

Monetary and Fiscal Policy Coordination During the Fiscal Dominance Regimes

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Research

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Abstract

This study evaluates the conduct of monetary and fiscal policies for the post-liberalization period 2005: Q1–2017: Q1 in India and explores the need for coordination. As quantifying the extent of coordination, mostly depends on the appropriate policy mix that responds effectively to different shocks, this study empirically examines the interaction between monetary and fiscal policy by using Vector Auto Regressions (VAR) and a Vector Error Correction Model (VECM). Further, this study discusses the Stackelberg interaction model with government leadership to know the strategic interaction between monetary and fiscal policy. The estimates show that an unexpected increase in the monetary policy effect: (i) has a contractionary impact on the economic growth; (ii) leads to a gradual decline in the inflation; (iii) tightens the liquidity conditions; and (iv) rise in the bond yields. On the other hand, an unexpected increase in the fiscal policy effect: (i) has a positive effect on GDP growth; (ii) has an initial decline, but a gradual rise in the inflation levels; and (iii) leads to falling bond yields. Monetary policy is found to be more responsive to fiscal policy effects. The results imply that there is a greater need for effective coordination between monetary and fiscal policy as a sufficient condition to achieve economic stability.

JEL Classification: C32; E31; E52; E62; E63

1. Introduction

The main purpose of the fiscal policy is to achieve full employment, economic stability through sustained progressive rate of growth. On the other hand, the major objective of monetary policy is to achieve price stability, which is an essential pre-condition for enhancing the economic well-being and the growth potential of an economy. Hence, fiscal policy and monetary policy are two important pillars of an economy to achieve economic stability. However, it is possible to achieve a high level of employment and economic output with a higher level of inflation, only in the short-run (Phillips curve), as there is no trade-off between employment and inflation in the long-run. As such, monetary policy plays an all-important role in the long-run. Of late, as many countries are moving towards inflation targeting, they stringently pursue the goal of price stability. By this, we gain an impression, that the role of fiscal policy becomes minimal, though, in reality, price stability needs the support from fiscal policy. However, a monetary policy more often than not operates with some lag. In a Ricardian regime, monetary policy acts as an active policy and fiscal policy act as a passive policy, because the fiscal policy quite often follows the monetary policy, as it needs to operate the fiscal tax to fulfill the condition of budget equilibrium. Macroeconomic stability is not a case of pure fiscal or a pure monetary problem. This calls for greater coordination between the framers of fiscal and monetary policies, as any disharmony between the two adversely affects the overall economic stability.

Many times, lack of coordination between the two policies, according to Blinder (1982) emanates due to three major reasons: (i) divergent objectives of monetary and fiscal authorities; (ii) difference of opinion and actions of the monetary and fiscal authorities derived from contradicting economic foundations; and

(iii) different forecasts on the state of the economy formulated by the two authorities. Perfect coordination between the monetary and fiscal policies is not only necessary for a good, efficient, and stable economy, but also credible policy sustainability. However, it is not that easy to achieve the perfect coordination between the two due to several constraints. First, it is the problem of time frame, as the two policies operate with their different time lags dependent on the efficiency of transmission in the economy. Second, the monetary policy measures impact on the fiscal policy measures, and the vice versa. Third, in most of the economies, the institutions that operate these two policies are acting independently within their mandates. Across nations, the central banks that are responsible for monetary policy are independent of the governments that are in control of the fiscal policy. Fourth, conducting monetary policy when fiscal space is limited is still a challenge.

Worldwide, the conduct of monetary policy has fuelled ongoing debates and research about the need for coordinated efforts of monetary and fiscal authorities to ensure economic stability. Given this context, this paper analyses the extent of coordination of monetary and fiscal policies in India as things have greatly changed in the last decade and more particularly after the global financial crisis. In India, the Reserve Bank of India (the central bank) and the government have taken several measures to maintain price stability and economic growth, including the expansionary monetary and fiscal policy measures to stimulate aggregate demand. The extant literature does not provide a recent study that analyses the coordination of the monetary and fiscal policy outcomes more particularly in the context of an emerging economy like India.

This study investigates the extent of coordination between monetary and fiscal policies in India over the post-liberalization period (2005: Q1–2017: Q1). More often, the quantification of the extent of coordination largely depends on the appropriate policy mix that responds effectively to different shocks. More specifically, this paper estimates the macroeconomic effects of monetary and fiscal policy shocks using a Vector Auto-Regression (VAR) model as well as a vector error correction model (VECM).

The results suggest that a contractionary monetary policy: (i) has a negative effect on GDP growth; (ii) leads to a gradual decline in the inflation; (iii) tightens the liquidity conditions; and (iv) rise in the bond yields. Further, an expansionary fiscal policy: (i) has a positive effect on GDP growth; (ii) has an initial decline, but a gradual rise in the inflation levels; and (iii) leads to falling bond yields. Monetary policy is found to be more reactive to fiscal policy effects. A positive shock to the monetary policy rate is mostly accompanied by a fall in the fiscal deficit, thereby, amplifying the effects of the monetary contraction.

The remainder of the paper is organized as below. Section 2 provides a brief review of the literature on monetary and fiscal policy coordination. Section 3 outlines the data and methodology used in the estimation approach. Section 4 presents a discussion on the results. Finally, Sect. 5 presents the conclusion and policy implications.

¹ From a theoretical and empirical standpoint, the fiscal policy was accorded a secondary role in favour of monetary policy due to some of the following reasons: (i) monetary policy has the potential of

maintaining a stable output gap; (ii) in the emerging economies the domestic bond market is still evolving and hence limits the use of fiscal countercyclical policy; (iii) given a mix of short-recessions and lags, the possible countercyclical measures of fiscal policy could arrive too late (Blanchard, Dell’Ariccia, & Mauro, 2010).

² The emphasis on the importance of monetary and fiscal policy coordination has historical precedence. While prescribing the way out of the Great Depression, Keynes wrote: “It seems unlikely that the influence of [monetary] policy on the rate of interest will be sufficient by itself. I conceive, therefore, that a somewhat comprehensive socialization of investment will prove the only means of securing an approximation to full employment.” These views continue to be relevant in the present juncture as well.

2. Review Of Literature

In the case of emerging market economies, where the financial markets are underdeveloped, the central banks assume a crucial role in managing the expectations of the economic agents through the use of the monetary policy. The exchange rate stabilization by the central banks helps in promoting output stabilization and cooling down of inflation at targeted levels (Taylor, 2002). However, the adoption of an inflation-targeting regime could subject these authorities to “constrained discretion” (Calvo and Mishkin, 2003; Minella *et al.*, 2003). A monetary contraction is found to have a large impact on real economic activity and benefits, controlling inflation in the short-term (Mallick and Sousa, 2012). Emerging economy literature suggests that since the early nineties, monetary policy has been a vital stabilizing policy tool (Du Plessis, 2006). Assessing the monetary policy rules in China, Wang and Handa (2007) and Burdekin and Siklos (2008) infer that the behavior of the monetary authority is characterized by external sector tracking, inflation targeting, and output smoothing. Then again, Erten (2012) emphasizes the importance of external demand shocks in explaining emerging economies' growth performance. In emerging markets, the literature offers evidence of significant relationships in the conduct of the monetary policy and fiscal policies (Jawadi *et al.*, 2014a).

Literature offers evidence of the crucial role of fiscal policy in emerging markets in tackling the serious policy issues related to high inflation and fiscal policy procyclicality (Talvi and Vegh, 2005; Alesina *et al.*, 2008; and Ilzetski and Vegh, 2008). Careful observation reveals the relevance of the fiscal bias, as government net assets tend to decrease over the business cycle in the emerging economies (Velasco, 2000). In the aftermath of the Asian financial crisis, Mallick (2006) shows that fiscal austerity measures caused the output decline. Investigating the macroeconomic effects of fiscal policy in the BRICs, Jawadi, *et al.*, (2014b) observe strong Keynesian-style fiscal policy effects where there is no evidence of “expansionary fiscal contractions”. Also, inflation concerns and economic growth considerations seem to drive the behavior of the fiscal policies in emerging market economies.

This paper is more related to the literature that is aimed at deriving the measures of unexpected variation in the monetary and fiscal policy effects. Country-level studies, like Afonso and Sousa (2012) and Christiano *et al.*, (2005) identify monetary and fiscal shocks using the VAR models and a Cholesky

ordering. In understanding the fiscal policy responses to the business cycle, Blanchard and Perotti (2002) use external information about the elasticity of fiscal variables. In identifying the unexpected variation in the interest rate and government spending, Uhlig (2005) uses sign-restrictions on the impulse-response functions.

Bayesian methods (Leeper and Zha, 2003) and simultaneous systems of equations (Afonso and Sousa, 2011) were employed to quantify the macroeconomic impact of interest rate shocks and to estimate the money demand and the policy rule equations respectively. Interestingly, Romer and Romer (2004, 2010) employ the so-called “narrative approach” to isolate political events and argue that conventional measures may be biased.

Recent theoretical contributions and international experience motivate a detailed analysis of the monetary and fiscal policy coordination. For example, the countries that grew rapidly during the 1990s like the US, China, and Ireland managed the policy coordination satisfactorily (Goyal, 2002). This paper contributes to the empirical literature on the coordination of the effects of monetary and fiscal policy in the context of emerging market economies.

3. Data And Methodology

This paper estimates the linkage between monetary policy and fiscal policy effects in India in the presence of control variables using a data set that contains substantial time series (45 quarterly data points) from March 2005 to March 2017 in each of the variables. The study period was so chosen because of the reason that the operating procedure of monetary policy in India underwent a paradigm shift in early 2000 with the introduction of the liquidity adjustment facility and the interest rate channel becoming the main monetary policy signaling instrument. Furthermore, the Fiscal Responsibility and Budget Management (FRBM) Act, 2003 prohibited the Reserve Bank of India from buying government securities in the primary market from April 2006.

