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Abstract

Using SVAR models on quarterly data for 1996-97:1 to 2011-12:1, the paper examines the relative importance of various transmission channels of monetary policy to GDP growth and inflation in India. It finds that external exogenous factors prolong the impact of monetary policy transmission on GDP growth and inflation in India, while removing the problem of 'price puzzle'. Among the various channels of transmission, interest rate channel, credit channel and asset prices channel are found to be important, while exchange rate channel is weak. A positive shock to policy rate leads to slowdown in credit growth with a lag of two quarters and subsequently impacts GDP growth and inflation negatively. The same monetary policy shock has a negative impact on asset prices from the third quarter onwards and, in turn, has a pronounced negative impact on GDP growth and inflation. Exchange rate channel is found to have an insignificant impact on GDP growth, but has non-negligible impact on inflation. Interest rate channel is found to account for about half of the total impact of monetary shocks on GDP growth and about one-third of the total impact on inflation, indicating that interest rate channel is the most important channel for monetary policy transmission in India.

JEL Classification: E43, E52, E58

Keywords: Interest Rate Channel, Monetary Policy, Monetary Transmission, Structural VAR

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Introduction

Monetary policy transmission is a process through which monetary policy decisions affect the economy in general and the price level in particular. Monetary transmission mechanism is a complex process - the famous "*black box*" - as many channels can simultaneously work to achieve the final policy objectives. Therefore, understanding the transmission mechanism of monetary policy to real activity has always been a subject of contemporary interest for researchers. Even though the literature identifies many channels, *viz*., interest rates, bank lending, the exchange rate, inflationary expectation, balance sheet effects, and asset price, there is little agreement on either their precise functioning or their relative importance in achieving the monetary policy objectives. Therefore, monetary policy transmission mechanism is still considered to be a "*black box*". Channels of monetary policy transmission are essential to identify from the perspective of the efficacy of various policy instruments and timing of policy actions and thus critically important for the design and implementation of monetary policy. In fact, successful conduct of monetary policy depends on the ability of policymakers to identify the changes in the parameters related to transmission, and to alter monetary frameworks accordingly.

The process of monetary policy transmission begins with the transmission of policy actions to market interest rates and from there onwards, transmission may proceed to real sector through any of the several channels. Monetary policy is considered to be effective, if it can affect, by managing a short-term interest rate, the longer end of interest rate structure, which is most relevant for decisions on investment and consumption. Nonetheless, the proliferation of monetary policy actions on the interest rate structure largely depends on development of financial markets' structure and expectations which can influence upon the working of various channels of monetary policy transmission. The focus of the present paper is, however, restricted to an attempt at identifying the channels of monetary policy in India which play critical role in achieving the final objectives of price stability and output. In the Indian context, a few studies have been attempted to examine the monetary policy transmission. However, most of them focused on investigating a particular channel of monetary policy transmission and, therefore, were limited in scope. The present paper studies all the major channels of monetary policy transmission by using structural VAR approach. Against this backdrop, the paper is

divided into four sections. Section II provides an overview as to how various channels can operate and influence inflation and output. Section III offers a review of literature on evidence of monetary policy transmission in the cross country as well the Indian context. Section IV discusses the methodological framework adopted in the paper for examining the monetary policy transmission in the Indian context. Section V discusses the empirical findings and Section VI provides concluding observations.

II. Monetary Policy Transmission: An Overview of Various Channels

There is a general consensus that monetary policy affects macroeconomic variables, *viz*., GDP and prices over the business cycle. It can happen through a number of channels. However, there is no empirical consensus on the precise working and the relative importance of the various channels and, therefore, monetary policy transmission is still considered to be a "*black box*".

The traditional channel for monetary policy transmission is the interest rate channel which is described under the Keynesian IS-LM model. Under the interest rate channel, changes in monetary policy are eventually reflected in the real long-term interest rates which influence aggregate demand by altering business investment and durable consumption decisions. This, in turn, gets reflected in aggregate output and prices. Under the assumption of sticky prices in the short-run, monetary policy expansion (tightening) leads to lower (higher) nominal interest rates which translate into lower (higher) real interest rates. However, the interest rate channel may remain active even under conditions of flexible prices.

Unlike the interest rate channel, the credit channel assumes that banks play an important role in financial intermediation in an economy. Credit channel becomes important as a certain category of small borrowers may not have access to bond markets. Therefore, bank credit is also taken into account along with money and bonds while examining the monetary policy transmission. In the credit channel, monetary policy affects the economy through two channels, as bank credit channel and as balance sheet channel that complement each other. Expansionary monetary policy leads to higher deposits inducing banks to disburse higher credit, which in turn impacts investment and consumer spending. However, efficacy of this channel has

been doubted as banks have increasingly shifted from non-traditional banking business and, therefore, may not be much important in overall financial intermediation in an economy. Credit channel which operates through balance sheet channel occurs through various ways. For instance, monetary policy expansion (contraction) can raise (lower) equity prices of firms which increase (decrease) their net worth and there will be lesser (higher) concerns for adverse selection of borrowers by banks. Similarly, monetary policy can impact banks' lending decisions by influencing household balance sheets.

