Chapter - IV

Empirical Analysis

This chapter presents the findings of an empirical analysis conducted using the methodology outlined in the previous chapter. The results of unit root tests and Structural Vector Autoregressive (SVAR) models are discussed, utilizing the impulse response and variance decomposition of the estimated models. The analysis aimed to provide insights into the relationship between various economic variables and the potential impacts of exogenous shocks on the system. By utilizing these models, it was possible to explore the dynamics of the system and gain a deeper understanding of the underlying mechanisms at play. The following sections provide a detailed discussion of the results obtained from each of these models.

4.1 Result of Unit Root test

The stationarity tests conducted on monetary policy, fiscal policies, and macroeconomic variables. As anticipated, the variables of interest exhibited unit root behaviour. To address this issue, the difference stationarity process test was utilised to transform the unit root variables into stationary variables. Table 3 provides a summary of the results of the tests. The table shows the results of the Phillips-Perron test for several variables, along with their t-statistics and critical values at the 5% level. The conclusion for each variable is based on whether it has a unit root or not, which is determined through the test.

For the variable "LN(interest rate)" and "LN(Inflation rate)", the test indicates that they have a unit root at the level, as the t-statistic value (-4.335 and -2.712 respectively) is less than the critical value (-2.890 and -2.891 respectively) at the 5% level. Therefore, we accept the null hypothesis that these variables have a unit root.

For the variable "LN(Expenditure)", the test indicates that it has a unit root at the level as well, as the t-statistic value (-1.910) is greater than the critical value (-2.891) at the 5% level. Therefore, we reject the null hypothesis that this variable has no unit root.

For the variables "LN(Taxes)", "LN(Output Gap)", and "LN(Exchange Rate)", the test indicates that they have no unit root at the level, as the t-statistic value (-2.267, -9.820, and -1.280 respectively) is greater than the critical value (-2.892, -2.968, and -2.890 respectively) at the 5% level. Therefore, we reject the null hypothesis that these variables have a unit root.

For all variables, when the first difference is taken, the test indicates that they have no unit root, as the t-statistic value for the first difference is much lower than the critical value at the 5% level. Therefore, we reject the null hypothesis that the first difference has a unit root.

4.2 Impulse response of structural shocks identified by using sign and zero restriction approach

This section presents an analysis of the interplay between monetary and fiscal policies, based on the impulse response derived from the Structural Vector Autoregression (SVAR) model estimation. The study identified five structural shock - monetary policy shock, government expenditure shock, government taxes shock,

aggregate demand and aggregate supply shock on basis of the identification technique discussed in the previous chapter.

The results of the impulse response analysis of the identified structural shocks are presented in Figures 1 to 5.

The impulse response functions of SVAR model using the restrictions given in Table 7. Solid black line is the median responses of relevant variables to the corresponding shock, while the borders of shaded area with grey are the 16th and 84th percentile of credibility intervals for the responses to the same shock. Therefore, the area in between the yellow borders represents 68 percent credibility interval of the response. Each response function represents the response of variable to a one standard deviation innovation to relevant shock. The result of each shock is discussed below:

4.2.1 Effect of monetary policy shock

The monetary policy shock was identified based on an increase in the interest rate, and negative impact on inflation and the output gap. The impulse response of various variables to the monetary function as seen in figure 1 revealed that as expected, the interest rate shock reduced the inflation. As the impulse response of inflation reacts negatively to interest rate shock. This result is similar to the result obtained by Raj et al. (2011) and Arora (2018) for the Indian economy.

However, concerning fiscal policy variables, an interest rate shock leads increase in expenditure and decrease in taxes in short -run. As a result, output gap fluctuates from positive to negative before stabilising in long run.

The increase in the output gap could be responsible for the increased tax revenue and decreased government expenditure due to the automatic stabilizer effect. However, it is worth noting that with the contractionary monetary policy shock is followed by fiscal expansion. As, a result of this the contractionary monetary policy shock is able to stabilise output only in long run.

This expansionary impact of fiscal policy could be due to the fiscal dominance that has been observed in case of India due to the populist approach of the government. Although the Fiscal Responsibility and Budget Management (FRBM) Act of 2003 was implemented, monetary policy was still influenced by fiscal policy, resulting in output fluctuations. Similar results have been found in study done by Raj et.al (2011) and Arora (2018). Raj et.al (2011) concluded that fiscal policy was pro cyclical in India.Arora (2018) had found an expansionary fiscal policy response to a positive interest rate shock.

According to Muscatelli et. al (2004) , the two policies were considered substitutes if a positive relationship was found between the interest rate and the net fiscal stance and complements in case of negative correlation (Arora, 2018 and Gerba and Hauzenberger, 2013). Here, the impulse response suggests that both policies acted as substitutes rather than complements in response to an interest rate shock.

