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Abstract

In this paper, the interaction between fiscal and monetary policies in Malawi is analyzed in a structural VAR framework employing sign restrictions. The key question addressed is whether macroeconomic policy environment in Malawi is characterized by fiscal dominance or monetary dominance. The model that we derive is used to identify government spending shocks, government revenue shocks, and monetary policy shocks so as to observe their respective effects on the conduct of fiscal and monetary policy. The results show that policy making in Malawi leans towards a monetary dominant regime rather than a fiscal dominant one. This is manifested by a counteractive reaction of monetary policy to loose fiscal policy on one hand and a cooperative reaction of fiscal policy to tight monetary policy stance on the other hand. The results also show that spending shocks are not financed by tax revenues which, coupled with the non-cooperative nature of monetary policy, is consistent the high public debt accumulation observed in the data.

JEL classification: *E52, E58, E62*

Keywords: *Fiscal dominance, monetary dominance, fiscal policy, monetary policy, structural VAR, sign restrictions, Malawi*

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1. Introduction

In this chapter, we explore the interaction between fiscal and monetary policy in Malawi in order to establish how the two affect each other and whether the macroeconomic policy environment in the country is characterized by of fiscal dominance or monetary dominance. In particular, we examine how the Reserve Bank of Malawi's monetary policy variables (the bank rate and reserve money) respond to structural shocks to the government's fiscal policy variables (government spending and revenues) and vice versa. We conduct the analysis by employing a structural vector autoregression (SVAR) with sign restrictions, an approach that has not been explored so far in the analysis of macroeconomic data for Malawi.[2] As such, our primary contributions are twofold. Firstly, we provide evidence on the form of interaction between fiscal and monetary policies in Malawi, and secondly we use the sign restrictions approach to analyze macro policy in Malawi. The motivation behind the study is as follows.

It is generally accepted that central bank independence, and synergy of fiscal and monetary policies are crucial for effective macroeconomic policy. A central bank's ability to execute monetary policy without undue influence from fiscal authorities enables it to adhere its set monetary policy rules that dictate the monetary policy stance deemed appropriate for attaining desired macroeconomic objectives such as price stabilization and business cycle moderation. It is therefore not surprising that a lot of evidence points to a positive relationship between macroeconomic performance of a country on one hand, and the level of independence of the central bank or it's adherence to monetary policy rules on the other.[3]

In the case of Malawi, how fiscal and monetary policies interact with one another is of particular interest given that the country's limited capacity for public revenue generation from its small tax base regularly results in substantial budget deficits as recurrent expenditures alone tend to exhaust virtually all domestically generated revenues.[4] This setting implies that if the Reserve Bank of Malawi (RBM) does not exercise full independence from the central government or if it does not strictly adhere to its own monetary policy rules, the risk of fiscal policy dominating monetary policy is high as long as the central bank takes into consideration the financing needs of the government when implementing monetary policy. However if monetary authorities remain committed to their policy objectives and are only minimally influenced by the government's fiscal needs, then fiscal policy would largely be influenced by monetary policy since the former would have to operate within the conditions set forth by the latter.

In general, policy environment that is reflective of fiscal or monetary dominance can take on many forms. With fiscal dominance for instance, monetary authorities may react to debt financed fiscal expansion by artificially holding interest rates low in order to create favorable borrowing conditions for the government. Another way would be for

[2] To the author's best of the knowledge, no study preceding this one has used SVAR with sign restrictions to analyze macroeconomic policy in Malawi.

[3] See Alesina, A. and L. Summers (1993), and Taylor J.B. (2013). Taylor shows that in the case of the US, adherence to monetary policy rules generated good monetary policy outcomes although formal central bank independence alone did not.

[4] See next section. Figures 1 and 2 provides a visual inspection of budgetary trends in Malawi.

monetary authorities to ignore inflation targets so that accumulated public debt is inflated away. But probably the most obvious and yet quite common form of fiscal dominance is seigniorage financing of government expenditures.[5] As for monetary dominance, one case arises when tight monetary policy raises concerns about fiscal solvency thereby prompting fiscal authorities to resort to fiscal tightening in order to satisfy the government's inter-temporal budget constraint. Heavily indebted economies with inflation targeting central banks or those pursuing exchange rate pegs for example are more susceptible to this kind of monetary dominance.[6]

At this point, it is important however to emphasize that in many countries fiscal and monetary policies do not operate in such parasitic relationships. Coordination between the two is a common feature in many economies and is encouraged by most economists. The response of United States of America to the 2008 global economic crisis serves as a good example of fiscal and monetary policy coordination. The US responded to the crisis by on one hand employing loose fiscal policy measures through the economic stimulus act of 2008 and the America Recovery and Reinvestment Act of 2009, both of which comprised of massive spending programs and tax rebates, while simultaneously employing an aggressively loose monetary policy through the quantitative easing programs. Some analysts have pointed to this coordination as the reason why the US presumably did not slide into an even greater recession and appeared to have recovered from the crisis faster and more robustly than other advanced economies such as in the euro area.

The euro area on the other hand is often criticized for having a monetary union without a common fiscal policy, an arrangement that renders coordination between monetary policy pursued at the European Central Bank (ECB), and the multiple country specific fiscal policies practically impossible. Not surprisingly, many of the critics have attributed the apparent slower recovery of the euro area to the fiscal-monetary policy coordination challenges. Orphanides, A. (2017) for instance does a comparative analysis of the fiscal and monetary policies of the euro area and the US and their effects economic outcomes and he finds that both fiscal and monetary policy in the euro area had been overly tight as a result of the institutional framework of fiscal policy and the rigidities that still hamper the ECB's implementation of monetary policy.

Whatever position one takes regarding the appropriate framework of macroeconomic policy, it is clear that fiscal and monetary policy coordination is crucial to attaining macroeconomic policy objectives. At the very least, fiscal and monetary authorities should not be working to undermine each other by necessitating significant compromises from the other party with regards to pursuing that party's own policy objectives. It is therefore important for macro-policy makers to empirically establish how the two policies interact with each other so that appropriate steps can be undertaken to enhance effective macroeconomic policy implementation.

[5] Sabate et al (2005) examines this kind of fiscal dominance in the case of Spain.

[6] Tanner, E. & Ramos, E.M. (2003) investigate whether Brazil had undergone this kind of monetary dominance during some periods in the past.

2. Literature review

2.1. Theoretical Literature

This section examines some of the main theoretical propositions that are relevant to the topic of fiscal and monetary policy interaction. First we do a quick review of the Quantity Theory of Money (QTM) and the Fiscal Theory of Price Level (FTPL). Although the main focus of these theories is not on how fiscal and monetary policies interact, they do provide insights on their respective individual roles with regards to their impacts on macroeconomic policy objectives. Secondly, we examine the theory proposed by Sargent, T.J and Wallace, N. (1981) in which the interaction between fiscal policy and monetary policy is explicitly modeled in order to see how monetary policy is affected by fiscal policy.

2.1.1. Quantity Theory of Money vs the Fiscal Theory of Price Level

In macroeconomic literature, inflation dynamics have largely been considered a monetary phenomenon. Therefore the monetarist view of price level determination, in which the quantity theory of money is at the core, has maintained traction over a long period of time. In its most basic form, the QTM is represented by the Fisher's equation of exchange which is specified as follows.

$$M_t V = P_t Y_t$$

where M_t is the period t supply of nominal money balances in the economy, V is the velocity of money which is assumed to be constant, P_t is the period t price level, and Y_t is the period t real output. The Fisher equation says that the value of total transactions in the economy must equal to total expenditures. The basic QTM goes on to assume low volatility of real output such that Y_t is considered constant at least in the short run thereby making the price level directly proportional to money supply by the equation

$$P_t = M_t V / Y$$

This setting implies that inflation is entirely determined by the supply of nominal money balances and therefore prices will adjust immediately with changes in money supply.

Unsurprisingly, the simplistic nature of the QTM has earned it a lot of criticism particularly with regards to the assumption of a constant money velocity, and also with regards to the implication that money is neutral. Furthermore, it is generally accepted that variables such interest rates and fiscal variables have significant influence on the price level, but these are completely overlooked by the QTM.

In sharp contrast to the QTM, the Fiscal Theory of Price Level (FTPL) whose main proponents include Leeper, E. (1991), Woodford, M. (1995), and Sims, C. (1994) focuses on fiscal factors as the primary determinants of prices. In the FTPL framework, public debt and primary fiscal surpluses rather than money supply determine the price level in the long run. This theory can be summarized as follows.

Let B_t stand for nominal government debt, T_t for nominal tax revenue, G_t for nominal government expenditures, and β for the discount factor. In this theory, the price level is determined by the government's solvency equation,

$$\frac{B_t}{P_t} = \sum_{t=0}^{\infty} \beta^t (T_t - G_t)$$

which says that at any given time t, government debt in real terms must be equal to the present value of current and future primary surpluses. Under a Ricardian fiscal regime, when real debt B_t/P_t rises, governments must adjust primary surpluses $T_t - G_t$ in order to ensure long run fiscal solvency. However, FTPL recognizes that in reality governments are mostly non-Ricardian in which case it is the price level P_t that has to adjust to changes in government debt or changes in primary fiscal surpluses. As such, in this framework prices are determined by fiscal policy.