Another important channel that can impact macro variables is the asset price channel. Apart from bond prices, there are two other major categories of asset prices through which monetary policy can transmit to the economy. First is the transmission of monetary policy on stock market prices which can impact macro variables through wealth effect as well as Tobin's q. Expansionary (contractionary) monetary policy can lead to higher (lower) valuation of equity which can induce (deter) household consumption as they perceive value of their wealth to be higher (lower). Monetary policy expansion can favourably impact equity prices which raises the market value of firms as compared to the replacement cost of capital (Tobin's q). When Tobin's q is high (low), firms will be encouraged (discouraged) to undertake investment by issuing equity which will accelerate (decelerate) economic activity in the economy.

Second is the transmission of monetary policy through exchange rate which can play a more critical role for open economies with flexible exchange rate. With monetary policy expansion (contraction), as interest rates fall (increase), domestic currency deposits become less attractive relative to foreign currency. Therefore, it can lead to a fall in value of domestic currency which in turn can act as a boosting factor for exports and hence overall aggregate demand for the economy. Impact of depreciating currency can also lead to higher inflation if the pass-through of higher import prices to domestic prices is complete. Similarly, changes in exchange rate can affect firms' balance sheet, particularly in emerging market economies (EMEs), as their debt may be denominated in foreign currency. Expansionary monetary policy, leading to depreciation of domestic currency, raises liabilities of firms as debt value in domestic currency increases. This can erode the net worth of firms and raise risk of adverse selection for banks. The overall impact will be lower lending from

banks to borrowers for investment which will adversely impact output. Such effect has been observed during recent global financial crisis in a number of EMEs.

Another channel that has been identified in literature is the expectations channel. Agents form expectations about the future shocks to the economy and the response of central bank. Under this channel, the entire expected path of interest rates, not solely the current policy rate, triggers changes in asset prices, credit and spending which, in turn, lead to changes in output and prices. Economic agents shape their views on future macroeconomic outcomes based on the belief about the central bank's ability and commitment in anchoring inflation expectations. Therefore, the efficacy of this channel also depends on the credibility of central banks.

The above discussion suggests that the impact of monetary policy on the economy can come through various channels which, however, are not entirely mutually exclusive. For instance, asset price channel (equity prices as well as exchange rate) works along with credit channel and it may be difficult to separate out their relative strength. The relative importance of each channel, however, may vary across economies depending on their structural characteristics, the depth of financial markets, the availability of monetary policy instruments, the fiscal policy and the degree of openness. The overall response of the macro variables to monetary policy is, therefore, expected to incorporate the impact of each of these channels.

III. Literature Review: Cross-country Evidence

A large body of literature on the monetary transmission mechanism has debated on the working of the traditional "monetary" or "interest-rate" channel and "credit channel" of transmission. The traditional channels of monetary policy transmission are based on models of investment, consumption and international trade. The interest rate channel lies at the core of the traditional Keynesian IS-LM model, originally propounded by Hicks (1937). In fact, the importance of traditional interest rate channel of monetary policy transmission was well argued in Keynes' general theory of output and employment. Ando and Modigliani's (1963) life-cycle theory of consumption emphasised the role of asset based wealth as well as income in determining consumption behaviour. Identifying a channel of monetary transmission, life-cycle theory highlighted that if stock prices fall after a tightening of

monetary policy, household would find the value of their assets (wealth) falling, leading to a fall in consumption and output. The description of the monetarist transmission mechanism by Friedman and Schwartz [1963] also involved a rich array of assets besides money supply. Subsequently, Tobin's [1969] *q*-theory of investment explained the traditional interest rate channel operating through the user cost of capital and portfolio choice.

Since Bernanke's seminal paper in 1986, providing alternative explanations of real and nominal sources of prices for explaining money-income relationship in addition to the standard explanations given earlier, the issue of monetary policy transmission has been extensively researched. Examining the impact of monetary policy on bank loans in the context of the US, Bernanke and Blinder [1988] suggested that open market sales by the Federal Reserve, draining reserves and hence deposits from the banking system, would limit the supply of bank loans by reducing banks' access to loanable funds. This effect, transmitted through the level and composition of bank assets, was over and above the traditional money supply and interest-rate effects implicit in IS-LM framework. However, Romer and Romer [1990] concluded that credit channel was ineffective.

The debate on monetary policy transmission was extended further in a Symposium on 'The Monetary Policy Transmission' in the Journal of Economic Perspectives [1995], where alternative views on channels of monetary policy transmission were provided by Taylor, Rogoff and Obstfeld, Meltzer, Bernanke and Gertler, and Mishkin. While there was consensus on the role of money in influencing aggregate demand and prices, disagreement continued over the transmission channel.