Reserve Bank of India database provides the data related to all the variables. The variables that go into the econometric specification include inflation, GDP_growth (GDPGR), a nominal exchange rate (ER), real_exchange_rate (REER), fiscal _deficit (FD), 5-year-bond-yield (5YB) and 10-year-bond-yield (10YB). Table 1 describes the variables and the summary statistics such as minimum, 25th percentile, mean, 50th percentile, 75th percentile, maximum, and standard deviation. Figure 1 shows the graphical illustration of the covariates. Figure 2 shows the density plots of the covariates. Figure 3 shows the heatmap of the variables which is a graphical representation of data where values are depicted by color. The heatmap visualizes the complex data and understand it immediately and allow us to simultaneously visualize clusters of samples and features.

Table 1
Summary statistics

<i>Descriptives</i>									
stats	INFL	GDPGR	ER	FD	WACMR	5YB	10YB	GDP	REER
mean	7.64	7.56	52.20	6.47	6.87	7.68	7.78	9.82	96.31
p25	5.50	6.25	44.72	6.50	5.94	7.27	7.49	9.35	92.09
p75	9.80	9.12	61.61	6.94	8.05	8.16	8.19	10.33	99.06
min	3.41	0.16	39.41	-0.39	2.42	5.38	5.26	8.90	84.31
max	15.30	13.70	67.90	7.50	14.07	8.93	8.83	10.63	117.56
sd	2.89	2.35	9.13	1.20	2.06	0.76	0.69	0.53	7.29
p50	6.90	7.30	48.45	6.74	7.11	7.75	7.85	9.82	94.61
cv	0.38	0.31	0.17	0.19	0.30	0.10	0.09	0.05	0.08
<i>Correlations</i>									
	INFL	GDPGR	ER	FD	WACMR	5YB	10YB	GDP	REER
INFL	1								
GDPGR	-0.04	1							
ER	-0.22	-0.40*	1						
FD	-0.05	0.16	-0.22	1					
WACMR	-0.09	-0.16	0.19	0.06	1				
5YB	0.19	0.01	0.11	-0.01	0.59*	1			
10YB	0.21	0.09	0.02	0.05	0.50*	0.96*	1		
GDP	-0.01	0.37*	0.89*	-0.20	0.25	0.32*	0.20	1	
REER	-0.36*	0.27	0.17	0.13	-0.14	-0.25	-0.24	0.25	1
* Indicates Significance at 0.05 levels									

Figure 4 shows the bivariate density and the correlations of the variables. We notice that WACMR is positively correlated with 5YB and 10YB at a 1% significance level. However, we notice the channels of correlation of the variables using Fig. 5 that shows the Dendrogram of the correlations. The fiscal policy

proxy variables LNFD is linked to the monetary policy variables through the inflation channel. We further explore the dataset to ascertain the correlation directions, Fig. 6 captures the correlation directed graph of the covariates. Interestingly, LNFD is positively linked to the 10YB, showing a negative link with 5YB. The fiscal policy variable LNFD and the monetary policy variable WACMR are positively linked with a network correlation value of 0.12.

Figure 7 captures the monetary policy effect on inflation, GDP growth, and Exchange rate. Similarly, Fig. 8 presents the interaction effect of fiscal policy effects on the macroeconomic variables.

3.1 The Model

This section introduces the model and estimation methodology. A vector autoregressive model (VAR) can be the best solution in testing the long-run dynamic relationship between the variables concerned in such a situation where the prior assumption of endogeneity and homogeneity of variables concerned may not always be made. VAR model treats all variables systematically without referring to the issue of dependence or independence. A VAR model additionally offers scope for intervention analysis through the study of impulse response functions for the endogenous variables in the model. Moreover, a VAR model allows the analysis of ‘variance decompositions’ for these variables and further helps to understand the interrelationships among the variables concerned.

The estimation sample has been chosen using a VAR model of the form:

$$\mathbf{Z}_t = \mathbf{A}(\mathbf{L})\mathbf{Z}_{t-1} + \boldsymbol{\mu} + \boldsymbol{\varepsilon}_t$$

\mathbf{Z}_t is a vector of endogenous variables, $\mathbf{A}(\mathbf{L})$ describes parameter matrices, $\boldsymbol{\mu}$ is a vector of constant terms and $\boldsymbol{\varepsilon}_t$ is a vector of error terms that are assumed to be white noise.

The mathematical representation of a VAR is:

$$\mathbf{y}_t = \mathbf{A}_1 \mathbf{y}_{t-1} + \dots + \mathbf{A}_p \mathbf{y}_{t-p} + \mathbf{B} \mathbf{X}_t + \boldsymbol{\epsilon}_t$$

— Eq. (1)

where y_t is k vector of endogenous variables, X_t is a d vector of exogenous variables, A_1, \dots, A_p and B are matrices of coefficients to be estimated, and $\boldsymbol{\epsilon}_t$ is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables. Since only lagged values of the endogenous variables appear on the right-hand side of the equations, simultaneity is not an issue and OLS yields consistent estimates.

Moreover, even though the innovations ε_t may be contemporaneously correlated, OLS is efficient and equivalent to GLS since all equations have identical regressors.

A recursive VAR constructs the error terms in each regression equation to be uncorrelated with the error in the preceding equations. This is done by judiciously including some contemporaneous values as regressors. Consider a three-variable VAR, ordered as A, B, C. In the first equation of the corresponding recursive VAR, A is the dependent variable and the regressors are lagged values of all three variables. In the second equation, B is the dependent variable and the regressors are lags of all three variables plus the current value of A. C is the dependent variable in the third equation, and the regressors are lags of all three variables, the current value of the A, plus the current value of B. Estimation of each equation by OLS produces residuals that are uncorrelated across equations. Seemingly, the result depends on the order of the variables: changing the order changes the VAR equations, coefficients, and residuals, and there are $n!$ recursive VARs, representing all possible orderings.

I prefer to use a reduced form VAR model consistent with the macroeconomic framework described in the literature. Three points are worth mentioning here. First, all of the parameters in the model are assumed to be time-varying reflecting the characteristics of a volatile macroeconomic environment. Second, by observing the impulse response functions, one can detect whether the arguments of Blanchard (2004) are holding good for the Indian economy. Third, I choose to employ a backward-looking setup as the procedure to estimate such systems necessitates a recursive algorithm. Further, I encounter the limitation of related expectation data for using a forward-looking model.

The coefficients are estimated by iterated seemingly unrelated regression. The impulse response functions (IRFs) generated to measure the effects of a shock to an endogenous variable on itself or another endogenous variable. To compute the IRFs the VAR must be stable. However, simple IRFs that give the effect over time of a one-time unit increase to one of the shocks, holding all else constant have a drawback. Because other shocks cannot be held constant as the shocks are contemporaneously correlated. As such, orthogonal innovations are employed to overcome this limitation. Then, I compute the forecast error variance decomposition (FEVD), which measures the fraction of the forecast error variance of an endogenous variable that can be attributed to orthogonalized shocks to itself or another endogenous variable.

Firstly, I estimate VAR of the monetary policy effects on fiscal policy variable (FD) in the presence of other macroeconomic variables. Second, VAR analysis of the fiscal policy effects on monetary policy effect variable (i.e. WACMR). Third, monetary policy effects on government bond yields (5-year bond yield and 10-year bond yield) are estimated. Finally, I perform a VAR analysis of the fiscal policy effects on government bond yields.

To begin with, in the recursive VAR model to estimate the monetary policy effects, the vector Z_t comprises the following variables:

$$Z_t = (FD_t + GDPGR_t + INF_t + ER_t)$$

---- Eq (2)

Where FD_t is the fiscal deficit, $GDPGR_t$ is the economic growth rate, and INF_t is inflation, and ER_t the exchange rate.

Second, in this specification to estimate the fiscal policy effects, the vector Z_t comprises the following variables:

$$Z_t = (ER_t + GDPGR_t + INF_t + WACMR_t)$$

---- Eq (3)

Where ER_t the exchange rate, $GDPGR_t$ is the economic growth rate, INF_t is inflation, and $WACMR_t$ is the weighted average call money rate.

Third, in the VAR model to estimate the monetary policy effects on bond yields, the vector Z_t comprises the following variables:

$$Z_t = (WACMR_t + 5YB_t + 10YB_t)$$

---- Eq (4)

Where $WACMR_t$ is the weighted average call money rate, $5YB_t$ is the government's 5-year bond yield, and $10YB_t$ is the government's 10-year bond yield.

Fourth, in the specification to estimate the fiscal policy effects on bond yields, the vector Z_t comprises the following variables:

$$Z_t = (FD_t + 5YB_t + 10YB_t)$$

---- Eq (5)

Where FD_t is the fiscal deficit, $GDPGR_t$ is the economic growth rate, and INF_t is inflation, and ER_t the exchange rate.

4. Results And Discussion

Before any analysis, first, I derive the summary statistics from the data to ascertain its nature and also estimate the correlations with significance levels (Table 1). I tested the stationarity of the variables and report the results of the unit root tests (ADF, PP, and KPSS Test) in Table 2. I perform a multivariate LM

test to test the presence of the autocorrelations and the VAR residual portmanteau tests for autocorrelations to establish the residual autocorrelations. Further, I performed the VAR Granger causality tests, to know whether each variable plays a significant role in each of the equations to help to establish a sensible causal ordering. I performed the VAR selection order criteria test gauge whether sufficient lags in the VAR are included. Because introducing too many lags wastes degree of freedom, while too few lags leave the equations potentially misspecified and are most likely to cause autocorrelation in the residuals. VAR selection order criteria test highlights the optimal lag. To know the stability of the VAR, I performed the VAR stability test to ensure that the moduli of the Eigenvalues of the dynamic matrix to lie within the unit circle. For brevity, the results of all the stages of the analyses are not reported. However, they are available for verification on request.

Table 2

Unit root tests We report the test statistics for the ADF, PP, and KPSS tests. ***, **, * indicate the significance of the result at 1%, 5%, and 10% respectively. For KPSS test results, asymptotic critical values are provided as per Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1). PP test, ADF test (H_0 : series has a unit root).

Variable	Test Statistic at the level form			Test Statistic at 1st diff.		
	ADF Test	PP Test	KPSS Test	ADF Test	PP Test	KPSS Test
GDPGR	-1.54	-1.69	0.21	-6.01***	-6.01***	0.24
ER	-0.38	-0.38	0.82	-6.85***	-6.85***	0.11
FD	-7.37***	-7.35***	0.30			
WACMR	-4.54***	-4.57***	0.18			
5YB	-3.12***	-3.12***	0.26			
10YB	-3.87***	-3.84***	0.19			

The general framework in this study implies that the monetary policy effects significantly impact on the fiscal stance of the economy and vice versa. I use the weighted average call money rate (WACMR) as the proxy for monetary policy and gross fiscal deficit (FD) as the proxy for the fiscal policy effects. In the following sub-sections, I discuss the impulse response functions and variance decompositions of the VAR analysis.