Both FTPL and QTM represent rather extreme views given their respective treatment of fiscal or monetary policy as the sole determinants of inflation, without exploring how the two policies might affect each other. One can make the argument that at any given point in time, both fiscal and monetary policy have some explanatory power on price movements and as such both theories are valid to some degree. If that is the case, then clearly monetary policy and fiscal policy would affect each other if either one of them was concerned with price movements. In that case, any theory attempting to explain price movements must unify the two views and incorporate the interaction between the two policies. Sargent, T. and Wallace, N. (1981) set out to do just that.

2.1.2. The Sargent and Wallace Model

In their seminal paper "Some Unpleasant Monetarist Arithmetic", Thomas Sargent and Neil Wallace provided new insights on how long run inflation could be affected by the relationship between fiscal and monetary policy. In their model, seigniorage is factored into their government inter-temporal budget constraint specified as

$$D_t = \frac{(M_t - M_{t-1})}{P_t} + [B_t - B_{t-1}(1 + R_{t-1})]$$

which says that fiscal deficit D_t is financed by adjustments in the monetary base M_t, and the issuing of government bonds B_t that pay R_t in real interest rate.

In the model, fiscal solvency beyond some horizon T is only achieved when the path of M_t satisfies the condition that the stock of real government debt, $b_T \equiv B_t/P_t$ be held constant at the level attained in period T. This is a restriction on fiscal policy which is consistent with there being a limit on the amount of real debt that the government can accumulate and sustain. This has interesting implications on inflation namely that, the inflation rate in periods beyond T depends on the level of period T real government debt b_T, and that b_T negatively depends on the growth rate of money, m. That is to say, tight monetary policy (low m) leads to high long run debt b_T, which in turn leads to higher long run inflation.[7] The model shows that in order to maintain b_T at a level consistent with solvency in the periods $t > T$, seigniorage will inevitably have to be used to finance

[7] See Sargent and Wallace (1981) page 4 for a detailed explanation.

fiscal deficits. In short, tight monetary policy cannot be sustained overtime due to accumulated government debt thus ensuring fiscal dominance in the economy.[8]

2.2. Empirical literature

Studies concerning the interaction of fiscal and monetary policy have been conducted by several authors. Some of the studies, mostly based on DSGE models, have focused on the optimal mix between the two policies, others, mostly employing VAR models, have looked at how the two policies shape each other. In this section, we review some of these studies with a focus on the latter category since the issues that they cover and the methodologies used are more aligned with our own study here.

Arora (2017) used a VAR with sign and magnitude restrictions to analyze how India's tax policy, government spending policy, and monetary policy affect each other and other macroeconomic variables. The study found evidence of fiscal dominance which manifested by an expansionary reaction of the two fiscal policies in response to a monetary policy tightening.

Sabate et.al (2005) focusses on identifying how fiscal policy affects monetary policy in the case of Spain. In this paper, they use a two variable VAR with only fiscal deficit and base money growth. They too find evidence of fiscal dominance that takes the form of seigniorage financing of fiscal deficits. They further conclude that it was this need for seigniorage financing of deficits that was responsible for Spain's renouncement of the gold standard.

Obenyeluaku and Viegi (2009) investigated fiscal and monetary dominance focusing on southern African countries. In this study, identification of the policy regime is achieved by examining the relationship between public liabilities and primary fiscal surplus. Specifically, they test how primary surpluses respond to temporary shocks in public liabilities in those countries. They concluded that Lesotho, Botswana, Malawi, Zambia and Zimbabwe have fiscal dominant regimes while South Africa, Swaziland, Mauritius, Seychelles and Tanzania have monetary dominant ones.

Similarly, Zoli (2005) also investigated fiscal and monetary dominance in several emerging economies by examining the relationship between current public liabilities and future primary fiscal surplus. The study also tested whether fiscal balances were integrated into the monetary policy functions of these countries. The study concluded that fiscal dominance existed in Argentina and Brazil in the 1990s and 2000s, while for Colombia, Mexico, Thailand and Poland the results were ambiguous.

The above cases all focus on a specific type of fiscal dominance, one in which monetary policy is constrained by concerns of fiscal solvency. However, a case has been made for a different kind of fiscal dominance, one whereby high public debt makes tight monetary policy undesirable since raising interest rates increases the risk of sovereign debt default which in turn depreciates the exchange rate and causes inflation. Blanchard (2004) looked at this type of fiscal dominance in the case of Brazil and found that the

[8] Another implication from the model is that the policy conflict between fiscal and monetary policy can be easily resolved by simply adjusting the power dynamics such that the monetary authorities make the first move by deciding θ and then fiscal authorities formulate fiscal policy within the parameter set forth by the monetary authorities.

level and the composition of public debt in Brazil as of the year 2002, and an increase in risk aversion in world financial markets, resulted in perverse effects of interest rate hikes on the exchange rate and inflation. Due to perceived increase in sovereign default risk, tight monetary policy led to capital flight and exchange rate depreciation which in turn resulted in higher inflation instead of lower inflation as intended. The aforementioned Zoli (2005) also looks at this kind of fiscal dominance for Brazil and found quite similar results to Blanchard's. Specifically, Zoli concluded that fiscal events had significantly influenced sovereign spreads and exchange rates in a way that pushed the economy into an equilibrium in which interest rate hikes were likely to be associated with a depreciation, rather than an appreciation of the exchange rate.

3. Methodology

Our analysis is based on a structural VAR model employing sign restrictions to identify fiscal and monetary policy shocks and analyze how they affect macroeconomic policy. The sign restrictions approach has recently gained popularity for among other reasons, the fact that it allows for more structure to be imposed into the VAR model so that crucial prior expectations are not violated.9 The approach also allows one to identify only the subset of shocks that are of relevance to the subject matter at hand without having to focus on identifying the other shocks in the model.

3.1. How SVAR with sign restrictions work

In this section we look at how the method of "SVAR with sign restrictions" works. We focus on how it achieves the identification of structural shocks from a given reduced form VAR model. For illustration, we use following n-variable reduced form VAR.

$$X_{\mathrm{t}} = \beta_0 C + \sum_{j=1}^{j=p} \beta_j X_{t-j} + e_t \ , \qquad t = 1, \dots, T. \tag{1}$$

where X_{t} is an $n \times 1$ vector of endogenous variables, C contains deterministic terms such as constants and trends, β_0 and β_j s are parameter matrices for C and X_{t-j} respectively, and e_t is the $n \times 1$ vector of zero mean normally distributed forecast errors which are likely correlated. Furthermore, denote Σ as the $n \times n$ variance-covariance matrix of the forecast errors such that:

$$\Sigma = E[e_t{}' e_t]$$

The goal in the SVAR framework is to discern the relationship between e_t and some vector of uncorrelated errors, $u_t \sim N(0, I)$. One way of achieving this is through the recursive SVAR approach where the variables in X_{t} are ordered based on their level endogeneity and then Σ and e_t are used to extract to $u_t$using the linear relationship:

$$e_t = \mathrm{A} u_t \tag{2}$$

where A is set to be the Cholesky factor of Σ. Thus in this framework, $u_t = A^{-1} e_t$ is the identified vector of structural shocks with zero mean and zero covariances.

[9] see Fry, R and Pagan. A (2011) for summary of papers that employ the sign restrictions methodology.

However the u_t derived by the recursive approach is only one of the many candidate structural shocks of equation (1). But in order to restrict the behavior of impulse responses, the sign restrictions approach seeks to generate many other candidate shocks, $\eta_{k,t}$, so that only those that conform to the imposed sign restrictions are retained or given higher weights during simulations. Using the "pure sign restrictions" approach of Uhlig (2005), this can be achieved by further transforming u_t using

$$\eta_{k,t} = Q_k u_t \tag{3}$$

where Q_k are set to be some n × n orthonormal matrices that are randomly generated from a uniform prior. In this case, given that

$$E\left[\eta_{k,t}\,\eta_{k,t}'\right] = E[Q_k u_t u_t' Q_k'] = Q_k E[u_t u_t'] Q_k' = Q_k Q_k' = I_n\,,$$

then it follows that all $\eta_{k,t}$ contain uncorrelated elements and therefore are candidate impulses for the VAR model (1). Once these impulses have been derived, identification of shocks becomes a matter of satisfying the relevant sign restrictions.

With the sign restrictions approach however, one must keep in mind two important issues when making statistical inference. The first is that two different shocks may look similar with respect to the identifying variables on which sign restrictions are imposed. If that happens to be the case, then one runs the risk of misidentifying the shocks and therefore making wrong inferences about how variables relate to one another. Fry, R. et al (2011) calls this the *multiple shocks problem*. It is therefore imperative when implementing this approach to provide enough restrictions necessary for distinguishing one shock from another because failure to do so may result in misidentification.