Additionally, the initial response of fiscal policy in terms of expenditure and taxes suggest that expenditure increased without tax increase suggesting dependence on government on market borrowing . Though debt is not taken as variable, here the indication of impulse response is that expenditure and tax revenue had a opposite response to interest rate shock which might indicate a non-ricardian fiscal policy. However, this needs further indication with debt as a variable.

The impulse response of exchange rate demonstrated that exchange rate appreciate in response to the interest rate shock, but then gradually depreciates to its previous level. This pattern may occur because an increase in interest rates tends to attract foreign capital inflows, which can cause the domestic currency to appreciate initially. However, over time, the effect of the interest rate shock on the REER fades as the economy adjusts to the shock. This interpretation is consistent with the standard theory of exchange rate determination, where changes in interest rates are one of the factors that affect exchange rates. However, opposite effect on interest rate was found in the study done by Arora (2018).

Overall, these findings suggest that the monetary policy shock has a significant impact on the fiscal policy variables, which, in turn, affects the overall macroeconomic environment. The long-term impact on fiscal policy variables requires further investigation as it could be destabilising. Understanding the dynamics between monetary and fiscal policies is critical for policymakers to effectively manage the macroeconomy and maintain economic stability.

4.3.2 Effect of Government expenditure shock

An expenditure shock was identified with a positive impact on both expenditure itself and the output gap. Figure 3 shows the impulse response of the macroeconomic variables to an expenditure shock. As expected, the output gap responds positively to a positive shock in government expenditure. This expansionary fiscal policy action is expected to increase aggregate demand in the economy, leading to inflationary pressure. In response, the monetary authorities implement a contractionary policy action, as seen in the impulse response of the interest rate. The interest rate increases to control inflationary pressure and stabilize the output. In response to the increased interest rate, inflation decreases and turns negative in the second quarter. Studies by Büyükbaşaran et al. (2020) , Arora (2018), Mountford and Uhlig (2009), and Canova and Pappa (2007) have found that low inflation rates are associated with an expenditure shock. This could be due to the strong contractionary policy action by the monetary authority.

A positive interest rate shock decreases the output gap and reduces inflation. Taxes initially respond negatively to a government expenditure shock. However, they subsequently rise to support government expenditure and reduce pressure on government debt, as the monetary authority raises the interest rate. There are fluctuations in expenditure and taxes before they stabilize over time, which could be the result of the automatic stabilizer of fiscal policy.

The initial response of both the policies to expenditure shock is that of a substitute. Studies by Büyükbaşaran et al. (2020) , Arora (2018) and Gerba and Hauzenberger (2013) and find the same for the expenditure shock.

Further, the impulse response of exchange rate demonstrated that an expenditure shock caused a depreciation in the domestic currency relative to the currencies of trading partners. This may occur due to an increase in government expenditure, which could lead to an increase in demand for imports and a decrease in demand for exports. The depreciation of the currency can help to mitigate the negative impact of the expenditure shock by making exports more competitive and imports more expensive, thus reducing the trade deficit. Further, if the depreciation persists for a prolonged period, it may lead to inflationary pressures in the economy. However, in this case exchange rate stabilises quickly.

Overall, these findings highlight the complex interplay between fiscal and monetary policies and their effects on the macroeconomy.

4.3.2 Effect of tax shocks

A tax shock was identified as having a positive impact on tax revenue and negative impact on output gap. The impulse response in Figure 2 gives impulse response of various variables to the tax shock. As expected, a positive shock to tax revenue had a negative impact on both output and inflation. This negative relationship between tax revenue and inflation can be explained through the demand channel, as an increase in

tax revenue reduces disposable income and, therefore, aggregate demand. Moreover, reduced inflationary expectations of the people could provide an additional explanation for the reduced inflation rate. When tax revenue increases, it signals the government's commitment to maintaining fiscal discipline, which could boost confidence in the economy and reduce inflation expectations. This, in turn, could mitigate the likelihood of people demanding higher wages or prices, thereby helping to keep inflation in check.

In addition, the rise in tax revenue led to a reduction in interest rates. The fall in inflation provided room for a reduction in interest rates, but an increase in tax revenue not accompanied by government spending also reduced the government's borrowing from the market, leading to a fall in demand for borrowed funds and thus, a fall in interest rates. The reduced interest rate could, therefore, stimulate investment and consumption and thus, further enhance economic growth.

Regarding the interaction between the two policies, a contractionary fiscal policy could be accompanied by an expansionary monetary policy through a reduction in interest rates. This policy mix could be effective in stimulating economic activity while simultaneously containing inflationary pressures. Overall, these findings suggest that tax revenue has a significant impact on the macroeconomy and, therefore, should be carefully managed to avoid unintended consequences. The impulse response of output shows that the output gap becomes positive, which is indicative of a positive impact. This impact can be attributed to the implementation of a expansionary monetary policy.