4.1 Monetary policy effects

Any shocks to the i^{th} variable not only directly affect the respective variable i^{th} variable only, but also it would be transmitted to all of the endogenous variables in the model through the dynamic (lag) structure of VAR. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. Figure 4 illustrates reports of the accumulated response of the macroeconomic variables, including fiscal policy variables to the monetary policy effect. The impulse responses show the effect of an unexpected 1 percentage point increase in WACMR on all

other variables, as it works through the recursive VAR system with the coefficients estimated from actual data. Also plotted are ± 1 standard error bands for each of the impulse responses. An unexpected rise in WACMR is associated with a decline in FD by a maximum of around - 0.0906 percent in the 1st period and a minimum - 0.0075 percent in the 8th period.

The impulse response functions (IRFs) discover the effects of a shock to one and thereby transmitted to other endogenous variables in the VAR system. However, it is also required to know the magnitude of shocks in the system. To overcome this problem, a variance decomposition mechanism is applied to separate the variation in an endogenous variable into the constituent shocks to the VAR system. The source of this forecast error is the variation in the current and future values of the innovations to each endogenous variable in the VAR. With the impulse responses, the variance decomposition based on the Cholesky factor can change dramatically if the ordering of the variables in the VAR is altered. For example, the first-period decomposition for the first variable in the VAR ordering is completely due to its innovation. Figure 10 illustrates the variance of decompositions of the impulse responses to the monetary policy effects. I notice that during the 1st period, 0.0034 percent of the errors in the forecast of WACMR are attributed to FD, and it increases to 0.0429 during the 8th -period shocks in the recursive VAR.

4.2 Fiscal Policy effects

The impulse responses indicate that an unexpected rise in FD is associated with a decrease in WACMR by a maximum of around - 0.3960 percent in the 1st period and a minimum of -0.0042 percent in the 7th period. Figure 11 illustrates the IRFs of the effect of FD on WACMR and other macroeconomic variables.

The variance of decompositions of the impulse responses to the monetary policy effects explains the effect based on the forecast error. Figure 12 illustrates the separate variance decomposition of FD for each endogenous variable based on the source of the forecast error. I notice that during the 1st period, 0.0034 percent of the errors in the forecast of WACMR are attributed to FD, and it increases to 0.0429 during the 8th -period shocks in the recursive VAR.

4.3 Monetary policy effects on Bond Yields

Figure 13 illustrates the monetary policy effects on bond yields using the Impulse responses to WACMR. The impulse responses suggest that an unexpected rise in WACMR is associated with a decline in 5YB of around - 0.0363 percent in the 1st period and a maximum rise of 0.0163 percent in the 2nd period. The intensity of the rise in the impulse responses gradually declines to 0.0021 percent in the 8th period. Similarly, the impulse responses of 10YB respond with a decline of around - 0.0364 percent in the 1st period and a maximum rise of 0.0201 percent in the 2nd period. As in the case of 5YB, the intensity of the rise in the impulse responses of 10YB also gradually declines to 0.0014 percent in the 8th period.

Further, I estimate the separate variance decomposition of WACMR for each Bond yield based on the forecast error due to the variation in the current and future values of the innovations to each endogenous variable in the VAR. Figure 14 illustrates the variance of decompositions of the impulse responses of bond yields to the monetary policy effects. I notice that during the 1st period, 0.1015 percent of the errors

in the forecast of WACMR are attributed to 5YB, and it increases to 0.1020 during the 8th -period shocks in the recursive VAR. Similarly, during the 1st period, 0.0598 percent of the errors in the forecast of WACMR are attributed to 10YB, and it increases to 0.0703 during the 8th -period.

4.4 Fiscal Policy effects on Bond Yields

Figure 15 shows the fiscal policy effects on bond yields using the Impulse responses to FD. The impulse responses suggest that an unexpected rise in FD is associated with a decline in 5YB of around - 0.1117 percent in the 1st period and a maximum decline of -0.2969 percent in the 8th period. The intensity of the decline in the impulse responses gradually increases during the horizon on analysis. Similarly, the impulse responses of 10YB respond with a decline of around - 0.1000 percent in the 1st period and a maximum decline of -0.2385 percent in the 8th period. As in the case of 5YB, the intensity of the decline in the impulse responses of 10YB also gradually declines during the horizon period.

Further, Fig. 16 illustrates the separate variance decomposition of FD for each Bond yield based on the forecast error due to the variation in the current and future values of the innovations to each endogenous variable in the VAR. During the 1st period, 0.0044percent of the error in the forecast of FD is attributed to 5YB, and it increases to 0.0433 during the 8th -period shocks in the recursive VAR. Similarly, during the 1st period, 0.0164 percent of the errors in the forecast of FD are attributed to 10YB, and it increases to 0.0439 during the 8th -period.

Finally, I test for a cointegrating relationship between the monetary and fiscal policy variables by using a Johansen Jusillius test. The presence of a co-integrating vector implies that the covariates are related strongly in the long run (Table 3). Johansen test of co-integration produces the Trace and Maximum Eigenvalue performed to determine the order of integration; which both indicates that we reject the null hypothesis that none of the variables is co-integrated since p-value $0.0000 < 0.05$, but revealed that there is at most one co-integrating equation or error since p-values are greater than 0.05 for both trace and Max. Eigenvalue i.e., the variables have a long-run relationship. The result of the normalized co-integrating coefficient is -0.2996 as the long-run coefficient for WACMR. Since the variables are co-integrated, I run the VECM model.

Table 3
Johansen Cointegration Test Results

H_0	H_a	Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
Unrestricted Cointegration Rank Test (Trace)						
r = 0	r > 0	None *	0.3836	29.2422	15.4947	0.0002
r ≤ 1	r > 1	At most 1 *	0.1408	6.9827	3.8415	0.0082
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)						
r = 0	r = 0	None*	0.3836	22.2595	14.2646	0.0022
r = 1	r = 1	At most 1*	0.1408	6.9827	3.8415	0.0082
1 Cointegrating Equation(s): Log likelihood = -108.0946						
FD		WACMR				
-1.6091		-0.2996				
(0.2952)		(0.6007)				
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level; Normalized cointegrating coefficients (standard error in parentheses); * denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values						

Table 4 reports that WACMR has a negative error correction term (ECT) coefficient meaning that WACMR has feedback to long-run equilibrium: adjusting in the short-run to restore long-run equilibrium. The ECT coefficient for WACMR is statistically negative, which implies that this variable fits into the model and suffers a shock and adjusts to restore their equilibrium.

Table 4
Monetary policy rate and Fiscal policy rate: VECM results

	D(LNFD)	D(WACMR)
ECT	-1.4529 (0.2946)	-0.5783 (0.5010)
D(LNFD(-1))	0.2917 (0.2326)	0.2006 (0.3956)
D(LNFD(-2))	0.1574 (0.1564)	0.1517 (0.2659)
D(WACMR(-1))	0.1657 (0.0986)	-0.4021 (0.1677)
D(WACMR(-2))	0.0936 (0.0915)	-0.2342 (0.1556)
Intercept	-0.0544 (0.1832)	0.0339 (0.3115)
R-squared	0.5866	0.2658
Adj. R-squared	0.5349	0.1740

Standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1. Specification includes constant

The error correction coefficient for WACMR is (-0.57) and it measures the speed of adjustment of WACMR towards long-run equilibrium. The coefficient carries the expected negative sign. The coefficient indicates feedback of about 57% of the previous quarter's disequilibrium from the long-run elasticity. About 57% percent of disequilibrium is "corrected" in each quarter by changes in WACMR.

Stackelberg Interaction Model with Government leadership

The central bank, undoubtedly, is independent of the government, nevertheless, the latter, being the leader, indirectly affects the central bank decision making to achieve its goals. The leader considers the possible policy reactions of the central bank to its decisions. This assumption is based on the conclusions of Dixit and Lambertini (2003) who claim that fiscal policy leadership is considerably more efficient than that of the monetary policy.

Table 5 summarizes the possible scenarios of combinations of shocks to monetary policy and fiscal policy in response to the macroeconomic scenarios. Each cell in the policy matrix represents the policy combination to respond to the shocks in the corresponding cell in the macroeconomic matrix. To clarify,

there are four possible combinations of positive (P) and/or negative (N) shocks to growth rate or inflation. The upper left corner cell denotes positive shocks to both growth rate and inflation, while the lower-left corner cell represents negative shocks to growth rate and positive shocks to inflation. Figure 17 shows the monetary and fiscal policy trends in India.

Table 5
Policy Response Matrix

Monetary Policy		
Fiscal Policy	Contraction	Expansion
Contraction	CC	CE
Expansion	EC	EE

The extent of coordination between the monetary policy and the fiscal policy mostly depends on the appropriate policy mix that responds effectively to different macroeconomic shocks. Given that the real GDP growth rate and inflation rate are the two important indicators of economic performance, shocks to both indicators represent the macroeconomic imbalances that necessitate effective policy coordination.

Overall, I notice a lack of effective coordination between an independent central bank and fiscal authority. Though there are several advantages of the independent central bank to pursue its objectives and operational autonomy, an effective monetary policy framework with the independent central bank should cultivate efficient methods of coordination of monetary and fiscal policies (Walsh, 2011). Effective interaction between the fiscal and monetary policy is emphasized by Bertella et al., (2015) in their study using a dynamic nonlinear model. Raj, Khundrakpam & Das (2011) also make similar conclusions in their empirical study of the interaction of monetary and fiscal policy for India from the period of 2000: Q2 to 2010: Q1 using quarterly data of inflation rate (WPI), change in the gross fiscal deficit, policy rate, and the output gap. They view that the reaction of monetary and fiscal policies to any shocks in inflation and output are mostly opposite.