The second issue is that of non-exact model identification which results from the use of multiple Q_k. This "multiple models problem" adds another source of uncertainty on top of that coming from the estimation of the VAR parameters, $(\beta_0\,, \beta_j\,, \Sigma)$ thereby making statistical inference more challenging. The pure-sign-restrictions approach addresses this issue by employing a Bayesian technique that assigns equal prior probabilities to all $\eta_{k,t}$ satisfying the sign restrictions and zero prior probabilities to those that do not. In this approach, Uhlig uses a Normal-Wishart prior and draws $\theta \equiv \left(\beta_0\,, \beta_j\,, \Sigma\right)$ from the resultant Normal-Wishart posterior distribution while selecting Q_k from a uniform distribution. This way, one can simply use the median and some quantiles of the generated impulse responses to summarize the models and make statistical inferences.[10] [11] We use this same approach in this study.

3.2. Identification of fiscal and monetary shocks

For our purposes, we identify and analyze 3 shocks namely: government spending shocks, government revenue shocks and monetary policy shocks. We do so by using the

[10] Fry R. et al (2011) make the point that, still more these percentiles should not be considered as providing point estimates and confidence intervals but rather just a glimpse of the possible range of impulse responses across possible models.

[11] Another approach is using median target which standardizes the impulse vectors and selects the model whose impulse responses are closest to the median response.

"pure sign restrictions" strategy explained above. The specification of the VAR system that we use, the data, and the sign restrictions imposed are outlined next.

3.2.1. VAR specification

The shocks under examination are identified using a Bayesian VAR model that corresponds to setting equation 1 such that X_t is an 8×1 vector of macroeconomic variables that include: government spending, government revenue, the bank rate, reserve money (monetary base), private credit, exchange rate, the Consumer Price Index (CPI), and industrial production index (IPI). All the variables in our VAR model, apart from the bank rate, are transformed into logs and the VAR model is fitted in levels (of the logs) as opposed to the stationary differences of the variables.[12] This follows arguments from Sims, C.A (1980) and Sims, C.A et al. (1990) where the idea of taking differences of the data it is argued against from the perspective that transforming data to its stationary differences entails loss of important information.

We include $p = 6$ lags in the system although the lag selection tools recommend fewer lags (1 lag in the case of the Bayesian Information Creterion (BIC)). The inclusion of up to 6 lags is based on the prior beliefs that policy makers base their decisions on data observed over a longer period of time rather than on the observations of the previous month alone. With regards to the choice of the deterministic components in the VAR, C is set to include a constant only. This choice is based on model stability tests and likelihood tests comparing 3 specifications of C. The results of these tests are summarized in Table 1 below. As the table shows, setting C to 0 results in a model that is not stable as the highest root of the characteristic equation lies outside the unit circle. On the other hand, setting C to contain a constant or a constant and a linear trend passes the model stability test. Therefore, our choice of C comes down to either a constant only or a constant and linear trend. For this decision, we look at the Bayesian Information Criterion (BIC) and there we choose the model with a constant only.

Table 1: *VAR model specification criteria*

Model	with no deterministic component	with intercept only	with intercept and trend
BIC	-4.187768	**-4.279801**	-4.245500
Log likelihood	1537.390	1569.980	1587.788
Highest root	1.001438	0.997980	0.972835

For the estimation of the parameters in our VAR, a diffuse normal-Wishart prior is used in which we set the first hyper-parameter μ_1 equal to 1 to reflect the persistence in our data, and set the second hyper-parameter λ_1 to infinity to maintain as much objectivity as possible.[13] The structural shocks which we use in our sign restrictions algorithm described in section 3.1, are computed from the posterior residual covariance matrices

[12] All eight variables are tested for stationarity using the augmented Dicky-Fuller test and the results show that all the variables are integrated of order one, *I(1).*

[13] Here, μ_1 is the hyper-parameter for the persistence of the variables' own first lags, and λ_1 is the hyper-parameter that controls the overall tightness of the prior distribution. The other hyper-parameters λ_3 and λ_4 are both set to zero.

which are derived analytically (thanks to our use of a conjugate prior) as opposed to by simulations with MCMC algorithms. We use EViews 9 software for the computations.

3.2.2. Data

This study utilizes monthly data from April 1995 to March 2015 (240 observations). This data is sourced from the Reserve Bank of Malawi (RBM), the Ministry of Finance (MoF) in Malawi, and International Financial Statistics (IFS) of the IMF. A total of 8 variables are used in the analysis and these variables are sourced as follows.

The two fiscal variables, government spending and revenue, are both sourced from MoF and are respectively defined as total government expenditures and total domestic revenue collected by the government.[14] For the monetary policy variables, the RBM bank rate and reserve money are used as measures the central bank's policy rate and money supply respectively.[15] Both these variables are sourced from the RBM statistical database. For private credit we use the RBM's data on credit extended by financial institutions to the private sector. The US dollar (USD) to Malawi kwacha (MWK) exchange rate is used for the exchange rate variable and it is also sourced from the RBM. For the CPI and IPI, both taken from the IFS.[16]

3.2.3. Identifying restrictions

The sign restrictions that are used in the identification of the shocks are summarized in Table 2 below. For each shock, the restrictions are imposed over a $K = 6$ month period starting from the impact month (month $k = 1$) through month number 6. We use $K = 6$ in order to rule out minor temporary movements in the variables that could be mistaken for the actual policy shocks. Stricter restrictions of 12 months are also employed in order to check if the results are sensitive to K.

Table 2: *Sign restrictions for identifying fiscal and monetary shocks*

	gov. spend.	gov. rev.	bank rate	reserve money	pvt. credit	exch. rate	CPI	IPI
Fiscal policy shocks								
spending shock	+	?	?	?	?	?	+	?
revenue shock	?	-	?	?	?	?	?	?
monetary policy shocks								
interest rate	?	?	+	?	-	?	-	?
money supply	?	?	?	-	-	?	-	?

Note: "+" / "-" means the variable reacts positively/negatively, for k = 1,…,6. "?" means the variable is unrestricted.

[14] Cubic spline interpolation is used to estimate 1 missing value (1996:03) of government revenue data.
[15] The RBM's bank rate is interest rate that the RBM charges commercial banks for short term loans. Its movements work as a signal to the banks regarding changes in monetary policy stance.
[16] Cubic spline interpolation is used to estimate 8 missing values in industrial production index data (2004:09 to 2004:12 and 2011:01 to 2011:04).

Fiscal policy shocks

The sign restrictions imposed on government spending shocks and government revenue shocks as presented in Table 2 correspond to the following assumptions:

Assumption 1: an expansionary government spending shock is one in which reactions of government spending and prices are not negative at horizons $k = 1, \dots, 6$.

Assumption 2: an expansionary government revenue shock is one in which the reaction of domestic revenue is not positive at the horizons $k = 1, \dots, 6$.

Assumption 1 is straight forward with respect to the government spending variable given that we are considering an expansionary shock. As for the restrictions on prices, we use the aggregate demand-aggregate supply (AG-AS) macroeconomic model as justification. This model has a generally supported the prediction that an increase in government spending *ceteris paribus*, implies higher aggregate demand and thus a positive adjustment of prices. *Assumption 2* it is also straight forward as it simply says that an expansionary revenue shock is characterized by reduction in government revenues.

For both types of fiscal shocks, the analysis is agnostic with respect to the reaction of the bank rate and reserve money, the two monetary policy variables whose reactions are of primary focus in this study. In fact, no hypothesis on the reaction of these variables is proposed since their respective reactions largely depend on institutional factors rather than economic theory. In other words, how they react is entirely an empirical issue.

Lastly, when we identify government spending shocks, we leave government revenues unrestricted and similarly when we identify revenue shocks, government spending is left unrestricted. This is done in order to observe the "pure" reactions of the two fiscal variables in response to a shock to the other. How these two react to each other provides some additional information on whether we have fiscal or monetary dominance.

Monetary policy shocks

With regards to monetary policy shocks, we focus on both interest rate and money supply shocks and examine how each of these two affect fiscal policy and vice versa. For this reason, we proceed by providing two different definitions of monetary policy, one corresponding to a targeting of interest rates and the other corresponding to a targeting of money supply. The sign restrictions that we impose for the two types of monetary policy shocks are summarized in Table 2 and these correspond to the following assumptions.

Assumption 3: a contractionary policy rate shock is one in which the reaction of the bank rate is not negative, and that of private credit and prices is not positive for periods $k = 1, \dots, 6$.

Assumption 4: a contractionary money supply shock is one in which reactions of reserve money, private credit, and prices are not positive for periods $k = 1, \dots, 6$.

Assumption 3 is guided by a very strong consensus among economists on the expected behavior of a policy rate shock. The restriction on private credit stems from the credit demand function whereby less credit is expected to be demanded if its price (interest rate) goes up. As such it is reasonable to expect that at the very least, borrowers

will not borrow more as a result of interest rates going up. One could also look at this argument from the supply side and note that lenders would have incentive to supply more credit if the return from it (interest rate) goes up. In this case one could identify the shock using supply side variables such as non-borrowed reserves as done by Uhlig (2005). With regards to the restriction on prices, the goal is to address the "price puzzle" that is often observed in monetary VAR models including those using Malawi data such as Ngalawa (2011). Under the Keynesian interest rate channel, we expect that monetary tightening through an interest rate hike will not lead to an increase in prices given that liquidity is negatively affected. As Uhlig (2005) states, the expected relationship between interest rates and prices is one of the least debatable issues in economics.