The tax increase funding the expenditure growth has a stabilising effect on output and does not led to inflationary pressure in the economy. Hence, the two policies behave like complements and stabilise the economy. Similar results are found for the US economy in Gerba and Hauzenberger (2013) study, for Turkey in Büyükbaşaran et al. (2020)study and for India in Arora (2018) study.

4.2.4 Effect of aggregate demand shock:

Aggregate demand shock was identified based on a positive response of output and inflation. The impulse response function given in figure 4 show the impact of aggregate demand shock on the various macroeconomic variables.

As a response to the aggregate demand shock , both the policies respond in a counter-cyclical manner. The monetary policies increased the interest rate in response to the inflationary pressure in the economy . On the other hand, the fiscal policy authorities also increase the taxes and decreases government spending. Both the policies seemed to have acted as complements rather than substitutes in case of an aggregate demand shock.

In a situation when the economic overheats and there is inflationary gap, both policy work in a direction of restoring the stability in macroeconomic environment. In fact, in comparison to the interest rate shock (figure 1) , the output gap seems to have stabilised faster (in period 5) as a result of contractionary policy for both sides.

Study done by Gerba and Hauzenberger (2013) for US economy does not differentiate between the demand and supply shock and simply identifies a business shock and analysed the policy reaction and found that both policies acted as complements in response to business policy shock.

Further, study done by Büyükbaşaran et al. (2020) for Turkey distinguished between aggregate demand and supply shock and found the two policies were in fact complements in case of an aggregate demand shock.

The result for India is in line with the other studies. This demonstrated that in case of aggregate demand shock both policies work towards stabilisation.

4.2.5. Effect of Aggregate Supply shock

Aggregate supply shock was identified based on a positive response of output but a negative response of inflation. The impulse response function given in figure 5 shows the impact of aggregate supply shock on the various macroeconomic variables.

In case of aggregate supply shock, the monetary authorities responds with an expansionary policy action ie. by decreasing the interest rate. The low inflationary pressure in the economy gives space to the monetary authority to decrease the interest rate. However, this expansionary action could further increase the output gap. However, fiscal authority responds with contractionary policy action ie. by increasing

the taxes which brings down the output gap. The increase in government expenditure is minimal. The movement of interest rate follows the inflation rate movement.

In case of aggregate supply shock, it can be noticed that the policies behaved as complements.

4.2.6 Response of exchange rate

The response of the exchange rate to an interest rate shock is as expected- it is expected that a positive interest rate shock would lead to an appreciation of the domestic currency due to increased demand for it as a result of higher interest rates. Empirical evidence suggests that an interest rate shock actually leads to a positive response in the exchange rate, resulting in a appreciation of the currency. This finding has important implications for policymakers and suggests that the relationship between interest rates and exchange rates in case of a monetary policy shock. Additionally, there could be other factors such as the level of capital mobility, exchange rate regime, transmission mechanism of monetary policy, fiscal variables that explain such a behaviour of exchange rate. However, the result found were contrary to similar study done by Arora(2018) for India. Arora (2018) finds a negative effect of exchange rate to monetary policy shock.

The response of exchange rate to a positive tax shock leads to depreciation of the domestic currency. The impulse response of exchange rate starts from zero and moves to the negative zone, it means that the tax shock has a contractionary effect on the

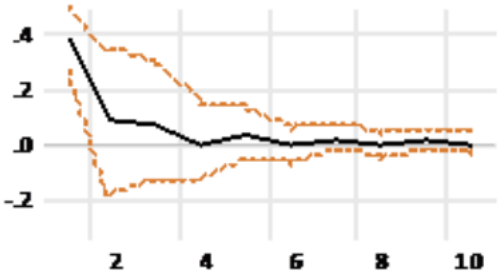
domestic economy. As a result, the demand for domestic goods and services decreases, leading to a decrease in the demand for the domestic currency. This decrease in demand for the domestic currency causes the exchange rate to depreciate, as foreign currency becomes relatively more valuable.

This response of the exchange rate to a tax shock is consistent with the standard theory of the Mundell-Fleming model, which predicts that a contractionary fiscal policy leads to a decrease in the demand for the domestic currency and a depreciation of the exchange rate. However, it is worth noting that the exact magnitude and duration of the exchange rate response may vary depending on a variety of factors, such as the openness of the economy and the strength of the automatic stabilizers.

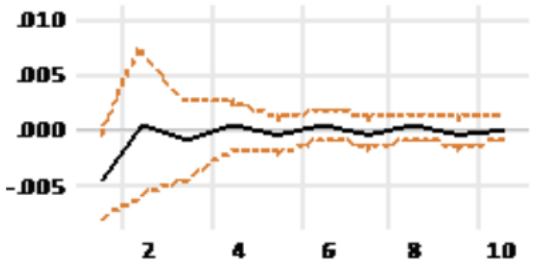
However, in case of an government expenditure shock, despite a positive shock to interest rate, there is the depreciation of the exchange rate .

