy, on the other hand, was more or less contractionary for the majority of sample periods. However, it also contributed positively to the 2014/15 high growth, though small. In general, it can also be seen from Figure figure 1.9 that fiscal policy has a greater impact on real GDP fluctuation than monetary policy, which is consistent with results in Dungey and Fry (2007).

1.5 Robustness Check.

The baseline results show that, among other results, the relative impact of fiscal policy is higher than that of monetary policy in explaining the business cycle fluctuation in Ethiopia. Several robustness checks are performed to see the sensitivity of the results presented in this paper.[43] These include robustness of results to an alternative ordering of fiscal variables, alternative short term interest rate, allowing for alternative lags, using different exogenous parameters, alternative interpolation approaches, and alternative identification approach.

Alternative ordering: Under these exercises, alternative ordering for fiscal variables, ordering interest rate before inflation and output as well as ordering net taxes after price and output

[43]Impulse responses are presented in appendix D.

were performed. The first alternative ordering of the fiscal policy components is discussed followed by the two alternative cases.

a) Ordering of fiscal shocks: Identification of fiscal policy shocks using Blanchard and Perotti (2002) approach depends on the decisions about the ordering of fiscal variables. Since there is little guidance about how to order the two fiscal variables, Blanchard and Perotti (2002) and Perotti (2002) suggested checking the robustness of the results to the two alternative orderings. Several authors estimated their models taking either ordering and then checked the robustness of their result to the alternative options. See, for example, Claus et al. (2006); Perotti (2004, 2005); de Castro and de Cos (2008); Favero and Giavazzi (2007); Lozano and Rodriguez (2011) and Ilzetzki (2011). These authors confirmed that the order of the two shocks is immaterial to their results. In this paper, the main results are presented assuming that government spending is ordered first ($\beta_{gt} = 0$). Therefore, it is important to check the sensitivity of results when an alternative ordering option is chosen, in which net tax is ordered first, before government spending ($\beta_{tg} = 0$). One can observe from Figure 1.15 that these results are not sensitive to experimenting with this alternative ordering both quantitatively and qualitatively.[44]

c) Ordering net tax after inflation and output: Caldara and Kamps (2008) argue that since movements in government spending, unlike movements in net taxes, are largely unrelated to the business cycle, government spending is not affected contemporaneously by shocks originating in the private sector, suggesting that shocks to output and inflation could have an immediate impact on the tax base and, thus, a contemporaneous effect on net taxes. To check whether this matters for the main results, the SVAR model is re-estimated after ordering output and inflation before net taxes, but after government spending. The result presented in Figure 1.15 shows that the impulse responses remain identical.

Effects of Contemporaneous relationships. Blanchard and Perotti (2002) identification approach crucially depends on the exogenous elasticities. Therefore, it is vital to examine how the results change when there is a small change in the value of the parameters used for contemporaneous relationship. Perotti (2002) suggested value of the price elasticity of government spending to be (-0.5) and the baseline model is estimated taking this value like in Perotti (2005); Claus et al. (2006); Favero and Giavazzi (2007); de Castro and de Cos (2008); Lozano and Rodriguez (2011) and Ilzetzki (2011). To check the robustness of the results in this paper, the model is re-estimated by taking the slightly lower value (-0.4) and slightly higher value (-0.6) of price elasticity of government spending. Figure 1.13 depicts the findings. Moreover, the sensitivity of results to a small change in output and price elasticity of net tax has also experimented for slightly lower and higher values. The result from these experiments are shown in Figure 1.12. Overall, the findings are robust to these exercises both quantitatively and qualitatively.[45]

[44] Some authors also check the sensitive of the results to setting both zero ($\beta_{tg} = \beta_{gt} = 0$); see Ilzetzki (2011). These option is also checked in this paper and the result confirms insensitivity of findings to these assumption.

[45] Blanchard and Perotti (2002) also examine the sensitivity of their results for different values of output elasticity of net taxes.

Alternative interpolation method: It usual to explore the sensitivity of the results to alternative interpolation methods in the literature when interpolated data are used. For instance, Ramey and Zubairy (2014) estimated their model where data on, among others, real GDP, nominal GDP, GDP deflator and population are interpolated in the pre-WWII period using a linear interpolation method. They used an alternative interpolation technique and provide the robustness of their results to the data. To examine the robustness of the main results in this paper, an alternative GDP series is constructed using Chow and Lin's (1971) interpolation method.[46] The baseline model is re-estimated using this real GDP series. The results presented in Figure 1.14 shows that findings from this exercise are qualitatively very similar.

Alternative identification approach: The SVAR shocks are identified using Cholesky Decomposition to check the robustness of the results to alternative identification scheme. The results are shown in Figure 1.14 (appendix D). As can be seen from Figure 1.14, the responses of the variables in the model to monetary policy shocks are very similar to the one identified by the Blanchard and Perotti (2002) and Perotti (2002, 2005) approach along with traditional short-run restrictions. However, though qualitatively very similar to the baseline model, the responses of output to net tax shocks are relatively muted when fiscal shocks are identified by Cholesky Decomposition. Ordering net tax before spending is also experimented to see whether impulse response changes due to this alternative ordering. The impulse responses are similar in both cases. In sum, the responses of the model's variables to fiscal and monetary policy shocks based on the traditional Cholesky Decomposition are very similar to results in the baseline model except for very marginal qualitative differences in the responses of output to fiscal policy shocks.

Alternative policy variable and lag length: In order to assess the robustness of the result in this paper, the baseline monetary policy variable is substituted with the short term deposit rate and the model is also re-estimated with 5 lags. The impulse responses in Figure 1.15 from the model with the deposit rate and in Figure 1.17 based on for five lags confirm that the results are broadly very similar to exercises.

Alternative Specifications: The baseline SVAR model is estimated at levels despite the fact that most variables are non-stationary. It might be true that resorting to alternative specifications might alter the baseline results. To check this, two alternative specifications are re-estimated. As a first specification, the SVAR model is re-estimated at first difference. The results depicted in Figure 1.18 show that the benchmark model is highly robust. Consistent with sustainable fiscal policy and in line with Blanchard and Perotti (2002) and Dungey and Fry (2009), co-integrating relationships between government spending, net taxes, output, and trade-weighted effective exchange rates are tested using the Johansen co-integration test. Observe from Table 1.10 (appendix C) that while the trace test indicates one co-integrating equation among these variables, the maximum eigenvalue test points to no co-integrating relationship. Based on the trace test statistics, the error correction term is estimated and alternative specification is chosen oven the benchmark model. The impulse responses in Figure 1.19 show that the baseline results are robust to this exercise. Alternatively, there is a substantial literature testing a co-integrating relationship between net taxes and government spending, consistent

[46]Bernanke et al. (1997) argued that the method of Chow and Lin (1997) is similar to the state-space method

with fiscal sustainability (Dungey and Fry, 2009). Accordingly, the co-integrating relationship between government spending and net taxes is also tested using the Johansen co-integration test. Similar to Blanchard and Perotti (2002), both trace and the maximum eigenvalue tests consistently show that there is no co-integration between government spending and net taxes (see Table 1.10 in appendix C). [47]

1.6 Conclusions.

This paper examines the impacts and relative importance of shocks from fiscal policy, monetary policy, and other sources explaining macroeconomic fluctuations in Ethiopia. The sample period for the paper ranges from 1997/98:1 to 2016/17:4. The model used has non-recursive structures based on Blanchard and Perotti (2002) and Perotti (2002, 2005) approach, traditional short-run restrictions, and Sims and Zha (1998) and Kim and Roubini (2000) approach. Ethiopia is an interesting case study because its high growth has attracted international attention in recent years. Moreover, inflation has been high and persistent exceeding double digits and the center of policy debate in the country since 2002/03.

The key results of the paper are presented as follows. First, spending shocks and net tax shocks are prominent sources of GDP fluctuations. Second, the important sources of shocks for inflation lie with net taxes and interest rate shocks. Third, shocks from interest rates and exchange rates contributed more to the inflation movement than the growth cycle movement in the country. Fourth, the relative importance of fiscal policy components shows that their contributions are roughly equivalent in explaining inflation dynamics and output fluctuations in Ethiopia. Fifth, the contributions of fiscal policy shocks have been larger than that of monetary policy shocks in explaining output fluctuations and inflation movements in the country. To check the sensitivity of the results to different specifications, the robustness of results to alternative orderings, using different exogenous parameters, alternative interpolation approaches, and alternative identification approaches are performed. These exercises show that the main results are robust.

[47] Blanchard and Perotti (2002) also show that estimating a co-integrated SVAR model or an SVAR model in the first differences does not make any substantial differences.

1.7 Appendix

Appendix A: Data Definitions.

The vector of variables included in the VAR model are Real Output (y_t), Government spending (g_t), Net tax (t_t), Interest rates (r_t), Inflation proxied by consumer price index (π_t) and Exchange rates (e_t). Definition of variables are adopted from Blanchard and Perotti (2002); Perotti (2002); Rahman (2005) and de Castro and Fernandez Caballero (2011). The sample periods ranges from 1997/98 up to 2016/17.

- **Government spending (g_t)**: Is a seasonally adjusted quarterly data on government spending that includes both current and capital spending excluding the interest payment on public debt, expressed in logs.
- **Net taxes (t_t)**: Comprises seasonally adjusted quarterly data on taxes from domestic as well as foreign sources excluding the interest receipts, expressed in logs.
- **Consumer Price Index (π_t)**: Is a quarterly and seasonally adjusted data on consumer price index that reflects the average cost of purchasing a fixed basket of goods and services, expressed in logs. It is used as a proxy for the level of inflation.
- **Interest Rates (r_t)**: Includes quarterly data on interest rates that is CPI adjusted to reflect the real cost of borrowing and lending. It is constructed from the average of lending and deposit rates minus expected inflation where the expected inflation is proxied by lagged inflation. Constructing it in this way, approach in Kim (2015) and Anaya et al. (2017), among others, is used.
- **Exchange Rates (e_t)**: Is quarterly value of trade weighted exchange rates for Ethiopia, expressed in logs.
- **Real Output (y_t)**: Quarterly data real GDP that includes the market value of all final goods and services produced in a given year, expressed in logs. It is used to capture the overall economic performance. Quarterly data on Real GDP used in the current paper is the one constructed by Ethiopian Development Research Institute (EDRI) up until 2010 and extended to 2016/17.[48] In fact, obtaining high-frequency data is not easy in many countries. Instead, interested researchers and practitioners opt on interpolating quarterly series from annual series or monthly series from quarterly series or directly interpolating monthly series from annual series.[49] For instance, Bernanke and Mihov (1998) interpolated monthly real GDP and the GDP deflator data for the U.S. Uhlig (2005) interpolated monthly real GDP, the GDP deflator, a commodity price index, total reserves, non-borrowed reserves and the federal funds rate series for U.S. Monch and Uhlig

[48] To check the robustness of the result, an alternative quarterly series is constructed using Chow and Lin (1997) method. Robustness exercise shows that results are insensitive (see robustness section for more detail). Bernanke et al. (1997) argued that the method of Chow and Lin (1997) is similar to the state-space method.

[49] Most commonly used interpolation methods are Chow and Lin (1997), Linear, State Space, Fernandez (1981) and Mitchell et al. (2005) methods; see Monch and Uhlig (2005) for more detail.

(2005) interpolated monthly Real GDP series for France, Germany, and Italy. Bernanke et al. (1997) interpolated US monthly data on GDP deflator, GDP and its component. Dungey and Fry (2009) interpolated quarterly series for New Zealand government debt for the period to September 1994. Ilzetzki (2011) interpolated quarterly data for government debt for a set of developing and developed countries. Buckle et al. (2002) used quarterly real GDP that has been interpolated back to 1978 by Haugh (2001) for Australia. Ramey and Zubairy (2014) interpolated quarterly series on, among others, Real GDP, Nominal GDP and GDP deflator, for the pre-WWII periods. Anaya et al. (2017) interpolated monthly data for US real GDP using Chow and Lin (1997) method.

Appendix B: Diagnostic Test Results.

Appendix B1: Unit root test results.

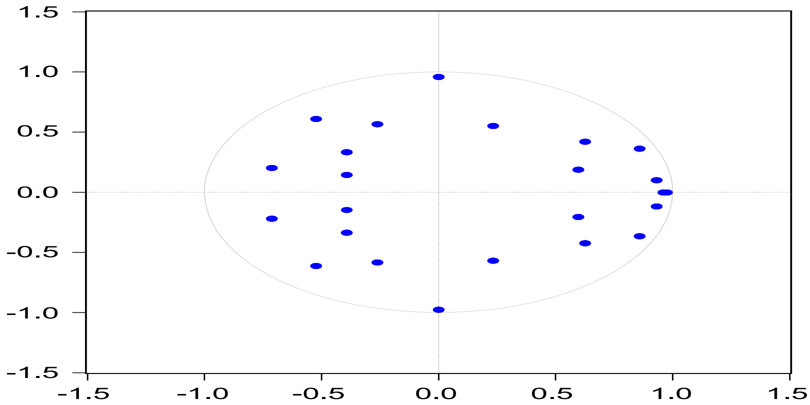
Table 1.4: Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests 1998Q1 to 2017Q4*.

Variables	ADF Test		PP Test	
	t-stats	P-Value	t-stats	P-Value
Real GDP(y_t)	-4.39	0.00	-2.73	0.22
Government spending (g_t)	-0.89	0.96	-1.66	0.77
Net tax (t_t)	-2.16	0.51	-2.30	0.43
Inflation(π_t)	-2.13	0.53	-2.14	0.53
Interest Rates (r_t)	-7.45	0.00	-7.45	0.00
Exchange Rates (e_t)	-1.62	0.77	-1.32	0.88

*Unit root tests contain a constant and trend. The lag length for ADF test is based automatic SIC. The P-values are the McKinnon (1996) one sided. The PP test is based on Automatic Newey-West bandwidth..

Appendix B2: Stability of VAR Model.

Figure 1.10: Value of roots from eigenvalues based on Estimated VAR.



Since no root lies outside the unit circle, VAR satisfies the stability condition.

Appendix B3: VAR Lag Order Selection Criteria.

Table 1.5: Lag length for the estimated VAR system 1998Q1 to 2017Q4

Lag	LogL	LR	df	p	FPE	AIC	SBIC	HQIC
0	-73.33				3.4e-07	2.12	2.30	-2.19
1	523.93	1194.7	36	0.000	1.1e-13	-12.85	-11.55*	-12.33
2	599.34	150.94	36	0.000	3.8e-14*	-13.90	-11.49	-12.94*
3	627.78	56.77	36	0.015	4.8e-14	-13.70	-10.18	-12.29
4	672.77	89..98	36	0.000	4.2e-14	-13.94*	-9.31	-12.09
5	708.44	71.34*	36	0.000	4.9e-14	-13.93	-8.18	-11.64

* Indicates lag order selected by the criterion, LR: Sequential Modified LR test statistic (each test at 5% level), FPE: Final Prediction Error, AIC: Akaike Information Criterion, SBIC: Schwarz Information Criterion, HQIC: Hannan-Quinn Information Criterion.

Appendix B4: VAR Residual Serial Correlation Test.

Table 1.6: Serial Correlation test using LM test

	$\rho = 2$		$\rho = 3$		$\rho = 4$		$\rho = 5$	
Lags(ρ)	LM-stat	Prob.	LM-stat	Prob.	LM-stat	Prob.	LM-stat	Prob.
1	41.52	0.242	58.35	0.011	47.17	0.101	41.38	0.247
2	51.12	0.049	50.22	0.058	41.54	0.242	36.13	0.463
3	33.07	0.609	45.21	0.140	39.09	0.333	32.74	0.625
4	40.74	0.269	33.26	0.600	35.72	0.482	31.59	0.678
5	36.29	0.455	24.94	0.917	28.59	0.805	23.31	0.949
6	55.79	0.019	48.80	0.075	41.80	0.233	36.15	0.461
7	32.62	0.630	29.51	0.769	38.14	0.372	50.20	0.058

Null Hypothesis: No serial correlation at lag order h, Probabilities from chi-square with 36 degrees of freedom. Test is performed based on VAR model with three different lags(ρ).

Table 1.7: Tests: No Cross Terms (only levels and squares)

	Joint test	
Chi-sq.	df	Prob.
987.49	1008	0.672

Null Hypothesis: Residuals are homoscedastic and independent of the regressors.

Appendix C: Seasonal Adjustment and Co-integration test.

Table 1.8: Seasonality Tests

Variable	**Moving Seasonality Test**					**Kruskal-Wallis Test**		
	Variation	Sum of Square	df	Mean Square	F-Value	Stat.	df	Prob.
Real Output	Between years	0.4	19	0.02	1.9*	16.4	3	0.00*
	Error	0.64	57	0.01				
Inflation	Between years	89.7	19	4.7	2.2**	51.0	3	0.00*
	Error	124.3	57	2.2				
Tax Revenue	Between years	376.4	19	19.8	1.1	35.1	3	0.00*
	Error	1021.8	57	17.9				
Spending	Between years	5764.9	19	303.4	2.8**	55.4	3	0.00*
	Error	6286.8	57	110.3				
Interest Rates	Between years	385.9	19	20.3	2.0*	2.4	3	0.49
	Error	590.5	57	10.4				
Exch. Rates	Between years	17.9	19	0.9	3.2**	4.7	3	0.19
	Error	16.9	57	0.3				

**Moving seasonality is present at 1%; *Moving seasonality is present at 5%; Null Hypothesis: No sign of seasonality

Table 1.9: Seasonality Tests

Variable	Stable Seasonality Test					Combined Seasonality Test
	Variation	Sum of Square	Degrees of Freedom	Mean Square	F-Value	
Real Output	Between years	0.2	3	0.06	2.9	Identified seasonality not present
	Residual	1.5	76	0.02		
	Total	1.7	79			
Inflation	Between quarters	136.7	3	45.56	15.1**	Identified seasonality present
	Residual	229.1	76	3.01		
	Total	365.8	79			
Tax Revenue	Between quarters	2295.6	3	761.19	22.0**	Identified seasonality present
	Residual	2649.0	76	34.86		
	Total	4944.6	79			
Spending	Between quarters	50440.0	3	16813.4	102.2**	Identified seasonality present
	Residual	12261.3	76	161.3		
	Total	62701.5	79			
Interest Rates	Between quarters	33.1	3	11.0	0.74	Identified seasonality not present
	Residual	1139.6	76	15.0		
	Total	1172.7	79			
Exch. Rates	Between quarters	0.87	3	0.29	0.52	Identified seasonality not present
	Residual	42.7	76	0.56		
	Total	43.5	79			

**Stable seasonality is present at 1%; *Stable seasonality is present at 5%; Null Hypothesis: No sign of seasonality

Table 1.10: Co-integration Test:number of co-integrating relations*

Tests	Trace	Max-eg
Variables: Government spending, net taxes, output and trade weighted exchange rates		
No. of co-integrating equations	1	0
Variables: Government spending and net taxes		
No. of co-integrating equations	0	0

Notes: *Critical values based on MacKinnon et al. (1999); Trace test statistics (Trace) and Maximum Eigenvalue test statistics (Max-eg).

Appendix D: Robustness Check.

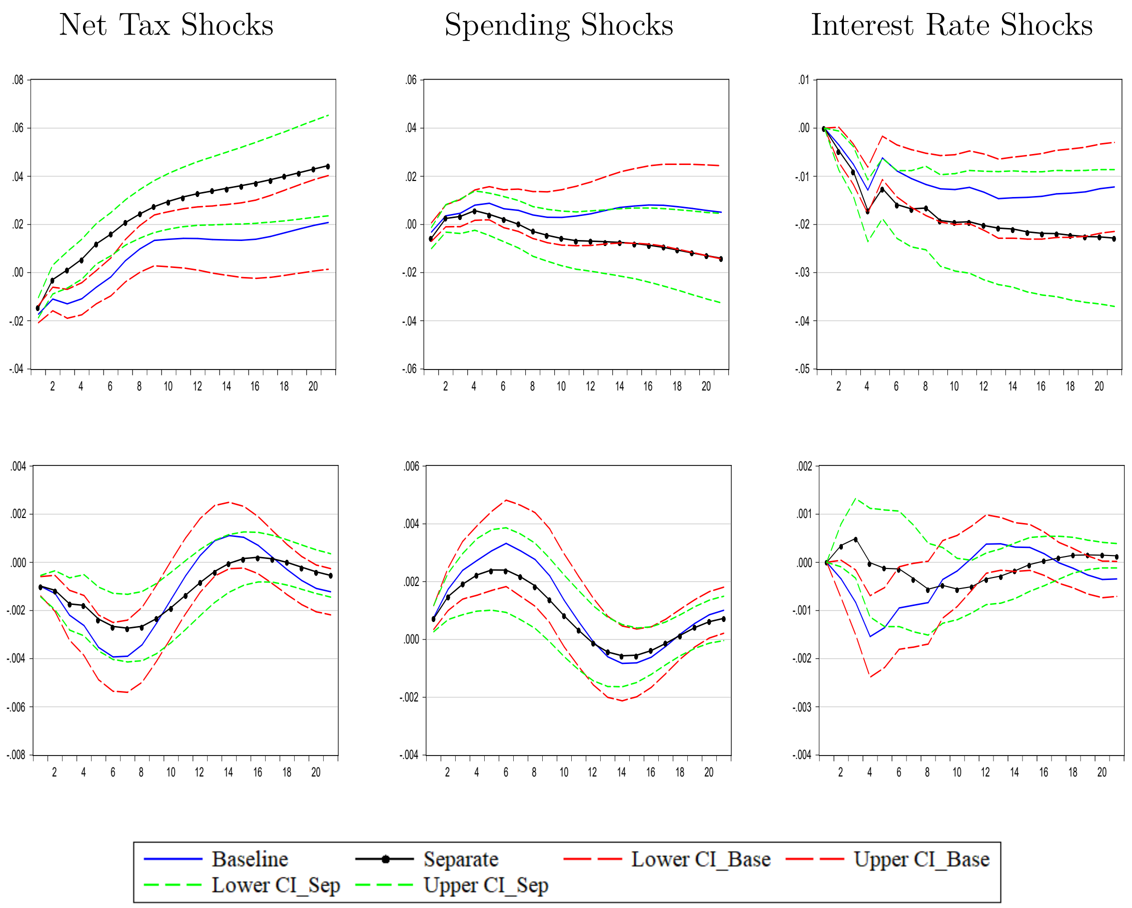


Figure 1.11: Impulse responses based on baseline model and separate models. The responses of real output and inflation to shocks in net taxes, government spending and interest rates are indicated in the first and second rows respectively. The blue lines show the response of inflation and output in the baseline model. The black lines with symbol shows their responses from the separate fiscal and monetary SVAR models. Lower and upper CI with underscore (_) base and sep represents the confidence interval from baseline and separate models, respectively.

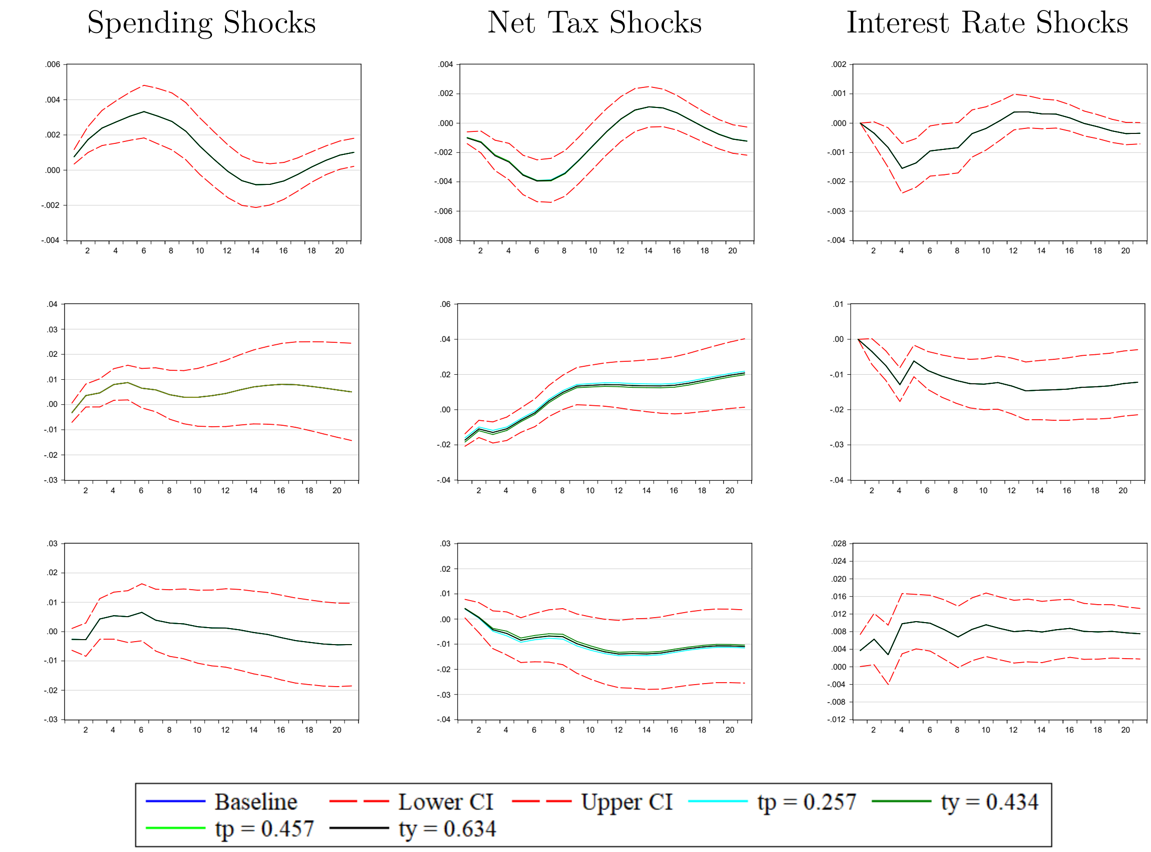


Figure 1.12: Impulse responses with slightly lower and upper price and output elasticity of net tax revenue. The responses of real output, inflation and exchange rates to shocks in net taxes, government spending and interest rates are shown in the first, second and third rows respectively. Baseline represents responses from the baseline model, tp = 0.257 ($\alpha_{t\pi} = -0.257$) and tp = 0.457 ($\alpha_{t\pi} = -0.457$) are responses for slightly lower and upper price elasticity of net tax revenue, respectively; ty = 0.434 ($\alpha_{ty} = -0.434$) and ty = 0.634 ($\alpha_{ty} = -0.634$) indicates responses for slightly lower and upper output elasticity of net tax revenue, respectively. Lower and Upper CI means lower and upper confidence interval, respectively.