India has provided a statutory and institutionalized framework for monetary policy by constituting the Monetary Policy Committee (MPC) under the auspices of Reserve Bank of India. MPC is entrusted with the task of fixing the benchmark policy rate (repo rate) required to contain inflation within the specified target level. In recent years, India has stuck to its fiscal discipline targets with a prudent implementation of FRBM. Therefore, in an environment where fiscal discipline is moderately accomplished, monetary policy action is not hindered by the fiscal performance of the economy; inflation can be managed effectively by implementing a tight monetary policy.

5. Conclusion

This study analyzed the interaction of fiscal and monetary policies in India using quarterly data for 2005: Q1 to 2017: Q1. Using a VAR and VECM approach, this study shows that an unexpected increase in the

monetary policy effect: (i) has a contractionary impact on the economic growth; (ii) leads to a gradual decline in the inflation; (iii) tightens the liquidity conditions; and (iv) rise in the bond yields. On the other hand, an unexpected increase in the fiscal policy effect: (i) has a positive effect on GDP growth; (ii) has an initial decline, but a gradual rise in the inflation levels; and (iii) leads to falling bond yields. Monetary policy is found to be more responsive to fiscal policy effects. Further, besides providing evidence of the macroeconomic impact of fiscal and monetary policies, this study emphasizes the need for effective coordination between monetary and fiscal policy as a sufficient condition to achieve economic stability. The monetary policy shock seems to be accompanied by a fiscal expansion that jeopardizes the credibility of the central bank monetary policy actions, thus indicating fiscal policy dominance. A comparison of the efficacy of the policies suggests that the monetary policy interest rate is more effective in stimulating output.

From a policy perspective, this study suggests that monetary policy authorities need to use their tools in harmony with the fiscal policy effects of the government to achieve macroeconomic stabilization. Intuitively, the autonomy of central bank independence should not result in non-coordination between the monetary and fiscal authorities. Weaker coordination can lead to a rise in fiscal deficits, which in turn puts pressure on the monetary policy to conduct its objective in stabilizing prices, despite the moderation of fiscal dominance of monetary policy through phasing out monetization. There is a need for well-structured coordination mechanisms between the operations of monetary and fiscal policy, more particularly during the times of severe downturns and economic booms.

Declarations

Ethics approval and consent to participate

I wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

Consent for publication

Not applicable

Availability of data and material

Data available on request from the authors. The data that support the findings of this study are available from the corresponding author upon reasonable request.

Competing interests

I state that there are no competing claims/interests in regard to this manuscript.