For *Assumption 4*, the negative restriction on prices with respect to money supply shocks is a prediction of the quantity theory of money which says that money supply shrinkage (growth) is disinflationary (inflationary). The restriction on private credit is a recognition that when altering money supply, central Banks target the liquidity of commercial banks in order to influence their lending behavior and facilitate or slow down the money creation process. As such a contractionary money supply is expected to lower the level of private credit extended by commercial banks due to the decreased liquidity of commercial banks. Lastly, in order to see the pure reaction of the fiscal variables to the monetary shocks, we leave government spending and revenues unrestricted.

3.3. Criteria for identifying fiscal or monetary dominance

As discussed in section 1, there are many ways in which fiscal and monetary policies affect each other. As such, different definitions of fiscal and monetary dominance tend to be used depending on the type of interaction that one is looking at. Therefore, having identified the shocks, our next step is to specify the criteria that we use to classify policy regimes. In other words, we need a precise decision rule on what behavior of policy variables given the identified shocks constitutes fiscal dominance and what constitutes monetary dominance. This criteria is presented in Figures 1 and 2 below.

Two conditions are used as decision rules for identifying a policy regime. The first is a necessary condition for ruling in or ruling out a particular regime. Under this condition, the dominance of a policy is *ruled out* if a shock to that policy *does* induce a counteractive reaction from other policy. Otherwise, it is ruled in. Thus in our analysis, if loose fiscal policy induces contractionary monetary policy, then fiscal dominance is ruled out since monetary policy is active.[17] Similarly if contractionary monetary policy induces loose fiscal policy, then we can rule out monetary dominance since fiscal policy is active.

The second condition that we use is a sufficient condition for deciding in favor of a particular regime over the other. Under this condition, the dominance of a policy is accepted if shocks to that policy are accommodated by cooperative adjustments in the dominated policy. For instance, it is sufficient to rule in favor fiscal dominance if expansionary fiscal shocks trigger monetary easing. Similarly, we can rule in favor of monetary dominance if a contractionary monetary policy shock triggers fiscal contraction. However, we take caution with regards to how we interpret the reactions of government

[17] we use Eric Leeper's definitions of active and passive policies. "An active authority pays no attention to the state of government debt and is free to set its policy as it sees fit. A passive authority on the other hand responds to debt shocks and is therefor constrained by the active authority's actions.

revenue in response to monetary policy. This is because when a monetary contraction is followed by a decline revenue, it may imply two things. Either government has adopted loose fiscal policy, or tax remittances have simply decreased. The latter does not necessarily signal a loosening of fiscal policy, but rather it may also reflect the tight economic conditions created by the monetary contraction. In this analysis therefore, the reaction of revenues to a monetary shock does not help us distinguish one regime from the other, and for this reason we focus on the reaction of government spending.

***Figure 1**: Regime identification given fiscal shocks*

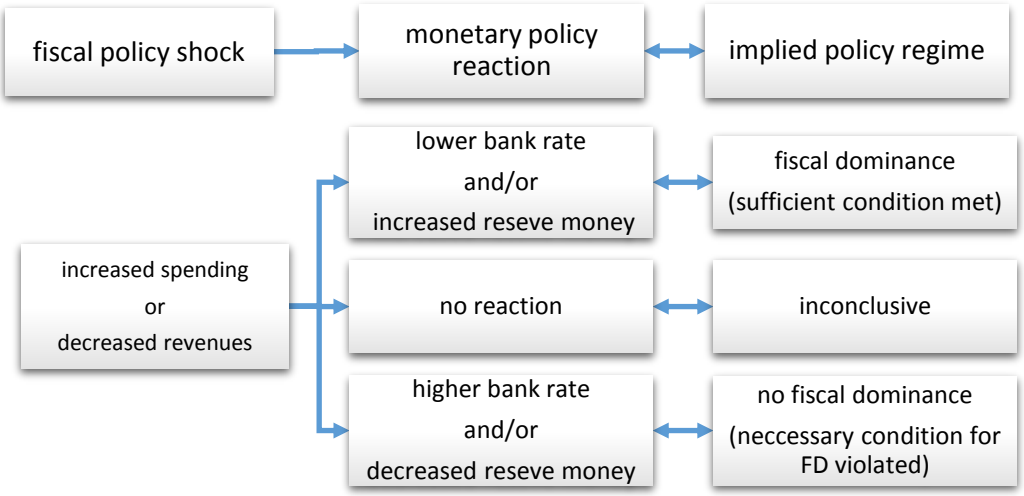
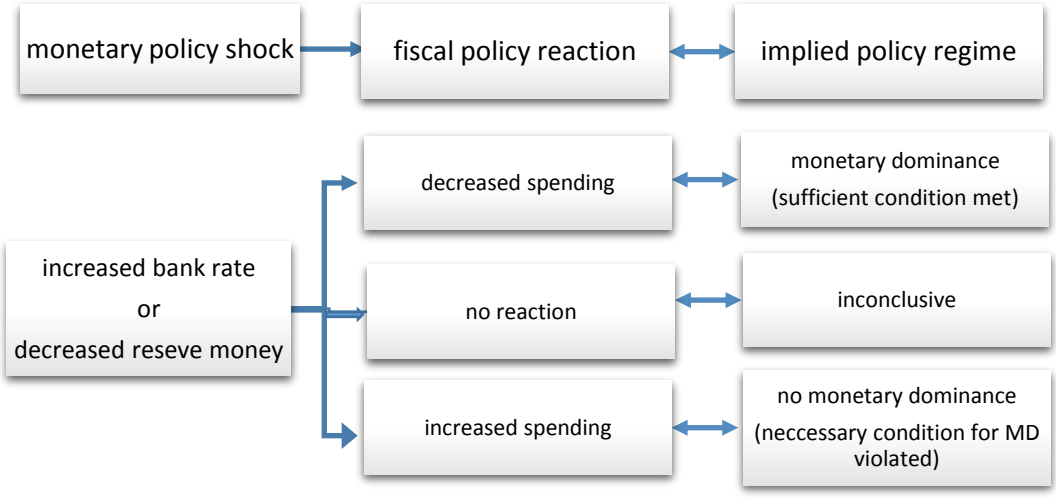


***Figure 2**: Regime identification given monetary shocks*



4. Findings

Our inferences are based on the analysis of impulse responses and forecast error variance decompositions (FEVDs) of the policy variables. The impulse responses help us decide on the type of policy regime that we have since they show us how policies react to one another. The FEVDs on the other hand help us discern how much influence the

policies have on each other. Our principle conclusion is that macroeconomic policy making in Malawi is characterized by monetary dominance and not fiscal dominance. This section provides the analysis leading to this conclusion.

4.1. Impact of fiscal policy on monetary policy

4.1.1. Government spending shocks

The impulse responses to a government spending shock are presented in Figure 3. But before analyzing the reaction of the monetary policy, we to examine the general behavior of the identified shocks and see if they resemble theoretical ones. Here we see that although the responses of government spending and prices are restricted to respond positively for the first 6 months after the shock, the former remain positive for the entire 40 months that we observe, increasing by up to 0.4 percent while the latter remains positive for at least 23 months, increasing by up to 0.1 percent. This implies that government spending shocks in our model are quite persistent. Other notable features of the shock are that the domestic currency appears to depreciate by about 0.3 percent although this result is only significant when we set K=12 (see appendix 1). The depreciation of the currency signals that when it comes to the Malawi Kwacha exchange rate movements, the price channel is more important than the interest rate channel. In other words, the rise in prices that comes with increased government spending dominate the exchange rate dynamics by causing a depreciation of the currency that offsets any appreciation pressures coming from any ensuing rise in the interest rate.

The spending shock also leads to a decline in industrial output of at least 0.15 percent which suggests that the expansionary spending policy crowds out investment in the industrial sector. This result supports our own Bayesian DSGE based findings (see Matola et.al 2019) where a crowding out effect of government spending on private investment is established. Furthermore, Uhlig (2009) also found similar result using US data where he showed that government spending shocks reduce investment although surprisingly not via interest rates. In our case however, we do observe a rise in the policy rate which provides more support to the "crowding out effect" proposition.

With the above observations put together, one can see that the identified shock does indeed resemble a theoretical government spending shock as all variables in the model react to the shock in ways that are expected.

Moving to our main question of how monetary policy reacts to spending shocks, we look at the impulse responses of the bank rate and reserve money. Here we find that following the shock, both these variables react in a manner that is indicative of a monetary policy tightening. Specifically, the bank rate steadily rises by up to 20 basis points by the 40^{th} month after the shock, while reserve money declines by about 0.15 percent within 11 months after the shock. This kind of reaction suggests that monetary authorities do not work to accommodate government spending whether through reducing interest rates or through providing seigniorage funds as would be the case in a fiscal dominance regime. On the contrary, they counteract expansionary spending policy in an attempt to subdue inflation pressures resulting from the shock[18] and also perhaps to reflect the upward

[18] see chapter 3 on how monetary policy in Malawi reacts to inflation.

pressure on interest rates that follows from increased government borrowing. In short, this result shows that while monetary policy is indeed influenced by fiscal policy, it is not in a manner that is inconsistent with its own policy objectives.