Following the views of Friedman (1970) on monetary policy transmission and his critics - including Meltzer, Brunner, Tobin and Patinkin - Taylor [1995] attempted to review the impact on monetary policy transmission on real GDP and prices using a financial market prices framework. This framework highlighted the role of monetary policy in determining prices and rates of return on financial assets, interest rates, and exchange rates which in turn influence the spending decisions of firms and households. Under the financial market view, Taylor [1995] found the traditional interest rate channel to be important for monetary policy transmission to the real economy. Rogoff and Obstfeld [1995] emphasised the importance of exchange rate

channel of monetary policy transmission. Meltzer [1995] argued for monetarist emphasis on monetary policy transmission through multiple asset prices extending beyond interest rates, exchange rate and equity prices. Based on the experience of Japanese economy during the 1980s and 1990s, he argued that monetary policy can have significant impact on the economy through wealth effect due to changes in value of land and property.

Bernanke and Gertler [1995] highlighted the inadequacy of interest rate channel due to weak cost of capital effects. Elaborating on the lack of understanding on the exact process of transmission of monetary policy, they argued:

> *"[T]he same research that has established that changes in monetary policy are eventually followed by changes in output is largely silent about what happens in the interim. To a great extent, empirical analysis of the effects of monetary policy has treated the monetary transmission mechanism itself as a 'black box'."*

Recognising the gaps in the conventional argument on interest rate channel, Bernanke and Gertler [1995] tried to elaborate their view on credit channel. Given the empirically well established theories that non-neoclassical factors, *e.g.*, accelerator variables (including lagged output levels), largely determine spending decisions, it was argued that cost of capital effect tends to be weak. Another argument was that the impact of monetary policy actions is expected to be stronger on short-term interest rate rather than long-term interest rates. If this is the case, then the puzzle is how monetary policy can have large effects on purchases of durable assets which should be responsive primarily to changes in real long-term rates. It was argued that credit channel could potentially help resolve these puzzles. While credit channel is not entirely a distinct and parallel channel to the traditional interest rate channel, it certainly propagates the interest rate effects by endogenous changes in the external finance premium, *i.e.*, cost differential of funds raised externally and generated internally. Monetary policy tightening increases external finance premium (through the balance sheet channel and the bank lending channel), which, in turn, amplifies the effect of traditional interest rate channel.[2] On the

2 Monetary policy tightening weakens borrowers' balance sheet as (i) rising interest rate directly increases debt servicing costs, reducing net cash flows and (ii) declining asset prices reduce the value of collaterals. As a result, external finance premium for borrowers increases.

contrary, Edwards and Mishkin [1995] argued that with increasing financial innovations, banks were becoming increasingly less important in credit markets.

Based on theoretical perspective provided on channels of monetary policy transmission, various studies have been conducted using either the narrative approaches or vector auto regression (VAR), including structural VAR (SVAR), factor augmented VAR. Ramey [1993] found that the money channel was much more important than credit channel in explaining the direct transmission of monetary policy shock on the US economy. Having found the inflation rising for a while after a monetary tightening, Christiano *et al.* [1999] viewed that the existence of a supply-side channel for monetary policy could be an explanation for the '*price puzzle*'.

In the context of euro area countries, Angeloni *et al* [2003] found that the interest rate channel completely characterised transmission in a few euro area countries, and was estimated to be substantial in almost all countries. Where the interest rate channel was not found to be dominant, there was some direct evidence supporting the presence of a bank lending channel (or other financial transmission channel). In another study on euro area, Angeloni and Ehrmann [2003] found financial markets channel to be somewhat weaker but suggestive. Examining the transmission of monetary policy in New Zealand by using a Structural VAR approach, Buckle *et al* [2003] suggested a weak transmission channel from domestic interest rates to domestic demand either indirectly through a reduction in equity returns or directly through a dampening effect on household consumption and firm investment. Recognising the limitations of low dimensional VAR models, Bernanke *et al.* [2005] suggested using FAVAR which can accommodate a rich data set relevant for explaining the '*price puzzle*' often found while examining monetary policy transmission to prices under traditional VAR framework. Using a DSGE model with financial frictions, Christiano *et al*. [2008] found that the ECB's policy actions had a greater stabilising effect than those of the Fed as the former's policy rule was characterized by greater persistence.

A number of studies have examined the efficacy of various channels for EMEs as well. De Fiore [1998] found credit and exchange rate channels to be more important than the interest rate channel for the Israeli economy. Hung [2007] found broadly the similar effects for the Vietnamese economy. Following the VAR framework, Disyatat and Vongsinsirikul [2003] found that in addition to the traditional

interest rate channel, bank credit play an important role in monetary policy transmission mechanism while exchange rate and asset price channels have been relatively less significant. Based on a macro econometric model for the Philippines economy, Bayangos [2010] provided evidence that bank credit channel mattered in monetary transmission mechanism. Using a broader set of 110 variables under FAVAR framework, Kabundi and Nonhlanhla [2011] for South Africa concluded that a monetary policy shock did not have a contemporaneous impact on the real economy and its effects did not last long. Similarly, a rise in the short-term interest rate decreases prices gradually, but the impact was found to be short lived. In addition to interest rate channel, the authors also found evidence of importance of confidence channel as business and consumer confidence are indicative of expectations of future economic outcomes.