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Authors' contributions

This is a sole author manuscript

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Not applicable

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Figures

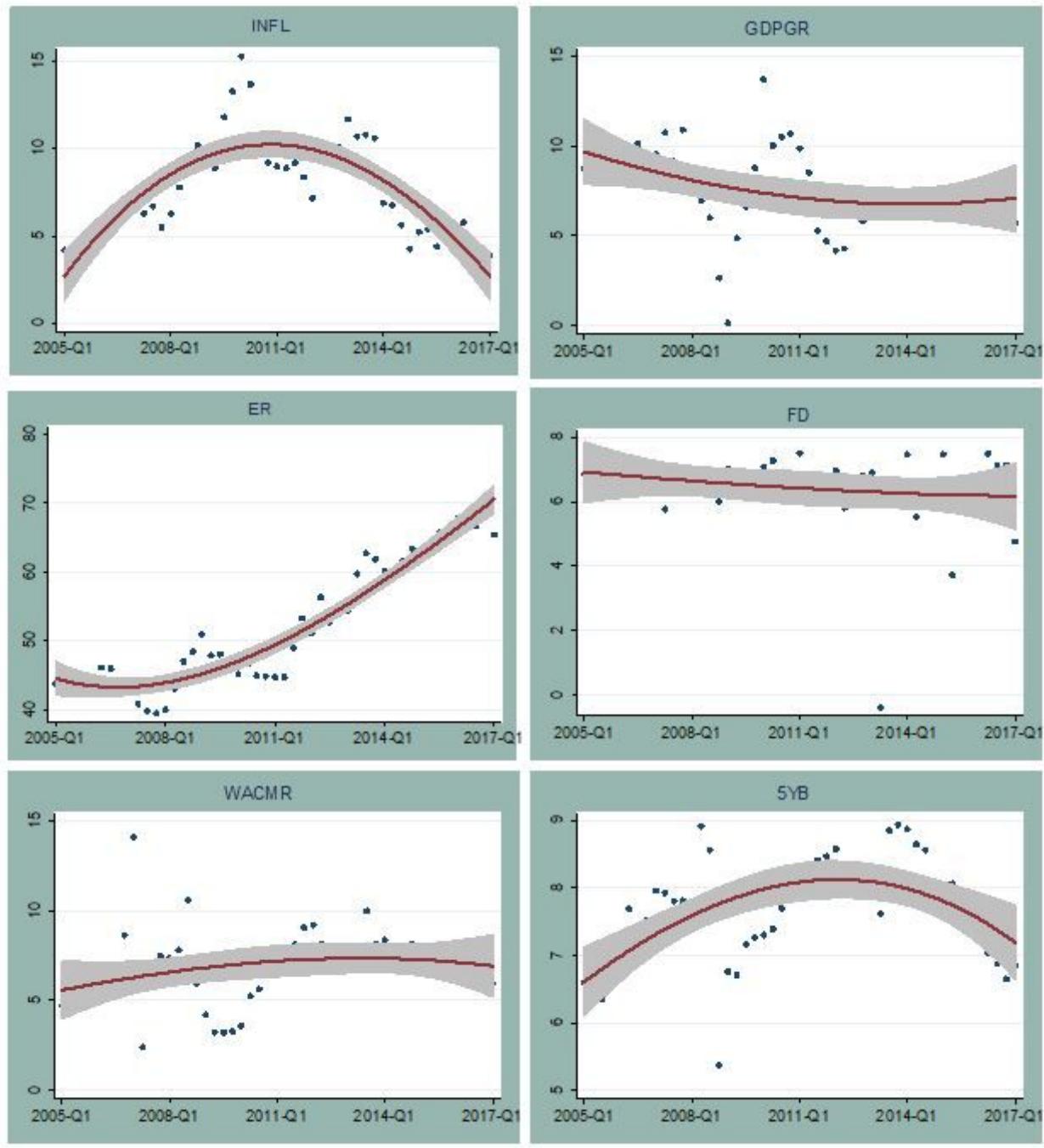


Figure 1

Macroeconomic covariates

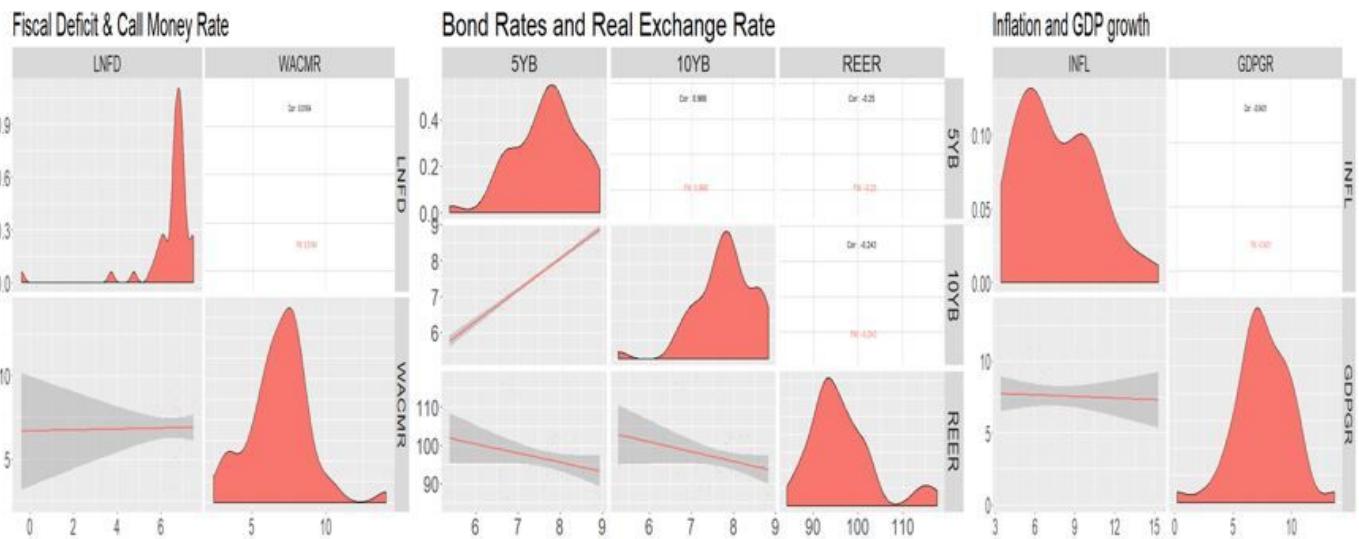


Figure 2

Density plots of the covariates

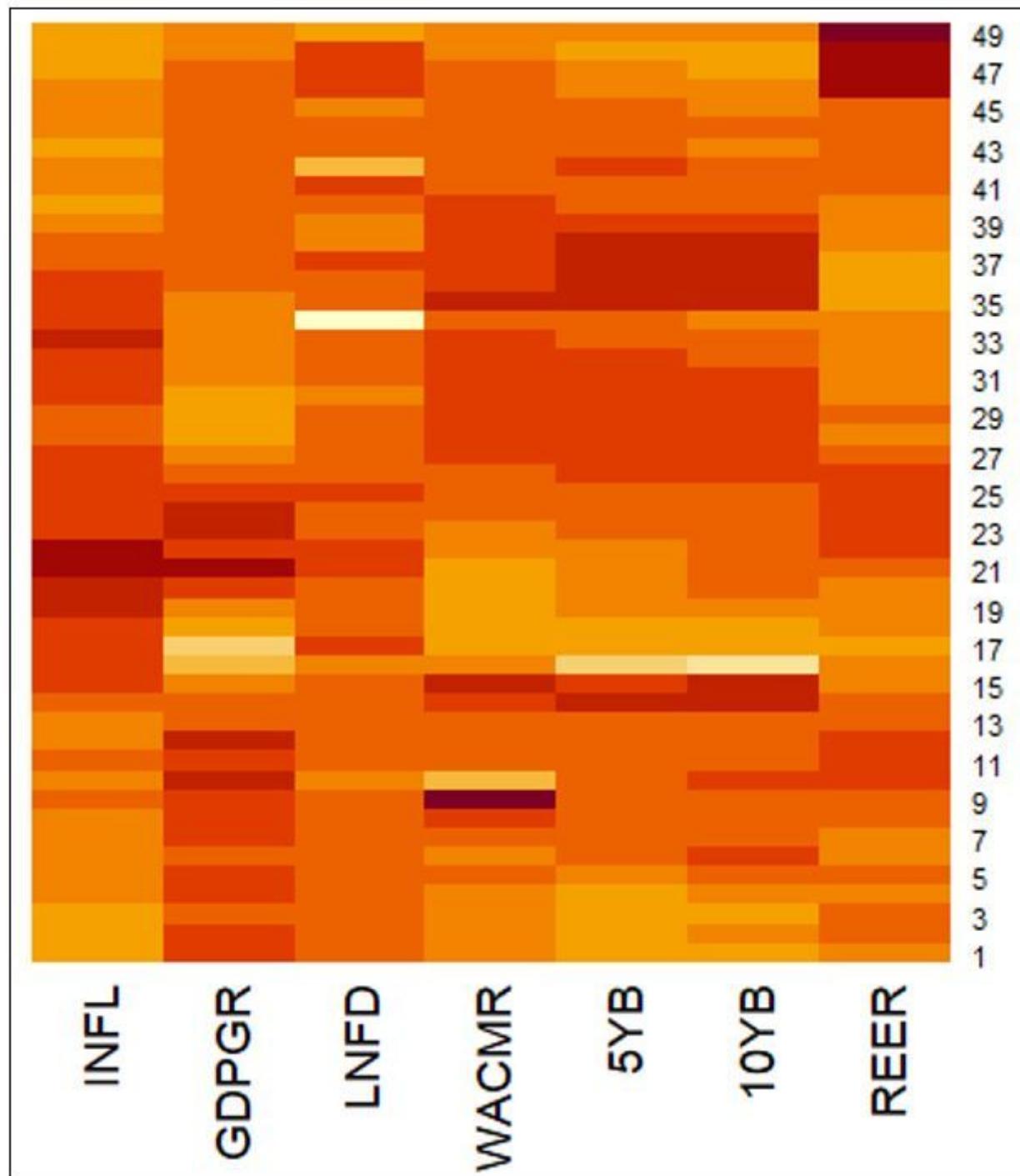


Figure 3

Heatmap of the variables