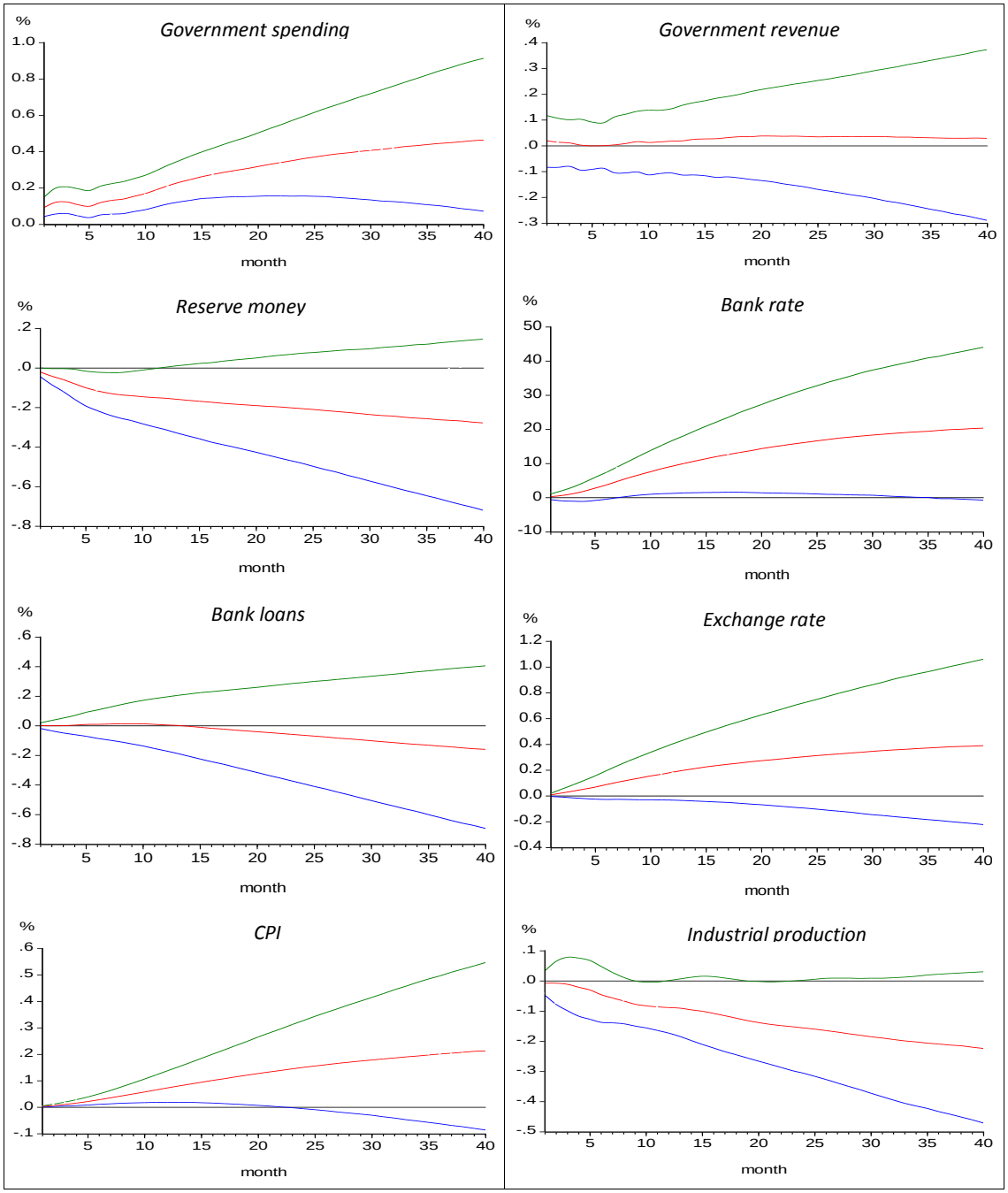


Figure 3: *Impulse responses to a government spending shock of one standard deviation in size. (Middle line is the median and bottom and top lines are the 16th and 84th percentiles.)*

With these observations, one important question that arises concerns how these expenditure shocks are financed given that monetary policy is non-accommodative. Fiscal prudence requires that the increased public spending be accompanied by increased public revenues through higher taxes. However looking at the response of government

revenues in our model, we find no significant reaction to the spending shock. This indicates that fiscal policy expansion in Malawi is mainly financed through debt rather than increased revenues or seigniorage, a conclusion that is consistent with the upward trend of public debt observed in the data.

How much of the changes in monetary policy is attributable to spending shocks?

In addition to observing the dynamic responses of variables, it is also informative to isolate how much of the variation in the policy variables we can attribute to a particular shock. This is done using the FEVD analysis which we summarize in Table 3 and graph in more detail in appendix 2. The table shows 40 month average and peak contribution of the government spending shocks to the variances of the variables in our model.

***Table 3**: Contribution of government spending shocks to variations in variables*

Variable	***Variance attributed to government spending shocks (%)***		
	mean contribution	*peak contribution*	*peak horizon*
government spending	15.29	19.07	22
government revenue	5.57	6.42	1
reserve money	7.80	9.57	9
bank rate	12.08	13.42	21
private loans	5.53	5.93	1
exchange rate	7.58	8.09	2
CPI	7.70	9.04	9
industrial production	10.73	12.30	24

Here, it is estimated that in the 40 month period after a government spending shocks, its contribution to the variation in the monetary policy variables is about 12 percent for the bank rate and 7.8 percent for reserve money. The contribution to the variance of the bank rate peaks at 13.4 percent at 21 months after the shock while for reserve money it peaks at 9.57 percent at 9 months after the shock. This means that at least up to 13 percent of adjustments in monetary policy is attributable to government spending shocks.

For government revenues, the mean variance due to the shock is less than 6 percent and only peaks at 6.4 percent, a result that is consistent with our observation that spending increases are not accompanied by meaningful tax increases. Lastly, more than 19 percent of the variation in government spending is unsurprisingly a result of own shocks.

4.1.2. Government revenue shocks

Dynamic responses to government revenue shocks

The impulse responses to shock revenue cuts are shown in Figure 4 below. In a nutshell, these responses provide no evidence of any significant policy reaction to revenue shocks, be it from monetary policy or from the spending side of fiscal policy. Monetary authorities, who seem to take strong action in response to spending policy appear to be inactive when it comes to revenue policy. One explanation is that monetary authorities find revenue policy to be inconsequential to their operational objectives. Indeed looking

at the impulse responses of their target variables such as prices and the exchange rate, we see that both these variables and even industrial output exhibit no significant reaction of any kind. As such, a non-response from the monetary authorities does make sense given that the goals of monetary policy are not affected by the revenue shock.