Based on VAR techniques, Tsangarides [2010] suggested weak monetary policy transmission mechanism in Mauritius as variations of the policy variables accounted for a small percentage of the fluctuations in output and prices. Amarasekara [2008] found interest rate to be an important channel for monetary policy transmission in Sri Lanka. Mohanty and Turner [2008] argued that credible monetary policy frameworks led the interest rate channel to be more effective across EMEs. On the contrary, Bhattacharya *et al* [2011] highlighted weakness in domestic financial system and the presence of a large and segmented informal sector responsible for ineffective monetary policy transmission. However, the study suggested exchange rate channel to be most effective channel for impacting inflation while interest rate was found to have no impact on aggregate demand, implying the absence of inflation-output trade-off. Mukherjee and Bhattacharya [2011] found the interest rate channel to be important for private consumption and investment in EMEs, with and without inflation targeting. Comparing the monetary policy transmission between dollarised and non-dollarised economies, Acosta-Ormaechea and Coble [2011] found that the traditional interest rate channel to be more important in Chile and New Zealand (non-dollarised) while the exchange rate channel played a more substantial role in controlling inflationary pressures in Peru and Uruguay (dollarized). While most studies found one or more channel to be working across EMEs, Mishra *et al.* [2010] found that weak institutional mechanism impaired the efficacy of interest rate, bank lending and asset price channels.

Based on the survey of empirical studies, Loyaza and Schmidt-Hebbel [2002] and Boivin *et al* [2010] concluded that interest rate channel continued to remain the core channel. Furthermore, recent theoretical works on the monetary transmission mechanism have also largely focused on better understanding of the traditional interest rate channel by using dynamic stochastic general equilibrium (DSGE) models.

Recent episode of financial crisis raised a number of issues with regard to monetary policy transmission mechanism as central banks had to undertake unconventional measures to keep the interest rate pass-through channel operational. Post-crisis research has broadly highlighted the incompleteness of extant models for studying the monetary transmission mechanism. Cecchetti *et al.* [2009] emphasised that separating out the effects of the various channels during the crisis period was difficult and also suggested to employ a modified framework to study monetary policy transmission. Walsh [2009] also discussed the role of financial frictions for understanding the monetary policy transmission process. Taylor and Williams [2010] viewed that simple interest rate rules worked well in transmitting the monetary policy *albeit* further research based on a wider set of information, especially international linkages of monetary policy, was needed. Bernanke [2010] was apprehensive about the efficacy of interest rate rule during pre-crisis period and concluded that central banks lacked the understanding of implications of financial innovation for monetary policy transmission. Carney [2010] assessed that the monetary policy transmission was a variable having a pro-cyclical process, which *inter alia* was determined by regulation changing over time, financial innovation and confidence. Allen and Rogoff [2010] observed that transmission mechanism for monetary policy has changed over time, particularly for countries with very deep and sophisticated mortgage markets.

Taking cognisance of the quantitative easing measures during the recent crisis, Curdia and Woodford [2010a, 2010b] emphasised that models for monetary policy transmission need to capture the additional dimensions of central bank policy measures, especially the balance sheet measures. Bean *et al.* [2010] highlighted the importance of role of financial intermediaries both in normal and crisis period for monetary policy transmission. They also argued that the role of monetary policy in the run up to crisis was less through conventional monetary policy channels but more from 'risk taking channel'. Yellen [2011] highlighted that even though the

transmission channels, transmitting conventional and unconventional measures of central banks, were quite similar, 'portfolio balance channel' and 'expectations' channel, however, played important role during crisis. Joyce *et al.* [2011] underscored the importance of asset prices during the crisis period, which were expected to have conventional effects on output and inflation.

Monetary Policy Transmission in India: Literature Review

A few attempts have been made to examine the channels of monetary policy transmission for India. Al-Mashat [2003], using a structural vector error correction model (VECM) for the period 1980:Q1 to 2002:Q4, found that interest rate and exchange rate channels strengthen the transmission impact of monetary policy while there was little evidence on the working of bank lending channel due to presence of directed lending under priority sector lending. RBI [2005] estimated a 5-variable VAR for the period 1994-95 to 2003-04 and suggested (i) a positive shock to the bank rate (*i.e.*, monetary tightening) had the expected negative effect on output and prices, with the peak effect occurring around six months after the shock, (ii) a positive shock to broad money (*i.e.*, monetary expansion) increased output as well as prices with peak effect occurring almost two years and one year, respectively, after the shock and (iii) a positive shock to the exchange rate (*i.e.*, depreciation of the rupee) leads to an increase in prices, with the peak effect taking place almost six months after the initial shock while the impact on output was found to be positive as was *a priori* expected. Pandit *et al.* [2006] found the existence of bank lending channel with small banks being more responsive to a policy shock.