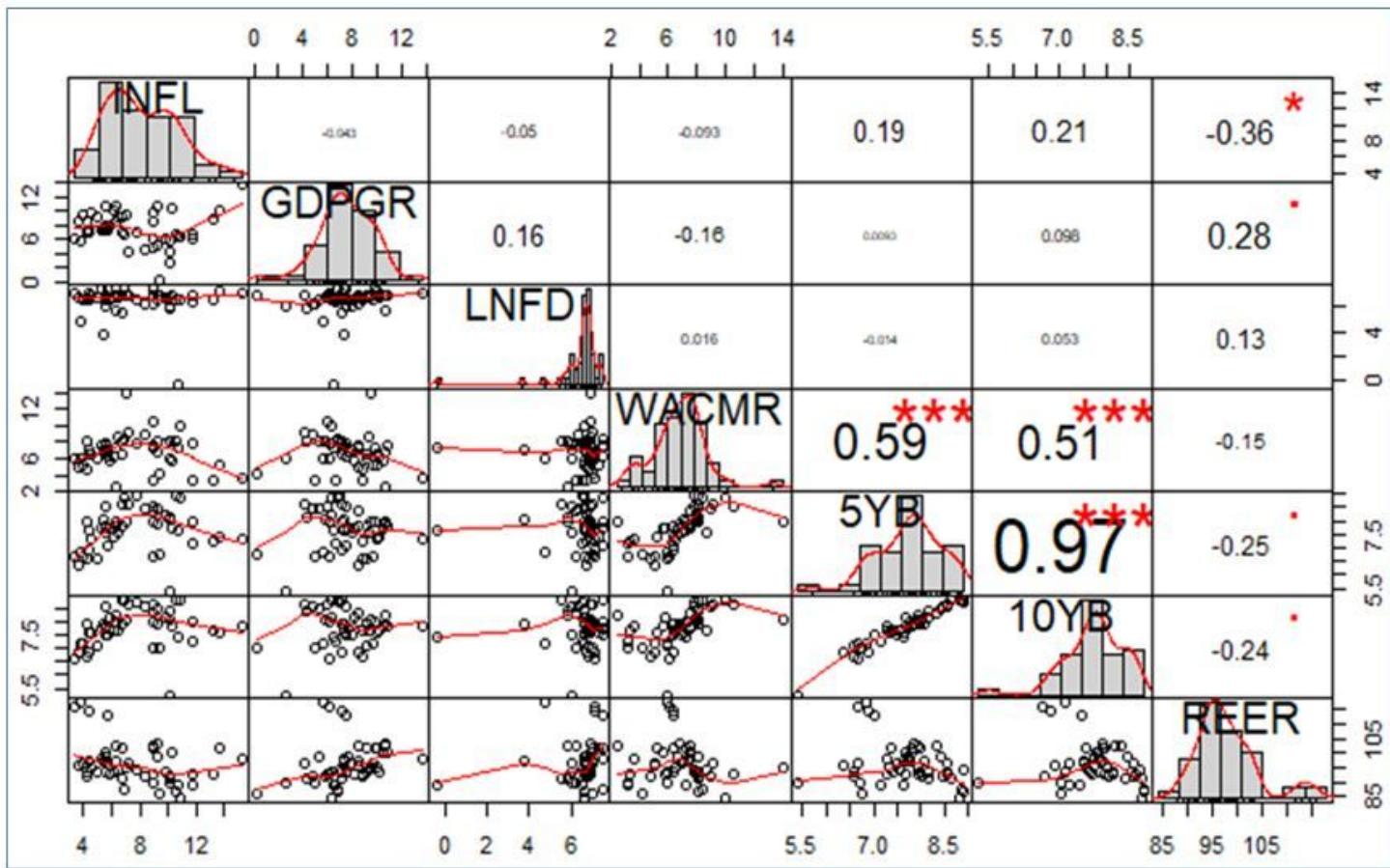


Figure 4

Bivariate density and correlations panel

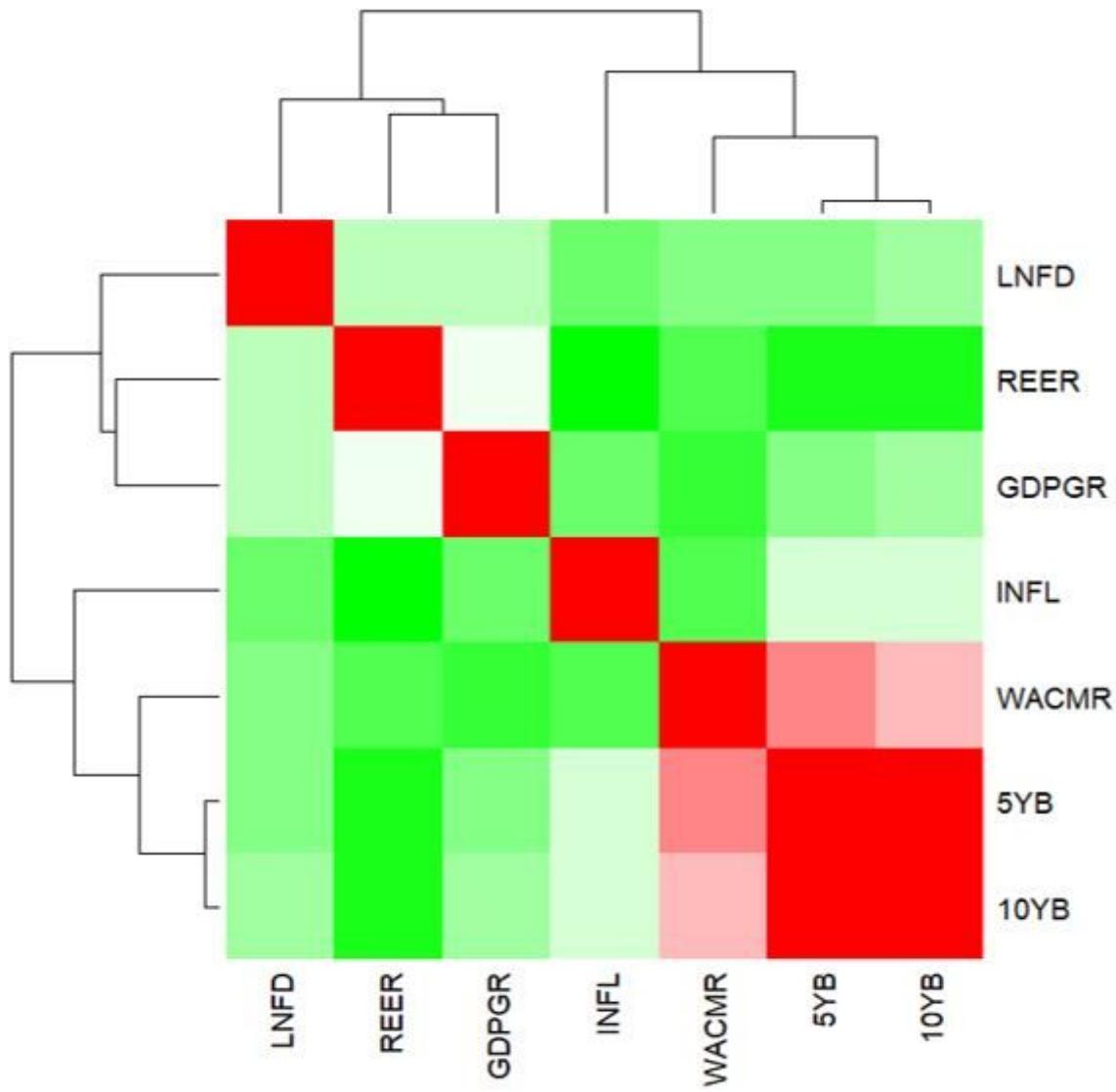


Figure 5

Dendrogram of the Correlations

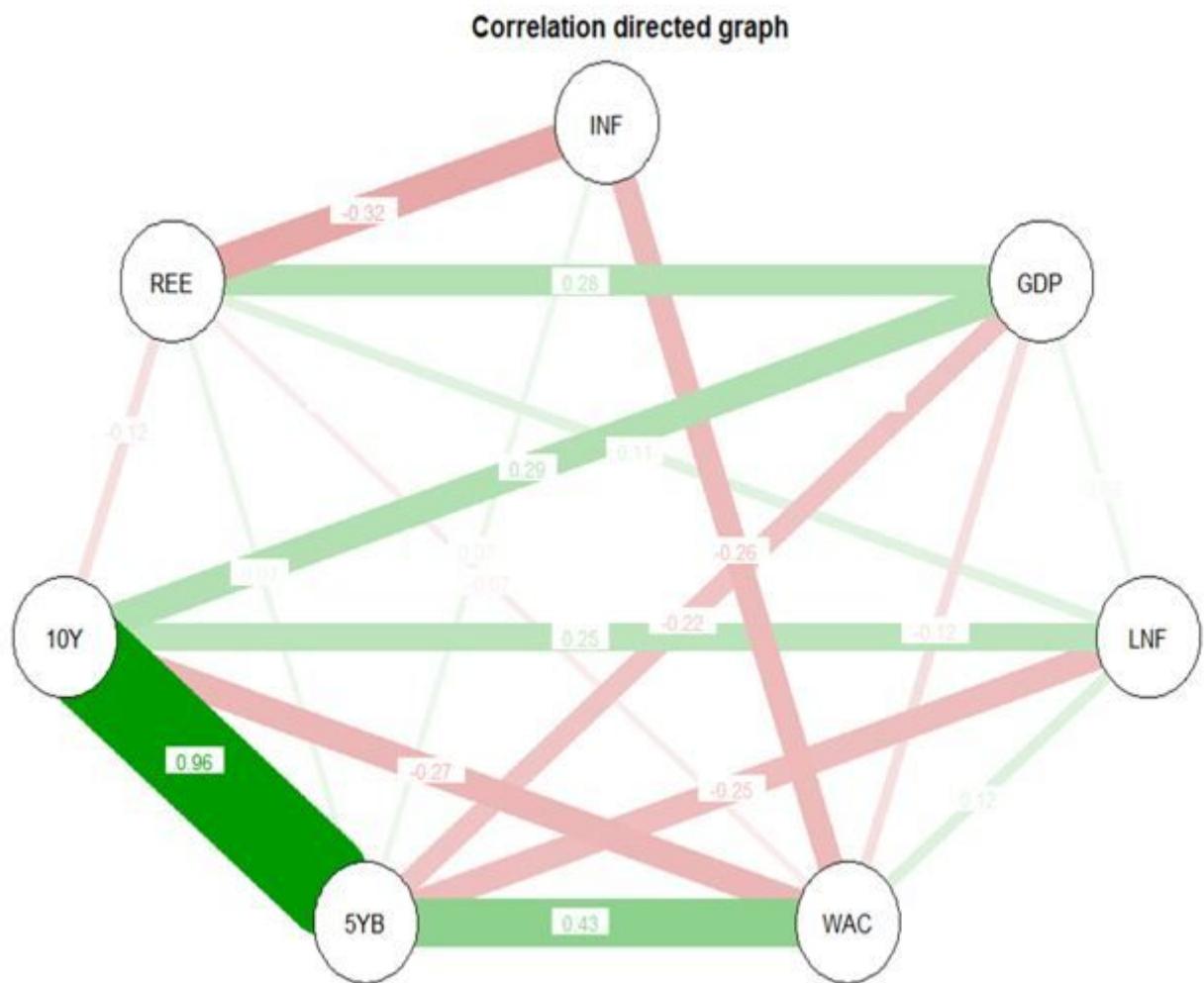


Figure 6

Correlation directed graph of the covariates

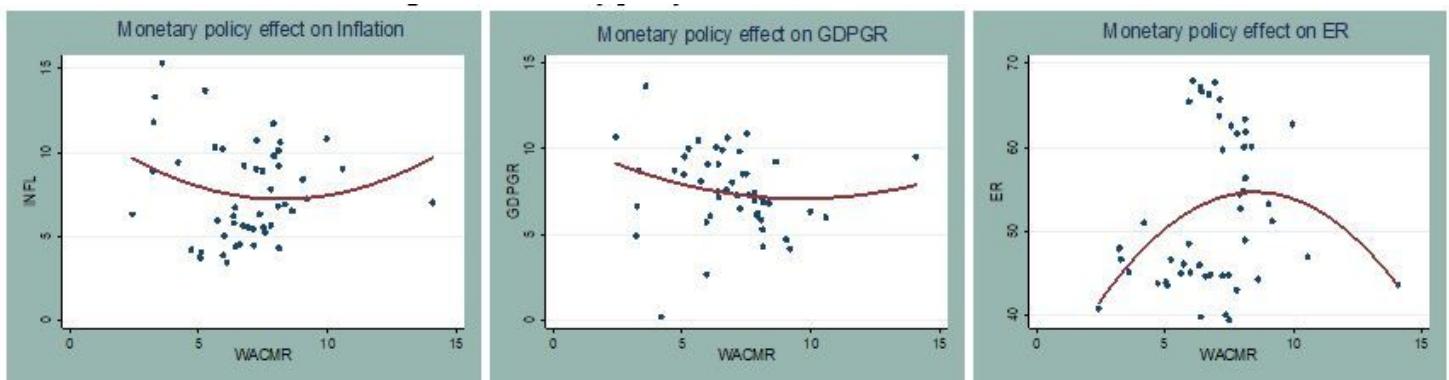


Figure 7

Monetary policy effect on macroeconomic variables

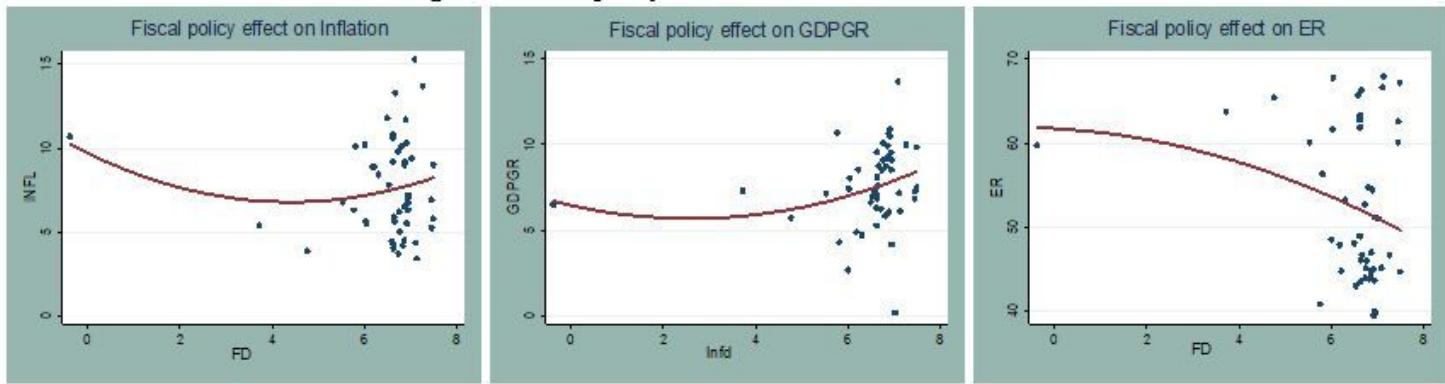


Figure 8

Fiscal policy effect on macroeconomic variables

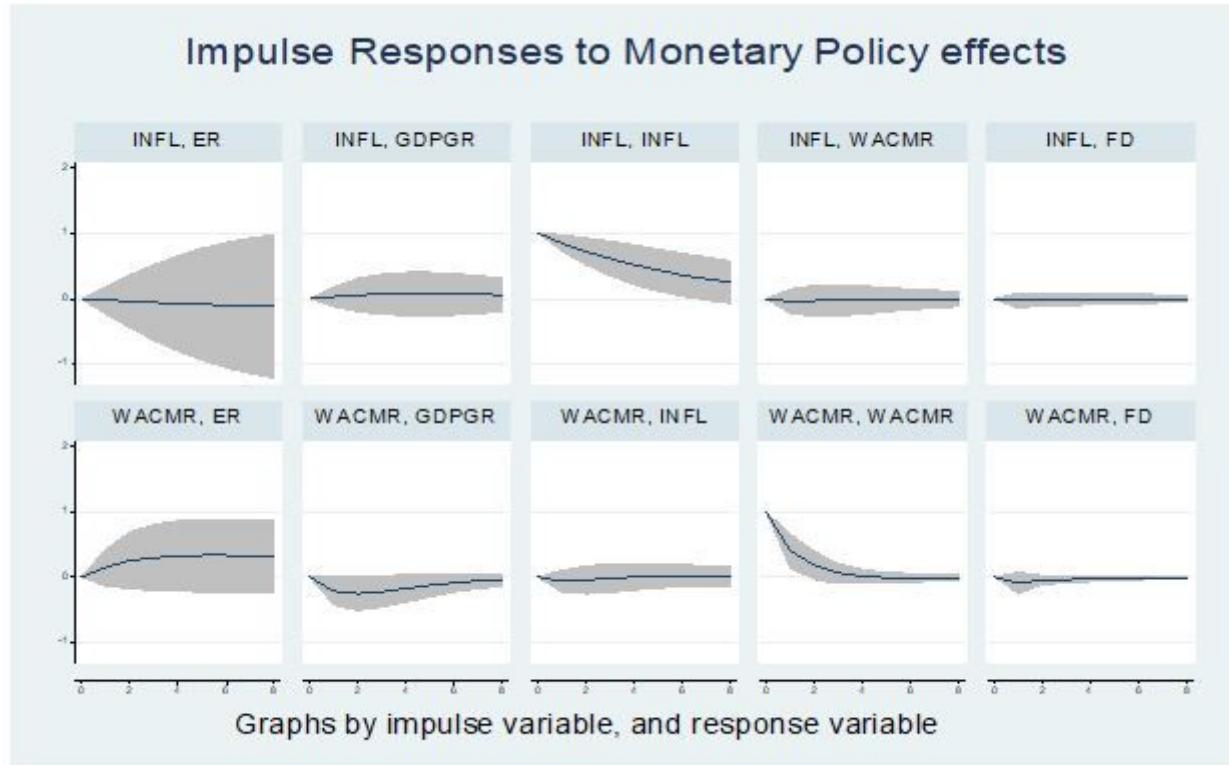