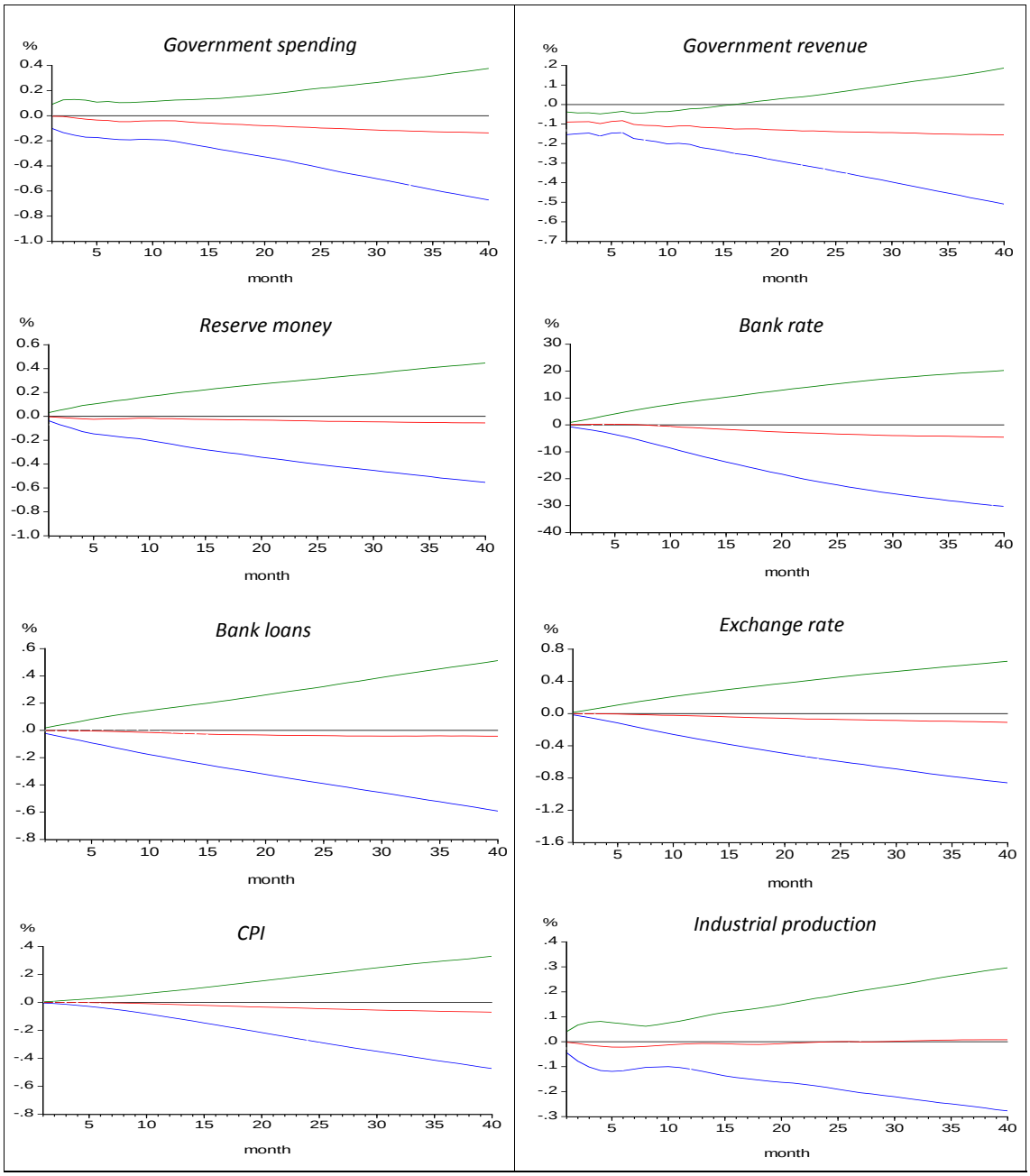


Figure 4: *Impulse responses to a government revenue shock of one standard deviation in size. (Middle line is the median and bottom and top lines are the 16th and 84th percentiles.)*

How much of the changes in monetary policy is attributable to revenue shocks?

The contribution of revenue shocks to the variances of the variables in our model is presented Table 4 below. Consistent with the impulse responses to this shock, the

forecast error variance decompositions also indicate that revenue shocks do not contain much information regarding the variations in both monetary policy and spending policy. For both reserve money and the bank rate, about only 6.5 percent of their respective variances are attributable to revenue shocks. Furthermore, the influence of this shock these variables peaks at only 6.75 percent for reserve money, and at 6.67 for the bank rate. With regards to government spending, only up to 7 percent of its variation is a result of revenue shocks, which again shows that spending decisions are not as closely tied to revenues as they would be in a more fiscally prudent environment.

Table 4: *Contribution of government revenue shocks to variations in variables*

Variable	***Variance attributed to government revenue shocks (%)***		
	mean contribution	*peak contribution*	*peak horizon*
government spending	6.7	7.2	7
government revenue	9.7	11.6	8
reserve money	6.5	6.8	13
bank rate	6.5	6.7	40
private loans	5.9	6.5	2
exchange rate	6.9	6.98	4
cpi	6.5	6.6	33
industrial production	7.3	8.1	12

Of the four policy variables, unsurprisingly government revenue is the one with the most variance attributed to own shocks, peaking at 11.6 percent after 8 months. The variances of all the other variables in the model are only modestly affected. Specifically, the shock contributes to less than 7 percent of the respective variances of private credit, exchange rate, and CPI and contributes only up to 8 percent for industrial output.

4.2. Impact of monetary policy on fiscal policy

4.2.1. Policy rate shocks

Dynamic responses to monetary policy

The impulse responses to a monetary policy shock as defined in assumption 3 are plotted in Figure 5. From this figure, one can see some of the features that we expect from a monetary policy shock. One such feature is that while the bank rate rises, money supply (as measured by reserve money) declines. Specifically our model shows that in a typical monetary policy shock, the bank rate rises on impact and remains raised for at least 7 months with the size of the increase estimated at around 30 basis points. The monetary base on the other hand gradually declines by up to 0.4 percent by the fortieth month following the shock. Other features of the shock include a decrease in prices of up to 0.1 percent and a persistent decrease in private credit of up to 0.6 percent. Interestingly, although private credit drops significantly following the shock, the impact on industrial output is not pronounced. As for the impact on the exchange rate, it is also inconclusive

although the point estimate indicates a downward movement (appreciation) which is what would be expected from an interest rate increase.

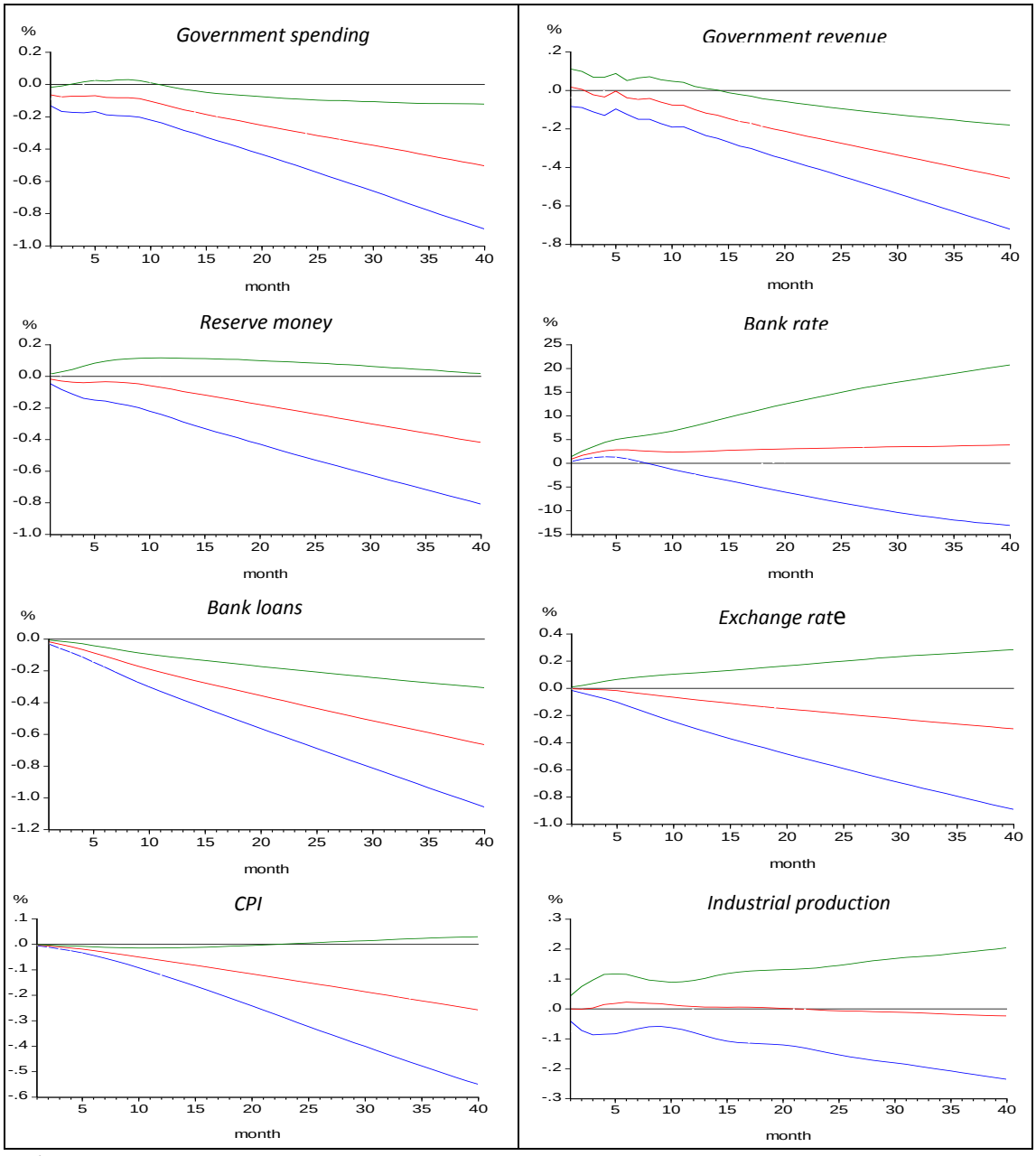


Figure 5: *Impulse responses to a tight monetary policy shock (one standard deviation) defined in assumption 3. (Middle line is the median and bottom and top lines are the 16th and 84th percentiles.)*

Turning to our main question, namely how monetary policy effects fiscal policy, we see that both government spending and revenues react negatively to a monetary tightening. Specifically, government spending declines on impact and continues to do so and reaching a total decrease of about 0.5 percent. Revenues on the other hand decrease by about 0.4 percent. The decline in spending may indicate two things. One is cooperation by fiscal authorities to monetary policy, and the other is reduction in debt financed

spending as a result of the tight monetary conditions. Either way, this reaction displays fiscal conformity to the tight monetary policy stance, a scenario which is consistent with a monetary dominant regime (refer to our criteria in section 3). As for the decline in revenues, not much can be inferred from this as already explained in section 3.

Put together, these results support those from the analysis of government spending shocks in the sense that with both shocks, it is fiscal policy that reacts within the conditions set forth by monetary policy while monetary policy appears to act in strict adherence to monetary policy objectives. Therefore, the presence of fiscal dominance is once again rejected while the case for monetary dominance is strengthened.

How much of the variation in fiscal policy is attributable to monetary policy shocks?

In Table 5, the percentages of forecast error variance that is attributed to monetary policy shocks are presented for all the variables in the model. Here we see that monetary policy accounts for a significant portion of variation in fiscal policy. Up to a fifth of the variance in government revenue can be attributed to this shock while for the variance in government spending, monetary policy accounts for up to 13 percent. This shows that fiscal policy is indeed significantly informed by changes in monetary policy.