Figure 1: Effect of Monetary policy shock

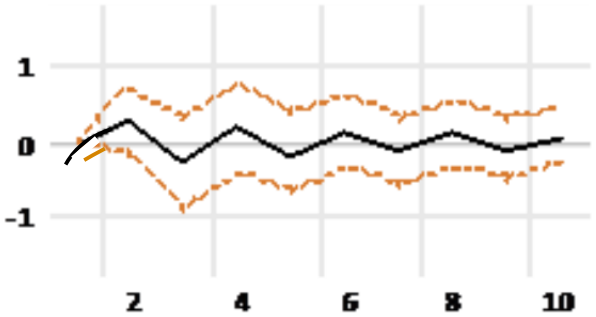
Interest Rate



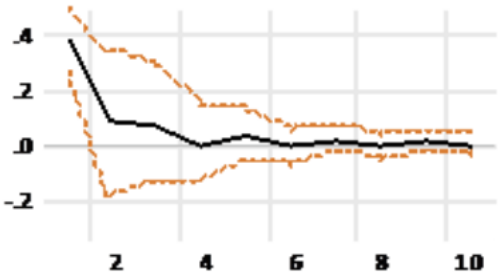
Inflation rate



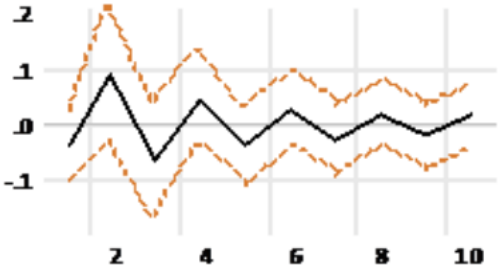
Output Gap