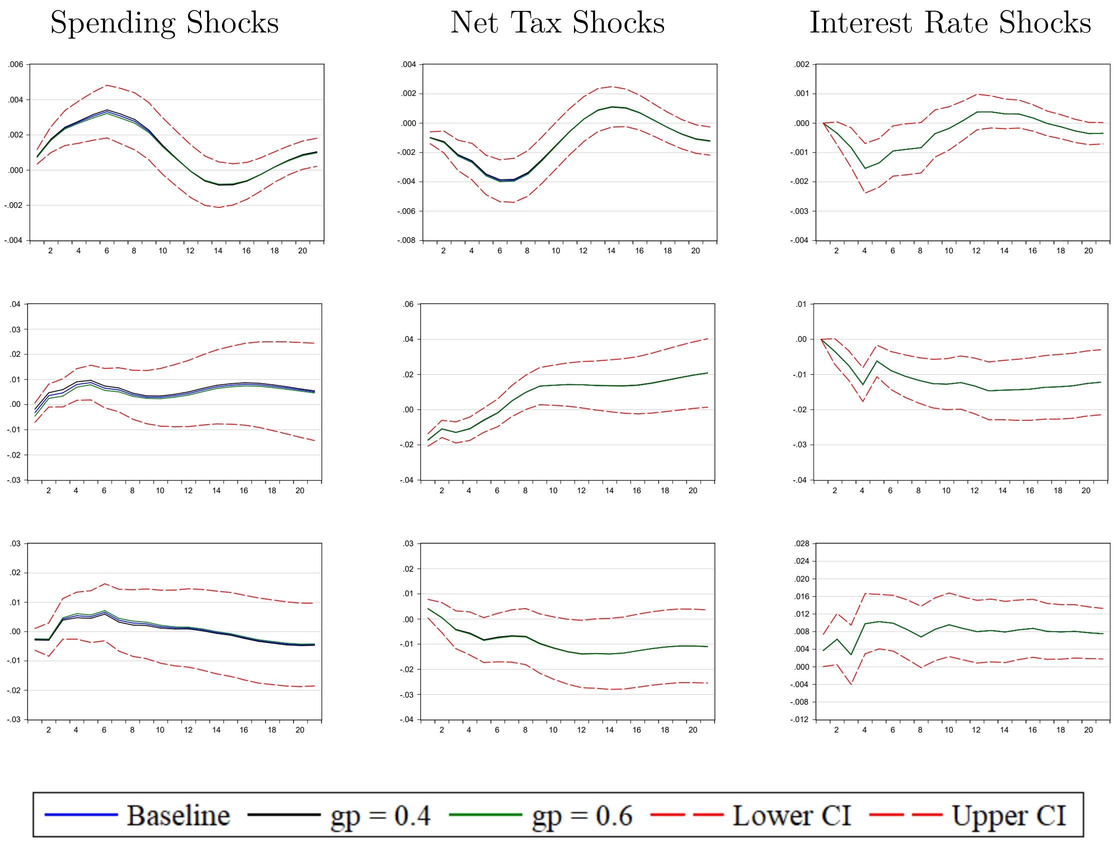


Figure 1.13: Impulse responses with slightly lower and upper price elasticity of government spending. The responses of real output, inflation and exchange rates to shocks in government spending, net taxes and interest rates are presented in the first, second and third rows respectively. Baseline represents responses from the baseline model, gp $= 0.4$ and gp $= 0.6$ are the responses for slightly lower and upper price elasticity ($\alpha_{g\pi} = -0.4$ and $\alpha_{g\pi} = -0.6$) of government spending, respectively. Lower and Upper CI means lower and upper confidence interval, respectively.

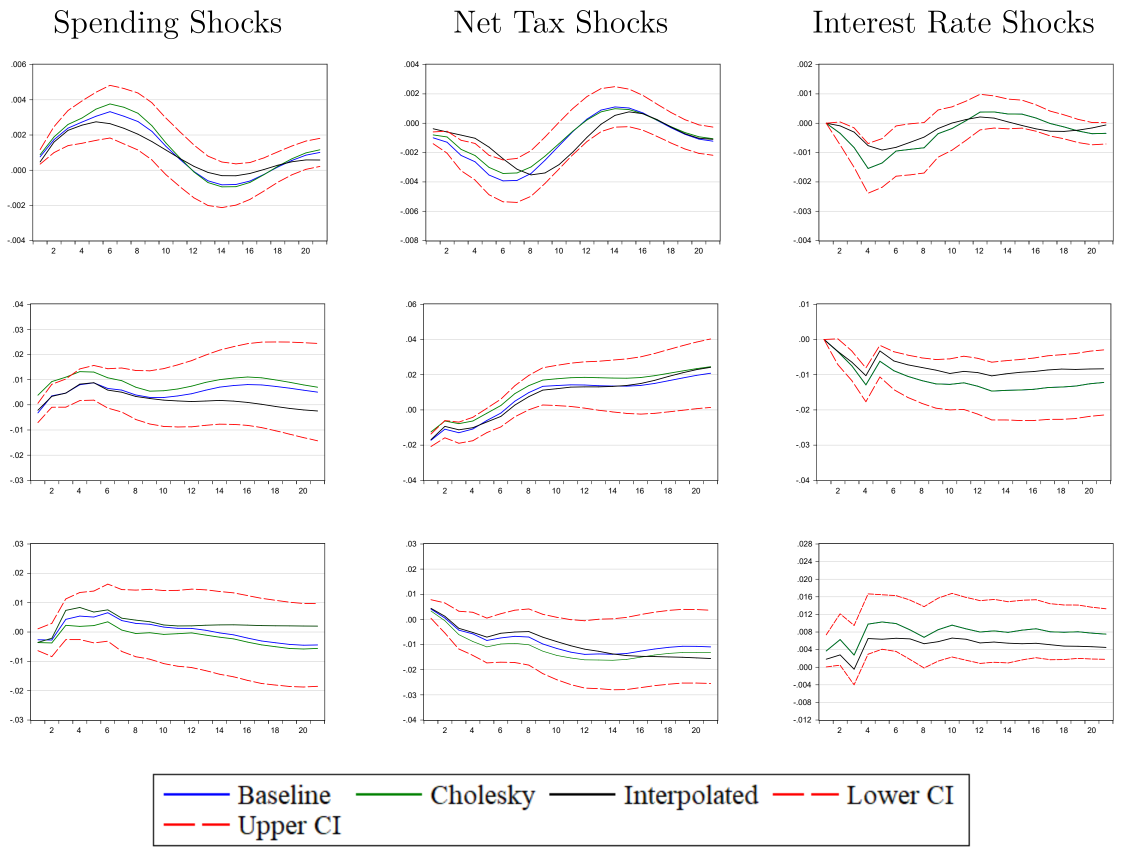


Figure 1.14: Impulse responses based on Cholesky Decomposition and Interpolated series. The responses of real output, inflation and exchange rates to shocks in government spending, net taxes and interest rates are presented in the first, second and third rows, respectively. Baseline represents responses from the baseline model, Cholesky indicates the responses when Cholesky decomposition is used to identify structural shocks; Interpolated represents impulse responses when alternative Real GDP series is used; Lower and Upper CI means lower and upper confidence interval, respectively.

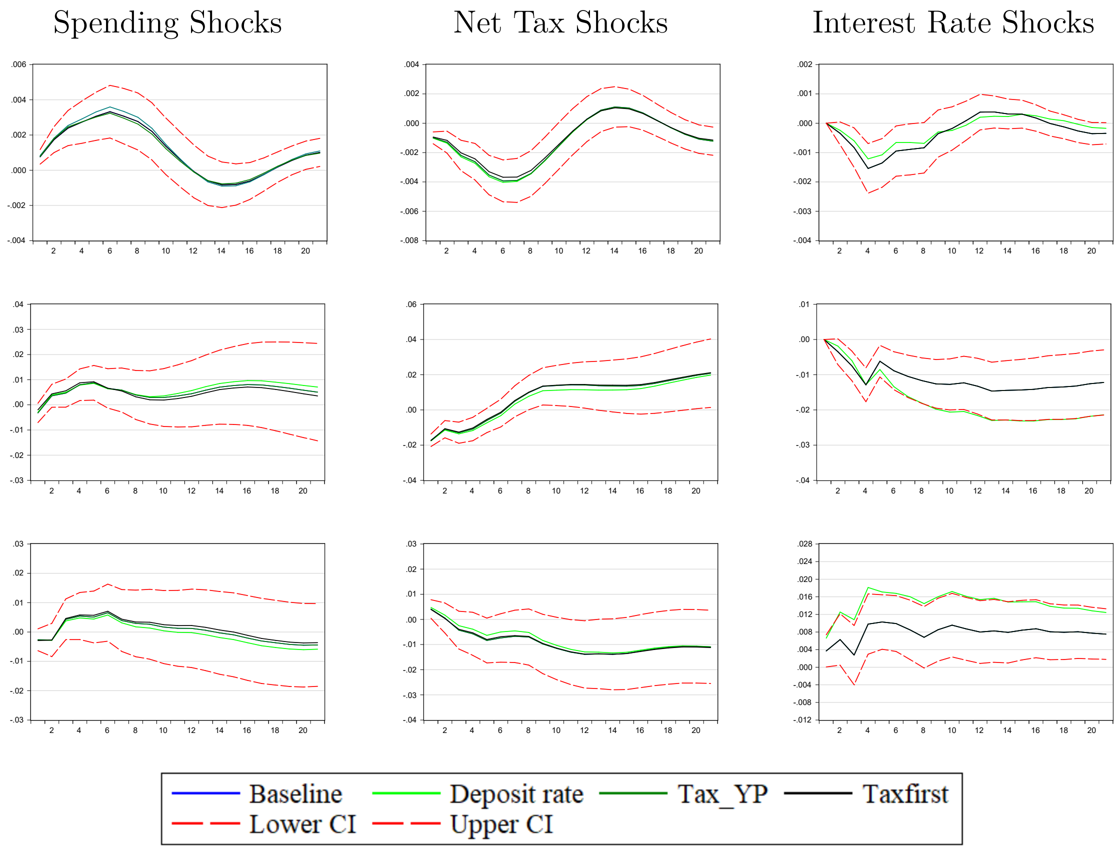


Figure 1.15: Impulse responses based on alternative ordering and alternative short-term interest rates. The responses of real output, inflation and exchange rates to shocks in government spending, net taxes and interest rates are shown in the first, second and third rows. Baseline represents responses from the baseline model; Deposit rates shows responses when the baseline short term interest rates is substituted with deposit rates; Tax_YP represents responses when inflation and output are ordered before net taxes; Taxfirst indicates when net tax shocks comes first ($\beta_{tg} = 0$) and Lower and Upper CI means lower and upper confidence interval, respectively.

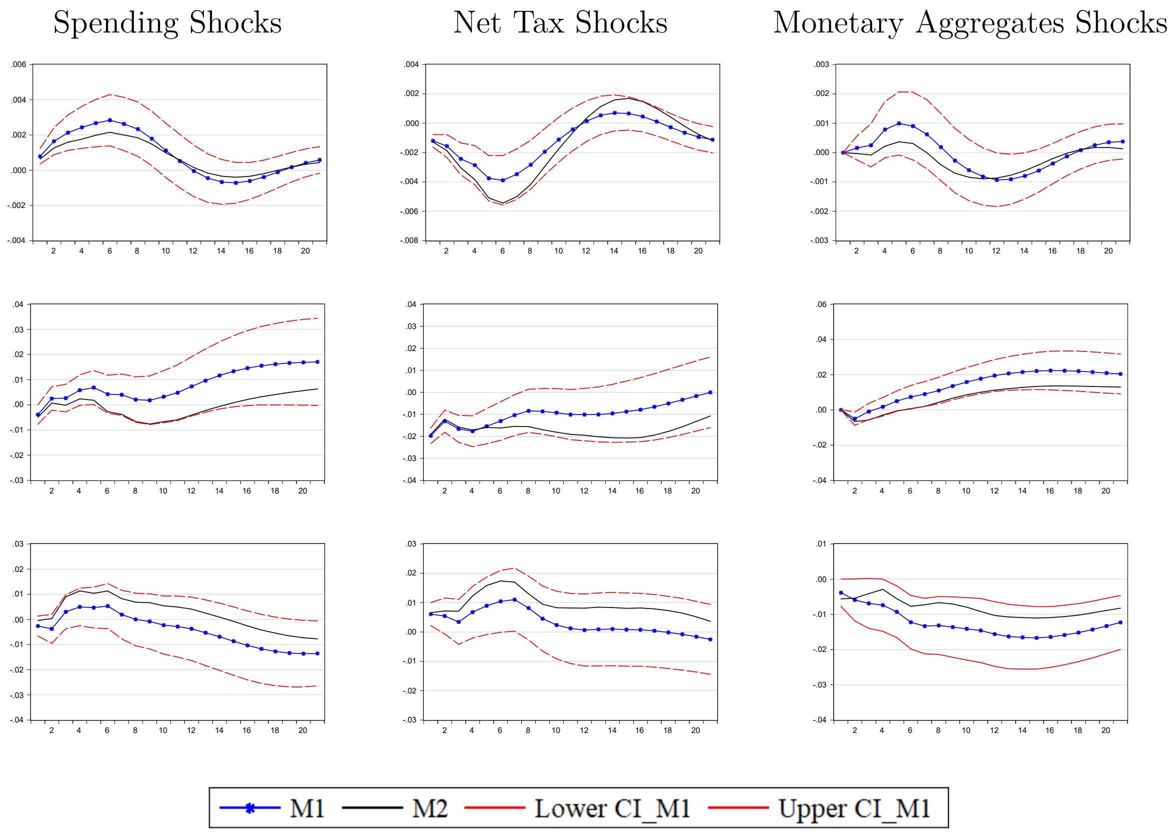


Figure 1.16: Impulse responses based on alternative monetary policy indicators (M1 and M2). Each impulse shows the responses of real output, inflation and exchange rates to shocks in M1 and M2. Lower and Upper CI_M1 means lower and upper confidence interval from M1 shocks, respectively.

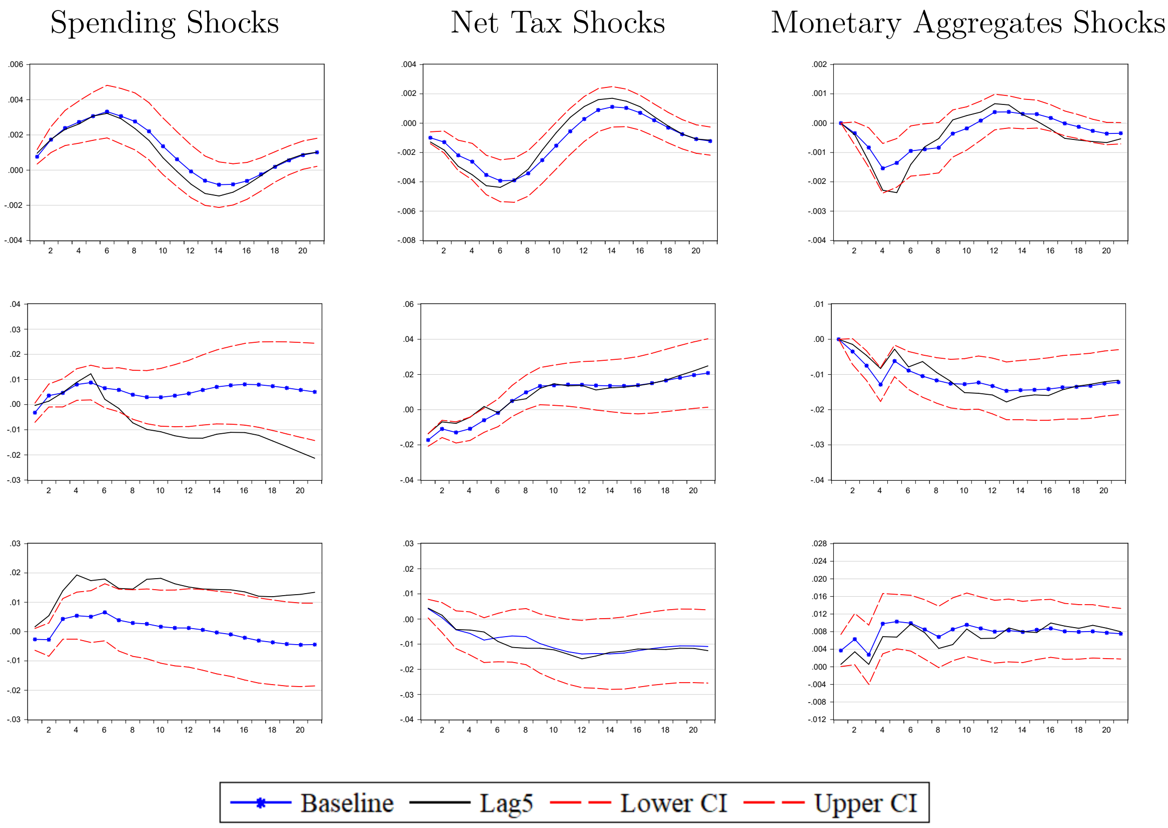


Figure 1.17: Impulse responses with five lags. The responses of real output, inflation and exchange rates to shocks in government spending, net taxes and interest rates are shown in the first, second and third rows. Baseline represents responses from the baseline model; Lag5 is responses when the model is estimated with five lags; and Lower and Upper CI means lower and upper confidence interval, respectively.

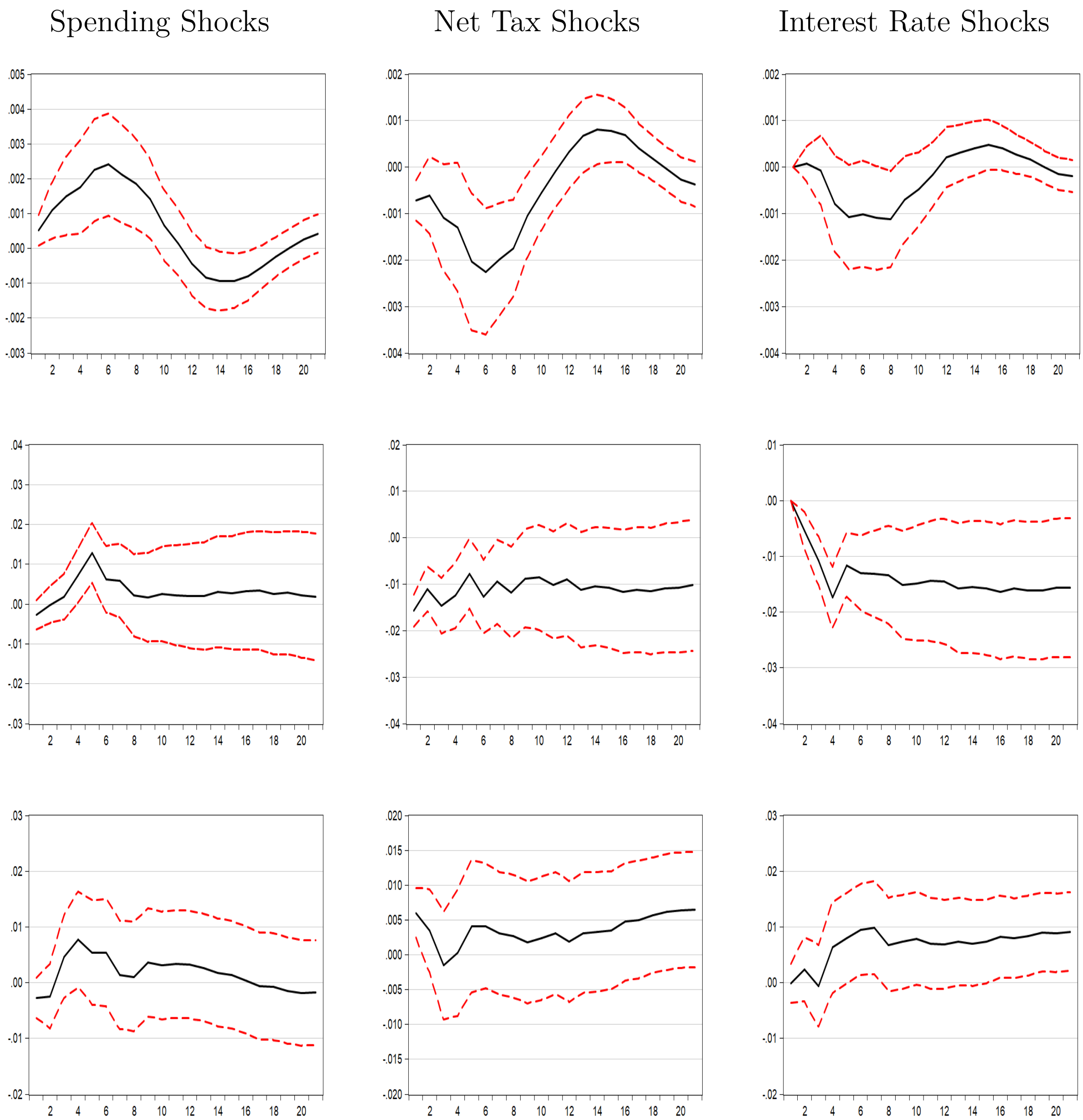


Figure 1.18: Impulse responses to a fiscal and monetary policy shocks based on SVAR with first difference of non-stationary variables. The rows show the responses of real output, inflation and exchange rates to shocks in government spending, net taxes and interest rates, presented in first, second and third columns , respectively.

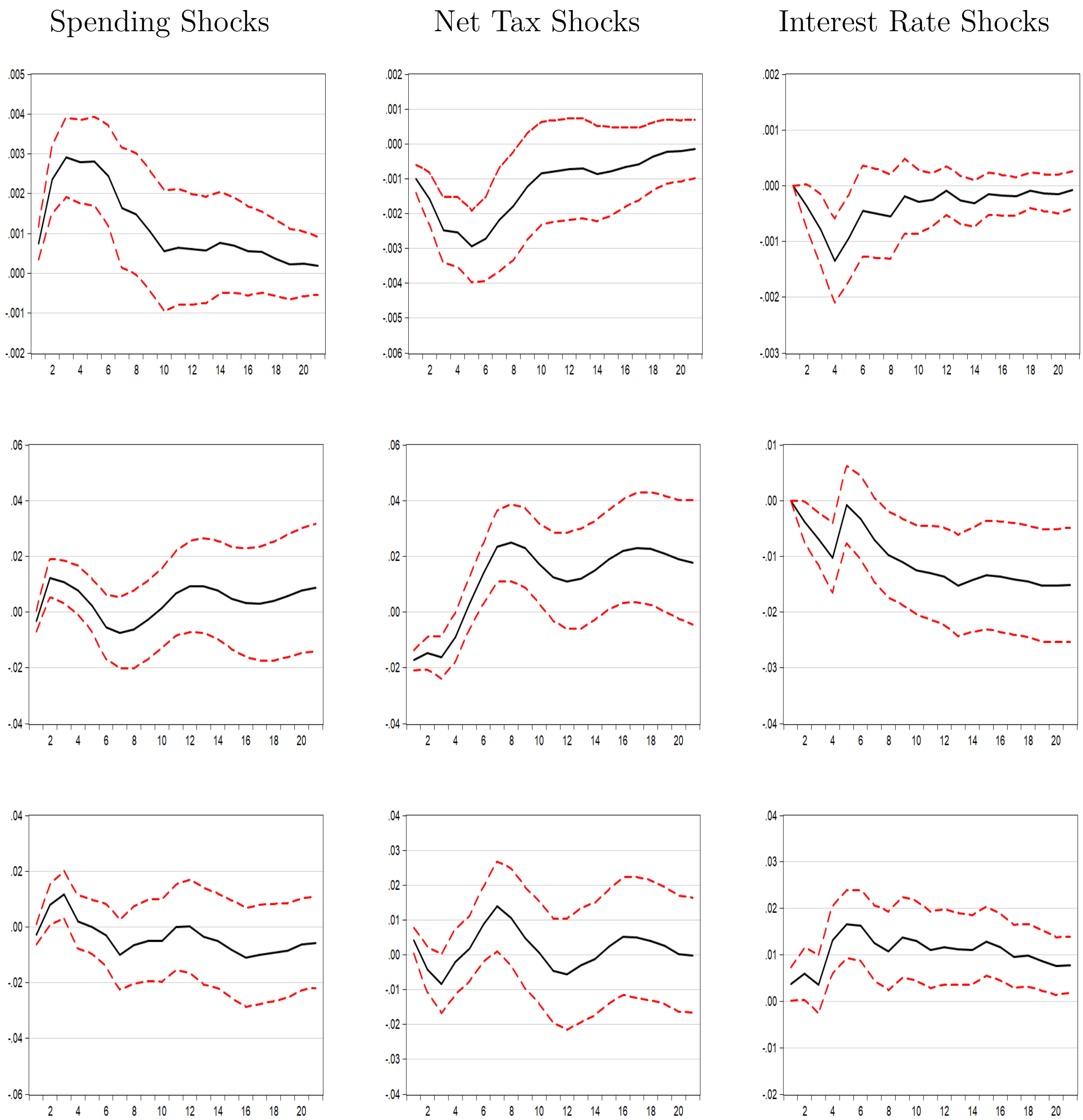


Figure 1.19: Impulse responses to a fiscal and monetary policy shocks based on SVAR model co-integrating relationships. The rows show the responses of real output, inflation and exchange rates to shocks in government spending, net taxes and interest rates, presented in first, second and third columns , respectively.

2 Does it matter where monetary expansion originates for international spillovers?

Abstract

This paper explores the international spillovers of the U.S, the Euro Area (EA hereafter), Chinese and Japanese monetary policy shocks on a number of macroeconomic variables in 17 Emerging Market Economies (EMEs). After expansionary monetary policy in these four big economies, industrial production increases in typical emerging markets. These results are robust to most countries considered in the analysis over the sample period. The short-term interest rates also fall in the typical emerging markets regardless of where the shock is originated. However, the response of the real trade-weighted exchange rates in the typical emerging market economies is strong and short-lived after monetary expansion in the Euro Area, but persistent after monetary expansion from the U.S, Japan, and China. Moreover, the size of the responses of the industrial production in emerging Europe and Asia respond more to the monetary innovations in the Euro Area and China, respectively. There is also a substantial cross country heterogeneity in the responses of the macroeconomic aggregates in the emerging markets, where the size of the spillovers vary with the country-specific characteristics. Countries with higher trade openness and higher financial integration display stronger spillover in production as compared to other counterparts after the U.S. and the Japanese M3 innovations. Moreover, the degree of debt burden matters for the transmission of the U.S, the Euro Area and Japan monetary policy shocks and does not seem to matter for monetary expansions in China.