More recently, Singh and Kalirajan [2008] highlighted the significance of interest rate as the major policy variable for conducting monetary policy in the post-liberalised Indian economy. On the contrary, Bhaumik *et al.* [2010] found the bank lending channel to be working much more effectively in a tight money period than in an easy money period in India. Analysing three channels, *viz.*, credit channel, asset price channel and exchange rate channel, Aleem [2010] found only credit channel to be important. Patra and Kapur [2010] argued that aggregate demand responds to interest rate changes with a lag of at least three quarters, and the presence of institutional impediments in the credit market such as administered interest rates can lead to persistence of the impact of monetary policy up to two years. Pandit and Vashisht [2011] provided evidence that policy rate channel of transmission

mechanism - a hybrid of the traditional interest rate channel and credit channel - operated in India and other EMEs. Khundrakpam [2011] found the credit channel of monetary transmission to be significant and robust in the post-LAF period. Analysing the interest rate channel, Mohanty [2012] provided evidence that policy rate increases have a negative effect on output growth with a lag of two quarters and a moderating impact on inflation with a lag of three quarters.

IV. Methodology

We use a structural vector autoregressive (SVAR) framework with external variables as exogenous variables to control for external influences[3]. These exogenous variables are assumed to have both contemporaneous and lag impact on the endogenous variables without any feedback effect.[4] Further, in view of the limited number of variables which can be considered in the SVAR without losing degrees of freedom, each of the channels of transmission is examined only one at a time. This involves estimating a baseline SVAR model, which is augmented by the variables representing a particular channel of transmission each time separately[5].

Baseline SVAR Model

The baseline model could be written as,

$$G(L)Y_t = C(L)X_t + U_t \quad (1)$$

Here G(L) and C(L) represent matrix polynomials in the lag operator L for vectors of exogenous variables (Y_t) and endogenous variables (X_t). U_t is a vector of structural disturbances.

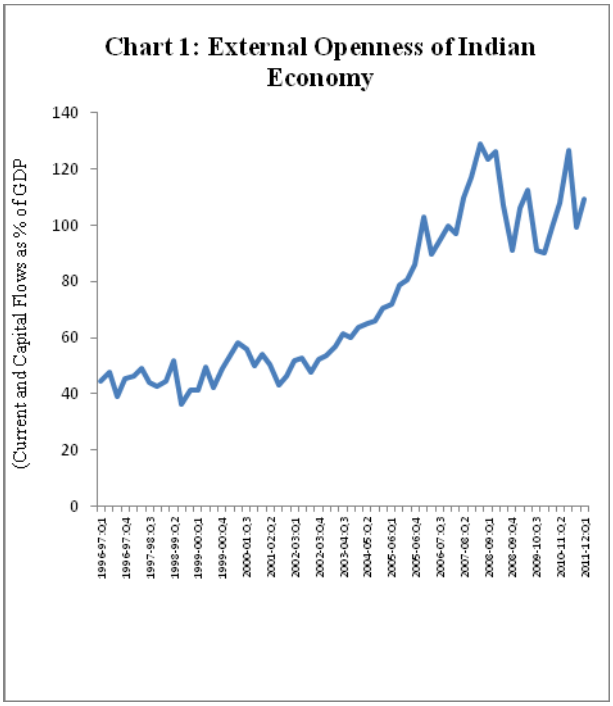
The endogenous variables in the baseline model include GDP, price and policy rate in that order. Potential exogenous variables include world GDP, world

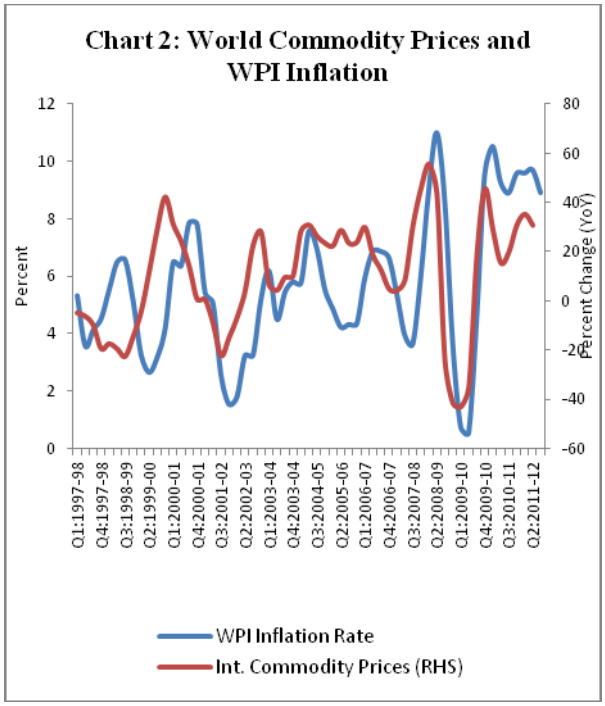
[3] SVAR model has been preferred as it enables providing explicit behavioral interpretations of the parameters. On the other hand, including external variables as exogenous variables, while controlling the increasing influence of external factors due to increasing globalisation, also enable resolving the problem of 'price puzzle' often faced by traditional SVAR models due to inability to accommodate all the relevant variables.