Figure 9

Accumulated impulse responses to WACMR

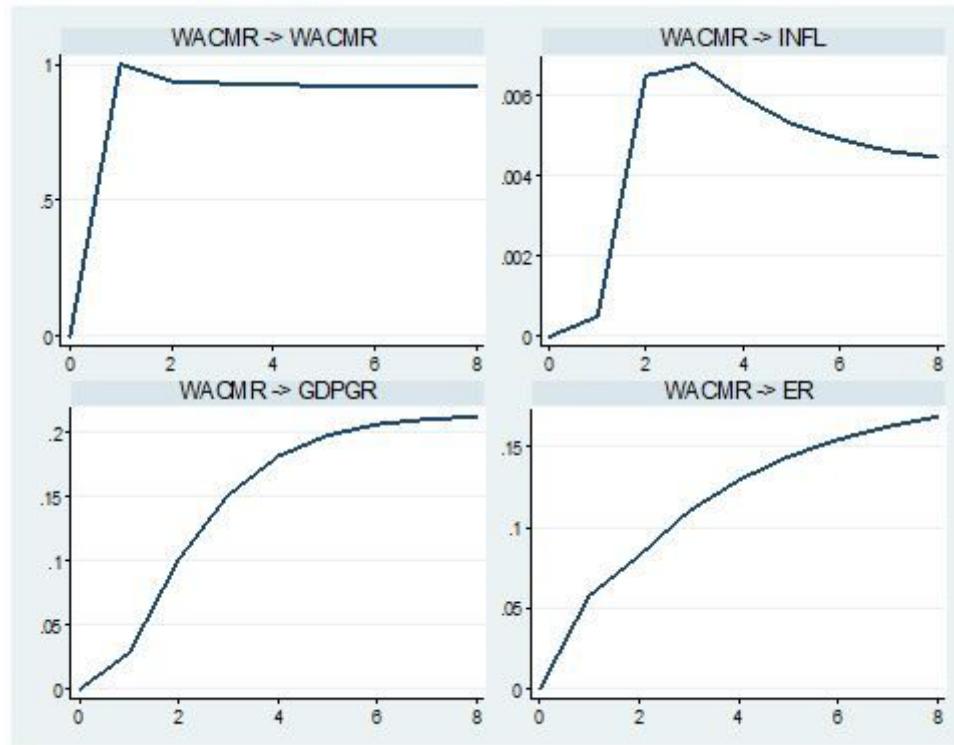


Figure 10

Variance decomposition of Impulse Response to WACMR

Impulse Responses to Fiscal Policy effects

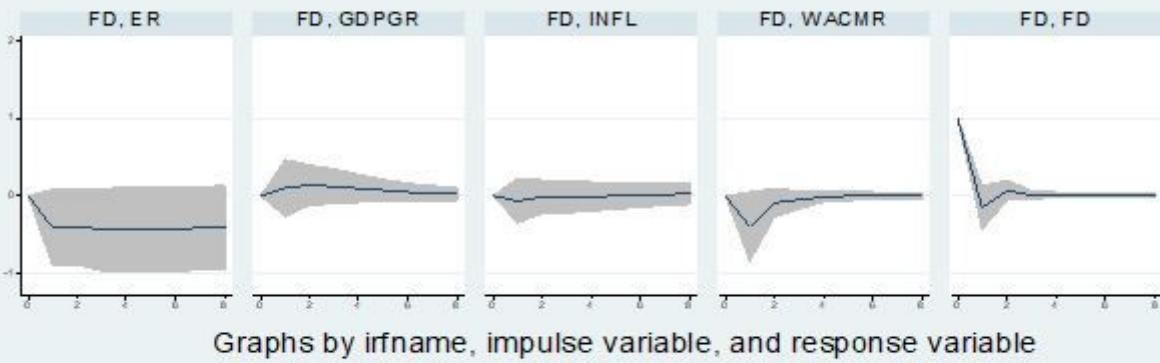


Figure 11

Accumulated impulse responses to FD

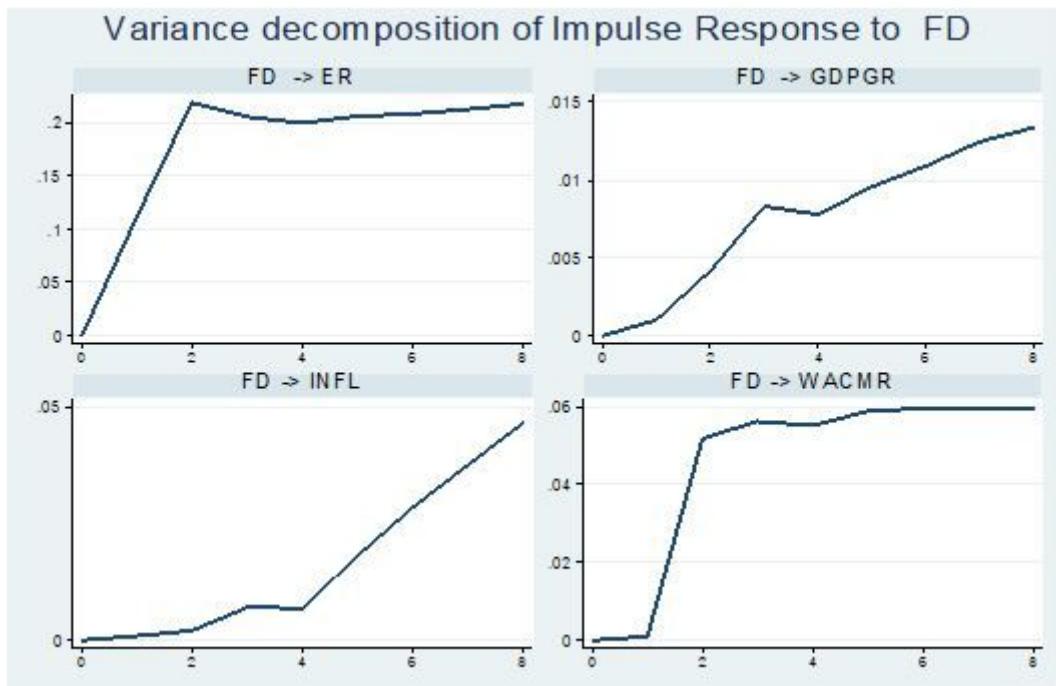


Figure 12

Variance decomposition of Impulse Response to FD

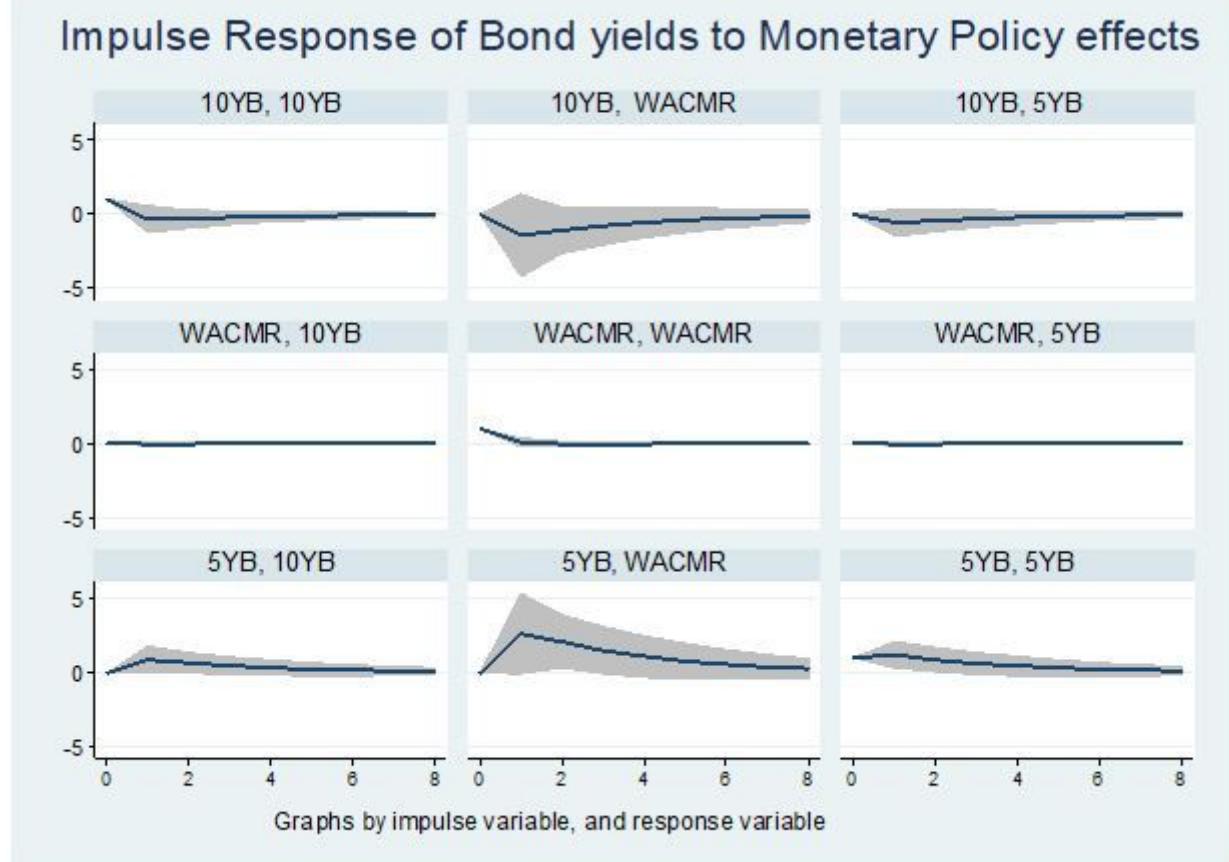


Figure 13

Impulse responses of Bond Yields to WACMR