2.1 Introduction

There is strong evidence that the world economy becomes more integrated globally, witnessed by the co-movement of most macroeconomic variables such as inflation, output, employment, interest rates, exchange rates, and trade balance following different international shocks. For example, large productivity gains due to technological advances during the 1990s have boosted global demand and affected different macroeconomic variables around the globe (Eickmeier, 2007). These positive gain to the world economy lasted up until the outbreak of the Global Financial Crisis (GFC) in 2008, which resulted into the slow down of the global economy including the U.S. In particular, a collapse of residential investments followed by the collapse of housing prices in the U.S. has resulted in a sharp decrease in housing prices and economic activities in Ireland, Japan, and the U.K., which have raised the issues concerning the transmission of international shocks across different countries (Kazi et al., 2013).

Different measures such as unconventional monetary policy measures in the form of Quantitative Easing have been taken to boost economic activity in the U.S., the Euro Area, and Japan. The immediate outcome of such unconventional measures is to increase different indicators of monetary aggregates (see Figure 2.1). The growth rate of monetary aggregates (nominal M3 here) have been strong during and aftermath of the global financial crisis, particularly in EA, and Japan. In general, there have been unprecedented expansionary monetary aggregates in Japan, China, and the Euro Area than in the U.S, which might indicate the importance of these economies to the world economy, at least through their effects on the global commodity prices. Despite growing empirical evidence on the issue, there are heated debates among empirical researchers and policymakers on how to retain their economy from the international monetary policy shocks. This lack of consensus might be attributed to the fact that most studies considered a limited number of countries and/or variables (Dedola et al., 2017).

The main contributions of this study to fast-growing literature on the global effects of monetary policy shocks in structural VAR are twofold. First, existing evidence shows that expansionary monetary policy had a strong and significant impact on the receiving country's macroeconomic outcome (Vespignani and Ratti, 2016; Potjagailo, 2017). However, several papers investigate the global output spillovers from U.S monetary policy to advanced economies (Mumtaz and Surico, 2009; Kazi et al., 2013; Ahmed and Zlate, 2014; Bowman et al., 2015; Rey, 2016; Tillmann, 2016; Georgiadis, 2016; Anaya et al., 2017), whereas international monetary transmission to emerging market economies is scarce (Anaya et al., 2017). The effect of international spillover to advanced countries may differ from EMEs, which indeed depends on the country-specific characteristics of the recipient economies. For instance, maintaining exchange rates stability could be more important for EMEs whose growth strategy is highly related to the export of primary commodities than advanced economies (Aizenman et al., 2016). Many previous works have focused on the transmission of single international monetary policy shocks (Bowman et al., 2015; Rey, 2016; Tillmann, 2016; Georgiadis, 2016; Potjagailo, 2017; Anaya et al., 2017). However, this study goes beyond this by analyzing the international transmission of monetary policy shocks from the U.S., the Euro Area, China, and Japan. Only a handful of empirical studies have attempted to explore this issue (Aizenman et al., 2016; Vespignani, 2015; Vespignani and Ratti, 2016, and Han and Wei, 2018). Aizenman et al. (2016) examine the global effects of the U.S., the Euro Area, Japan, and China's unconventional monetary policy to EME using the two-step regression model. While Vespignani (2015) explores the effect of international expansionary monetary policy shocks from China, the Euro Area and the U.S. to the Japanese Economy, Georgiadis (2016) examines the transmission of these international shocks to Euro Area. This paper complements their work by analyzing the international spillover to the EMEs. It, however, differs from the above studies in a number of aspects, including the specifications of the empirical model, the identification approaches, frequency of data and the country considered in the empirical estimation.

Second, this paper is related to the literature analyzing the role of specific country characteristics – such as the exchange rate regime, degree of trade openness, degree of financial integration, debt burden and so on - for spillovers (see Miniane and Rogers, 2007; Georgiadis, 2016; Dedola et al., 2017; Anaya et al., 2017). Some earlier empirical evidence suggests that international monetary policy shocks have substantial global spillovers to advanced economies and emerging market economies and the strength of the transmission depends on a host of country characteristics (see Ehrmann, 2000; Georgiadis, 2014, 2016; Rey, 2016; Potjagailo, 2017). There are, however, little empirical evidence on why some EMEs experience larger spillovers than others to the changes in international expansionary monetary policy shocks. In this paper, attempts are made to explore the country characteristics that give rise to cross-country variations in the magnitude of the spillovers from the U.S, the Euro Area, China, and Japan. The results in this paper make an important contribution to these two strands of the literature on the role of international monetary policy shocks to 17 EMEs.

The key results of the paper are as follows. After expansionary monetary policy in these four big economies, industrial production increase in typical emerging markets. These results are robust to most countries considered in the analysis over the sample period. The short-term interest rates also fall in the typical emerging market economies regardless of where the shock is originated. However, the response of the real trade-weighted exchange rates in the typical emerging market economies is strong and short-lived after monetary expansion in the Euro Area, but persistent after monetary expansion from the U.S, Japan, and China. Moreover, the size of the responses of the industrial production in emerging Europe and Asia respond more to the monetary innovations in the Euro Area and China, respectively. There is also a substantial cross country heterogeneity in the responses of the macroeconomic aggregates in the emerging markets, where the size of the spillovers vary with the country-specific characteristics. Countries with higher trade openness and higher financial integration display stronger spillover in production as compared to other counterparts after the U.S. and Japanese M_3. Moreover, the degree of debt burden matters for the transmission of the U.S, the Euro Area and Japan monetary policy shocks and does not seem to matter for monetary expansions in China.

The key research questions to be explored in this paper are: does a monetary expansion in EA, Japan, China or the U.S have the same consequences in improving or in worsening production in the EMEs? Why some EMEs experience larger spillovers than others to changes in international monetary policy shocks? This paper contributes to the literature by exploring these research questions to the 17 EME's macroeconomic outcomes. The remainder of the paper is organized as follows. Section two discusses data and the model used in the paper along with the specification and identification of shocks. The third section presents the empirical results. Forth section presents the main sensitivity analysis. The fifth section is devoted to conclusions.

2.2 Data and Model

2.2.1 Data

The data are monthly on international and domestic macroeconomic aggregates from January 1999 to December 2018. The starting date for the sample is exclusively determined by the creation of the European Central Bank (ECB) and the availability of the monthly frequency for countries considered in the analysis. Data for both international and domestic variables are obtained from various sources depending on availability.

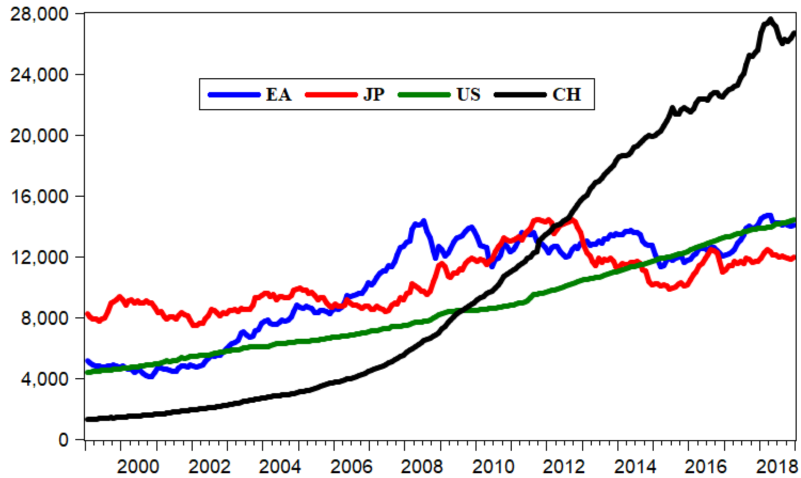


Figure 2.1: M3 for the U.S.(US), the Euro Area (EA), Japan (JP) and China (CH) in billions of USD

The major sources are Federal Reserve Bank of St. Louis database (FRED), Thomson Reuters DataStream, the IMF's International Financial Statistics (IFS) database, Organization for Economic Cooperation and Development (OECD): Main Economic Indicators (MEI) and Bank for International Settlements (BIS) database. All variables except the interest rates, are seasonally adjusted and transformed into natural logarithms. Different considerations are taken into account while selecting emerging market countries. First, countries that have limited information in terms of the number of variables and time series are excluded. Second, countries that don't have monthly data on economic and related variables for all domestic economies are not included. However, the dataset covers a broad range of EMEs and closely resembles the number of EME economies considered in the literature elsewhere (see, for instance, Bowman et al., 2015; Aizenman et al., 2016). Eventually, the sample contains the following 18 EME countries: Argentina (AR), Brazil (BZ), Chile (CL), Colombia (CO), Hungary (HU), India (IN), Indonesia (ID), Korea (KO), Mexico (MX), Malaysia (MY), Czech Republic (CZ), the Philippines (PH), Poland (PO), Russia (RU), South Africa (SF), Singapore (SG), Taiwan (TW), and Turkey(TK), and 4 large international economies, namely the United States (U.S), the Euro Area (EA), China (CH) and Japan (JP), which accounts for more than 60 percent of world economy, in terms of GDP in U.S dollars from World Bank.

In order to study the impacts of international monetary expansions, the structural VAR model is estimated using a large number of country-specific domestic and international variables and then the impulse response functions are computed. For each domestic economy, the following variables are considered: (i) the industrial production; (ii) the nominal and real effective exchange rates; (iii) the short-term interest rates; (iv) CPI; (v) commodity price index; and (vi) broader monetary aggregates. The commodity price index for each EMEs is included in order to isolate exogenous international monetary policy shocks and thereby to control for the inflationary pressure or supply shocks.[1] The detail sources of each EMEs series along with data transformations are presented in Table 2.11 in the appendix.

2.2.2 Unit Root and Co-integration

Estimation of the standard Structural VAR model is based on the assumption that there are no co-integrating relationships among the non-stationary variables. However, the analysis may changes when there exist co-integrating relationships among the model's variables, which may suggest estimation of the VAR/VEC model. Before estimating the empirical model of the paper, the behavior of the model's variables is tested for stationarity using the Augmented Dickey-Fuller (ADF) test (Table 2.8 through 2.10 in appendix). Phillips-Perron (PP) test is also used to check the robustness of the ADF test results. As can be seen from Table 2.8 through 2.10, all variables are the first difference stationary, which is robust to all countries. Following Vespignani and Ratti (2016) and in line with the quantity theory of money, co-integration relationships are tested among each emerging market economy's prices (CPI), money (M3) and output (industrial production) using the Johansen co-integration test.[2] The test results are

[1]Literature has shown that domestic economies monetary policy strongly follows the international monetary policy. For example, Grilli and Roubini (1995) find that positive U.S. short-term interest rate innovations lead to a significant and substantial increase in the non-U.S. short-term interest rates. However, Kim (2001) documented that such an endogenous reaction of domestic economies monetary policy to international monetary policy is due to the fact that past studies did not carefully isolate exogenous international monetary policy shocks. Since international monetary policy may reflect inflationary or supply shocks that may also affect other domestic economies, we need an approach to isolate exogenous international monetary policy shocks. She concludes that, after controlling for these shocks by including a commodity price index, the endogenous reaction of domestic monetary policy to international monetary policy is not substantial.

[2]See also Bachmeier and Swanson (2005) and Garratt et al. (2009) for similar applications.

Table 2.1: Co-integration Test:number of co-integrating relations*

Variables: log(IP_t), log(M_{3t}), log(CPI_t)					
Country	Trace	Max-eg	Country	Trace	Max-eg
CZ	1	1	MX	0	0
HU	1	1	ID	1	1
PO	1	1	IN	1	1
RU	1	1	KO	1	1
TK	1	1	MY	0	0
AR	2	1	PH	0	0
BZ	0	0	TW	1	1
CL	1	1	SF	0	0
CO	1	1			

Notes: *Critical values based on MacKinnon et al. (1999); Trace test statistics (Trace) and Maximum Eigenvalue test statistics (Max-eg).

presented in Table 2.1.

The co-integration test results based on the Trace and Maximum Eigenvalue test consistently show that there is a co-integration vector among prices (CPI), money (M3) and output (industrial production) for most EMEs except Brazil, Mexico, Malaysia, Philippines, and South Africa. The number of co-integrating relationships are also robust to both tests except for Argentina where both Trace and Maximum Eigenvalue tests suggest a different number of co-integrating relationships.[3] Accordingly, an error correction term among prices (CPI), money (M3) and output (industrial production) are estimated for each of the 18 emerging market economies and the SVEC model is preferred, allowing for both short and long-term properties of the data to be captured.

2.2.3 Empirical Specification and Identification of shocks

In order to explore whether a monetary expansion in the Euro Area, Japan, China, and the U.S have a different impact on the macroeconomic aggregates of the EMEs, the SVEC model is constructed for each EMEs using both international and domestic macroeconomic aggregates. The variables included in the EMEs SVEC model are four international monetary variables such as the U.S. M3 ($USM3_t$), the Euro Area M3 ($EAM3_t$), Japanese M3 ($JPM3_t$), and Chinese M3 (CHM_{3t}).[4] The monetary variables are expressed in U.S. dollars. On the other hand, other

[3]To check the sensitivity of the model's result, the alternative error correction term is estimated for Argentina. These exercises show that the main results are robust quantitatively and qualitatively.

[4]These economies account for more than 60 percent of the world economy in terms of GDP in U.S dollars.

domestic variables in each countries SVAR model[5] are broad monetary aggregate M3 (M_{3t}), industrial production (IP_t), consumer price index (CPI_t), the global commodity price index in U.S. dollars (CP_t), the short term interest rates (IR_t), and the real effective trade-weighted exchange rates (ER_t). For estimation, the model is represented by SVEC models for each country as follows:

$$Y_t = AY_{t-s} + \gamma X_{t-1} + \lambda G_{t-s} + Bu_t,\ u_t \sim WN(0_{nx1}, I_n), t = 1, ..., N \tag{2.1}$$

where N is the sample size, the Y_t is the $nx1$ vector of endogenous variables and X_t it is the error correction terms of each emerging market economies. B is an nxn non-singular matrix containing structural parameters, and u_t is an $nx1$ dimensional vector of structural innovations. In order to isolate country-specific effects from the monetary aggregates (such as demand for money in the U.S., the Euro Area, China, and Japan), the $nx1$ vector G_t of global variables affecting every country are included. A, γ and λ are the coefficients matrices, with suitable dimensions. s is the optimal lag length, determined by the Schwartz Information Criterion (SIC), one lag in this case. The optimal lag-length in each SVEC model is selected to ensure no autocorrelation in the residuals and stability of the VAR model.[6]

The vector Y_t can be expressed as :

$$\begin{aligned} Y_t = [&logUSM_{3t},\ logEAM_{3t},\ logJPM_{3t},\ logCHM_{3t}, \\ &logIP_t,\ logCPI_t,\ logCP_t,\ I_t,\ logM_{3t},\ logER_t \end{aligned} \tag{2.2}$$

The error correction term X_t is given by :

$$X_t = log(CPI_t) - \alpha - \phi log(IP_t) - \theta log(M_{3t}) \tag{2.3}$$

The vector of country-specific exogenous variables can be given by:

[5]The number of endogenous and foreign variables are the same and homogeneous across all countries.

[6]The baseline model is estimated with one lag in each country-specific SVEC model based on Schwarz Information Criterion (SIC). As a robustness exercise, the model is also re-estimated with two lags based on Akaike information criteria (AIC). See also Vespignani (2015) and Vespignani and Ratti (2016) for similar applications.

$$G_t = [USI_t, EAI_t, JP_t, CHI_t, logUSCPI_t, logEACPI_t,$$
$$logJPCPI_t, logCHCPI_t, logUSIP_t, logEAIP_t, logJPIP_t, logCHIP_t] \quad (2.4)$$

The interest rates, CPI and the industrial production of the U.S., of the Euro Area, Japan, and China are used as a country-specific exogenous variables.[7] Since the above EMEs SVEC model resembles VAR specifications from the literature on identifying monetary policy shocks, restrictions in the model in equation 2.1 through 2.4 are based on, among others, Christiano et al. (1999); Dedola and Lippi (2005); Vespignani (2015) and Anaya et al., 2017 to the extent possible given presence of international monetary aggregates.

In the model, the international monetary aggregates are assumed to be contemporaneously exogenous, but affect the EMEs variables after one month (see Kim, 2001; Vespignani, 2015; Vespignani and Ratti, 2016 for similar applications).[8] The international monetary aggregates are followed by macroeconomic variables in each EMEs. The vector of domestic variables for EMEs is industrial production, consumer price index, commodity price index, short-term interest rates, monetary aggregates (M3) and the trade-weight real effective exchange rates. The model is constructed separately for each country and assumes that each EMEs are small enough not to affect world variables. This assumption implies that domestic shocks do not affect the external variables in Y_t. Identifications of domestic variables in the model are carried out according to the standard restrictions in the economic literature (See, for instance, Christiano et al. (1999); Dedola and Lippi (2005); Vespignani (2015) for more detail). Industrial production is contemporaneously exogenous with respect to the domestic variables. Moreover, industrial production, consumer price index, and commodity price index enter the monetary authorities' reaction function simultaneously (but respond to it with a lag). The VAR specification for the EMEs also includes the exchange rates, based on the assumption that this variable is more relevant in EMEs and plays an important role in the transmission mechanism of shocks. The exchange rates enter the last equation after the short-term interest rates, thus assuming that

[7] In order to deal with the dimenstionality problem of the SVAR model and to make the comparison of the impact of the four international shocks meaningful, two separate SVAR models for each emerging market economies are estimated based the proximity and connection of the of the international shocks. Specifically, the first sub-model includes U.S and Euro Area international shocks while the second sub-model includes international monetary policy shocks from China and Japan. Doing so will enable to compare the impact of the international monetary policy shocks from at least U.S and Euro Area, as well as from China and Japan, and partially solves the problem of dimestionality.

[8] Alternatively, the international variables are allowed to affect the domestic variables simultaneously. The results based on these exercises also confirm the baseline results. See section section §2.4 for detail.

monetary policy does not respond contemporaneously to it (Sims and Zha, 1995; Dedola and Lippi, 2005).

2.3 Empirical Results

2.3.1 The Impact of the international shocks on domestic variables

Table 2.2 and 2.3 summarizes the median responses of variables in the emerging markets economies[9] to one-standard deviations of international monetary policy shocks.[10] The last four columns of Table 2.3 show the responses of the emerging markets economy's macroeconomic variables to the innovations in monetary aggregates in the U.S, the Euro Area, Japan, and China, respectively.

Let us see how variables in typical emerging markets respond to international monetary policy shocks. The industrial production (IP) in the typical emerging markets responds positively to an unanticipated monetary policy expansion in the U.S, the Euro Area, Japan, and China. Note that these impulse responses are very similar to many results in the literature (see for example Maćkowiak, 2007; Allegret et al., 2012; Vespignani, 2015). That is, emerging markets output respond slowly to international monetary policy shocks. In the third block of Table 2.3, the dynamic responses of emerging markets short term interest rates (I) are presented. The results show that positive innovations in the U.S. M3, the Euro Area M3, Japanese M3, and Chinese M3 have a negative, on average, impact on the short term interest rates in typical emerging market economies. This is consistent with both empirical evidence (see, for example, Kim, 2001; Canova, 2005; Anaya et al., 2017) and theoretical prediction of Svensson and Wijnbergen (1989) and Obstfeld and Rogoff (1995) inter-temporal models, who show that monetary expansions within large economies decreases interest rates and enhances aggregate output.

Positive monetary policy shocks to the Euro Area and Chinese M3 have a positive effect on the typical emerging market's consumer price index (CPI). These results are consistent with the result present in Figure 2.1, which shows unprecedented expansionary monetary policy in the Euro Area and China. In contrast, the consumer price index in emerging markets tends to decline with positive innovations in the U.S. M3 and Japanese M3, as the negative and strong effects of the U.S.M3 and Japanese M3 on emerging Latin American CPI dominates the average effects. Vespignani (2015) also obtained a similar result to Japan.

[9] The average median impulse response is calculated as the mean of the median impulse response functions across all EME countries except Singapore. Singapore is excluded from the calculation of the median response because the estimated reactions of the Singapore's variables are strong and statistically significant only to innovations in U.S monetary aggregates, but statistically insignificant to other monetary expansions, which might bias the average median responses of the EMEs.

[10] Confidence bands were omitted from the tables for the sake of clarity.

Table 2.2: The impulse responses to an international monetary policy shocks

Var.	Horizons (Months)	Emerging Europe				Emerging Latin -America			
		US	EA	JP	CH	US	EA	JP	CH
IP	1-12	0.09	0.08	-0.04	0.02	-0.02	0.06	0.12	0.02
	13-24	0.18	0.13	-0.05	0.02	0.01	0.20	0.38	0.01
	25-36	0.24	0.18	-0.06	0.002	0.08	0.26	0.68	0.02
CPI	1-12	-0.01	0.11	0.004	-0.01	-0.01	0.02	-0.04	0.005
	13-24	0.04	0.07	-0.05	-0.02	-0.03	0.07	-0.18	0.03
	25-36	0.10	-0.01	-0.07	-0.02	-0.07	0.15	-0.37	0.05
I	1-12	0.003	0.07	-0.01	-0.01	-0.02	-0.24	-0.23	-0.02
	13-24	0.01	-0.04	0.01	-0.02	-0.08	-0.23	-0.40	-0.02
	25-36	0.003	-0.03	0.05	-0.02	-0.12	-0.18	-0.68	-0.04
M3	1-12	0.19	0.51	0.31	-0.04	0.001	0.30	0.56	-0.07
	13-24	0.35	1.19	0.90	-0.08	0.06	0.96	1.33	-0.12
	25-36	0.56	1.35	1.28	-0.06	0.20	1.43	2.00	-0.07
ER	1-12	-0.10	-0.20	-0.04	-0.11	-0.10	-0.50	0.20	-0.26
	13-24	-0.18	0.33	0.35	-0.10	-0.20	-0.28	0.57	-0.34
	25-36	-0.16	0.38	0.51	-0.07	-0.24	-0.18	0.65	-0.35

Notes: "1–12" stands for the average median response between the first month after a shock and 12 months after a shock. "13–24" stands for the average median response between 13 months after a shock and 24 months after a shock. "25–36" stands for the average median response between 25 months after a shock and 36 months after a shock. Each row in the column, "for example Emerging Europe', is the average median responses of macroeconomic variables in emerging Europe to the 4 international monetary policy shocks (i.e the U.S., the Euro Area, China and Japan). Emerging Europe includes Czech Republic, Hungary, Poland, Russia, Turkey and Emerging Latin-America are Argentina, Brazil, Chile, Colombia, Mexico.

The fourth block of Table 2.3 shows the response of the emerging market M3 to the four international monetary policy shocks. Consistent with the Figure 2.1, positive innovations in the Euro Area and Japan have had strong expansionary effects to the emerging market M3 than positive innovations in the U.S. The responses of the real trade-weighted effective exchange rates in emerging market economies are presented in the last block of Table 2.3. The responses show that while the response of the emerging market real exchange rates to the Euro Area M3 is strong and short-lived, the effect of monetary expansion in the U.S., Japan and China have had persistent effects.

Table 2.3: The impulse responses to an international monetary policy shocks

Var.	Horizons (Months)	Emerging Asia-Africa				Emerging Market-Economies[11]			
		US	EA	JP	CH	US	EA	JP	CH
IP	1-12	0.07	-0.08	0.05	0.10	0.04	0.02	0.04	0.05
	13-24	0.13	-0.04	-0.08	0.18	0.11	0.09	0.09	0.07
	25-36	0.15	-0.01	-0.10	0.20	0.15	0.14	0.17	0.07
CPI	1-12	-0.02	-0.01	0.02	0.02	-0.01	0.04	-0.01	0.004
	13-24	-0.03	-0.02	0.02	0.02	-0.01	0.04	-0.07	0.01
	25-36	-0.03	-0.01	-0.01	0.03	0.001	0.04	-0.15	0.02
I	1-12	-0.02	-0.03	0.02	-0.03	-0.01	-0.06	-0.07	-0.01
	13-24	-0.02	-0.04	0.003	-0.02	-0.03	-0.09	-0.13	-0.02
	25-36	-0.02	-0.04	-0.01	-0.02	-0.05	-0.08	-0.20	-0.02
M3	1-12	0.06	0.35	0.08	0.08	0.08	0.38	0.32	-0.01
	13-24	0.17	0.78	0.23	0.14	0.19	0.98	0.82	-0.02
	25-36	0.41	0.95	0.32	0.13	0.39	1.24	1.20	0.003
ER	1-12	-0.10	-0.32	-0.16	-0.12	-0.10	-0.34	0.001	-0.16
	13-24	-0.25	-0.03	0.16	-0.06	-0.21	0.01	0.36	-0.17
	25-36	-0.24	0.03	0.25	-0.05	-0.22	0.08	0.47	-0.16

Notes: "1–12" stands for the average median response between the first month after a shock and 12 months after a shock. "13–24" stands for the average median response between 13 months after a shock and 24 months after a shock. "25–36" stands for the average median response between 25 months after a shock and 36 months after a shock. Each row in the column, "for example Asia-Africa', is the average median responses of macroeconomic variables in emerging Asia to the four international monetary policy shocks (i.e the U.S., the Euro Area, China and Japan). Emerging Asia-Africa includes Indonesia, India, Korea, Malaysia, Philippines and South Africa whereas Emerging Market Economies are countries in Emerging Europe, Latin-America and Asia-Africa.

In sum, while short-term interest rates and monetary aggregates in typical emerging market economies respond more strongly to the Euro Area and Japanese monetary expansion than innovations in the U.S. M3 and in China M3, emerging markets industrial production response more strongly to the U.S. and Japanese monetary policy expansions.