Expenditure



Taxes



Exchange Rate

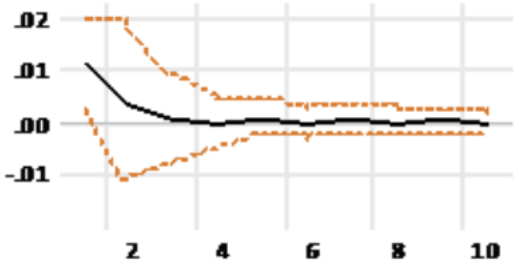


Figure 2 : Effect of tax shock

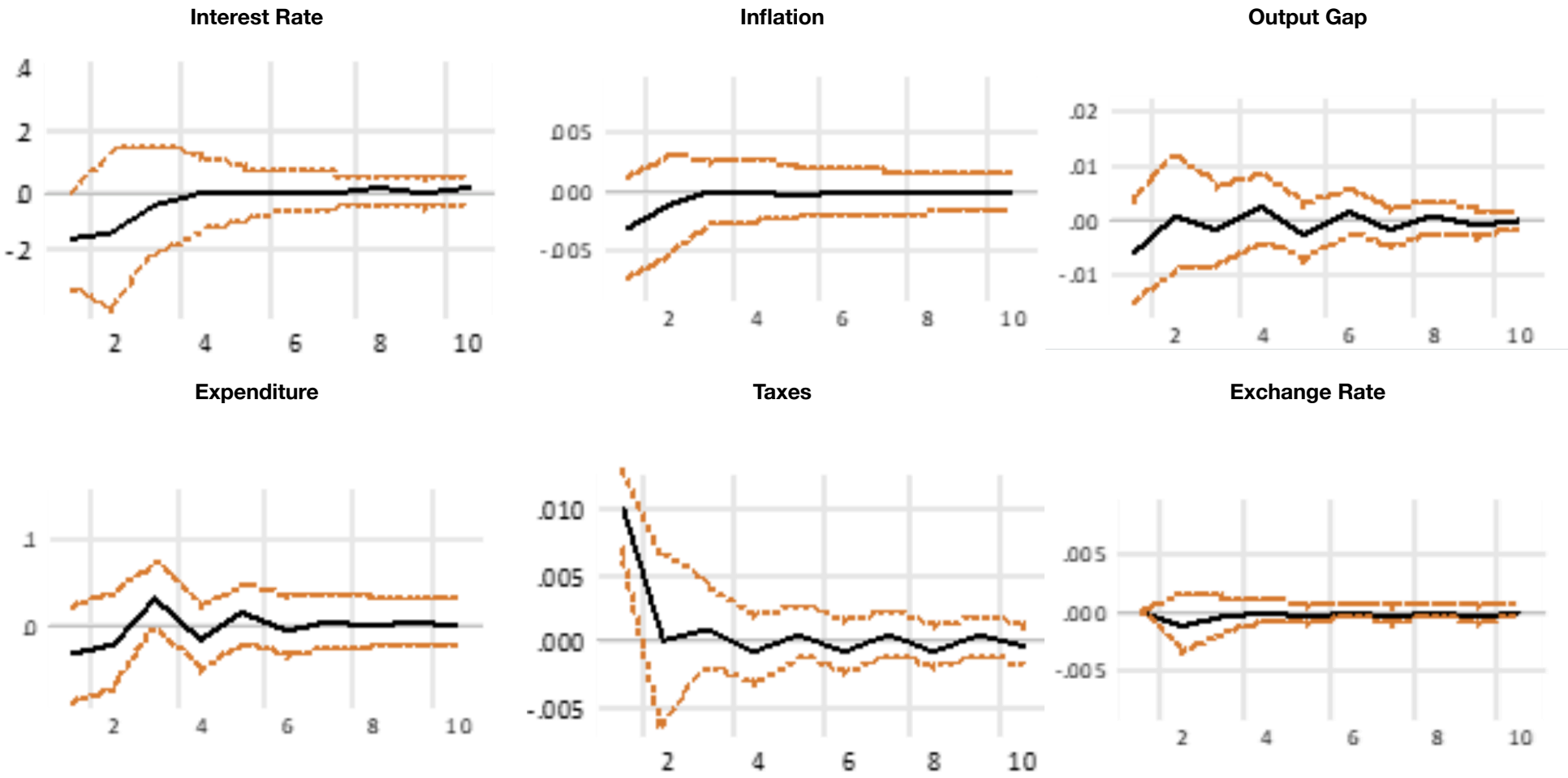


Figure 3 : Effect of Expenditure shock