[4] It may, however, be noted that an exogenous variable will have a statistically significant direct impact only on the relevant endogenous variable, while the impact of other exogenous variables will not be statistically different from zero. Therefore, the exogenous variables do not necessarily have statistically significant direct impact on all the endogenous variables.

[5] For similar methodology, see for example, Disyatat and Vongsinsirikul (2003) and Aleem (2010). However, while we use a SVAR framework, these studies employ a traditional VAR approach, besides the differences in the details of specifications.

commodity prices, interest rate policy of major developed countries such as the US and gross portfolio inflows, among others. The importance of including these external factors as controlling variables is for the following reasons. First, Indian economy has been increasingly getting integrated with the global economy, both financially and in terms of real economic activity. These are reflected in the increasing proportion of exports and imports and financial flows to GDP (Chart 1). Thus, the importance of global business cycle in the domestic economic activity would have increased over the years, leading to increasing synchronization in domestic and international business cycles. Consequently, world economic activity affects the level of aggregate demand and prices in the economy, and thus influences the monetary policy actions. Second, the influence of global commodity prices on some sectors of domestic prices might have become important over the years, though pass-through still continues to remain significantly suppressed such as that of crude oil prices. However, we do not observe any significantly synchronized movement between world commodity price inflation and WPI inflation in India during major part of our study period (correlation coefficient=0.2 during 1997-98:Q1 to 2007-08:Q4) (Chart 2).

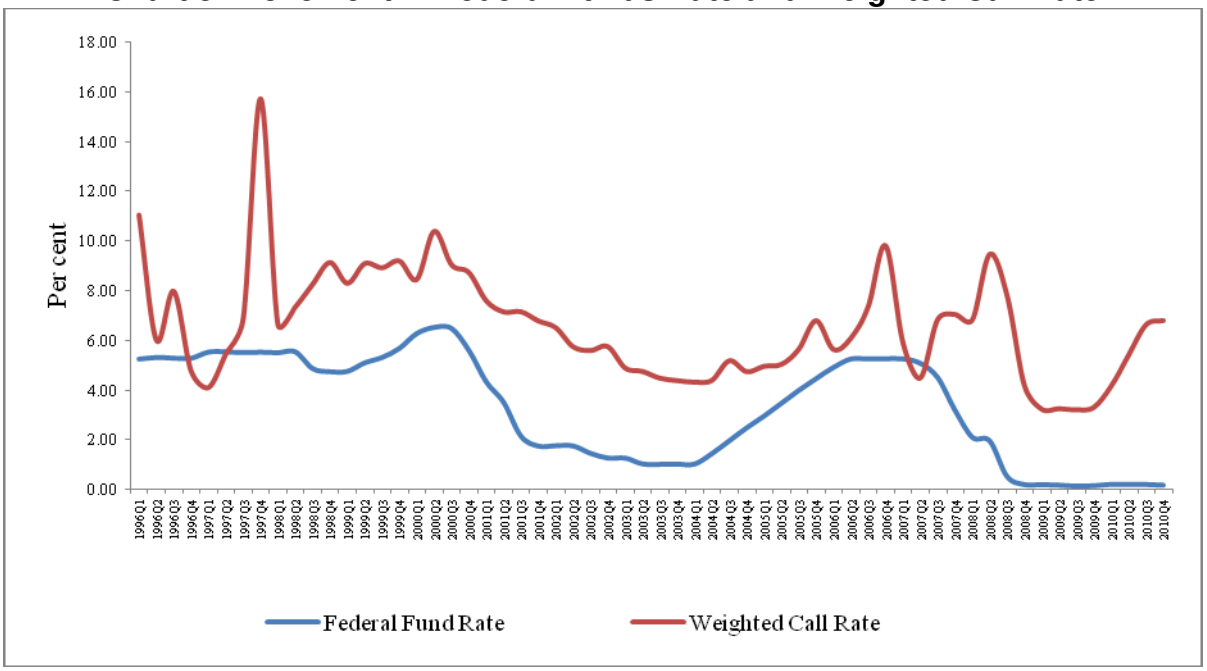




Third, interest rate policy of the major advanced economies can have a major bearing on the domestic interest rate policy via the impact on real economic activity and financial flows. Financial flows have significant potential impact on the exchange

rate movements, which in turn will affect both the exports and imports. Domestic prices will be affected by the resulting change in aggregate demand and also via the pass-through impact of change in import prices brought about by the exchange rate movements. If the exchange rate movements following financial flows are controlled through intervention, domestic liquidity will be affected unless they are fully sterilised, which is not without cost. This change in domestic liquidity will, in turn, have effects on output and prices in the economy. However, financial flows in the aftermath of global crisis have largely been influenced by the quantitative easing pursued by the developed countries and not by the interest rate policy *per s*e, as it has remained at zero or near zero since the crisis broke out. Thus, the movements in the US policy interest rates (Fed fund rate) and Indian policy rate (weighted call rate) are far less synchronised (Chart 3). Instead of federal funds rate, gross portfolio flows, capturing all push and pull factors, including that of federal funds rate and quantitative easing, could be directly included among the exogenous variables.