Consider the impact of the international shocks to the domestic variables in emerging Europe, Latin America, and Asia, as summarized in Table 2.2 and 2.3 shows that the macroeconomic aggregates in emerging Europe respond more strongly to the Euro Area monetary expansion than other international monetary policy shocks in most cases. These results are robust to all variables and most horizons and are even more strong for the response of CPI, short-term interest rates, M3, and trade-weighted real effective exchange rates. Such evolution might be due to the geographic proximity of emerging Europe to the Euro Area and thereby the fact

[11] An emerging market economy is the economy of a developing nation that is becoming more engaged with global markets as it grows. Countries classified as emerging market economies are those with some, but not all, of the characteristics of a developed market. Classification of countries under EMEs are based on the existing studies in the area, see for example (Aizenman et al., 2016; Anaya et al., 2017; Georgiadis, 2014)

that emerging Europe is more closely tied to developments in the Euro Area. On the other hand, while the industrial production and CPI in emerging Asia respond more strongly to the monetary expansion in China in most cases, interest rates and M3 respond more to the Euro Area M3. Finally, emerging Latin-American Economies are more affected mainly by innovations in the Euro Area and Japanese M3 than innovations in the U.S. M3 and China M3. In particular, the industrial production, interest rates, CPI, and real trade-weighted exchange rates in emerging Latin America respond more to the shocks in the Euro Area and Japanese M3. This result contrasts the expectations that geographic proximity matters for the transmission of international shocks. This might be due to the increased trade integration all over the world since the 1990's and decreased share of trade with the U.S. and growing importance of China, Japan and the Euro Area in the world economies.

2.3.2 The importance of the international shocks to the domestic variables.

To further investigate the regional propagation of the four international monetary policy shocks, the dynamic responses are complemented by the analysis of historical decomposition. Impulse response functions are helpful to see how macroeconomic variables respond to and their respective dynamics in the event of particular shocks. Following the approach in Dungey and Pagan (2000); Claus et al. (2006); Buckle et al. (2007) and Vespignani (2015), the structural VAR model in equations 2.1 to 2.4 is used to identify the contribution of the four international monetary policy shocks to the macroeconomic fluctuations of output and CPI in typical emerging market economies over the past 20 years.

$$y_t = y_0 + \sum_{j=0}^{t-1} \sum_{h=1}^{3} \omega_{jh} u_{h(t-j)} \tag{2.5}$$

Where y_t represent variable of interest in each country, y_0 denotes initial conditions in each country, ω_{jh} is the j^{th} impulse response associated with the h^{th} shock for four shocks in each country.

The historical contributions of monetary aggregates of the U.S., the Euro Area, Japan, and China to the macroeconomic fluctuations in output and CPI are depicted in Figure 2.2. The zero lines in each Figure corresponds to the point at which, for instance, the output is at the trend and the point where the respective shocks are making a zero contribution to deviations in output from the trend. A negative (positive) value for each shock implies that the particular shock has contributed towards moving output below (above) trend line, respectively.

Figure 2.2 presents the contributions of the U.S, the Euro Area, Japanese and Chinese monetary aggregates to industrial production and CPI movements in emerging Europe, emerging Latin America, Emerging Asia-Africa and emerging market economies, presented in the first, the

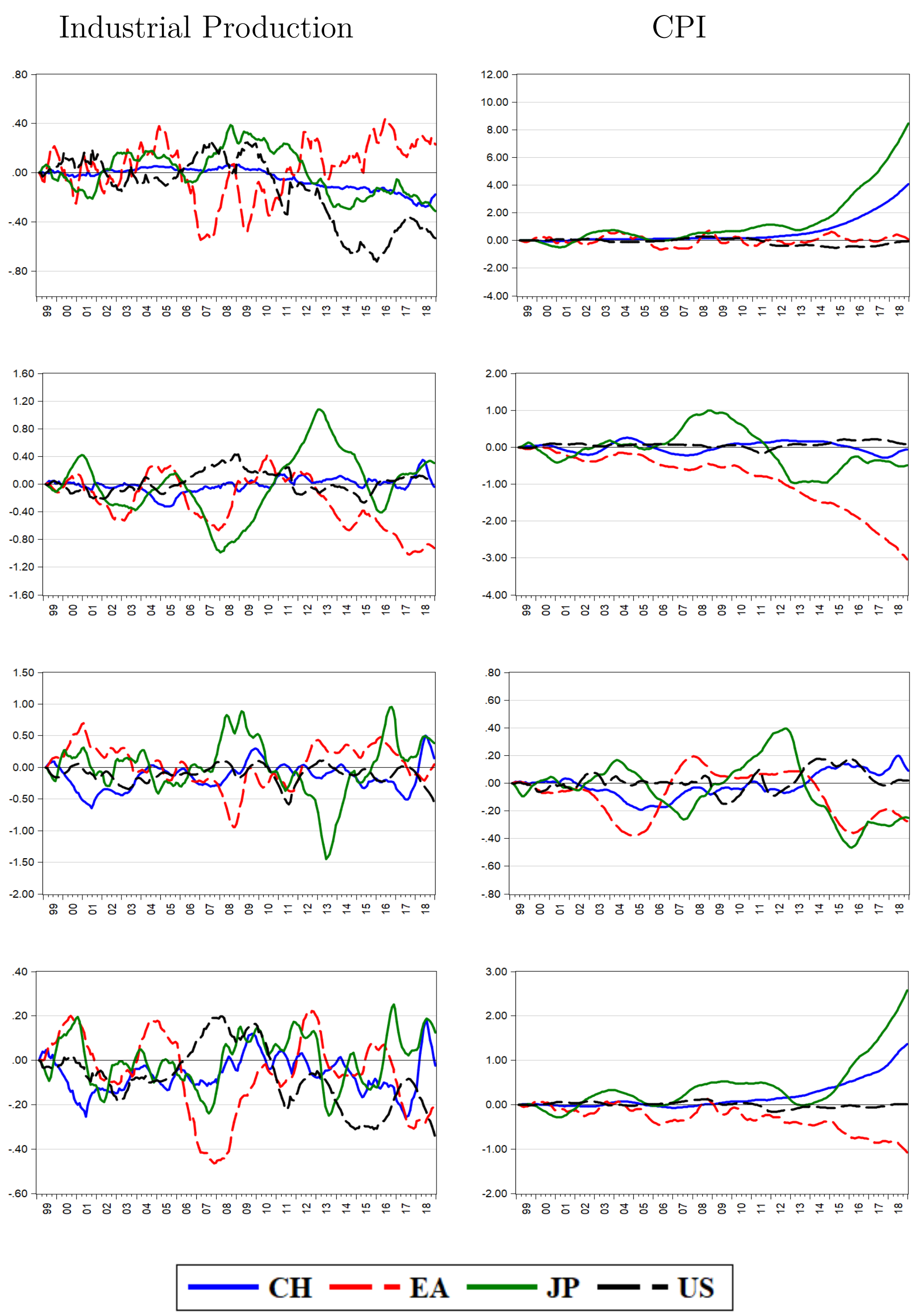


Figure 2.2: The contributions of the U.S, the Euro Area, Japan and China monetary aggregates to the movements in industrial production and CPI in emerging Europe (first row), emerging Latin America (second row), Emerging Asia-Africa (third row) and emerging market economies (last row). The contributions of the U.S M3, the Euro Area M3, China, and Japan M3 are represented by the dotted black, dotted red, solid blue and the solid green lines.

second, the third and the fourth rows, respectively. The contributions of the U.S M3, the

Euro Area M3, Japan M3, and China M3 are represented by the dotted black, dotted red, solid green and solid blue lines, respectively. It shows that the contribution of the U.S. and the Euro Area monetary aggregates in explaining output fluctuations in emerging Europe is much stronger than the contributions of the Chinese and Japanese monetary aggregates. In particular, innovations in the Euro Area monetary aggregates explains much larger proportions of output fluctuations in emerging Europe (the first row) followed by M3 innovations from the U.S. Moreover, the contributions of the U.S monetary aggregates are much smaller than that of the Euro Area and Japanese monetary aggregates in explaining output fluctuations in emerging Latin America (second row) and emerging Asia-Africa (third row). These results confirm the findings presented in section section 2.3.1.

In general, while output fluctuations in typical emerging market economies are much explained by all international monetary policy shocks, especially by innovations from the Euro Area monetary aggregates, the CPI movements are vulnerable to the innovations in the Japanese and the Euro Area monetary aggregates. The strong contributions of the Japanese monetary aggregates to the emerging market CPI is due to its strong contributions to the Latin American CPI movements. Given the policy measures taken by the U.S., the Euro Area, and Japan, their contributions to emerging market output fluctuations are more volatile during and aftermath of the global financial crisis.

2.3.3 Country Characteristics

Before going into the detailed analysis of the responses of the domestic variables in EMEs to the international monetary policy shocks, it is important to explore the cross country heterogeneity in their responses. For this purpose, the median responses of key EME's macroeconomic aggregates to the one standard deviation innovations in the U.S, the Euro Area, Japan, and China are depicted in Table 2.7 (appendix A.1.).

From Table 2.7, at least two key results can be observed. First, monetary expansions in the U.S, the Euro Area, China, and Japan lead to an increase in industrial production. In particular, in the large majority of the EMEs, one can observe an increase in industrial production and CPI after monetary expansions in the U.S, the Euro Area, China, and Japan. Second, monetary expansions in the U.S, the Euro Area, Japan, and China lead to the fall in the short-term interest rates in most of the emerging market economies considered in the analysis. Now it is important to see whether these responses are uniform across all EMEs after the four international monetary policy expansions. Starting with the U.S monetary policy innovations, it is evident from the Table table **??** that the responses of the industrial production in Argentina, Malaysia, and Turkey are more pronounced and less pronounced in Chile, Taiwan, and Russia. The strongest reactions of the short term interest rates to the U.S monetary expansion are also evident in Argentina, Russia and Chile with the smallest reactions in Korea, Czech Republic, and Malaysia.

When it comes to the Euro Area monetary policy expansions, similar to the U.S. monetary expansion, industrial production and CPI increase in most EME countries, with strongest reactions in the Philippines, Brazil, and Korea for industrial production, and, Russia and Chile for CPI. On the other hand, the industrial production in Mexico and CPI in Malaysia and Mexico display the smallest reactions after the monetary expansion in the Euro Area. In addition, while most EME country's short term interest rates react with the fall, the real trade-weighted effective exchange rates depreciated (negative values) following innovations in the Euro Area, with the strongest reactions in Argentina and Brazil. Finally, the median responses of the EME's industrial productions, CPI, and short term interest rates in a typical EMEs to the Japanese and Chinese monetary policy shocks is depicted in the last six columns of Table 2.7, respectively.

Observe that while industrial production and CPI rise in the large majority of EMEs countries after monetary innovations in Japan and China, similar to the reactions of these variables to the innovations in the U.S and the Euro Area, the short term interest rates fall after monetary expansions in Japan and China. But, the response of industrial production is more pronounced in Argentina and the Philippines after monetary innovations in Japan and China, with less pronounced reactions in Turkey and Brazil, respectively. In general, one can observe there is substantial heterogeneity in the responses of the EME's macroeconomic aggregates after the four international monetary policy expansions. Such heterogeneity in the reactions of EMEs variables to the international monetary policy expansions raise questions why some EMEs display strongest reactions than other counterparts. The answer to this question is explored in this section in detail.

Table 2.4: Measure of country-specific characteristics

Country characteristics	**Measurement**
Trade openness	The share of trade to GDP from World Development Indicators (WDI).
Financial Integration	The share of gross foreign liability and asset to GDP from International Financial Statistics (IFS).
Exchange rate regime	Based on the exchange rates volatility calculated as the standard deviations of log daily exchange rates data from Bank of international settlements (BIS).
Commodity exporters	Based on the Dedola et al. (2017)[12].
Degree of indebtedness	The share of debt to GDP from WDI.
Geographical location	Based on the geographic proximity to the four international shocks.

To these end, the potential transmission channels through which international shocks could be transmitted into the domestic economies are explored by splitting EMEs into two sub-

[12] These classification is based on the share of the exports of primary goods (fuels, metals, food and other raw materials) to total trade.

groups based on several country-specific characteristics. The EMEs are divided into two subgroups based following country-specific and geographic characteristics: (i) the share of trade to GDP; (ii) the share of the gross asset and liability to GDP; (iii) the level of the exchange rate volatility against the U.S. dollar; (iv) the incidence of the commodity exports; (v) the degree of indebtedness and (vi) the geographic proximity. To categorize the countries into each respective groups, as presented in Table 2.5, the measurement of each of the above country-specific characteristics along with their sources are indicated Table 2.4. For each measure, except the geographic proximity and degree of indebtedness, countries are divided into two subgroups depending on whether the mean value of the respective measure falls above or below the cross-country median value over the whole sample period. The classification of the countries into high and low subgroups with respect to debt to GDP ratio is based on classification made by International Monetary Fund (IMF), World Bank (WB) and European Central Bank as well as previous empirical evidence. WB and IMF's classifications show that countries are classified under low and high debt categories if the debt to GDP ratio is below and above 60 percent, respectively.

Table 2.5: Country classifications[a]

Country	Trade Openness	Financial Integration	Exchange rate regime	Commodity exporters	Indebtedness	Geographical location
Argentina	Less	Less	More	Export	High	Latin
Brazil	Less	Less	More	Export	High	Latin
Chile	More	More	Less	Export	Low	Latin
Colombia	Less	Less	More	Export	Low	Latin
Czech Republic	More	More	More	None	Low	Europe
Hungary	More	More	Less	None	High	Europe
Indonesia	Less	Less	Less	None	Low	Asia
India	Less	Less	Less	None	High	Asia
Korea	More	Less	Less	None	Low	Asia
Malaysia	More	More	Less	None	Low	Asia
Mexico	Less	Less	More	None	Low	Latin
Poland	More	More	Less	None	Low	Europe
Russia	Less	More	More	Export	Low	Europe
Philippines	More	Less	Less	None	Low	Asia
South Africa	Less	More	More	Export	Low	Africa
Turkey	Less	Less	More	None	Low	Europe

[a] Notes: More (less) and high (low) is when country's mean value of the respective indicator fall above (below) the cross-country median over the sample period, respectively. Export = Commodity exporters, None = Non-commodity exporters.

Similarly, the main fiscal rules for the Euro Area member states in the Stability and Growth Pact (SGP) of the European Central Bank states that the fiscal deficit to GDP ratio and debt to GDP ratio should be below 3 percent and 60 percent, respectively (Begg, 2017). It has also been shown that the threshold level for debt to GDP ratio for emerging market economies is set at 60 percent and similar to the threshold in advanced economies (Reinhart and Rogoff, 2010; Lysandrou, 2013).[13] Country classifications into the respective sub-groups are presented in Table 2.5.

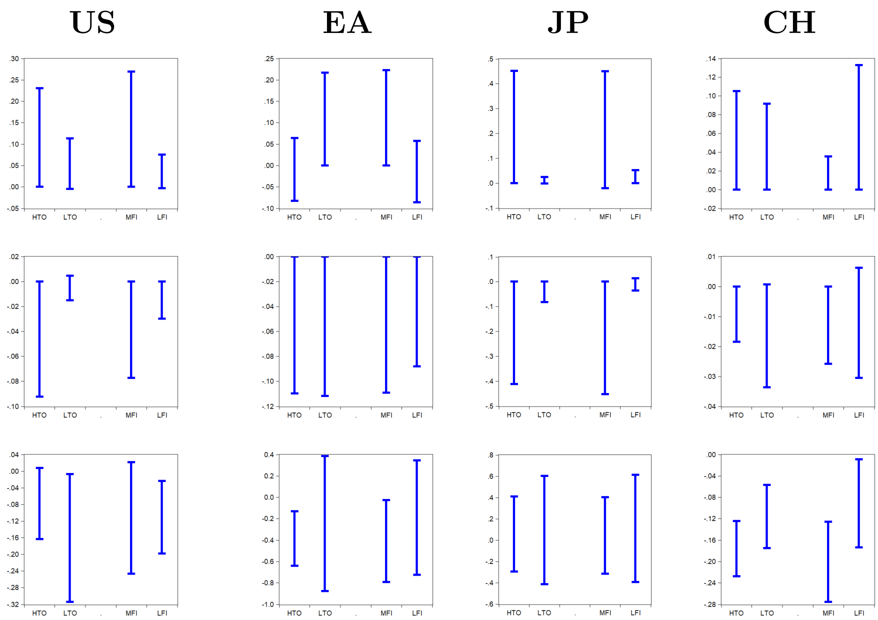


Figure 2.3: Peak responses for grouping with different country-specific characteristics. The first, the second and the third rows show the peak responses of industrial production, interest rates and exchange rates in EMEs for two groups, respectively. Each Figure is constructed with one standarded deviations confidence interval of estimated peak impacts. Notes: HTO: Trade Opennes above cross-country median, LTO: Trade Openess below cross-country median, MFI: Financial Integration above cross-country median, LFI: Financial Integration below cross-country median. U.S: United States, EA: the Euro Area, JP: Japan and CH: China.

Now let us go into detail analysis and see to what extent the EMEs are affected by the international monetary shocks. For these purposes, the economies are grouped into two subgroups according to the country-specific characteristics. To see the relative responses of each group following the four international shocks, the estimated peak responses of the each subgroup's macroeconomic variables to the innovations in the U.S., the Euro Area, Japan, and China monetary aggregates are depicted in Figure 2.3, 2.4 and 2.5. The differences in peak responses to the international monetary policy shocks show the differences in cumulative impulse response functions for each group of the country and this way of comparison is consistent with the existing

[13]This threshold is also used by other researchers to classify economies into low and high debt categories, see for example Ilzetzki et al. (2013).

studies (Anaya et al., 2017). The peak responses for industrial production, short term interest rates, and real trade-weighted effective exchange rates for one standard deviation confidence bands are presented in the first, the second and the third rows, respectively.

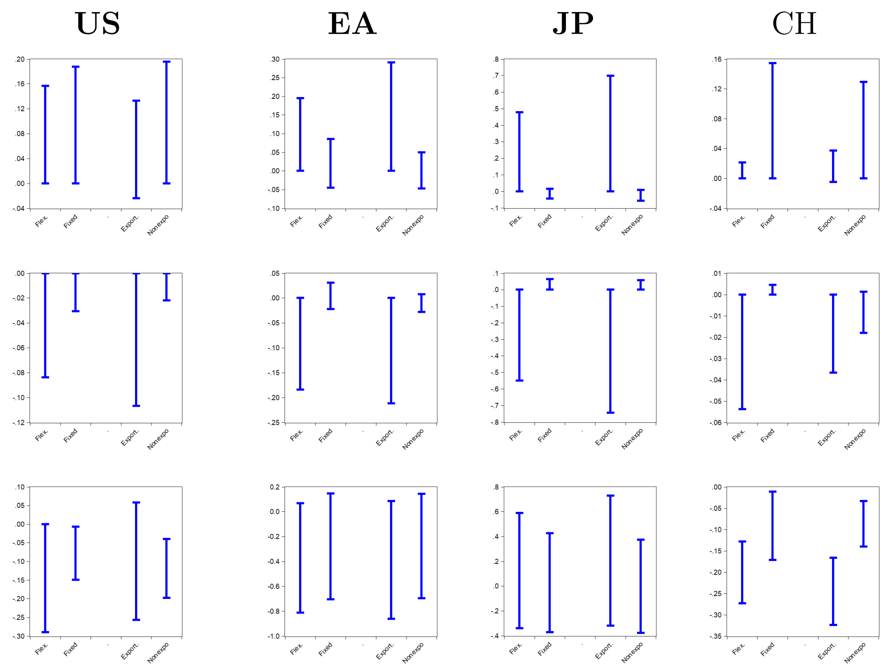


Figure 2.4: Peak responses for grouping with different country-specific characteristics. The first, the second and the third rows show the peak responses of industrial production, interest rates and exchange rates in EMEs, respectively. Each Figure is constructed with one standarded deviations confidence interval of estimated peak impacts. Notes: Flex.: Countries with the flexible exchange rate regime, Fixed: Countries with the fixed exchange rate regime, Export.: Commodity Exporters, Non-export: Non-commodity exporters. U.S: United States, EA: the Euro Area, JP: Japan and CH: China.

1. **Degree of trade openness and financial integration**: Figure 2.3 shows the estimated peak responses of the country groupings based on the degree of trade openness (left panel) and financial integration (right panel). The degree of trade openness and financial integration may affect the magnitude of spillovers from international monetary policy through various channels. While the degree of trade openness is relevant for the transmission of international monetary policy through foreign demand and spending switching channels, the degree of financial integration works through the financial channel (Georgiadis, 2016; Potjagailo, 2017). Accordingly, an economy that is more open in global trade and more financially integrated may display larger spillovers to domestic variables following international monetary shocks. To explore this, the EMEs are splitted into two groups: one with the mean share of the trade-in GDP and the mean share of gross foreign asset and liability to GDP above and below the cross country median, respectively.

   Observe in Figure 2.3 that industrial production increases substantially, in most cases, after international monetary policy shocks in all sub-groups. However, the responses are stronger in countries with a high degree of trade openness with respect to the U.S. and Japan M3. On the other hand, the degree of trade openness does not seem to matter for the Euro Area and China M3 shocks. With respect to the degree of financial integration, the response of EMEs industrial production is more pronounced with respect to the U.S, the Euro Area and Japanese monetary expansions in the group of countries with more financial integration, where the reverse is true for Chinese monetary expansion. Coming to the responses of short term interest rates, the financial channel seems to matter for the transmission of international monetary policy shocks in most cases, where countries with a high degree of financial integration display the strongest response of interest rates. In contrast to the reaction of interest rates in emerging market economies, countries with a low degree of trade openness more pronounced responses of real trade-weighted effective exchange rates in most cases.

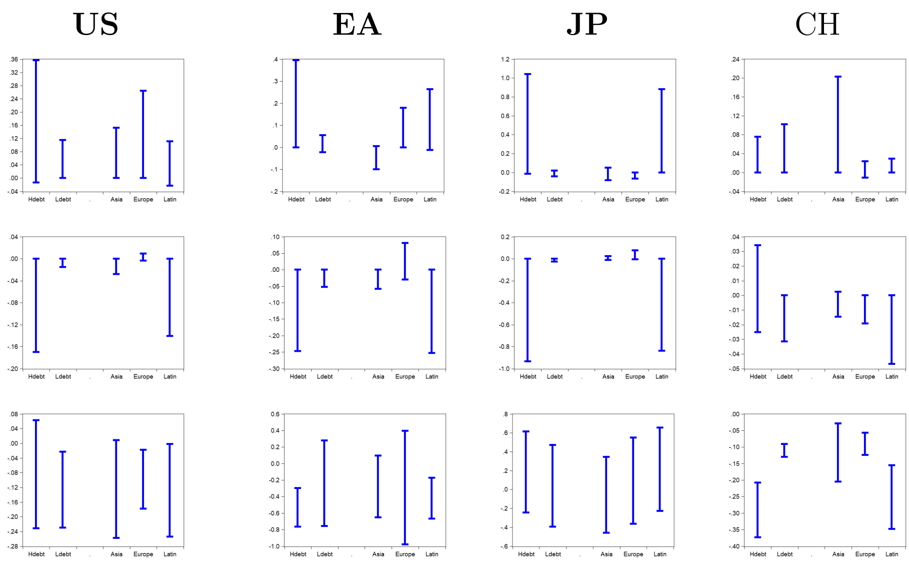


Figure 2.5: Peak responses for grouping with different country-specific characteristics and geographic regions. The first, the second and the third rows show the peak responses of industrial production, interest rates and exchange rates in EMEs, respectively. Each Figure is constructed with one standarded deviations confidence interval of estimated peak impacts. Notes: Hdebt: Countries with high debt to GDP ratio, Ldebt: Countries with low debt to GDP ratio; Asia: Emerging Asia, Europe: Emerging Europe, Latin: Emerging Latin America. U.S: United States, EA: Euro Area, JP: Japan and CH: China.

1. **Exchange rate regime and incidence of commodity exporters**: Next, let us explore the role of exchange rate regimes and the incidences of commodity exporters to the magnitude of the international spillover to the domestic economy. For this purpose, the sample countries are splitted into two sub-groups depending on the degree of exchange rate volatility and the incidence of the primary commodity exports as countries with flexible versus fixed exchange rate regimes and commodity exporters versus non-commodity exporters. The estimated peak responses of the industrial production, short term interest rates and exchange rates for both measures of country characteristics are depicted in

the first, the second and the third rows, respectively of Figure 2.4. In the Figure, flex., fixed, export and non-export denote flexible exchange rate regime, fixed exchange rate regime, commodity exporters and non-commodity exporters, respectively. In countries with flexible exchange rate regimes, flexible exchange rates could potentially mitigate the magnitudes of spillover effect through spending switching effects (Georgiadis, 2016).

One can observe from Figure 2.4 that the reactions of industrial production are stronger with a low degree of exchange rate volatility following the U.S. and Chinese international monetary policy shocks. In addition, the degree of exchange rate regimes does not seem to matter for the transmission of the Euro Area monetary expansion to the emerging market economies. The responses of the industrial production following innovations in the U.S. and Chinese monetary policy shocks is more pronounced for the non-commodity exporters than a group of the country exporting primary commodities, but it is the group of commodity exporters who experience stronger responses after the Euro Area and Japanese monetary policy expansions. On the other hand, the primary commodity exporters display a stronger reaction of industrial production following the Euro Area and Japanese monetary expansions. Another important observation is that the responses of short term interest rates are more pronounced for the group of countries with flexible exchange rate regimes and the largest share of primary commodities exports. This result is robust to all international monetary policy shocks. Moreover, the responses of the real trade-weighted effective exchange rates are slightly more pronounced in a group of countries with the flexible exchange rates and for a high degree of primary commodity exporters after the U.S. monetary policy expansion. The degree of exchange rate regimes and the incidence of primary commodity exports does not seem to matter for the size of the responses of real trade-weighted effective exchange rates after the Euro Area, Japanese, and Chinese monetary policy expansions.

2. **The geographical locations and the degree of indebtedness**: Finally, the reactions of industrial production, short-term interest rates, and real trade-weighted effective exchange rates depending on where each economy is located and the degree of indebtedness are shown in Figure 2.5. With regard to geographical locations, the EMEs analyzed here are grouped by geographic regions as Emerging Europe (Czech Republic, Hungary, Poland, Russia, Turkey); Emerging Latin-America (Argentina, Brazil, Chile, Colombia, Mexico) and Emerging Asia-Africa (Indonesia, India, Korea, Malaysia, Philippines, South Africa). Ideally, we could expect stronger reactions of, for instance, industrial production, in emerging Latin-America, emerging Europe and Emerging Asia to monetary innovations in the U.S., the Euro Area and in Japan, respectively, because of their respective geographic proximity and tied economic connections. Moreover, countries with low debt to GDP ratio may have sufficient fiscal policy space to mitigate negative spillovers coming from an international monetary policy (Georgiadis, 2016). The peak responses of the industrial production, short term interest rates, and real trade-weighted effective exchange rates following the four international shocks are presented in the first, the second and third rows of the Figure 2.5. The peak estimated responses are computed for one standard deviation.