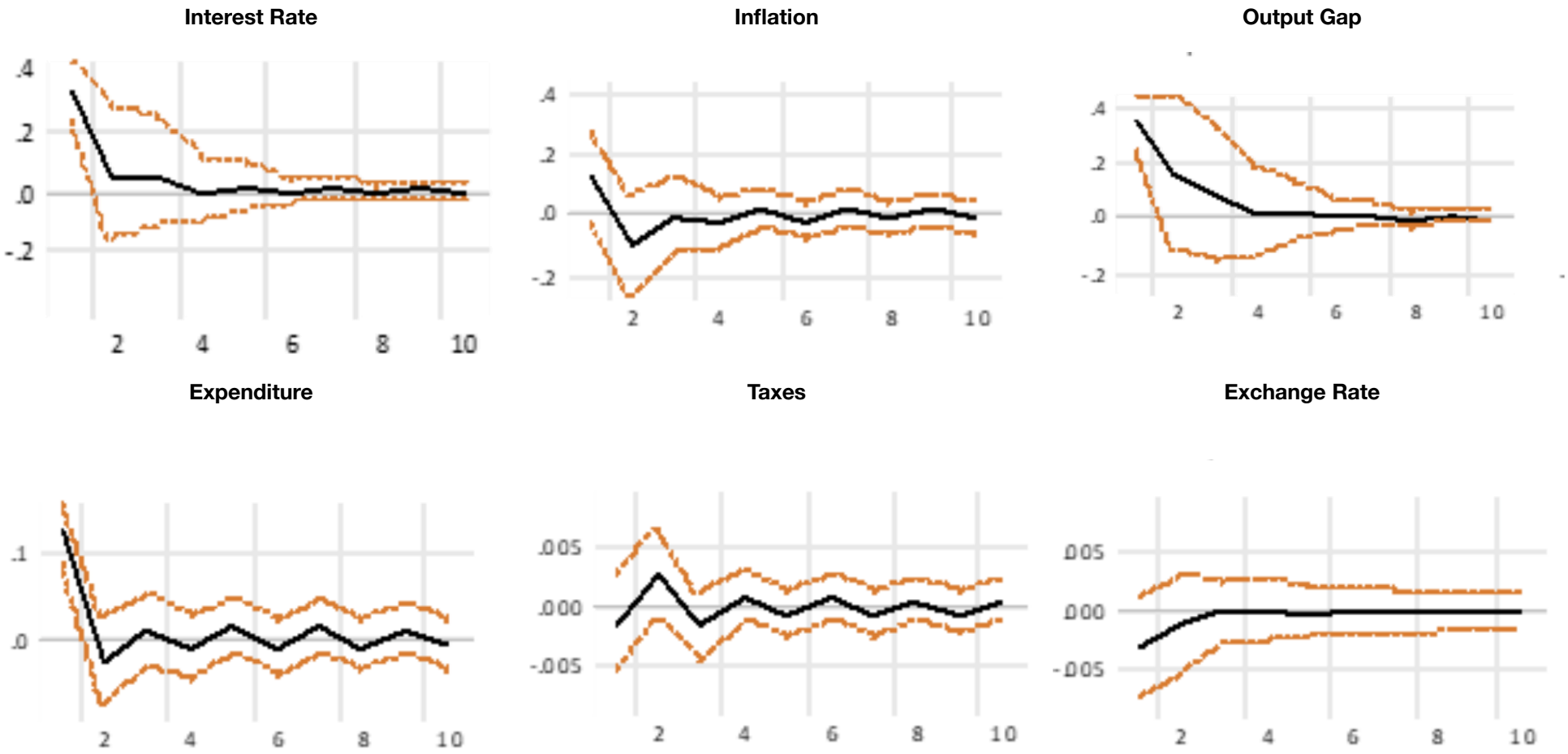


Figure 4 : Effect of Aggregate demand shock

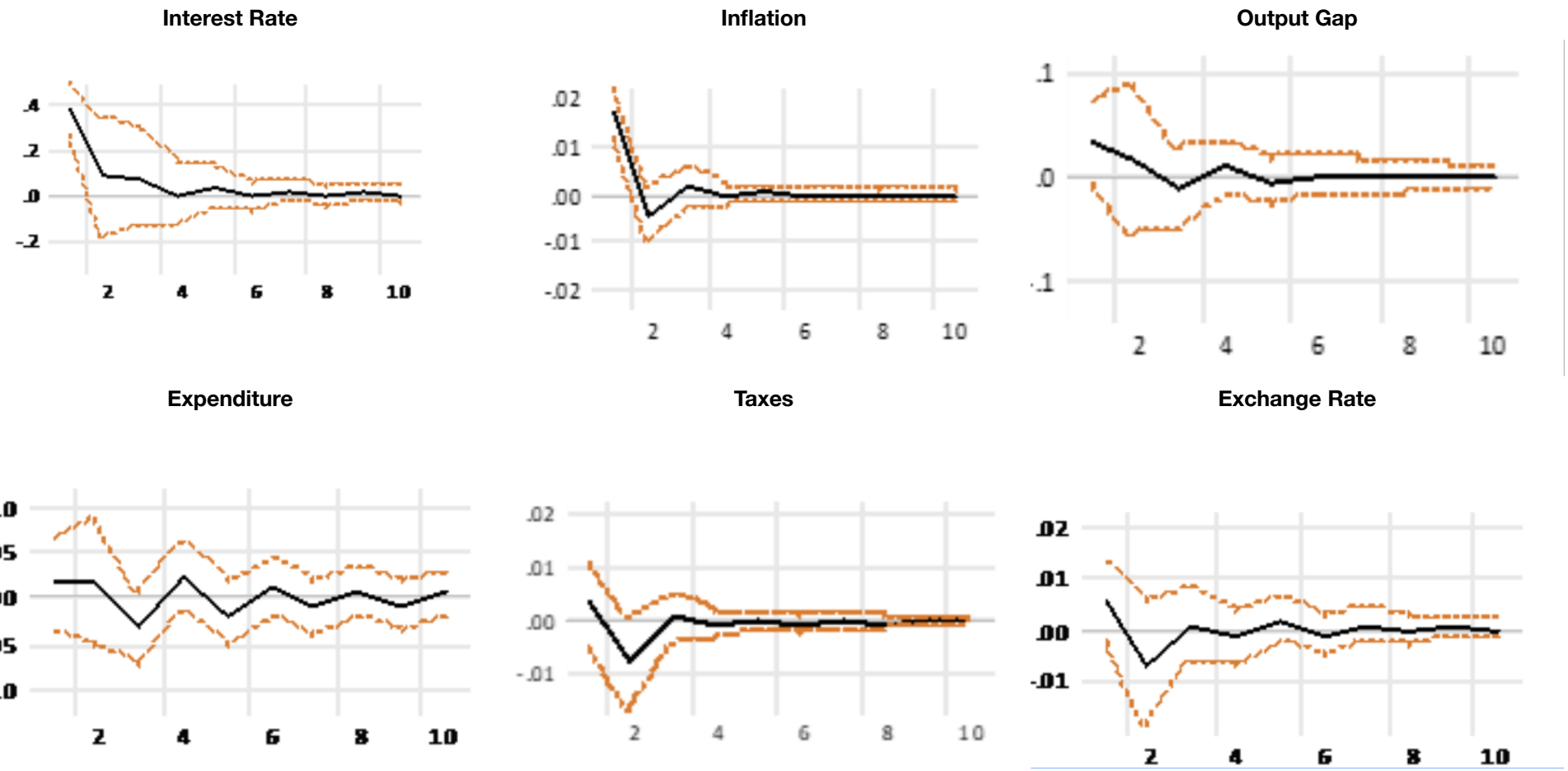
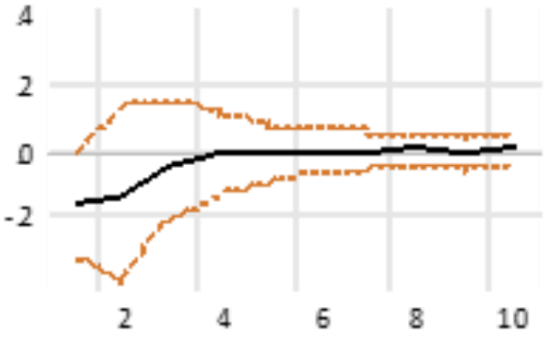
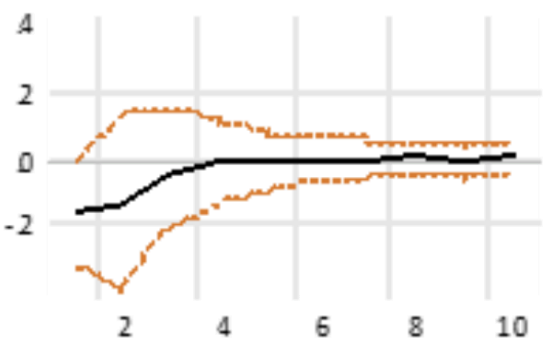