Chart 3: Movement in Federal Funds Rate and Weighted Call Rate



As for structural restrictions, we use point zero restriction approach for identification of monetary policy shock (for example, Vonak, 2005). It is assumed that monetary policy shocks have no immediate impact on real variables. Thus, in the matrix containing the contemporaneous impact of structural disturbances on endogenous variables, the elements pertaining to the impact of monetary policy on real variables are restricted to zero.

Thus, the benchmark SVAR model is written as,

$$\begin{bmatrix} \varepsilon_t^{gdp} \\ \varepsilon_t^{wpi} \\ \varepsilon_t^{call} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ c21 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} e_t^{gdp} \\ e_t^{wpi} \\ e_t^{call} \end{bmatrix}$$

where e_t denotes VAR residuals and ε_t denotes structural shocks. The first equation represents no contemporaneous effect of shocks in price and interest rates to GDP. The second equation implies only GDP has a contemporaneous impact on price. The third equation removes the contemporaneous impact of GDP and price shocks to policy interest rate, implying monetary policy reacts to GDP and prices only with some lags.

Augmented SVAR Model

To examine the various transmission channels, each of the corresponding variables representing a particular channel are added to the above benchmark model alternatively, as an exogenous variable, and then, as the fourth endogenous variable. When considered as an exogenous variable, the structure of the SVAR restrictions remains the same as in the benchmark model, and the transmission through this channel is blocked. On the other hand, by treating it as an endogenous variable and allowing the dynamic interactions with the other variables, the transmission through this channel is opened. It is assumed that this transmission related variable is contemporaneously affected by all the three variables included in the baseline model. Thus, the augmented SVAR model of four variables takes the following form,

$$\begin{bmatrix} \varepsilon_t^{gdp} \\ \varepsilon_t^{wpi} \\ \varepsilon_t^{call} \\ \varepsilon_t^{channel} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ c21 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ c41 & c42 & c43 & 1 \end{bmatrix} \begin{bmatrix} e_t^{gdp} \\ e_t^{wpi} \\ e_t^{call} \\ e_t^{channel} \end{bmatrix}$$

The strength of each channel is obtained by comparing two sets of impulse responses of inflation and growth to shocks on policy rate. The first impulse response is from the augmented VAR with channel related variable as an endogenous variable. The second impulse response is with the channel related variable as one of the exogenous variables in the augmented VAR. The two VAR

models have identical orthogonalized innovations, but with the difference that when the variables in interest is treated as exogenous, it blocks off any responses within the VAR that passes through the variable (Disyatat and Vongsinsirikul, 2003 and Aleem, 2010).

Thus, we have three sets of variables, *viz*., purely endogenous, purely exogenous and transmission related variables which are alternatively considered as endogenous and exogenous variables. Purely endogenous variables are real GDP, WPI and policy rate (CMRSA). Purely exogenous variables are OECD GDP and gross portfolio inflows[6]. The transmission channel related variables are non-food credit and total credit (for credit channel), BSE SENSEX (for asset price channel), and REER and NEER (for exchange rate channel). For robustness tests, three alternative measures of real GDP at factor cost were used, *viz*., total GDP, non-agricultural GDP and non-agricultural non-government GDP[7].

The time period considered is quarterly data from 1996-97Q1 to 2011-12Q1. All the variables have been seasonally adjusted and log transformed except for the interest rate variables. It was found that, barring interest rate variables, all other variables were non-stationary and integrated of order one. Therefore, the SVAR estimates were carried out in first difference, except interest rate variables. The optimum lags of various models, baseline model as well as all other augmented models, suggested by various criteria varied from one to four. We, however, selected two lags to ensure that the lag is neither too short that it is unable to capture underlying dynamics in the system nor too long to run into degrees of freedom problem.

V. Empirical Findings

A. Baseline SVAR model

Of the three alternative measures of GDP, the overall consistency of the model in terms of direction of all the impulse responses *vis-à-vis* our *a priori*

[6] World commodity prices and federal funds rate were excluded from the vector of exogenous variables, as they show no synchronized movement with call rate and WPI inflation in Chart 2 and 3, respectively.

[7] Non-agricultural GDP is defined as total GDP excluding agriculture and allied activities, while non-agricultural non-government GDP further excludes 'community, social and personal services', which primarily reflects good and services provided by the general government, from non-agricultural GDP.