Observe from 2.5 that the role of the geographic proximity in the transmission of international shocks to the domestic EME's key macroeconomic aggregates does not seem to matter in most cases. Industrial production in emerging Latin America experiences the strongest reaction after monetary innovations in the Euro Area and Japan. The strongest reaction of industrial production in emerging Asian economies seems to suggest the role of geographic proximity. Monetary expansions from all international shocks have more pronounced effects on the emerging Latin American country's short term interest rates than other regions. Another important consideration from Figure 2.5 is that the debt burden seems to matter for the size of the effects of the U.S., the Euro Area, and Japanese monetary policy expansions. In particular, the responses of the industrial productions are more strong in EMEs after the U.S., the Euro Area, and Japanese monetary policy expansions for a group of countries with high debt to GDP ratio. By contrast, the degree of indebtedness does not seems to matter for the reactions of EME industrial productions to monetary expansion in China. Moreover, the responses of interest rates are much stronger for a group of countries with a high debt burden regardless of where the shock is originated. With respect to the real trade-weighted effective exchange rates, while it experiences strongest reactions after the U.S. and Chinese monetary innovations in countries with a high debt burden, debt burden does not seem to matter for Japanese monetary expansions.

New results for Alternative Specifications

Two alternative specifications are estimated: (1) using the long term interest rates instead of the short term interest rates for domestic economies and (2) examining the effect of international contractionary monetary polices instead of the impact of the international monetary expansions from the U.S., the Euro Area, Japan, and China. First, the impact of international monetary innovations to emerging market economies long term interest rates is examined based on the arguments that the long-term interest rates are more related across countries than the short-term rates and captures the effects of international monetary policy shocks (Hellerstein, 2011; Dahlquist and Hasseltoft, 2013).

For this purpose, a 10-year long term government bonds series is used in the analysis. Among the 17 emerging market economies included in the short term interest rates analysis, most economies do not have appropriate long-term government bond yield data for relatively extended periods and therefore are excluded in this part of the analysis. Since most emerging market economies have limited data coverage for 10-year government bond data than those of the short-term interest rates, the SVEC model is estimated for 6 emerging market economies. The results reported in Figure 2.19 (appendix 2A.1.) show that the responses of reported emerging market economies long-term interest rates are similar to the results for the short-term interest rates in the benchmark model. However, there are also slight differences in terms of short and long term interest rates for some economies such as Poland. In principle, comparisons of the responses of long term and short term interest rates have to be treated with caution as the responses are based on different sample periods.

The second specification is replacing the effects of expansionary international monetary aggregates shocks from the U.S., the Euro Area, Japan, and China with their short term interest rates. This is based on the assumption that the growth rates of monetary aggregates depend on a variety of non-policy influences and thus, more contaminated by endogenous responses to contemporaneous economic conditions (McCallum, 1983; Bernanke and Mihov, 1998). For this purpose, the baseline SVEC model is re-estimated to see whether a change in international monetary policy measures changes the result. Results presented in Figures 2.16 through 2.18 show that contractionary monetary policy had a statistically significant effect in most emerging market's main macroeconomic variables. This is true for the responses of CPI in typical emerging markets. Another important observation is that both expansionary and contractionary monetary policy from Japan and China have had an insignificant effect on emerging European industrial production in most cases. Generally speaking, international monetary policy shocks to the U.S. M3, the Euro area M3, Japanese M3, and Chinese M3 have had significant effects on key macroeconomic variables in typical emerging market economies than short term interest rates shocks from these economies. This might be due to the fact that most big economies such as the U.S., the Euro Area, and Japan followed loose monetary policies since the aftermath of the global financial crisis (GFC).[14]

2.4 Sensitivity Analysis

In this section, several sensitivity analyses are conducted to check the robustness of the baseline results to alternative specifications to the model in equations 2.1 through 2.4. These specifications include (1) alternative models, (2) alternative lag lengths, (3) alternative contemporaneous restrictions and alternative ordering of the variables, (4) Global energy price and oil price indices, (5) the effects of the global financial crisis, and (6) great moderation.

Alternative Models: To confirm whether the benchmark model's key results are robust, alternative models such as Structural Factor-Augmented Vector Error Correction Model (SFAVEC) and Structural Factor-Augmented Vector Autoregressive (SFAVAR) models are employed. The details of the empirical FAVAR model used in this paper are discussed below before going into discussions of the model results.

(a) Structural Factor-Augmented Vector Error Correction Model (SFAVEC) Model: A Structural Factor-Augmented Vector Autoregressive model (SFAVAR) proposed by Bernanke et al. (2005) has been used recently to identify domestic monetary policy shocks.

[14] The monetary aggregates also capture unconventional monetary policy such as quantitative easing (Vespignani, 2015; Vespignani and Ratti, 2016). If the interest rates is near zero lower bound (which is the case with global financial crisis), emerging market variables respond weaker to international shocks than when the interest rates is above zero (Han and Wei, 2018). To see whether the inclusion of the global financial crisis (GFC) changes the baseline results, the SVEC model for contractionary international monetary policy is re-estimated after controlling for GFC. The impulse responses presented in Figure 2.23 show that the benchmark result without controlling for GFC is similar to the result after controlling for it for most domestic variables. However, the responses are slightly weaker when we control for GFC.

Table 2.6: Number of factors retained and explained variance in the factors analysis.

	Number of factors	Eaxplained Variance	KMO
Short term interest rates (I)			
US	1	0.99	0.86
EA	1	0.99	0.84
JP	1	0.93	0.72
CH	1	0.99	0.58
Consumer price index (CPI)			
US	1	0.92	0.87
EA	1	0.92	0.78
JP	3	0.96	0.72
CH	1	0.99	0.72
Industrial production (IP)			
US	2	0.91	0.65
EA	2	0.99	0.64
JP	2	0.90	0.66

Country code: US: United States, EA: Euro Area, JP: Japan, and CH: China. Kaiser-Meyer-Olkin (KMO) measure is used to assess suitability of the data considered for factor analysis. It measures sampling adequacy for common factors and each variables in the factor model. Accordingly, if the KMO index is larger than 0.5, then data is suitable for factor analysis and the sample is adequate (Kaiser, 1970,1974; Taherdoost2014; AfzaSyeda2008; Williams et at 2010).

It has also been extended to account for the transmission of international monetary policy shocks. The idea behind the FAVAR model is that the small number of variables in small scale models such as standard VAR models may not contain all the available information set used by economic agents. Hence, this information contained in a large number of variables can be summarized into a reduced number of factors by employing the method of factor analysis and can be included in the standard VAR models. In the empirical literature, the method of factor analysis can be used for two purposes: to incorporate all the informations contained in the monetary policy when making policy decisions (Bernanke et al., 2005; Mumtaz and Surico, 2009; Potjagailo, 2017) or to include all the information describing monetary policy stance (Lombardi and Zhu, 2014; Vespignani and Ratti, 2016; Kucharčuková et al., 2016). The FAVAR approach in this paper goes to the second strand of literature and it is chosen over other large scale VAR models such as Global VAR (GVAR) based on the argument that it is more preferred when the number of domestic variables examined in each domestic country is large while the number of domestic variables are restricted in GVAR models (Vespignani and Ratti, 2016; Kamber et al., 2016).

Following the above strand of literature, a Structural Factor-Augmented Vector Error Correction Model (SFAVEC) is employed as an alternative model to check the robustness of the benchmark results from the SVEC model. The SFAVEC in this paper can be presented by re-writing the equations 2.1 through 2.4 as:

$$Y_t = AY_{t-s} + \gamma X_{t-1} + \lambda F_{t-s} + Bu_t,\ u_t \sim WN(0_{nx1}, I_n), t = 1, ..., N \tag{2.6}$$

where $F_t = [FI_t,\ FCPI_t,\ FIP_t]$ is a vector of unique factors for the short term interest rates, consumer price indices, and industrial productions, respectively, for the U.S., the Euro Area, Japan and China given by:

$$FI_t = \left[FI_t^{US},\ FI_t^{EA},\ FI_t^{JP},\ FI_t^{CH}\right] \tag{2.7}$$

$$FCPI_t = \left[FCPI_t^{US},\ FCPI_t^{EA},\ FCPI_t^{JP},\ FCPI_t^{CH}\right] \tag{2.8}$$

$$FIP_t = \left[FIP_t^{US},\ FIP_t^{EA},\ FIP_t^{JP},\ FIP_t^{CH}\right] \tag{2.9}$$

where superscripts US, EA, JP and CH, represent unique factors for the U.S., the Euro Area, Japan and China, respectively.

Similar to the benchmark model, the monthly data set for the FAVEC model covers the period from 1999:1 through 2018:12. The data set along with their transformation is presented in appendix section §2.6 from Table 2.12 through 2.15. The series which were not available in a seasonally adjusted form are seasonally adjusted before the further transformation. The number of factors retained and explained variance in the data are presented in Table 2.6. To determine the number of factors to be retained for each unique factor of short term interest rates, consumer price indices and industrial production, Kaiser method is used. According to the Kaiser method, the number of factors retained for short term interest rates and industrial production of the U.S., the Euro Area, Japan, and China, are 1 and 2 each, respectively. On the other hand, while 3 factors are retained for Japanese CPI, the number of factors retained for the U.S., the Euro Area, and China is 1 each. When the number of factors are larger than 1, the case with Japanese CPI, the unique factor is determined based on the weighted sum of each unique factor (with weights given by the percentage of overall data variability explained by each factor). For example, the unique factor for Japanese CPI is determined by the weighted sum of the three factors, with weights given by the proportion of overall variability (96% in Table 2.6)

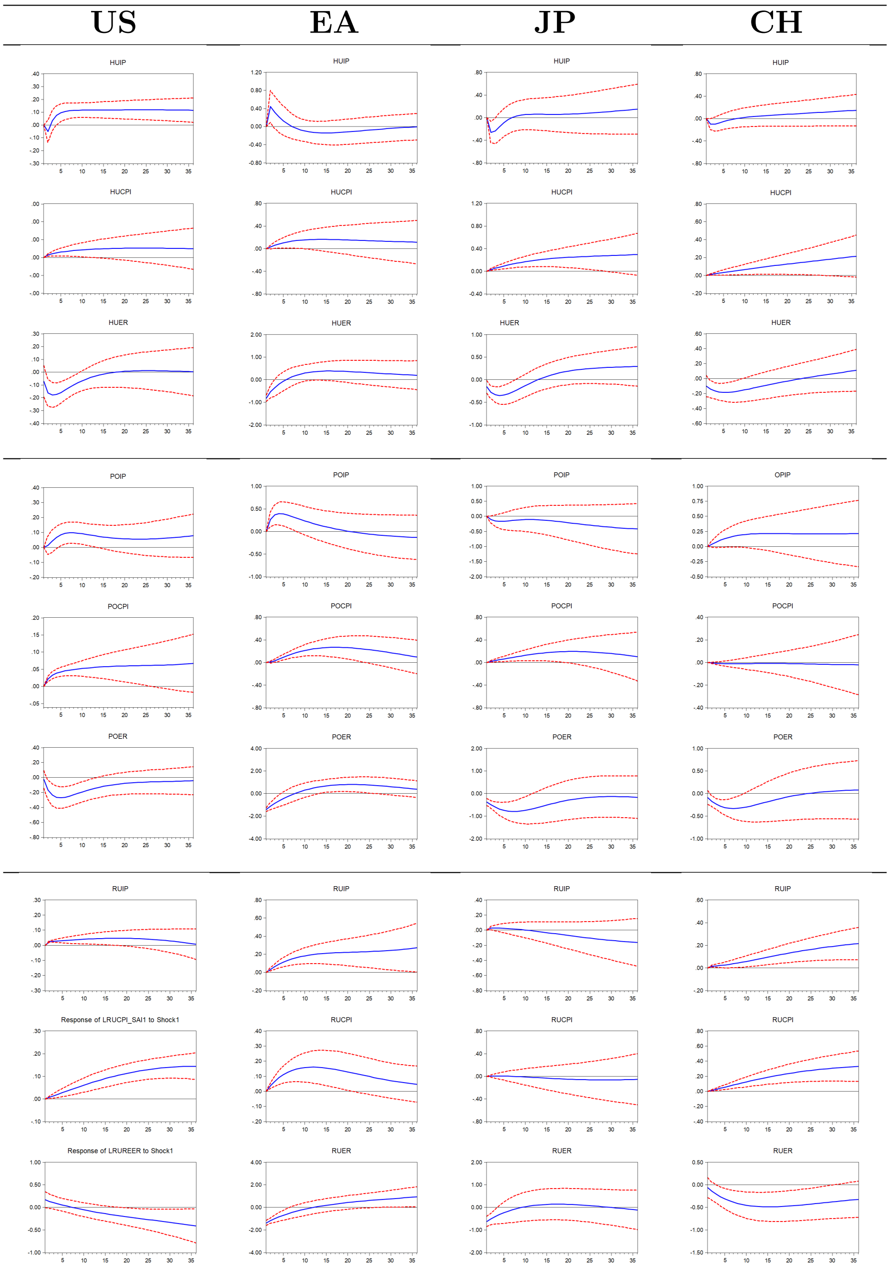


Figure 2.6: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected emerging European countries to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3(CH). Country code: HU: Hungary, PO: Poland and RU: Russia.

explained by each factor i.e. 52 %, 32%, and 12 %, where 52 %, 32%, and 12 % are percentage of total variability explained by the first, second and third factors, respectively. This way of computation is consistent with factor analysis literature (see for example Kucharčuková et al., 2016). As can be seen from 2.6, the retained factors explain more than 90 percent of the total variability in the data.[15] The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is also sufficiently larger than 55 percent for all common factors.

The impulse response functions of the selected macroeconomic variables in emerging Europe, emerging Latin America and emerging Asia-Africa based on equations 2.6 through 2.9 are depicted in Figures 2.6 through 2.8. Each Figure presents the responses of industrial production, CPI and real trade-weighted effective exchange rates in selected emerging market economies following international monetary policy shocks from the U.S., the Euro Area, Japan, and China. The dotted lines represent a one standard deviation confidence band. The impulse responses presented in Figure 2.6 through 2.8 from SFAVEC are very similar to those in the benchmark SVEC model in Figure 2.10 through 2.12 in most cases.

(b) Structural Factor-Augmented Vector Autoregressive (SFAVAR) Model: In the above section, the FAVAR model is estimated to capture both the short-run and long-run properties of the data. In this section, the error correction term is omitted based on the argument that a sample of 20 years may not be enough to effectively capture the long-run relationships among variables and thereby to further check the robustness of the benchmark model's results.[16] The impulse responses of the key macroeconomic aggregates for selected emerging market economies from the SFAVAR model are presented in Figures 2.13 through 2.15. The impulse responses are presented for selected emerging market economies from Europe, Latin America and Asia-Africa, in Figure 2.13, 2.14 and 2.15, respectively following monetary policy shocks from the U.S., the Euro Area, Japan, and China. One can observe that the results from the short term SFAVAR model are very similar to the one presented in Figure 2.6 through 2.8 in most of the cases.

Alternative Lag Length: The second sensitivity analysis performed to confirm the baseline result is re-estimating the model (1) through (4) for alternative lag length. In the baseline analysis, the model is estimated with one lag based on the Schwarz information criterion (SIC). The baseline model is then re-estimated with two lags based on the Akaike Information Criterion (AIC) and the one standard deviation innovations impulse responses of the EMEs are presented in Figure 2.9. In the Figure, the confidence bands are excluded since a large number of impulses responses are being presented. Observe from Figure 2.9 that the results with two lags are very similar to the baseline model estimated with one lag in most cases. One notable difference is the short-run responses of the industrial production to the U.S monetary expansion, which in fact disappears after the eighth months.

[15] The proportion of total variability explained by common factors for factor analysis in many empirical factor literature lies in the range of 40-60 percent (Potjagailo, 2017).

[16] The use of the quantity theory of money relationships is frequently undertaken with even less than 16 years of sample periods in the literature (see for example Bruggeman, 2000; Carstensen, 2006; Vespignani and Ratti, 2016).

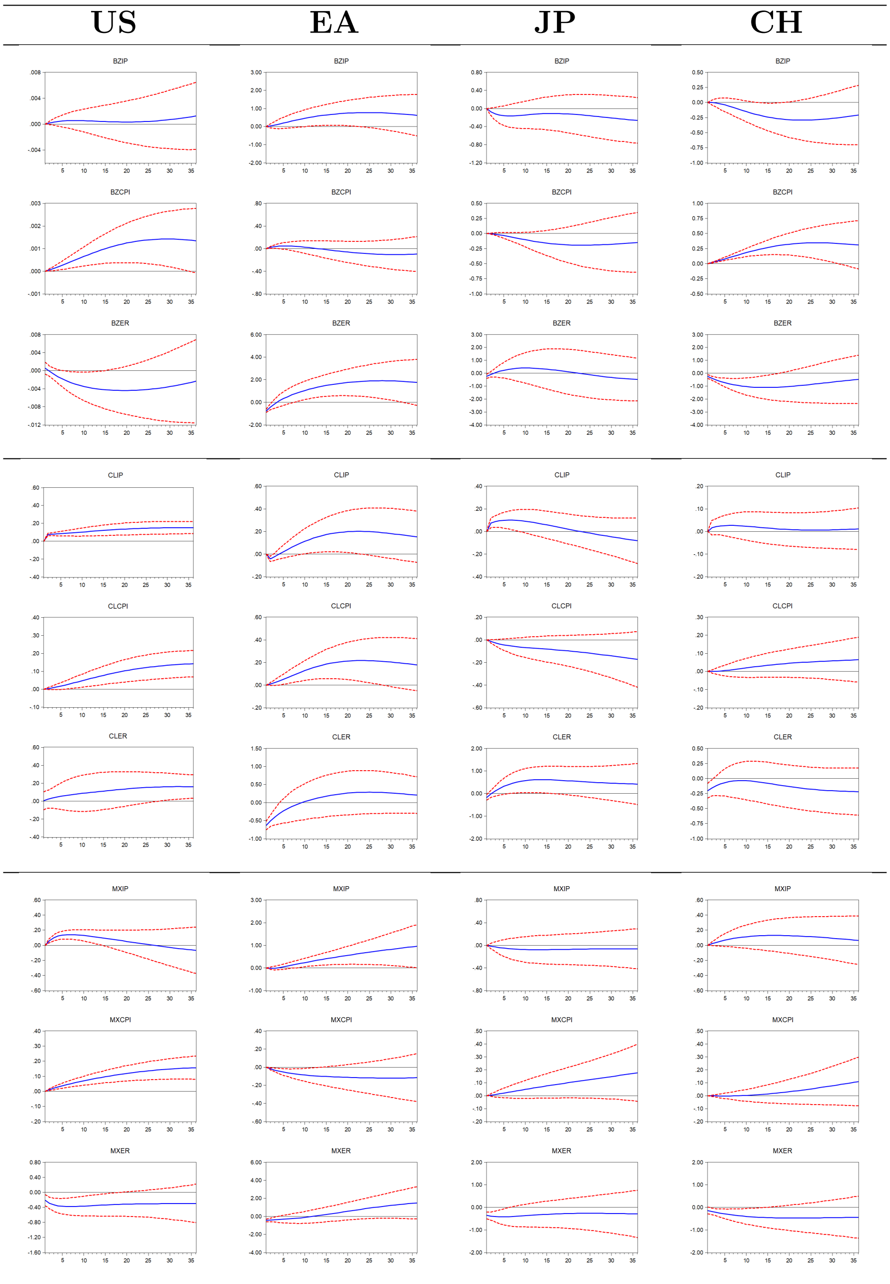


Figure 2.7: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected emerging Latin American countries to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3(CH). Country code: BZ: Brazil, CL: Chile and MX: Mexico.

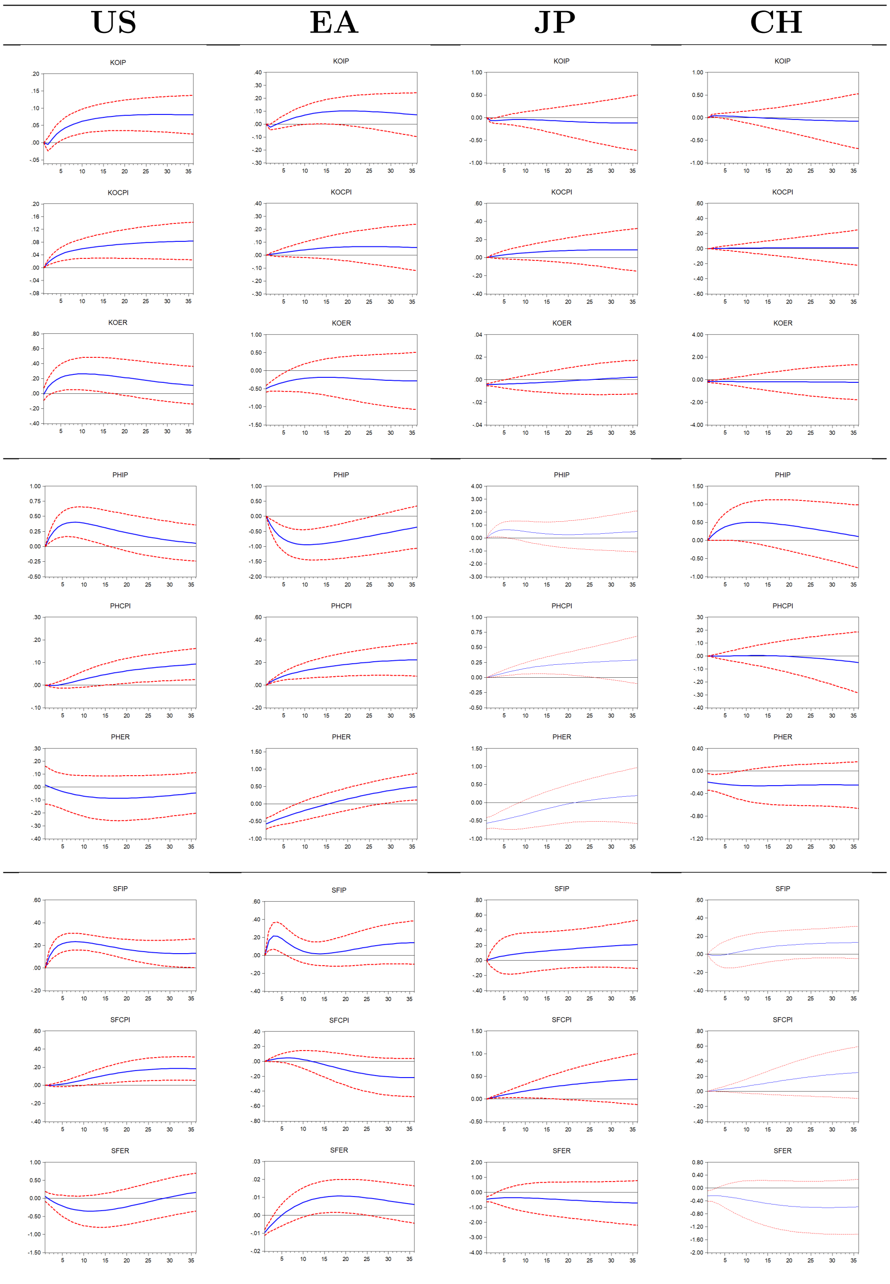


Figure 2.8: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected emerging Europe to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3(CH). Country code: KO: South Korea, PH: Philippines and SF: South Africa.

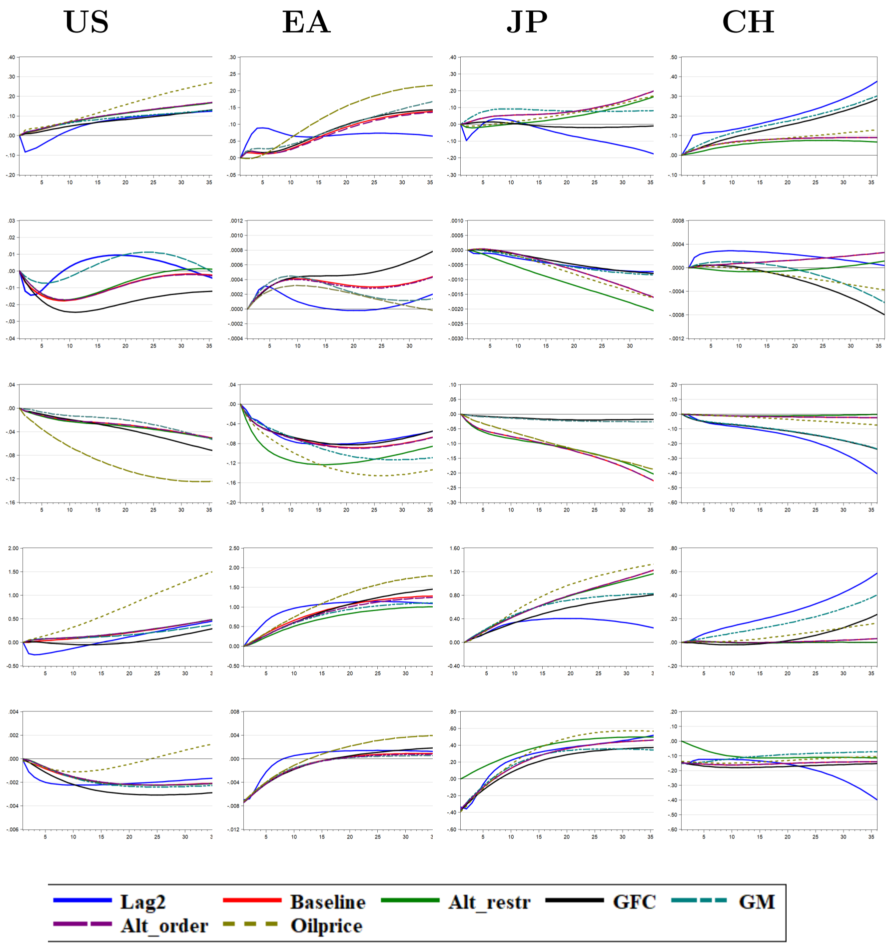


Figure 2.9: Sensitivity analysis: The impulses responses of industrial production, CPI, short-term interest rates, domestic monetary aggregates (M3) and trade-weighted real effective exchange rates in EMEs to one standard deviation innovations to the U.S M3, the Euro Area M3, Japanese M3 and China M3 are shown in the first, the second, the third, the fourth and the fifth rows, respectively. The impulse responses are for different specifications such as the baseline model (red solid line), alternative lag length (blue solid line), alternative contemporaneous restrictions (solid green line), for global oil price instead of the commodity price (dotted, light yellow line), dummy global financial crisis (solid black line), alternative ordering (dotted grey line) and dummy great moderation (light dotted green line). The confidence intervals are excluded for the sake of clarity.