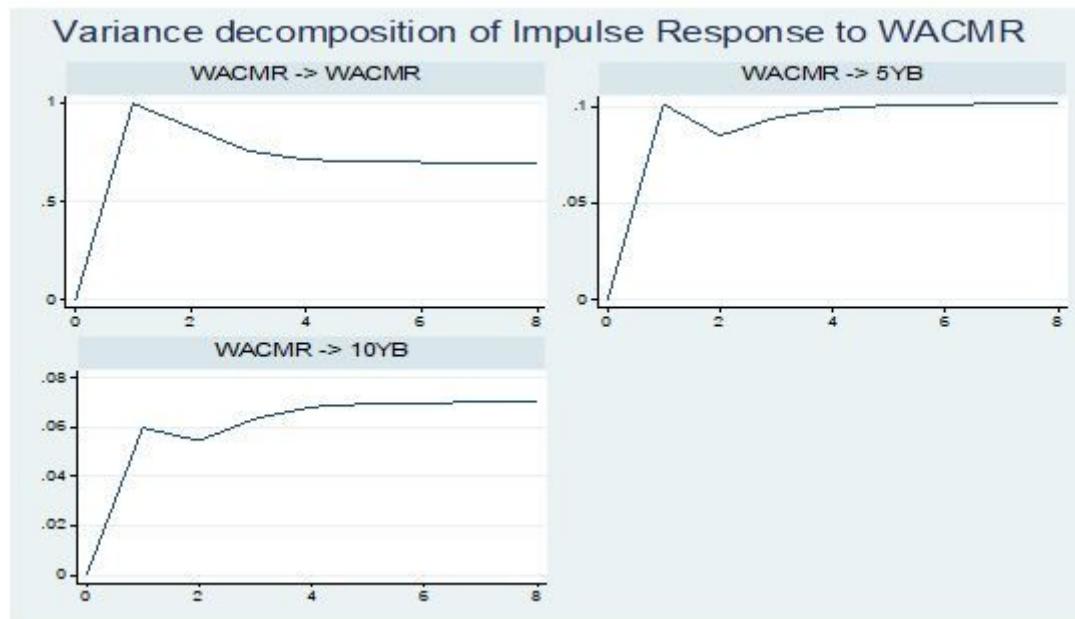


Figure 14

Variance decomposition of Impulse Response of Bond Yields to WACMR

Impulse Response of Bond Yields to Fiscal Policy Effects

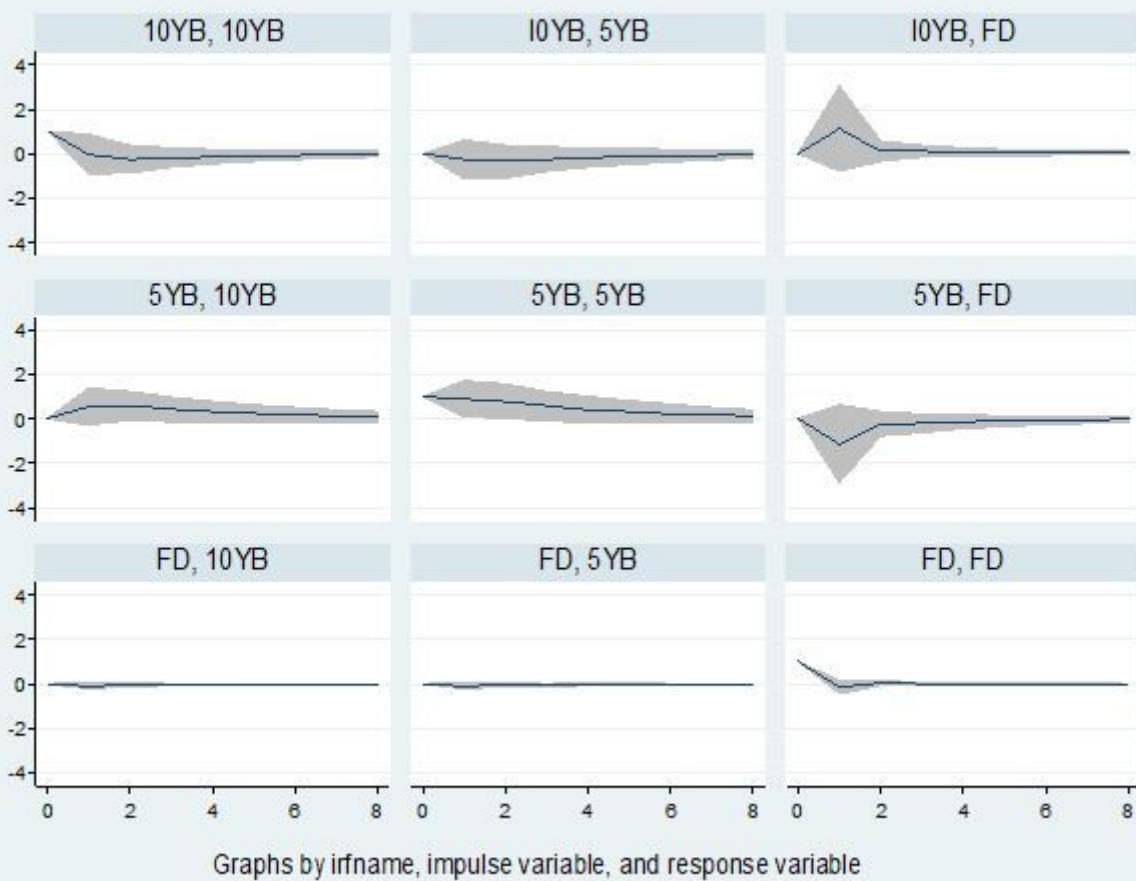


Figure 15

Impulse responses of Bond Yields to FD

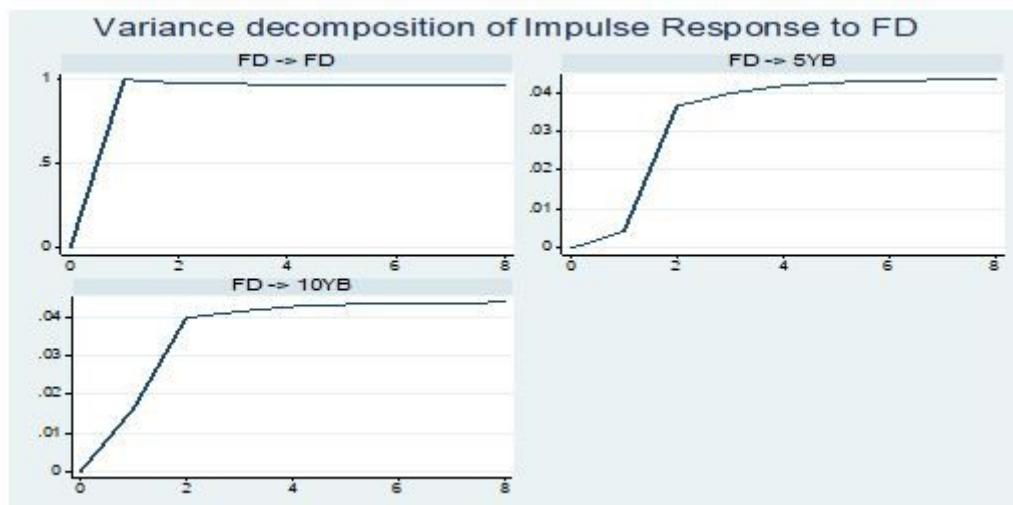


Figure 16

Variance decomposition of Impulse Response of Bond Yields to FD

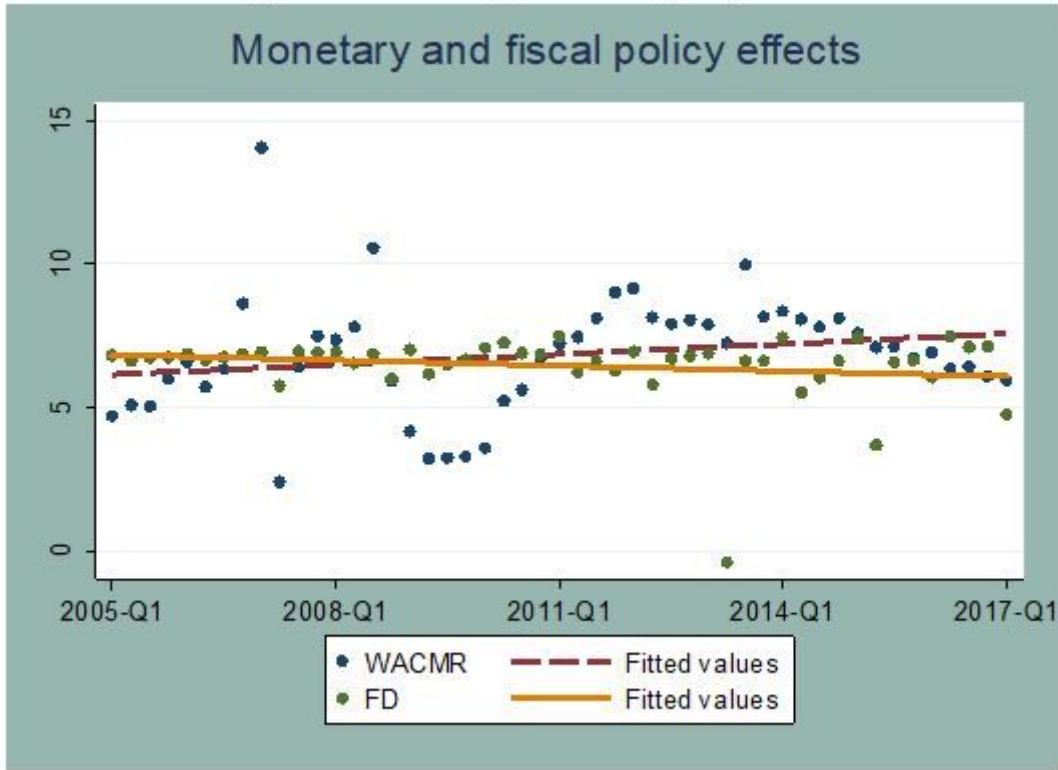


Figure 17

Monetary and fiscal policy trends