Figure 5 : Effect of Aggregate supply

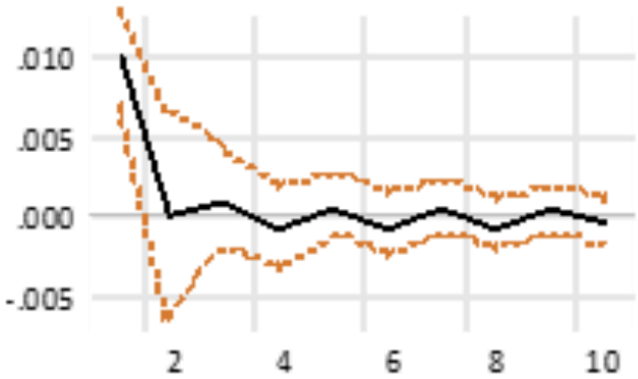
Interest Rate



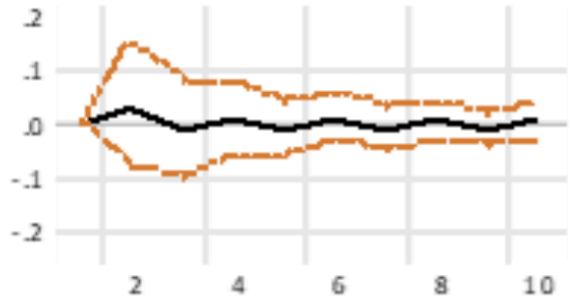
Inflation



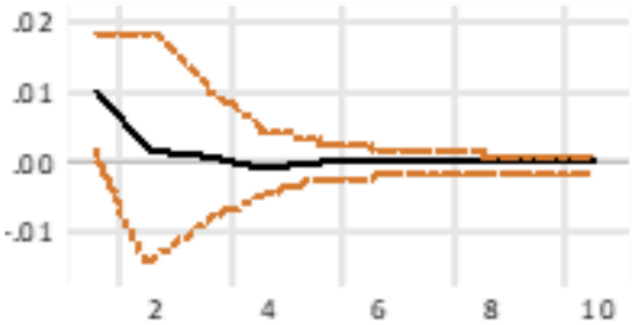
Output Gap



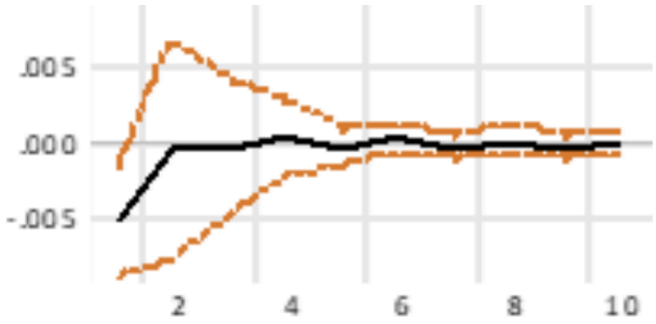
Expenditure



Taxes



Exchange Rate



4.3 Variance decomposition Analysis

In this section, we report the results of a variance decomposition analysis for each variable in the SVAR model, which was identified using the Cholesky identification technique. The aim of this analysis is to determine the extent to which each variable is responsible for fluctuations in other variables. Tables 1 to 6 present the variance decomposition results for each variable.

Variance decomposition of Taxes:

In the short run that is quarter 3, shock to real expenditure can cause 11.09 percent fluctuation in real net tax, shock to output gap can cause 0.47 percent fluctuation in real net tax, shock to call money rate can cause 1.77 percent fluctuation in real net tax, shock to inflation rate can cause 0.38 percent fluctuation in real net tax and shock to exchange rate can cause 1.32 percent fluctuation in real net tax.