Table 5: Contribution of monetary policy shocks to variations in variables

Variable	***Variance attributed to a Monetary policy shock (%)***		
	mean contribution	*peak contribution*	*peak horizon*
government spending	9.5	13.2	40
government revenue	12.7	20.9	40
reserve money	7.6	9.99	40
bank rate	4.1	14.9	2
private loans	17.5	20.9	40
exchange rate	4.3	4.7	1
CPI	6.7	7.1	3
industrial production	5.7	6.9	9

4.2.2. Money supply shocks

Using the second definition for a monetary policy shocks does not change the results and our conclusions made above regarding the impact of monetary policy on fiscal policy. This can be seen in the impulse responses plotted in Figure 6 below where declines in government spending and revenues are still observed and hence confirming the existence of monetary dominance. Additionally, in this case the appreciation of the exchange rate due to monetary policy tightening is found to be statistically significant thus confirming that tight monetary policy appreciates the domestic currency.

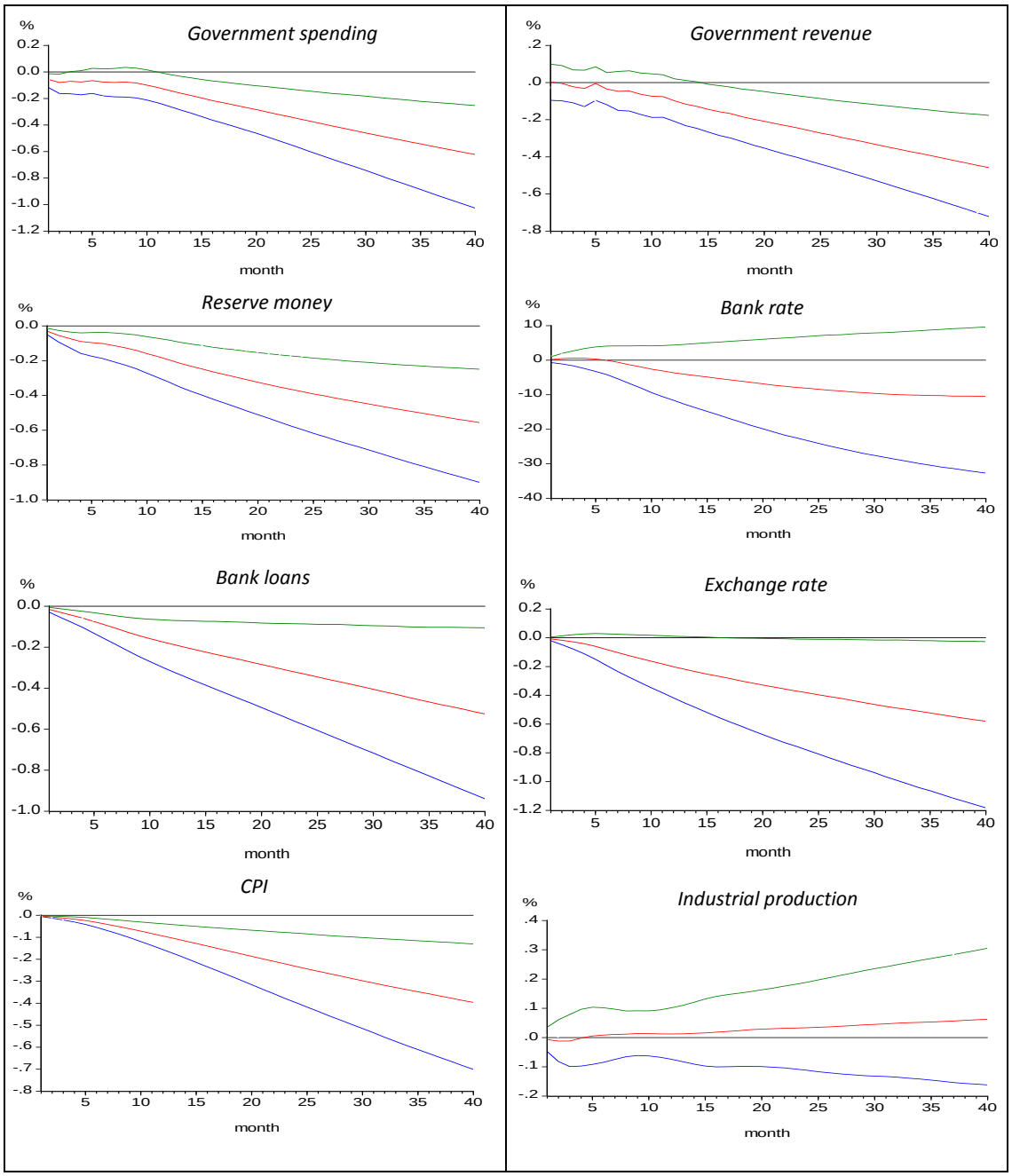


Figure 6: *Impulse responses to a tight monetary policy shock (one standard deviation) defined in assumption 4. (Middle line is the median and bottom and top lines are the 16th and 84th percentiles.)*

5. Conclusions

In this paper we have investigated the ways in which fiscal policy and monetary policy interact with each other in Malawi in order to establish whether macroeconomic policy making environment can be characterized as that of fiscal dominance or monetary dominance. A structural VAR with sign restrictions was employed in order to identify government spending shocks, revenue shocks, and monetary policy shocks so as to observe their dynamic effects on the fiscal and monetary policy variables.

Our principle conclusion is that policy making in Malawi is characterized by monetary dominance, not fiscal dominance. In this regard, we have established that while the two policies affect each other, the manner in which they do differs. Monetary policy responds to fiscal policy in a manner that is indicative of strict adherence to its own policy goals or rules. Specifically, loose fiscal policy via government expenditure is countered by tight monetary policy through higher interest rates and lower money supply. Fiscal policy on the other hand reacts to monetary policy in a manner that shows adherence with the monetary stance. It does so by responding to contractionary monetary policy with expenditure cuts. The analysis also shows that government revenues do not respond to spending shocks which, coupled with the absence of seigniorage and the observed rise in interest rates, indicates that fiscal shocks are generally financed by public debt.

These findings paint the macroeconomic policy making process in Malawi as quite encouraging especially on the part of monetary policy. The central bank's tendency to counter increased spending with tight monetary policy indicates that it exercises a degree of independence from fiscal authorities by exercising restraint to accommodate loose fiscal policy at the expense of monetary policy objectives. This independence is an important attribute in the conduct of monetary policy. On the fiscal side however, the non-response of government revenues to spending shocks is a cause for concern as it entails an unsustainable path of public debt that may eventually result in fiscal dominance.