Alternative restrictions and ordering of the variables: It is possible that alternative ordering and alternative contemporaneous short-run restrictions could potentially lead to different results. To check these cases, different alternative ordering and alternative contemporaneous restrictions are allowed to see the sensitivity of the benchmark results. For instance, in the baseline model, (i) international monetary aggregates are allowed to contemporaneously affect the domestic exchange rates in all EME economies, (ii) international monetary aggregates are also assumed to be independent of each other and (iii) the U.S monetary aggregates are ordered before the Euro Area and Japanese monetary aggregates. To check the robustness of the baseline results, the domestic exchange rates in EMEs are assumed to be contemporaneously exogenous to the international monetary aggregates, all international monetary aggregates are allowed to affect each other contemporaneously and the Euro Area and Chinese monetary aggregates are ordered before the U.S and Japanese monetary aggregates, respectively and vice versa. The impulses responses from these exercises show that the results are very similar to the baseline model. The one standard deviation innovations to the four international monetary policy shocks when the domestic trade-weighted effective exchange rates are assumed to be contemporaneously exogenous to the international monetary aggregates are reported in Figure 2.9. This result also confirms the benchmark result from the SVEC model.

Moreover, in the baseline, the international monetary aggregates are assumed to be contemporaneously exogenous, but affect the EMEs variables after one month. This is based on the assumption that the contemporaneous responses of domestic variables to international monetary aggregate shocks are assumed to be zero within high-frequency data (see also Kim, 2001; Vespignani, 2015; Vespignani and Ratti, 2016 for similar applications). Alternatively, international monetary aggregates are allowed to affect the domestic variables simultaneously. The impulse responses of selected EMEs to one standard deviation innovations in the U.S. M3, the Euro Area M3, Japanese M3, and Chinese M3 is depicted in Figure 2.21 and 2.22. Observe from the Figure that the impulse responses from this exercise confirm the benchmark results in most cases.

Global energy price and oil price indices: Because of the role of the global commodity price index to the EME economies and its role in identifying the exogenous international monetary policy shocks, empirical literature elsewhere estimate their models with commodity price index (see among others, Christiano et al., 1999; Kim, 2001; Dedola and Lippi, 2005). The benchmark model for each EME is estimated with the commodity price index. As an alternative specification, the commodity price index is substituted with global energy price and oil price indices and the results are reported in Figure 2.9. To avoid cluttering the Figures, the responses of the EME variables with the energy price index are not reported in Figure 2.9.[17] One can observe from Figure 2.9 that the impulse responses with these alternative specifications are very similar to the baseline results except for the strongest reactions of the EME's short term interest rates and M3 to the U.S. monetary policy shocks.

[17]While re-estimating the model with the oil price index, this variable is assumed to be exogenous to other variables in the model. Alternatively, as in the case of restrictions with the commodity price index, similar restrictions are also imposed with the oil price index. Results from these exercises (not shown here) also confirm the baseline result.

The effects of the global financial crisis: The behavior of macroeconomic variables in EME economies might have different dynamics during the global financial crisis, great moderation, Asian Crisis and before the introduction of the Euro Area. Since the baseline analysis in this paper excludes the period of Asia Crisis (1997-98) and analysis before the introduction of the Euro Area, the focus is given to the behavior of EME macroeconomic aggregates during the global financial crisis and great moderation (see below). To explore whether the global financial crisis influences the baseline findings, the dummy variable that takes the value 1 from 2008:07 to 2008:12 and zero otherwise are introduced following the previous literature. The responses of macroeconomic variables in EME economies with the dummy global financial crisis variable included are depicted in Figure 2.9. One can observe from Figure 2.9 that the results are very similar to the baseline results.

The period of Great Moderation: The international monetary spillovers to the domestic economy can also be expected to change before and after the great moderation. To capture these periods, the full sample in the baseline model is divided into two periods after identifying the end of the great moderation to be 2007:12 following works in Gadea et al. (2018); Vespignani and Ratti (2016) and Taylor and Williams (2009). Accordingly, the dummy variable with the value 1 up to 2007:12, and zero otherwise is introduced into each equation of the emerging market economy's baseline model. The baseline model is then re-estimated with this dummy variable and the impulse responses are generated to compare these results with the benchmark findings. The results in Figure 2.9 confirm that the results from these exercises are similar to the baseline model.

2.5 Conclusions

This paper explores the international spillovers of the U.S, the Euro Area, Chinese and Japanese monetary policy shocks on a number of macroeconomic variables in 17 emerging market economies (EMEs).

After expansionary monetary policy in these four big economies, industrial production increases in a typical emerging markets. These results are robust to most countries considered in the analysis over the sample period. The short-term interest rates fall in the typical emerging market economies after monetary expansion in the U.S., the Euro Area, China, and Japan regardless of where the shock is originated. Moreover, the size of the responses of the industrial production in emerging Europe and Asia respond more to the monetary innovations in the Euro Area and China, respectively. These results suggest where monetary expansion originates matters for the typical emerging market economies. There is also a substantial cross country heterogeneity in the responses of the macroeconomic aggregates in the emerging markets, where the size of the spillovers vary with the country-specific characteristics. Countries with a higher degree of trade openness and higher financial integration display stronger spillover in production as compared to other counterparts after U.S. and Japanese monetary policy shocks. Moreover, the degree of debt burden matters for the transmission of the U.S, the Euro Area and Japan monetary policy shocks and does not seem to matter for monetary expansions in

China. While the baseline results are based on Structural Vector Error Correction (SVEC) models, a Structural Factor-Augmented Vector Error Correction (SFAVEC) and Structural Factor-Augmented Vector Autoregressive (SFAVAR) models are also estimated to confirm the robustness of benchmark results.

2.6 Appendix

Appendix 2A.1. Impulse Responses.

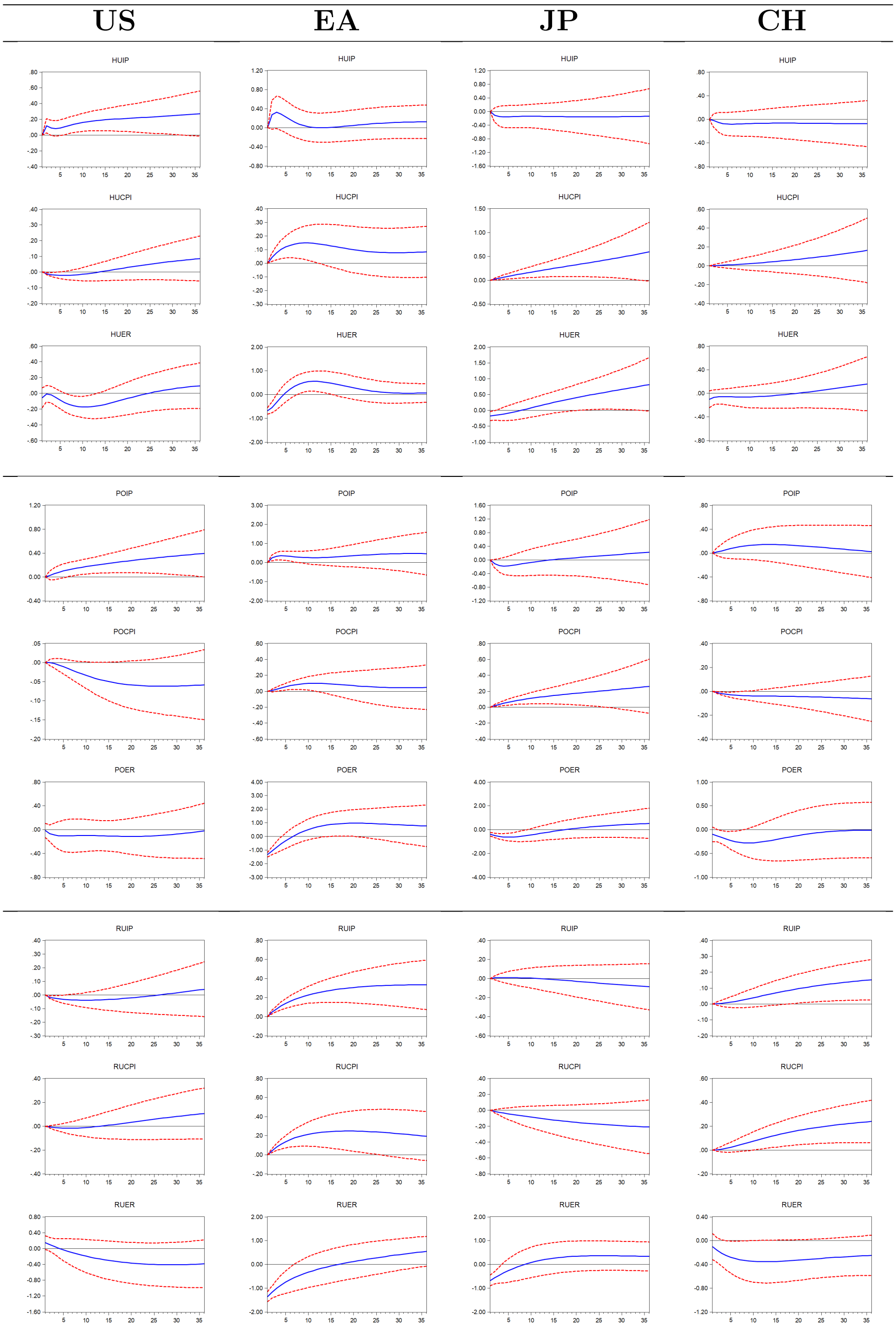


Figure 2.10: Baseline Model: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected emerging European countries to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3(CH). Country code: HU: Hungary, PO: Poland and RU: Russia.

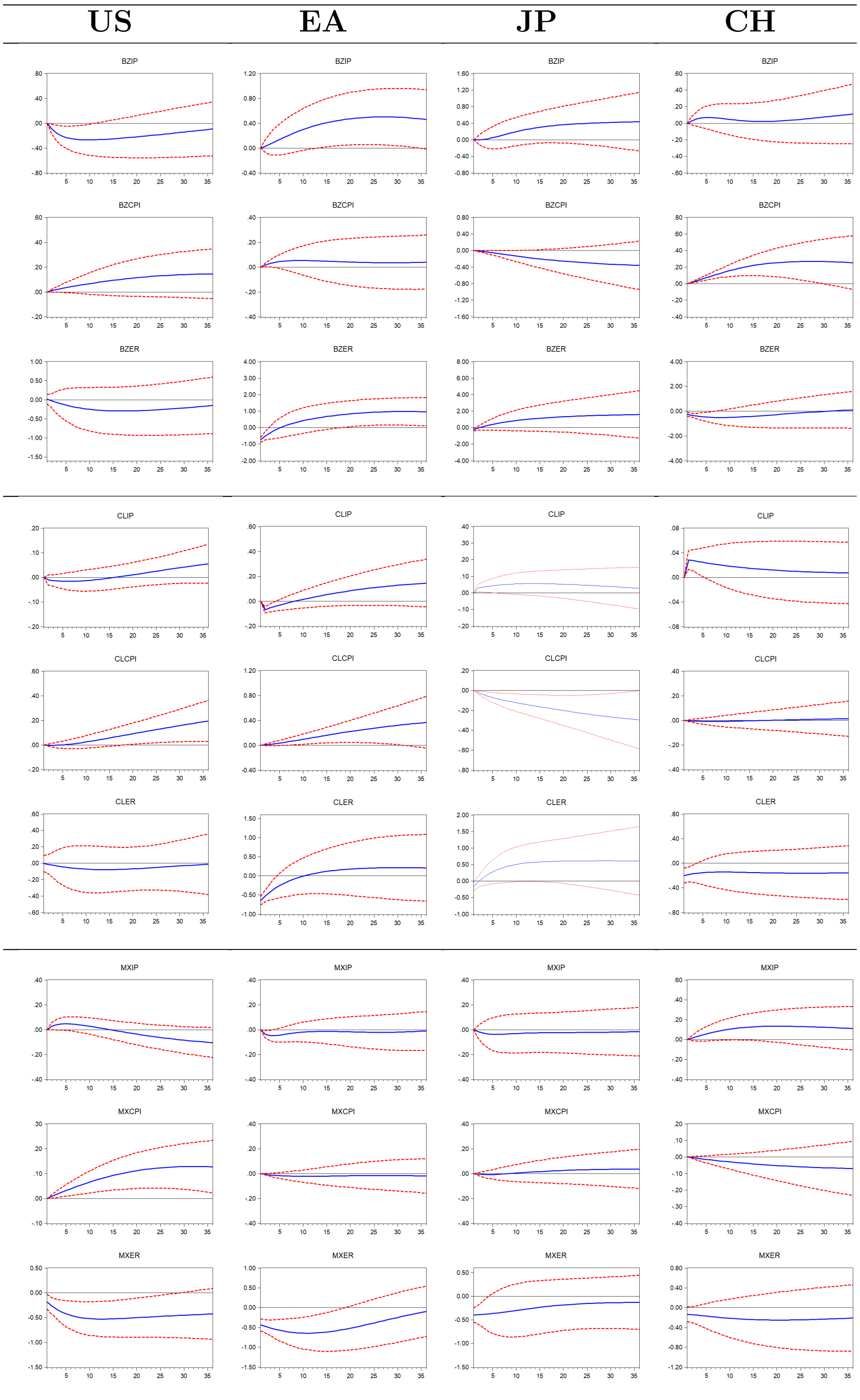


Figure 2.11: Baseline Model: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected emerging Latin American countries to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3(CH). Country code: BZ: Brazil, CL: Chile and MX: Mexico.

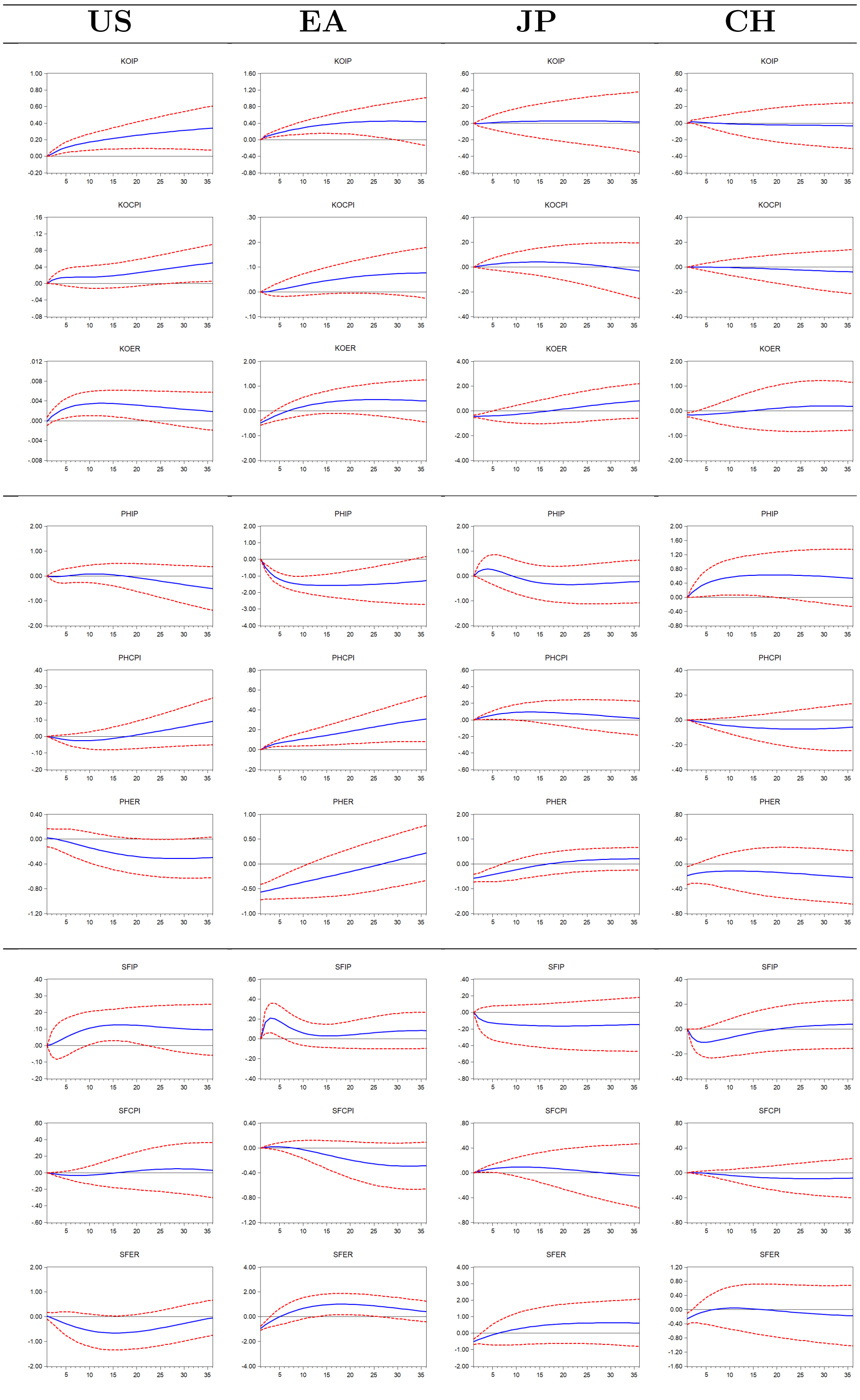


Figure 2.12: Baseline Model: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected emerging Europe to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3(CH). Country code: KO: South Korea, PH: Philippines and SF: South Africa.

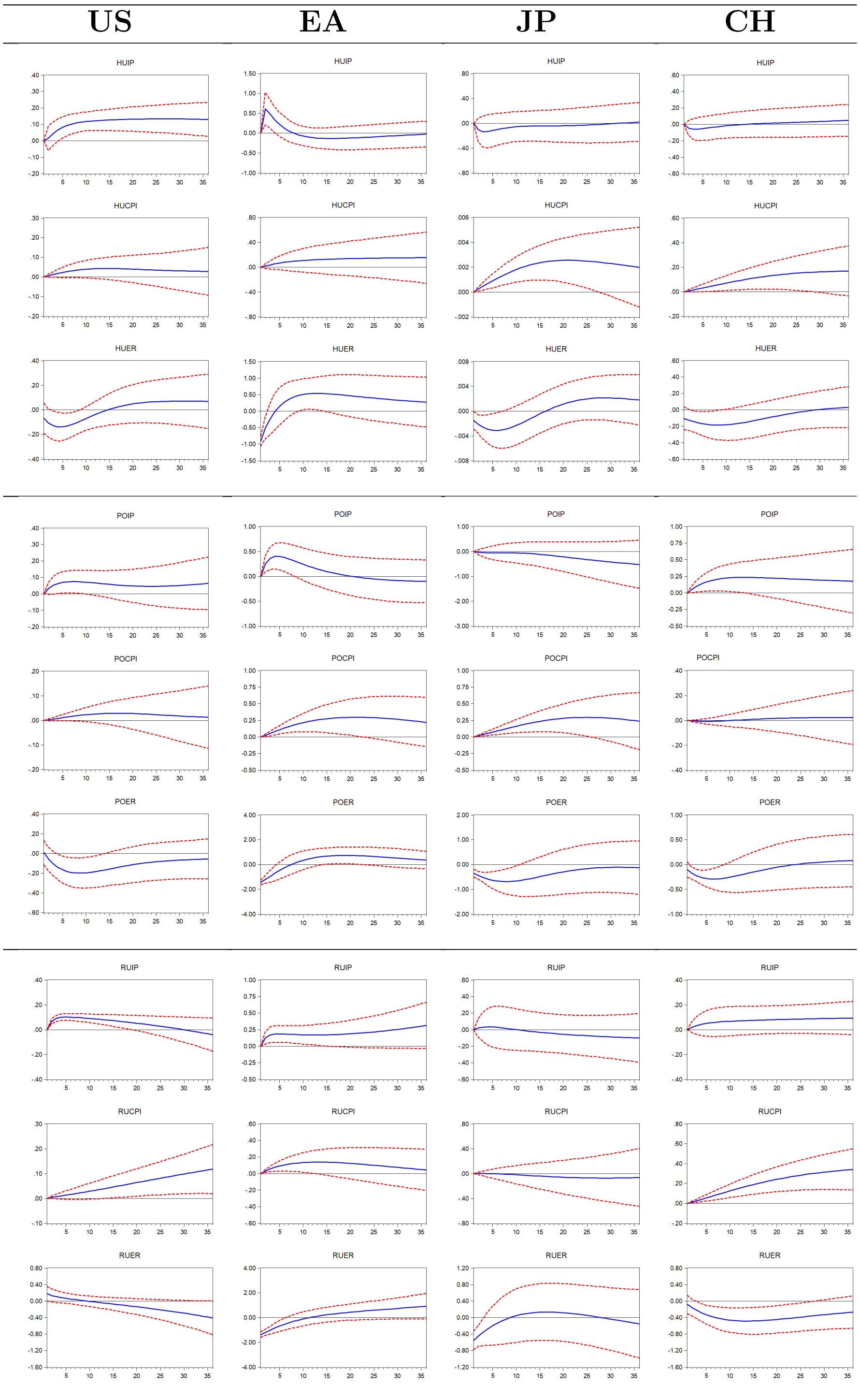


Figure 2.13: SFAVAR Model: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected emerging European countries to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3(CH). Country code: HU: Hungary, PO: Poland and RU: Russia.

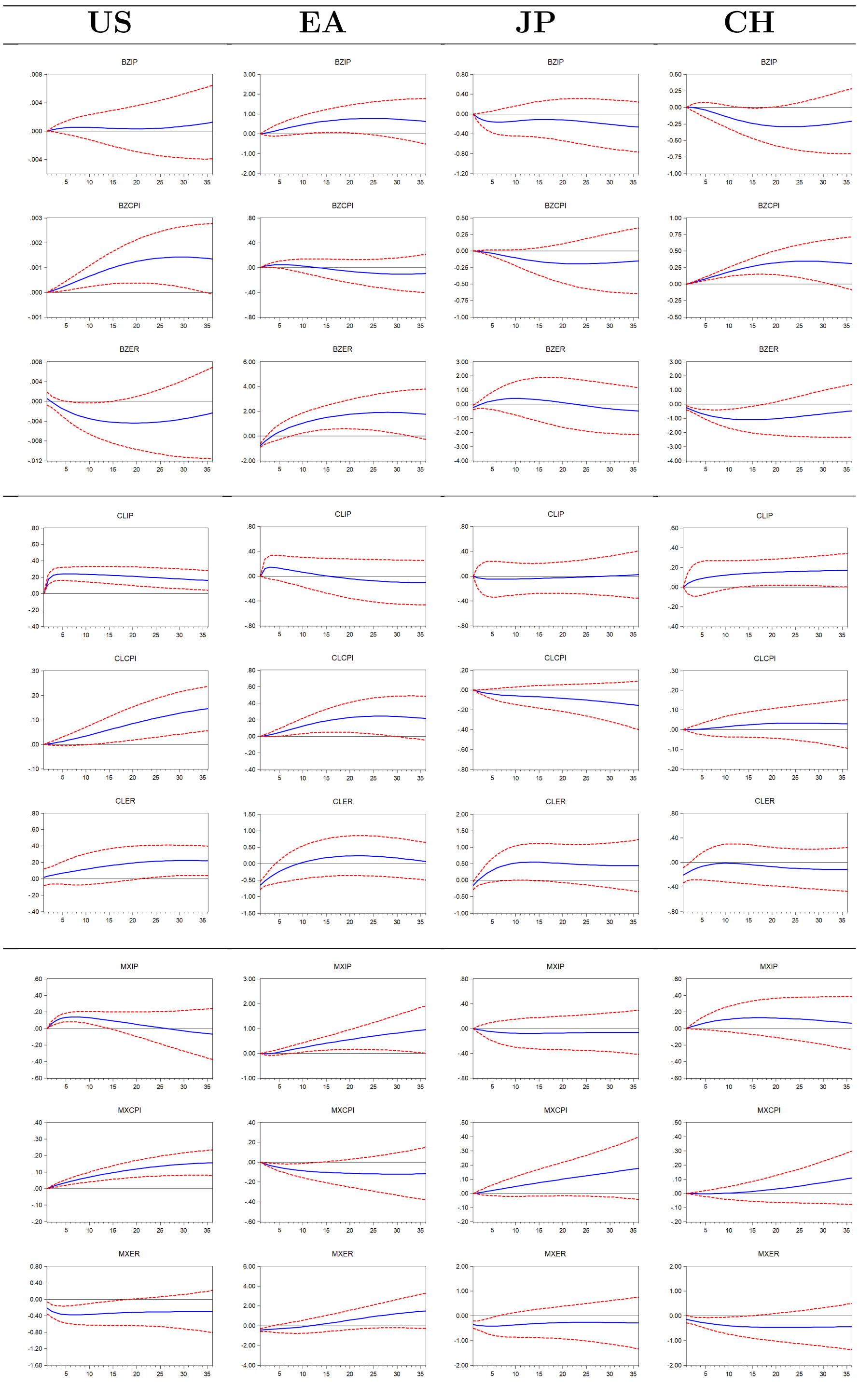


Figure 2.14: **SFAVAR Model:** The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected emerging Latin American countries to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3(CH). Country code: BZ: Brazil, CL: Chile and MX: Mexico.