In the long run that is quarter 10, impulse or innovation or shock to real expenditure can cause 14.50 percent fluctuation in real net tax, shock to output gap can cause 1.30 percent fluctuation in real net tax, shock to interest rate can cause 2.17 percent fluctuation in real net tax, shock to inflation rate can cause 0.53 percent fluctuation in real net tax and shock to exchange rate can cause 2.90 percent fluctuation in real net tax.

Variance decomposition of Expenditure:

In the short run that is quarter 3, impulse or innovation or shock to real net tax account for 13.39 percent variation of the fluctuation in real expenditure, shock to output gap can cause 7.86 percent fluctuation in real expenditure, shock to call money rate can cause 0.86 percent fluctuation in real expenditure, shock to inflation rate can cause 0.24 percent fluctuation in real expenditure and shock to exchange rate can cause 0.91 percent fluctuation in real expenditure.

In the long run that is quarter 10, impulse or innovation or shock to real net tax account for 13.52 percent variation of the fluctuation in real expenditure, shock to output gap can cause 14.41 percent fluctuation in real expenditure, shock to call money rate can cause 1.31 percent fluctuation in real expenditure, shock to inflation rate can cause 0.85 percent fluctuation in real expenditure and shock to exchange rate can cause 1.19 percent fluctuation in real expenditure.

Variance decomposition of Output:

In the short run that is quarter 3, impulse or innovation or shock to real net tax account for 18.82 percent variation of the fluctuation in output gap, shock to real expenditure can cause 41.96 percent fluctuation in output gap, shock to call money rate can cause 5.11 percent fluctuation in output gap, shock to inflation rate can cause 1.38 percent fluctuation in output gap and shock to exchange rate can cause 3.61 percent fluctuation in output gap.

In the long run that is quarter 10, impulse or innovation or shock to real net tax account for 14.46 percent variation of the fluctuation in output gap, shock to real expenditure can cause 43.18 percent fluctuation in output gap, shock to call money rate can cause 5.58 percent fluctuation in output gap, shock to inflation rate can cause 0.97 percent fluctuation in output gap and shock to exchange rate can cause 5.78 percent fluctuation in output gap.

Variance decomposition of Interest rate:

In the short run that is quarter 3, impulse or innovation or shock to real net tax account for 11.08 percent variation of the fluctuation in interest rate, shock to real expenditure can cause 12.74 percent fluctuation in interest rate, shock to output gap can cause 0.76 percent fluctuation in interest rate, shock to call money rate can cause 73.31 percent fluctuation in interest rate (own shock), shock to inflation rate can cause 0.49 percent fluctuation in output gap and shock to exchange rate can cause 1.60 percent fluctuation in interest rate.

In the long run that is quarter 10, impulse or innovation or shock to real net tax account for 11.67 percent variation of the fluctuation in interest rate, shock to real expenditure can cause 13.57 percent fluctuation in interest rate, shock to output gap can cause 5.52 percent fluctuation in call money rate, shock to interest rate, shock to inflation rate can cause 5.00 percent fluctuation in output gap and shock to exchange rate can cause 1.92 percent fluctuation in interest rate.

In the short run that is quarter 3, impulse or innovation or shock to real net tax account for 8.48 percent variation of the fluctuation in inflation rate, shock to real expenditure can cause 10.98 percent fluctuation in inflation rate, shock to output gap can cause 7.46 percent fluctuation in inflation rate, shock to interest rate can cause 21.88 percent fluctuation in inflation rate, and shock to exchange rate can cause 0.84 percent fluctuation in inflation rate.

In the long run that is quarter 10, impulse or innovation or shock to real net tax account for 7.92 percent variation of the fluctuation in inflation rate, shock to real expenditure can cause 13.22 percent fluctuation in inflation rate, shock to output gap can cause 10.43 percent fluctuation in inflation rate, shock to interest can cause 20.62 percent fluctuation in inflation rate and shock to exchange rate can cause 1.15 percent fluctuation in inflation rate.

In the short run that is quarter 3, impulse or innovation or shock to real net tax account for 5.36 percent variation of the fluctuation in exchange rate, shock to real expenditure can cause 8.46 percent fluctuation in exchange rate, shock to output gap can cause 3.85 percent fluctuation in exchange rate, shock to interest rate can cause 17.95 percent fluctuation in exchange rate, shock to inflation rate can cause 10.18 percent fluctuation in exchange rate.

In the long run that is quarter 10, impulse or innovation or shock to real net tax account for 7.72 percent variation of the fluctuation in exchange rate, shock to real expenditure can cause 8.26 percent fluctuation in exchange rate, shock to output gap

can cause 4.03 percent fluctuation in exchange rate, shock to interest rate can cause 17.40 percent fluctuation in exchange rate, shock to inflation rate can cause 10.02 percent fluctuation in exchange rate.