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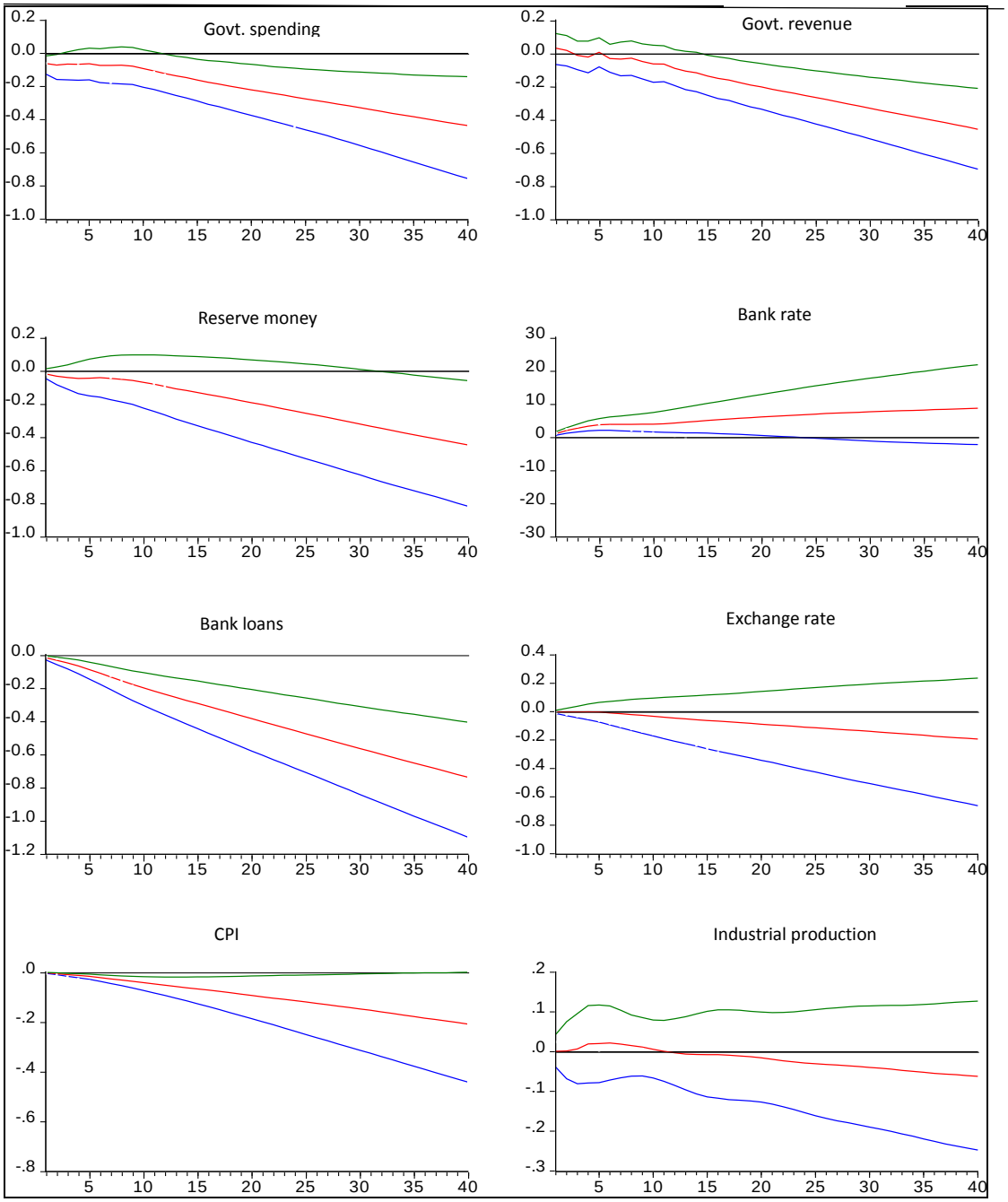
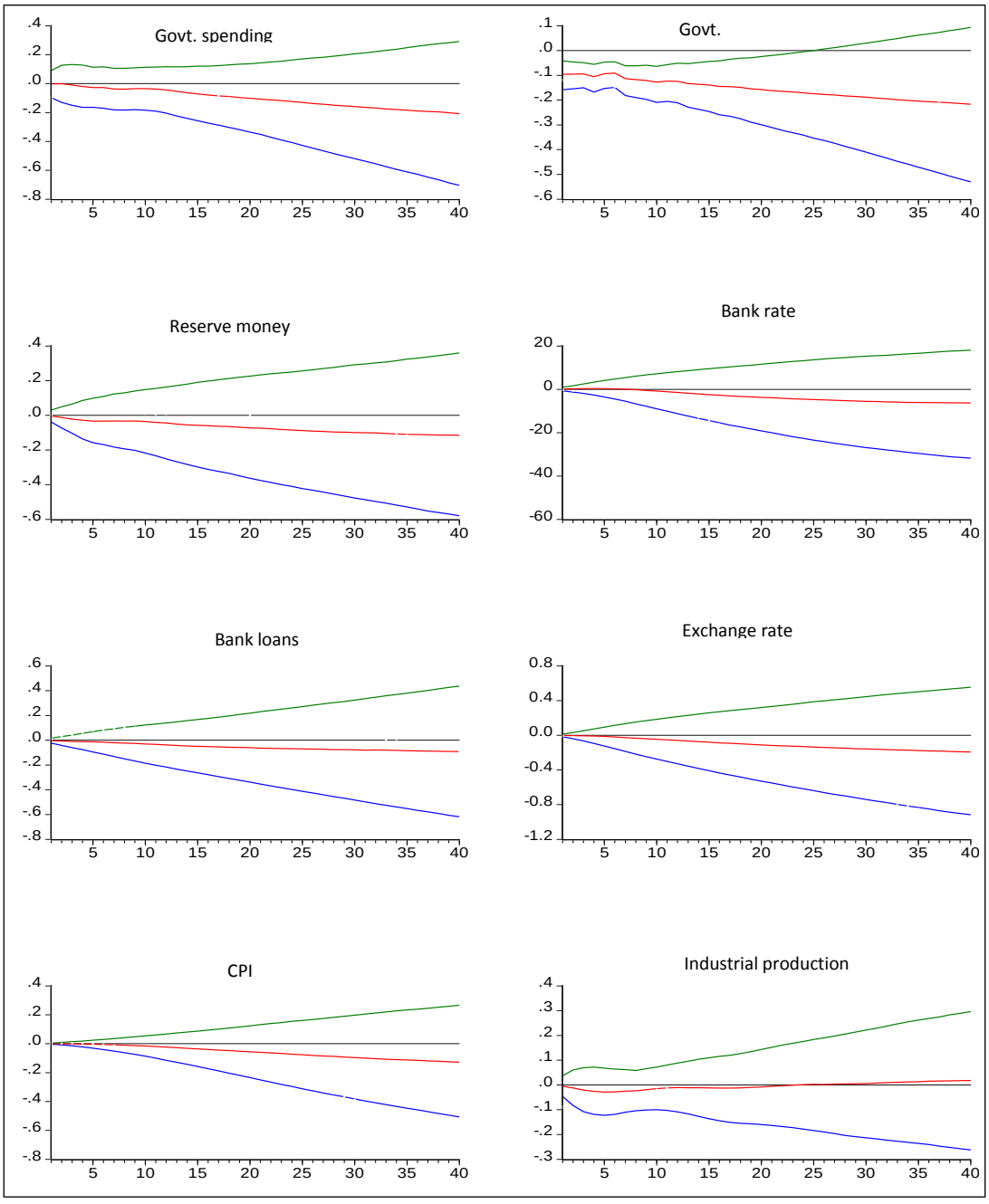
Appendices

Appendix 1: *impulse responses identified using K=12*

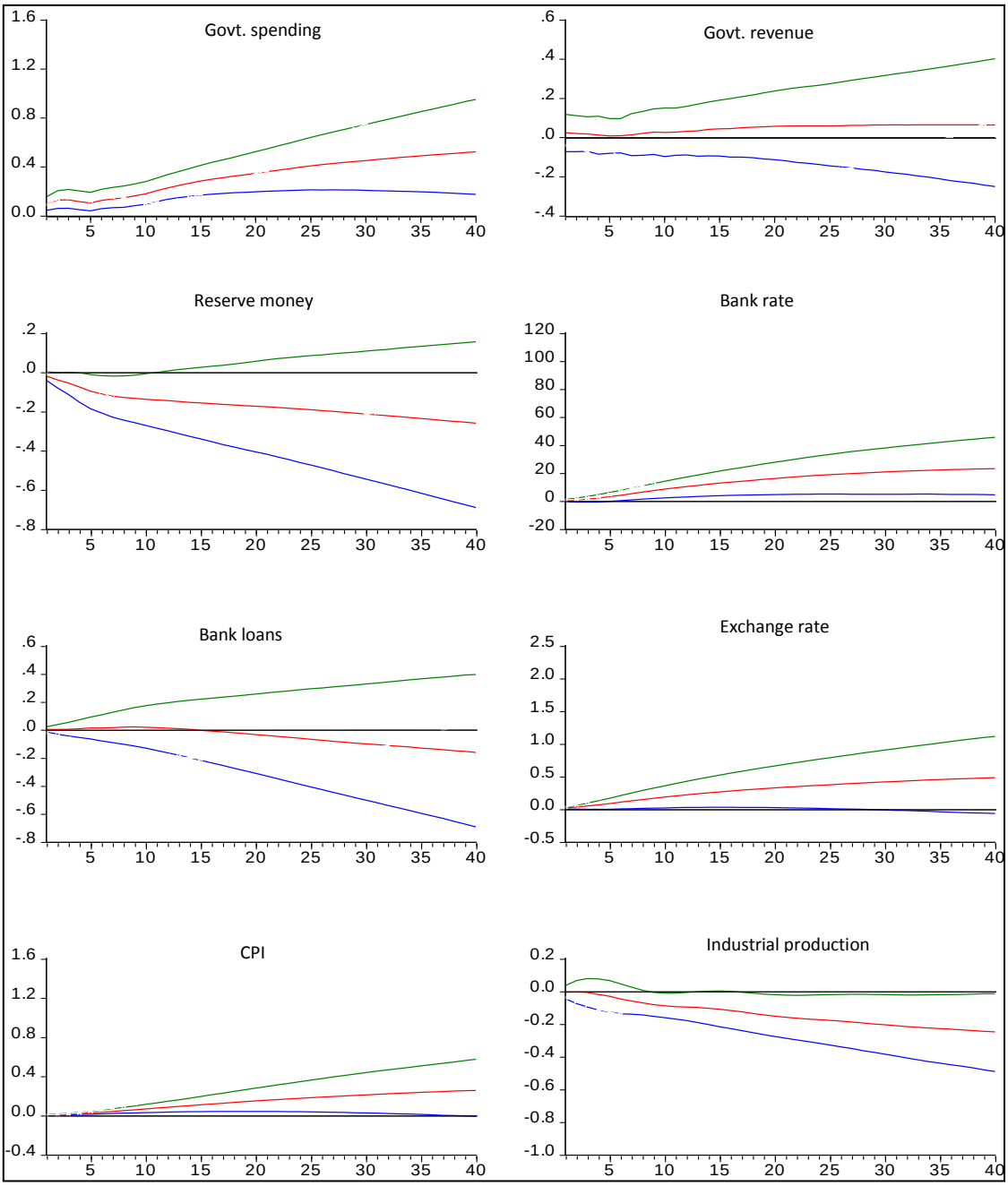
Impulse response to a monetary policy shock



Impulse responses to a government revenue shock



Government spending shock



Appendix 2: *Forecast variance error decompositions overtime*