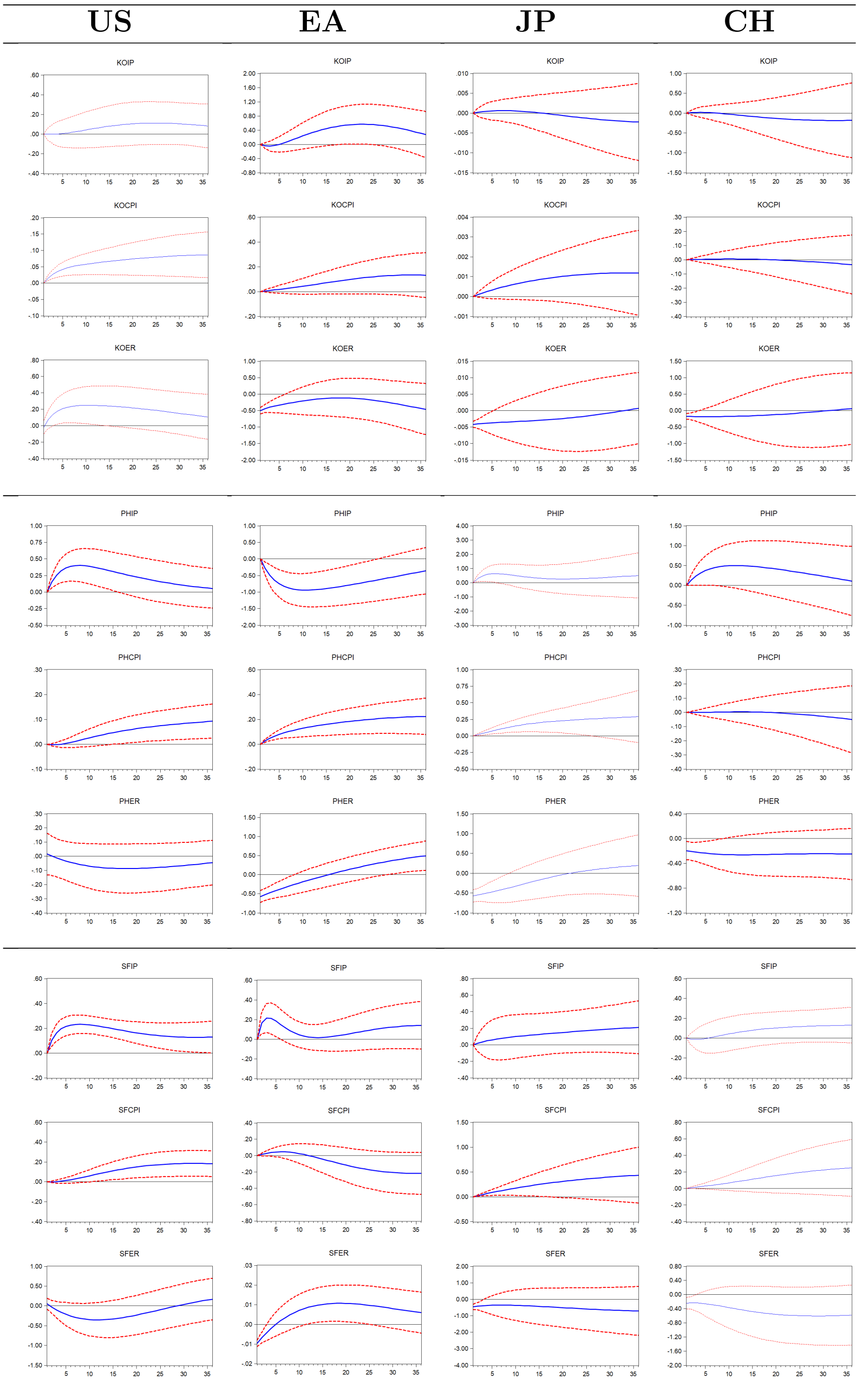


Figure 2.15: SFAVAR Model: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected emerging Europe to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3(CH). Country code: KO: South Korea, PH: Philippines and SF: South Africa.

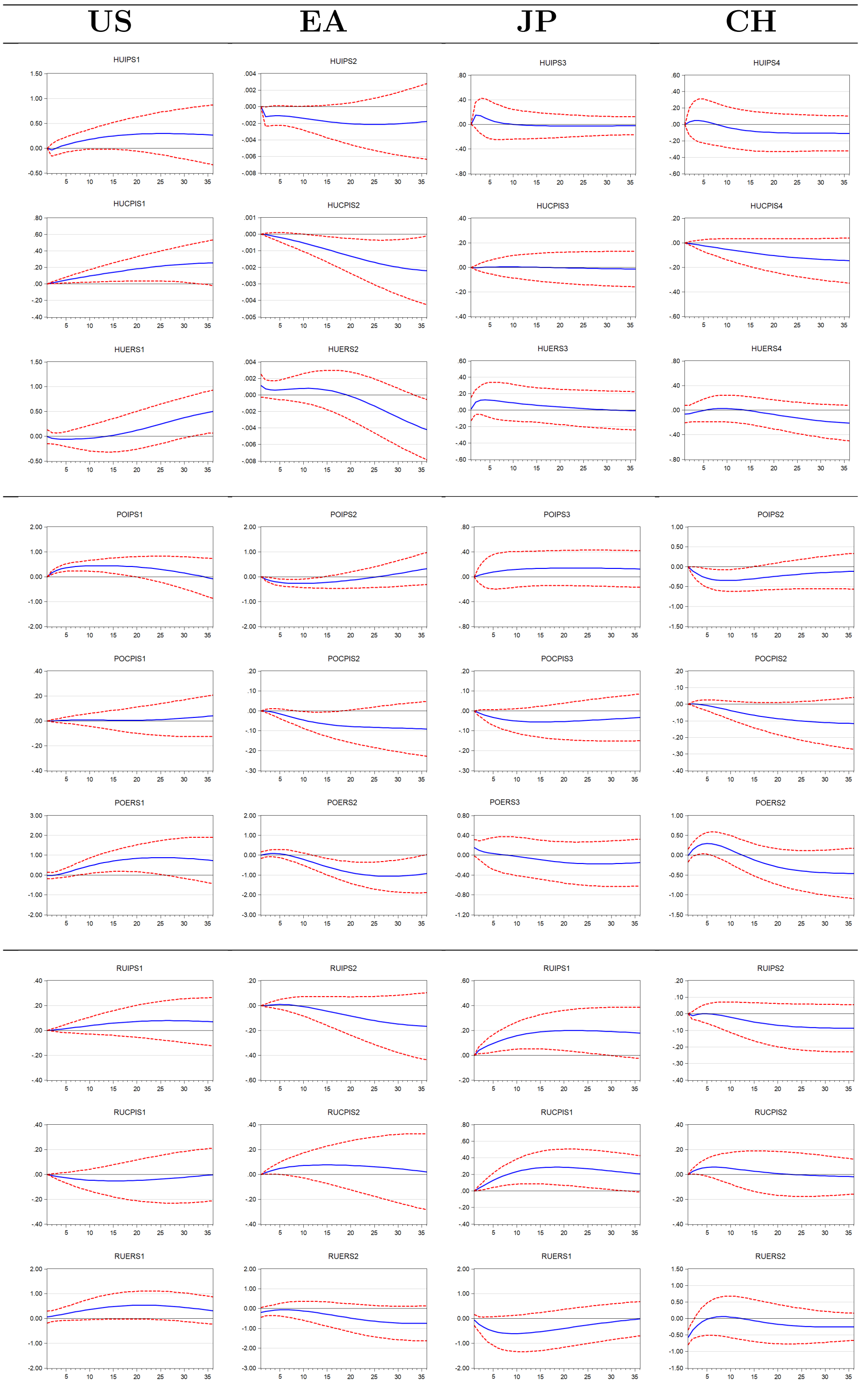


Figure 2.16: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected emerging Europe to one standard deviation innovations to the U.S PR (US), the Euro Area PR (EA), Japanese PR (JP) and China PR (CH). Country code: HU: Hungary, PO: Poland and RU: Russia.

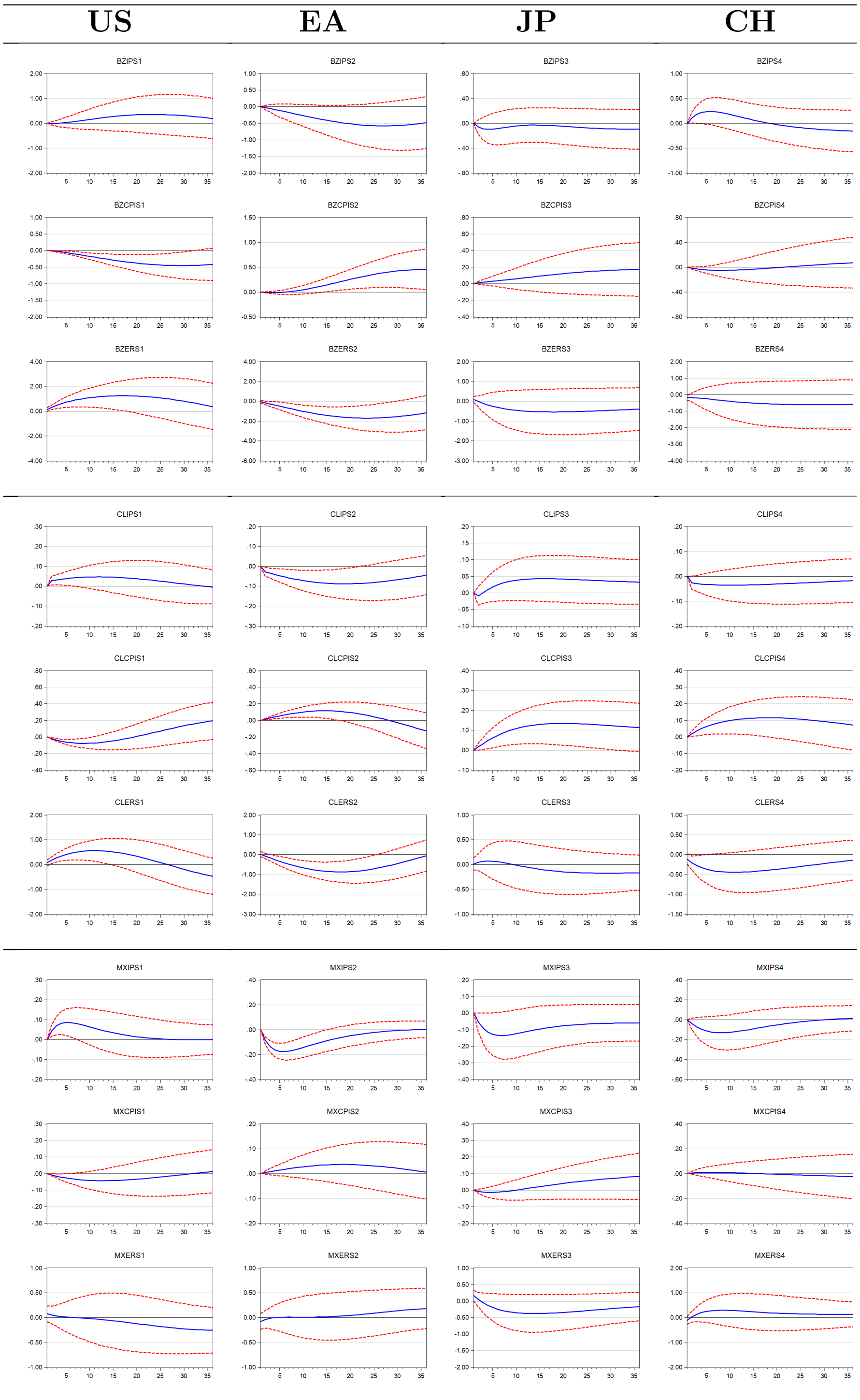


Figure 2.17: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected emerging Europe to one standard deviation innovations to the U.S PR (US), the Euro Area PR (EA), Japanese PR (JP) and China PR (CH). Country code: BZ: Brazil, CL: Chile and MX: Mexico.

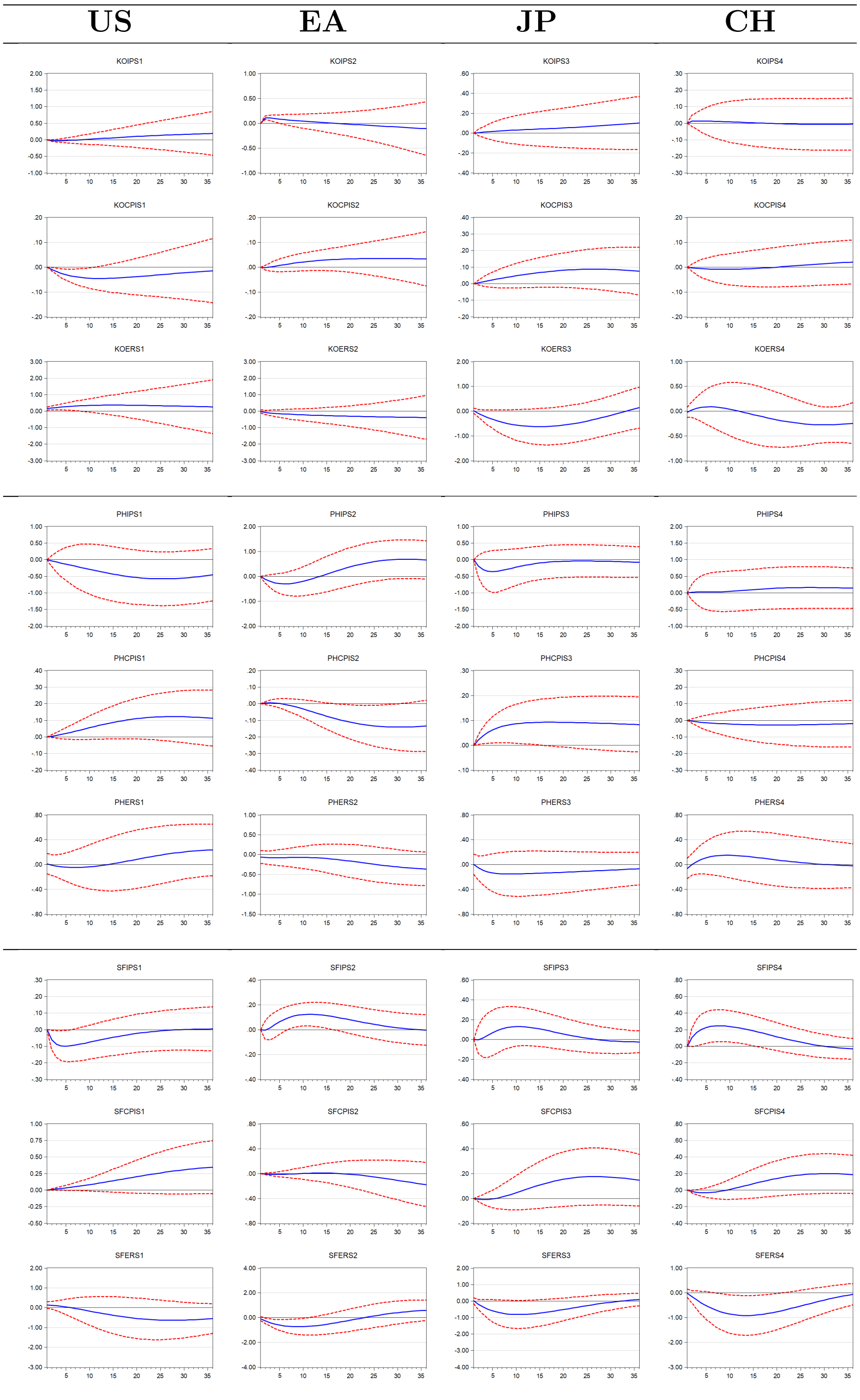


Figure 2.18: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected emerging Europe to one standard deviation innovations to the U.S PR (US), the Euro Area PR (EA), Japanese PR (JP) and China PR (CH). Country code: KO: Korea, PH: Philippines and SF: South Africa.

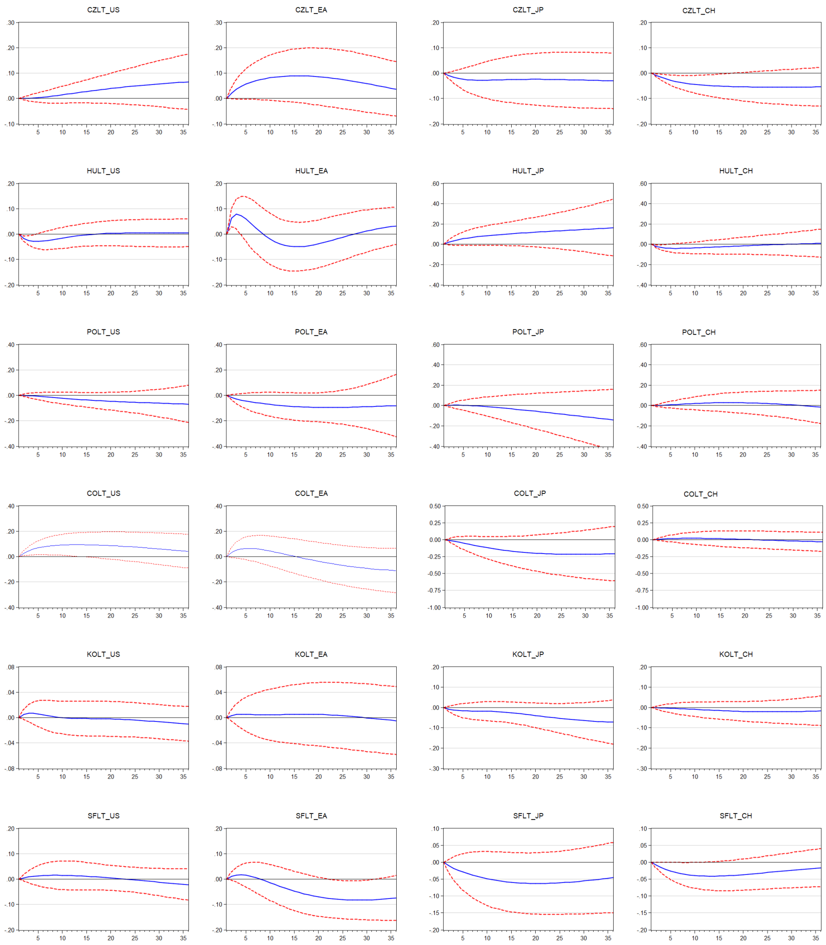


Figure 2.19: The impulses responses of long term interest rates (LT) in selected emerging Europe to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3 (CH). Country code: CZ: Czech Republic, HU: Hungary, PO: Poland, CO: Colombia, KO: Korea, and SF: South Africa.

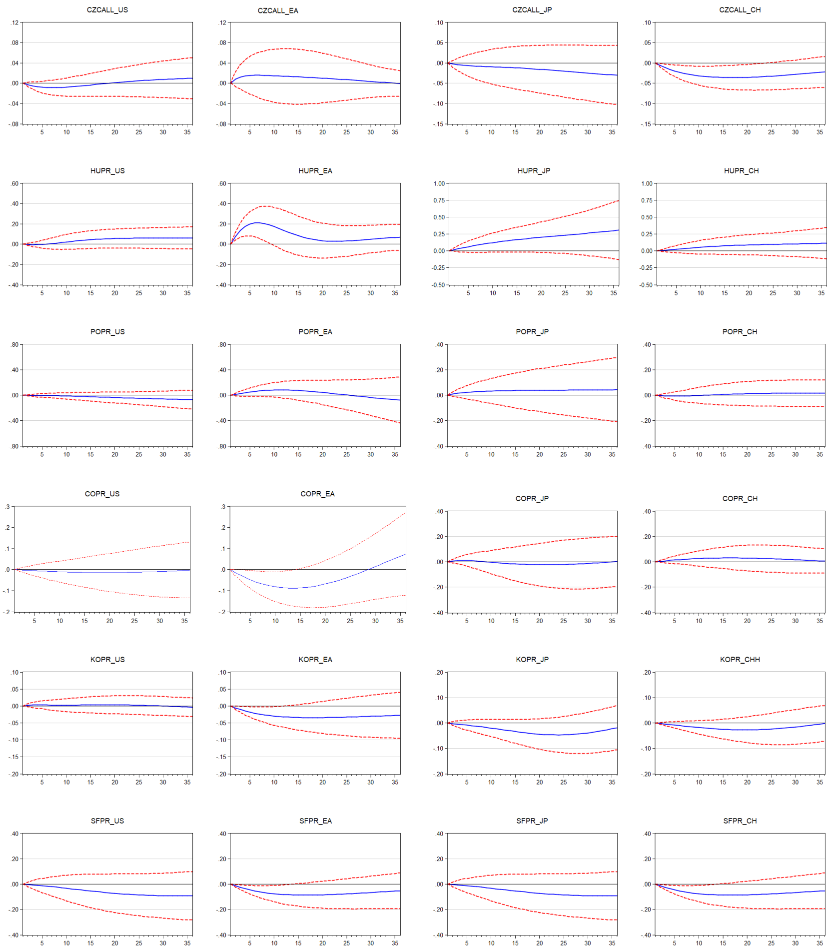


Figure 2.20: The impulses responses of short-term interest rates (PR) in selected emerging Europe to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3 (CH). Country code: CZ: Czech Republic, HU: Hungary, PO: Poland, CO: Colombia, KO: Korea, and SF: South Africa. Sample:- Europe: 2001M01-2018M12; Latin America: 2003M01-2018M12; Asia-Africa: 2000M10-2018M12.

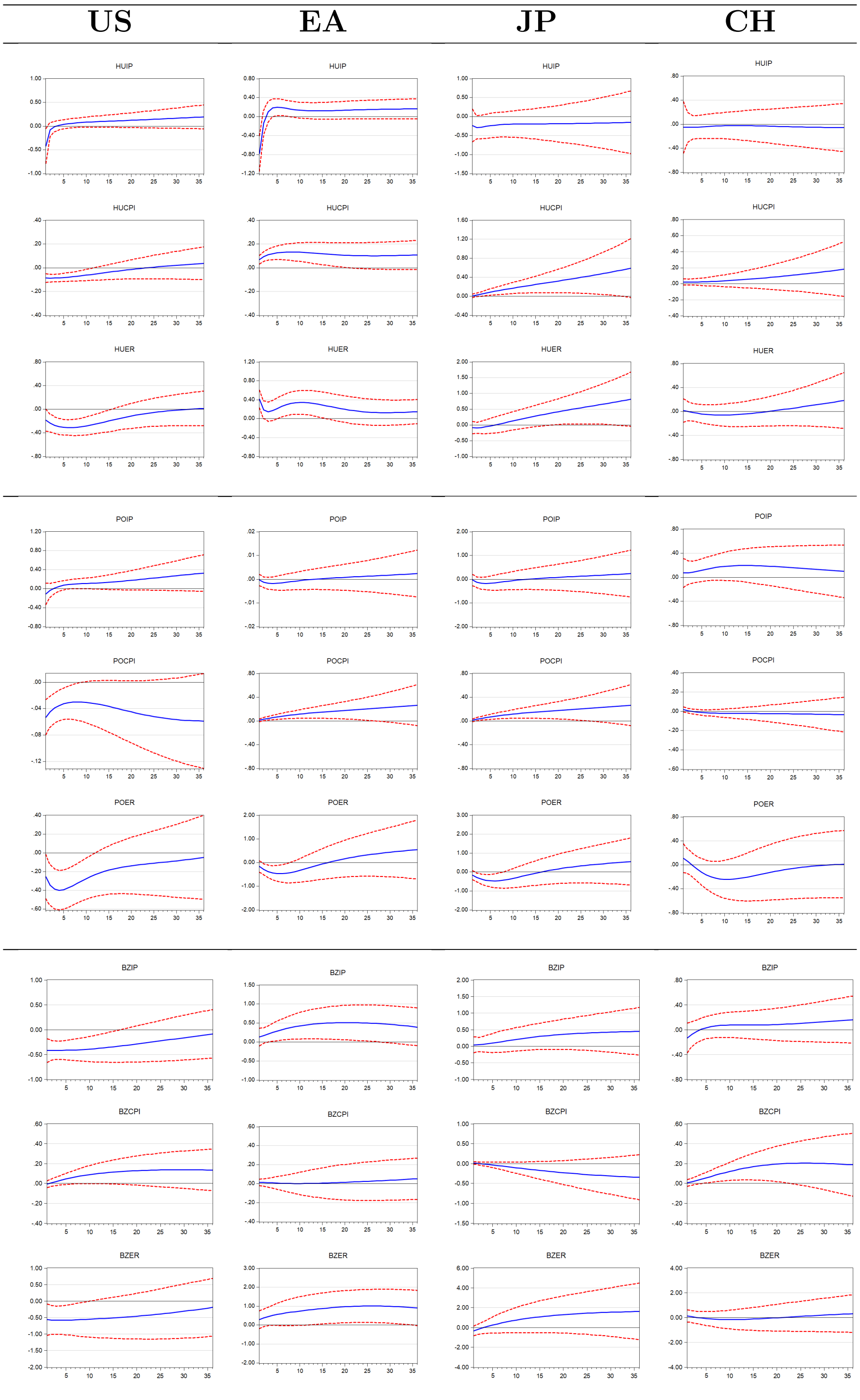


Figure 2.21: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected EMEs to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3(CH), based on the the restrictions that foreign shocks affects the domestic shocks contemporaneously. Country code: HU: Hungary, PO: Poland, and BZ: Brazil.

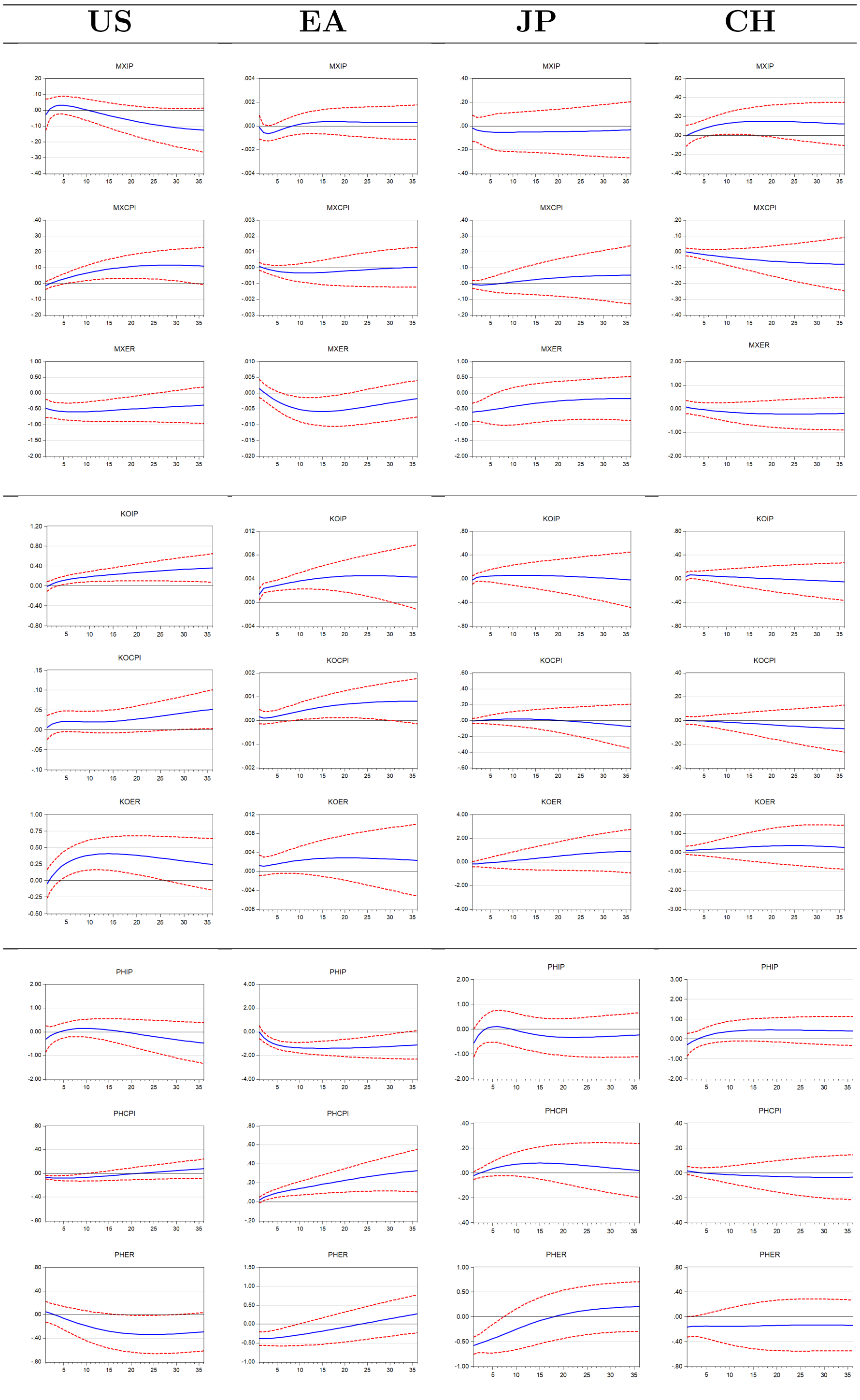


Figure 2.22: The impulses responses of Industrial Production (IP), Consumer Price Index (CPI), and trade-weighted real effective exchange rates (ER) in selected EMEs to one standard deviation innovations to the U.S M3 (US), the Euro Area M3 (EA), Japanese M3 (JP) and China M3(CH), based on the the restrictions that foreign shocks affects the domestic shocks contemporaneously. Country code: MX: Mexico, KO: Korea, and RU: Philippines.

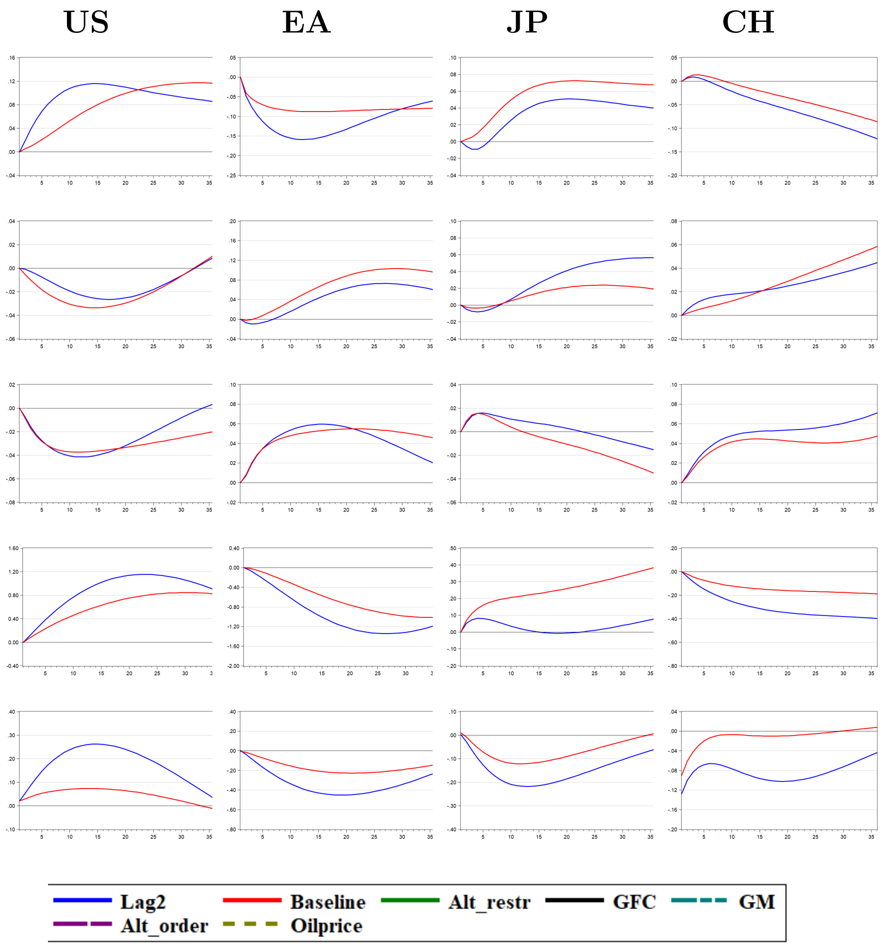


Figure 2.23: Interest rate shocks and GFC: The impulses responses of industrial production, CPI, short-term interest rates, domestic monetary aggregates (M3) and trade-weighted real effective exchange rates in EMEs to one standard deviation to the U.S, the Euro Area, Japanese and China interest rate innovations are shown in the first, the second, the third, the fourth and the fifth rows, respectively. The impulse responses are for the baseline model (blue solid line) and dummy global financial crisis (solid red line). The confidence intervals are excluded for the sake of clarity.

Country	US			EA			JP			CH		
	IP	**CPI**	**I**	**IP**	**CPI**	**I**	**IP**	**CPI**	**I**	**IP**	**CPI**	**I**
AR	0.32	-0.47	-0.28	0.35	0.07	-0.78	1.29	-0.34	-1.59	-0.06	-0.03	-0.04
BZ	-0.20	0.11	-0.03	0.46	0.04	-0.11	0.35	-0.24	-0.18	0.05	0.25	0.07
CL	0.01	0.08	-0.07	0.07	0.20	-0.08	0.05	-0.19	-0.07	0.01	0.00	-0.04
CO	-0.01	0.01	0.00	0.13	0.03	-0.04	0.23	-0.14	-0.10	-0.03	0.01	-0.04
CZ	0.06	0.02	0.004	-0.17	-0.03	0.03	0.14	0.11	0.01	-0.08	-0.06	-0.03
HU	0.21	0.02	0.02	0.09	0.09	0.05	-0.15	0.30	0.15	-0.07	0.06	0.01
ID	-0.06	-0.13	0.02	0.04	0.02	-0.09	-0.06	-0.04	0.00	0.08	0.15	0.01
IN	0.20	-0.03	-0.04	0.24	-0.18	-0.04	0.13	-0.01	0.03	0.20	0.16	0.02
KO	0.24	0.02	0.00	0.41	0.05	-0.02	0.02	0.02	-0.01	-0.02	-0.02	-0.01
MY	0.43	-0.02	-0.01	0.40	0.02	-0.02	-0.05	-0.08	-0.01	0.26	0.00	0.00
MX	-0.03	0.11	0.01	-0.02	-0.02	-0.06	-0.02	0.02	0.002	0.12	-0.05	-0.06
PO	0.26	-0.06	-0.06	0.35	0.06	0.22	0.05	0.17	0.20	0.10	-0.04	0.04
PH	-0.04	0.002	-0.04	-1.49	0.17	-0.10	-0.26	0.07	0.05	0.59	-0.06	-0.01
RU	-0.02	0.03	0.12	0.30	0.22	-0.14	-0.02	-0.14	-0.30	0.09	0.15	0.00
SF	0.10	0.01	-0.04	0.07	-0.17	-0.03	-0.16	0.05	-0.04	0.00	-0.08	-0.07
TK	0.37	0.19	-0.04	0.21	-0.03	-0.13	-0.26	-0.69	0.03	0.01	-0.22	-0.12
TW	0.02	-0.07	-0.02	0.09	-0.06	0.01	-0.08	0.08	0.002	0.10	0.01	-0.04

Table 2.7: The median responses of the EME variables to shocks in the U.S., the Euro Area, and Japan monetary expansions. The responses are computed for one standard deviations confidence bands. Notes: **Variables**: Broad Monetary Aggregate (M3), Industrial Production (IP), Consumer Price Index, All Items (CPI), Short-term interest Rates (PR) and Real Effective Exchange Rates (ER). See Table 2.11 footenotes for country codes.

Appendix A.2. Unit Root Test Results and Data sources

Table 2.8: Unit root tests 1999:1–2018:12

At level			At first difference		
Variables	ADF	PP	Variables	ADF	PP
International Variable					
log(USM3)	10.09	16.31	Δlog(USM3)	-2.63***	-5.64***
log(EAM3)	1.98	2.05	Δlog(EAM3)	-11.07***	-11.02***
log(JPM3)	0.86	0.79	Δlog(JPM3)	-11.99***	-12.04***
log(CHM3)	6.12	10.64	Δlog(CHM3)	-1.93*	-6.54***
log(CP)	1.08	1.05	Δlog(GNPI)	-10.03***	-10.33***
Czech Republic					
log(CZIP)	3.13	2.58	Δlog(CZIP)	-5.75***	-19.01***
log(CZCPI)	5.20	6.48	Δlog(CZCPI)	-4.69***	-12.22***
log(CZM3)	2.68	2.65	Δlog(CZM3)	-12.61***	-12.70***
log(CZER)	1.45	1.45	Δlog(CZER)	-13.77***	-13.76***
Hungary					
log(HUIP)	3.30	2.47	Δlog(HUIP)	-9.50***	-28.06***
log(HUCPI)	4.18	6.43	Δlog(HUCPI)	-2.61***	-6.17***
log(HUM3)	-2.10	-2.08	Δlog(HUM3)	-12.25***	-12.39***
log(HUER)	0.52	0.70	Δlog(HUER)	-12.29 ***	-12.20***
Poland					
log(POIP)	4.72	4.60	Δlog(POIP)	-20.45***	-19.72***
log(POCPI)	4.34	4.72	Δlog(POCPI)	-3.24***	-6.23***
log(POM3)	2.60	2.66	Δlog(POM3)	-11.05***	-11.28***
log(POER)	0.25	0.16	Δlog(POER)	-10.78***	-10.87***
Russia					
log(RUIP)	2.59	2.53	Δlog(RUIP)	-20.95***	-20.74***
log(RUCPI)	4.15	6.92	Δlog(RUCPI)	-3.89***	-3.74***
log(RUM3)	2.57	3.16	Δlog(RUM3)	-7.75***	-7.83***
log(RUER)	1.01	1.04	Δlog(RUER)	-9.99***	-8.94***
Turkey					
log(TKIP)	2.52	2.76	Δlog(TKIP)	-17.00***	-16.94***
log(TKCPI)	1.70	3.80	Δlog(TKCPI)	-2.44***	-3.64***
log(TKM3)	2.24	2.40	Δlog(TKM3)	-12.69***	-12.68***
log(TKER)	-0.28	-0.30	Δlog(TKER)	-11.18***	-10.37***

Notes: M3 of the U.S., the Euro Area, Japan and China, Each emerging market's Consumer Price Index (CPI), Industrial Production (IP), Global Commodity price (CP), and real trade weighted exchange rate index (ER). The lag selection criteria for the ADF is based on Schwarz information Criteria (SIC) and for the PP is the Newey–West Bandwidth. ***, **, * indicates rejection of the null hypothesis at 1%, 5% and 10%, levels of significance.

Table 2.9: Unit root tests 1999:1–2018:12

At level			At first difference		
Variables	ADF	PP	Variables	ADF	PP
Argentina					
log(ARIP)	1.01	0.84	Δlog(ARIP)	-15.78***	-16.03***
log(ARCPI)	4.07	6.85	Δlog(ARCPI)	-2.65***	-3.06***
log(ARM3)	0.38	0.45	Δlog(ARM3)	-17.29***	-17.29***
log(ARER)	-1.60	-1.52	Δlog(ARER)	-11.97***	-12.12***
Brazil					
log(BZIP)	0.84	0.74	Δlog(BZIP)	-17.95***	-17.91***
log(BZCPI)	5.76	10.41	Δlog(BZCPI)	-2.18**	-3.43***
log(BZM3)	2.21	1.87	Δlog(BZM3)	-11.40***	-11.69***
log(BZER)	0.42	0.03	Δlog(BZER)	-12.75***	-12.81***
Chile					
log(CLIP)	1.82	2.36	Δlog(CLIP)	-18.05***	-32.09***
log(CLCPI)	6.02	7.39	Δlog(CLCPI)	-2.63***	-6.55***
log(CLM3)	3.17	3.58	Δlog(CLM3)	-10.87***	-10.89***
log(CLER)	-0.24	-0.28	Δlog(CLER)	-11.94***	-11.62***
Colombia					
log(COIP)	2.14	1.78	Δlog(COIP)	-5.71***	-31.83***
log(COCPI)	2.97	10.30	Δlog(COCPI)	-1.65*	-2.85***
log(COM3)	1.92	2.11	Δlog(COM3)	-10.48***	-10.41***
log(COER)	-0.12	-0.01	Δlog(COER)	-11.24***	-11.09***
Mexico					
log(MXIP)	1.17	1.16	Δlog(MXIP)	-17.78***	-17.61***
log(MXCPI)	7.98	12.36	Δlog(MXCPI)	-1.67*	-4.30***
log(MXM3)	2.66	2.88	Δlog(MXM3)	-12.53***	-12.61***
log(MXER)	-0.48	-0.42	Δlog(MXER)	-12.80***	-12.60***

Notes: Each emerging market's Consumer Price Index (CPI), Industrial Production (IP), Global Commodity price (CP), and real trade weighted exchange rate index (ER). The lag selection criteria for the ADF is based on Schwarz information Criteria (SIC) and for the PP is the Newey–West Bandwidth. ***, **, * indicates rejection of the null hypothesis at 1%, 5% and 10%, levels of significance.

Table 2.10: Unit root tests 1999:1–2018:12

At level			At first difference		
Variables	ADF	PP	Variables	ADF	PP
Indonesia					
log(IDIP)	3.59	2.87	Δlog(IDIP)	-19.44***	-33.65***
log(IDCPI)	7.35	7.79	Δlog(IDCPI)	-1.96***	-10.71***
log(IDM3)	3.53	3.53	Δlog(IDM3)	-12.94***	-12.91***
log(IDER)	0.66	0.71	Δlog(IDER)	-13.07***	-12.60***
India					
log(INIP)	5.37	5.44	Δlog(INIP)	-20.85***	-19.95***
log(INCPI)	8.55	11.71	Δlog(INCPI)	-1.81*	-8.76***
log(INM3)	5.00	5.97	Δlog(INM3)	-9.53***	-9.73***
log(INER)	0.57	0.53	Δlog(INER)	-13.62***	-13.56***
Korea					
log(KOIP)	2.90	2.85	Δlog(KOIP)	-15.36***	-15.39***
log(KOCPI)	11.60	9.91	Δlog(KOCPI)	-1.40**	-11.24***
log(KOM3)	3.50	3.51	Δlog(KOM3)	-9.98***	-9.92***
log(KOER)	0.37	0.32	Δlog(KOER)	-10.24***	-10.36***
Malaysia					
log(MYIP)	3.40	2.80	Δlog(MYIP)	-19.25***	-20.84***
log(MYCPI)	5.22	6.35	Δlog(MYCPI)	-3.05***	-4.60***
log(MYM3)	3.41	3.77	Δlog(MYM3)	-3.24***	-14.37***
log(MYER)	-0.39	-0.33	Δlog(MYER)	-11.22***	-11.15***
Philippines					
log(PHIP)	0.67	1.07	Δlog(PHIP)	-19.25***	-20.84***
log(PHCPI)	5.90	8.93	Δlog(PHCPI)	-3.05***	-4.60***
log(PHM3)	6.41	5.77	Δlog(PHM3)	-3.24***	-14.37***
log(PHER)	0.21	0.30	Δlog(PHER)	-11.22***	-11.15***
Taiwan					
log(TWIP)	1.47	1.63	Δlog(TWIP)	-7.93***	-13.44***
log(TWCPI)	2.57	3.18	Δlog(TWCPI)	-18.21***	-18.25***
log(TWM3)	4.03	4.92	Δlog(TWM3)	-10.12***	-10.18***
log(TWER)	-0.98	-1.00	Δlog(TWER)	-14.52***	-14.50***
South Africa					
log(SFIP)	1.05	0.96	Δlog(SFIP)	-21.51***	-21.51***
log(SFCPI)	4.12	8.83	Δlog(SFCPI)	-2.62***	-4.40***
log(SFM3)	1.51	1.50	Δlog(SFM3)	-12.11***	-12.15***
log(SFER)	-0.35	-0.36	Δlog(SFER)	-12.33***	-12.28***

Notes: Each emerging market's Consumer Price Index (CPI), Industrial Production (IP), Global Commodity price (CP), and real trade weighted exchange rate index (ER). The lag selection criteria for the ADF is based on Schwarz information Criteria (SIC) and for the PP is the Newey–West Bandwidth. ***, **, * indicates rejection of the null hypothesis at 1%, 5% and 10%, levels of significance.

Table 2.11: Sources of data and transformation

Country	Variables							
(region)	M3	IP	CPI	I	ER	GNPI	GEPI	GOPI
Global						IFS	IFS	FRED
US	MEI	FRED, DS	FRED, DS	DS				
EA	MEI	FRED, MEI	FRED, MEI	BIS, DS				
JP	MEI	FRED, MEI	FRED, MEI	BIS, DS				
CH	MEI	FRED, DS	FRED, MEI	BIS, DS				
CZ	MEI	FRED, MEI	FRED, MEI	BIS, DS	BIS			
HU	MEI	FRED	FRED, MEI	IFS	BIS			
PO	MEI	FRED, MEI	FRED, MEI	BIS, DS	BIS			
RU	MEI	FRED, MEI	FRED, MEI	BIS, FRED, MEI	BIS			
TK	MEI	FRED, MEI	IFS	IFS	BIS			
AR	DS	DS	BIS	IFS, DS	BIS			
BZ	MEI	FRED, MEI	FRED, MEI	BIS, FRED, MEI	BIS			
CL	MEI	FRED, MEI	DS	BIS, DS	BIS			
CO	MEI	FRED, MEI	FRED, MEI	IFS, FRED, MEI	FRED			
MX	MEI	FRED, MEI	FRED, MEI	IFS	BIS			
IN	MEI	FRED, MEI	FRED, MEI	FRED, MEI	BIS			
ID	MEI	DS	IFS	FRED, MEI	BIS			
MY	IFS, DS	DS	IFS, DS	IFS	BIS			
PH	DS	IFS	IFS	BIS	BIS			
KO	MEI	IFS	IFS, BIS	BIS, DS	BIS			
TW	DS	DS	DS	DS	BIS			
SF	MEI,DS	DS	IFS	BIS, FRED, MEI	BIS			
SG	IFS, DS	IFS	IFS, BIS	DS	BIS			
Transf	1, SA	1, SA	1, SA	0,NA	1, NA	1, NA	1, NA	1, NA

Abbreviations and transformation code:**Variables**: Broad Monetary Aggregate (M3), Industrial Production (IP), Consumer Price Index, All Items (CPI), Interest Rates (I), Real and Nominal Effective Exchange Rates (ER), Global Commodity Price Index (GCPI), Global Energy Price Index (GEPI) and Global Oil price Index (GOPI). **Data Sources**: Federal Reserve Bank of St. Louis database (FRED), Thomson Reuters Datastream (DS), the IMF's International Financial Statistics database (IFS), MEI – OECD Main Economic Indicators, Organization for Economic Cooperation and Development (OECD), and Bank for International Settlements (BIS) database. **Country code**: United States (U.S), Euro Area (EA), Japan (JP), Czech Republic (CZ), Hungary (HU), Poland (PO), Turkey (TK), Argentina (AR), Brazil (BZ), Chile (CL), Colombia (CO), Mexico (MX), India (IN), Indonesia (ID), Malaysia (MY), South Korea (KO), Philippines (PH), Taiwan (TW), South Africa (SF), Singapore (SG). **Transformation**: SA - Seasonally Adjusted, NA– Not Seasonally Adjusted; 0 = None, 1= logarthimic transformation.

Table 2.12: FAVAR: Data sources and transformations

Variable	Data sources	Transf.
United States		
Interest Rates, interest rate for united states		0,sa
Immediate Rates: Less than 24 Hours: Federal Funds Rate for the U.S		0, sa
3-Month or 90-day Rates and Yields: Interbank Rates for the U.S		0, sa
3-Month or 90-day Rates and Yields: Certificates of Deposit for the U.S		0, sa
Immediate Rates: Less than 24 Hours: Prime Rates for the U.S		0, sa
3-Month or 90-day Rates and Yields: Eurodollar Deposits for the U.S		0, sa
Interest Rates, Government Securities, Treasury Bills for U.S		0, sa
Interest Rates, Discount Rate for U.S		0, sa
Long-Term U.S. Government Securities for U.S		0, sa
Consumer Price Index: Total All Items for the U.S		1, sa
Consumer Price Index: OECD Groups: All items non-food non-energy: Total for the U.S		1, sa
Consumer Price Index: Total Services for the U.S		1, sa
Consumer Price Index: Health : Total for the U.S		1, sa
Consumer Price Index: Food and non-Alcoholic beverages for the U.S		1, sa
Consumer Price Index for All Urban Consumers: Transportation		1, sa
Consumer Price Index - All Urban Consumers - Electricity		1, sa
Consumer Price Index for All Urban Consumers: Household furnishings and operations		1, sa
Consumer Price Index for All Urban Consumers: Education		1, sa
Consumer Price Index for All Urban Consumers: Communication		1, sa
Industrial Production Index in United States: Total industry for the U.S		1, sa
Production: Manufacturing: Total manufacturing: Total manufacturing for the U.S		1, sa
Production: Construction: Total construction: Total for the U.S	FRED	1, sa
Production: Mining: Total mining: Total for U.S		1, sa
Production: Energy: Total energy: Total for U.S		1, sa
Industrial Production: Final Products and Nonindustrial		1, sa
Industrial Production: Nondurable Goods: Clothing		1, sa
Industrial Production: Nondurable Goods: Foods and tobacco		1, sa

Table 2.13: FAVAR: Data sources and transformations

Variable	Data sources	Transf.
Euro Area		
Interest Rates, interest rate for the EA		0, sa
Call Money/Interbank Rate for the EA		0, sa
3-Month or 90-day Rates and Yields: Interbank Rates for the EA		0, sa
Long-Term Government Bond Yields: 10-year: Main for the EA		0, sa
Consumer Price Index: Total Actual Rentals for Housing for the EA		1, sa
Consumer Price Index: All items: Total: Total for the EA		1, sa
Consumer Price Index: Total Services for the EA		1, sa
Consumer Price Index: Total Energy for the EA		1, sa
Consumer Price Index: OECD Groups: All items non-food non-energy: Total for the EA		1, sa
Consumer Price Index: Clothing and footwear: Total for the EA		1, sa
Consumer Price Index: Food and non-Alcoholic beverages for the EA		1, sa
Consumer Price Index: Health (COICOP 06): Total for the EA		1, sa
Consumer Price Index: Transport: Total for the EA		1, sa
Consumer Price Index: Communication: Total for the EA		1, sa
Consumer Price Index: Harmonised prices: Education for the EA		1, sa
Industrial Production Index: Total industry: Total industry for the EA		1, sa
Production: Industry: Total industry: Total industry excluding construction for the EA		1, sa
Production: Manufacturing: Total manufacturing for the EA		1, sa
Production: Construction: Total construction: Total for the EA		1, sa
Production: Manufacturing: Consumer goods for the EA		1, sa
Production: Manufacturing: Investment goods: Total for the EA		1, sa
Production: Manufacturing: Intermediate goods: Total for the EA		1, sa

Table 2.14: FAVAR: Data sources and transformations

Variable	Data sources	Transf.
Japan		
Interest Rates, interest rate for Japan		0, sa
Call Money/Interbank Rate for Japan		0, sa
Immediate Rates: Less than 24 Hours: Central Bank Rates for Japan		0, sa
3-Month or 90-day Rates and Yields: Certificates of Deposit for Japan		0, sa
Long-Term Government Bond Yields: 10-year: Main (Including Benchmark) for Japan		0, sa
Consumer Price Index of All Items in Japan	FRED, MEI, BS, DS	1, sa
Consumer Price Index: Energy for Japan		1, sa
Consumer Price Index: Food and non-Alcoholic beverages : Total: Total for Japan		1, sa
Consumer Price Index: OECD Groups: Services: Total for Japan		1, sa
Consumer Price Index: Education : Total: Total for Japan		1, sa
Consumer Price Index: Health: Total: Total for Japan		1, sa
Consumer Price Index: Communication: Total: Total for Japan		1, sa
Consumer Price Index: OECD Groups: Housing: Total for Japan		1, sa
Consumer Price Index: Transport: Total: Total for Japan		1, sa
Production in Total Manufacturing for Japan		1, sa
Industrial Production Index for the Japan		1, sa
Production: Manufacturing: Investment goods: Total for Japan		1, sa
Production: Manufacturing: Intermediate goods: Total for Japan		1, sa
Production: Construction: Total construction: Total for Japan		1, sa
Production: Energy: Total energy: Total for Japan	FRED	1, sa
Production: Mining: Total mining: Total for Japan		1, sa

Table 2.15: FAVAR: Data sources and transformations

Variable	Data sources	Transf.
China		
Interest Rates, interest rate for China	FRED, MEI, BS, DS	0, sa
Interest Rates, Discount Rate for China		0, sa
3-Month or 90-day Rates and Yields: Treasury Securities for China		0, sa
Immediate Rates: Less than 24 Hours: Central Bank Rates for China		0, sa
3-Month or 90-day Rates and Yields: Interbank Rates for China		0, sa
Immediate Rates: Less than 24 Hours: Call Money/Interbank Rate for China		0, sa
Consumer Price Index: All Items for China		1, sa
Consumer Price Index: Total Food Including Restaurants for China		1, sa
Consumer Price Index: Food and non-Alcoholic beverages (COICOP 01): Total: Total for China		1, sa
Industrial Production Index: Total industry: Total industry for China		1, sa

Sources: Federal Reserve Bank of St. Louis database (FRED), Thomson Reuters Datastream (DS), MEI – OECD Main Economic Indicators, Organization for Economic Cooperation and Development (OECD), and Bank for International Settlements (BIS) database. **Transformation**s: 0 – none, 1 – log transformation, sa - seasonally adjusted and na - not seasonally adjusted.

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