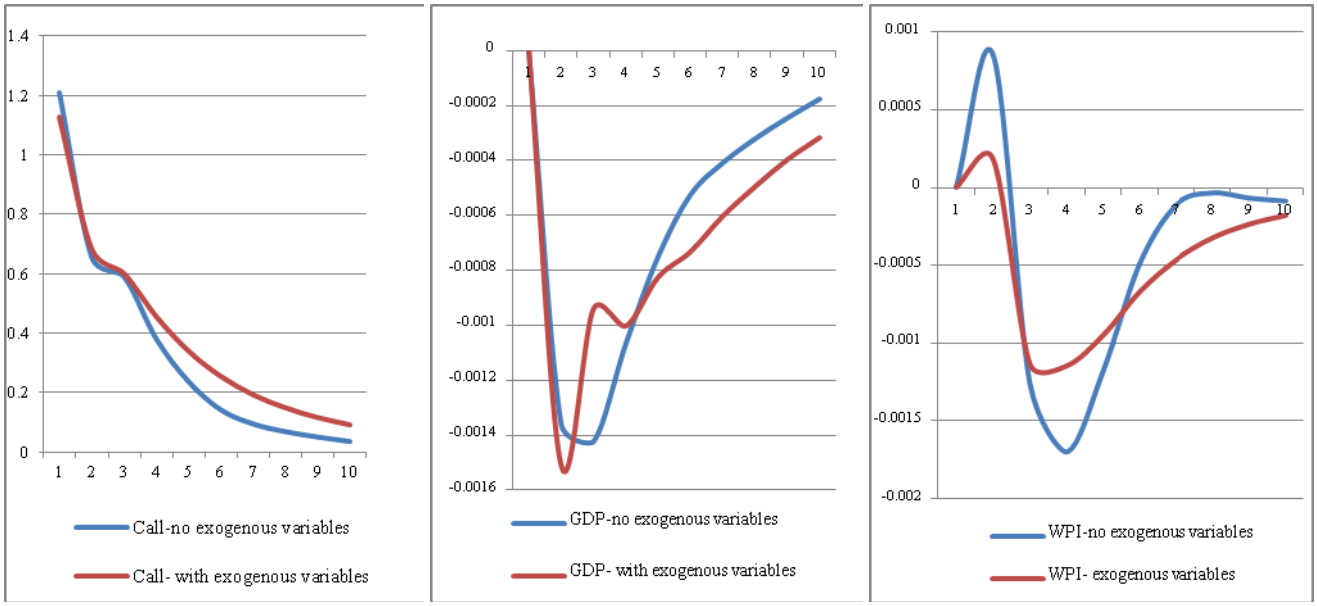
expectations was found to be more evident when non-agricultural non-government GDP was considered (Annex Chart 1)[8]. However, the responses of GDP growth and inflation to shocks in monetary policy (call rate) are negative in all the three alternative measures of GDP and are statistically significant for a number of lags in and around the peak impact . Thus, we report the results based on non-agricultural non-government GDP in the main text, while other results are presented in the Annex.

Chart 4 depicts the dynamic response of GDP growth, inflation and call rate to one standard deviation shock in the call rate under two baseline VAR estimates, which are with and without the external exogenous variables[9]. The following can be observed. First, call rate to its own shock takes a longer time to converge back with exogenous factors than without. This is despite the shock of one standard deviation in call rate being smaller with exogenous variable than without as shown by blue line which is above the red line in the first period. Second, there is an elongated V-shaped response of output, *i.e.*, an unanticipated hike in policy rate leads to decline in GDP growth that dissipates slowly. However, with exogenous external factors included, the peak negative impact on GDP growth is felt faster in the second quarter as against in the third quarter without exogenous factors. But, the dissipation of the impact is much slower with the inclusion of exogenous variables than without. Third, the negative impact on inflation follows after the decline in GDP growth and the peak impact is also felt with a lag of one quarter from the corresponding peak impact on GDP growth. However, the peak impact is higher without exogenous variables than with exogenous variables, but the impact dissipates faster in the former than the latter. In other words, inclusion of external variables prolongs the impact of monetary policy shocks on GDP growth and inflation. Fourth, inclusion of exogenous variables more or less removes the problem of '*price puzzle'*.

[8] For instance, with government component of GDP included, the impulse response of call rate to GDP growth shock was found to be negative. This negative response, however, could follow if this government component of GDP, which forms about 13 per cent of total GDP, is not affected by monetary policy shocks. Similarly, price initially falls to a positive shock in GDP growth that includes this government component of GDP.

[9] Besides the two external exogenous variables, a dummy variable which is 1 for 1997:4 and zero otherwise was included to control for sharp unexplained hike in weighted call rate.

Chart 4: Impulse Response of Policy rate, GDP and WPI to shock in Policy Rate



The variance decomposition reported in Table 1 shows that call rate explains for 12.0 per cent of the total variation in GDP growth in about three years, while inflation explains for about 17.0 per cent of the total variation in the call rate. It we consider period since 2000:1, after the adoption of liquidity adjustment facility (LAF) with interest rate as the principal instrument of signaling policy stance, call rate accounts for over 21.0 per cent of the fluctuation in GDP growth. A higher percentage of over 24.0 per cent in the fluctuation of call rate is also explained by change in inflation rate. It is thus indicated that the importance of interest rate in the fluctuation of economic activity in India has increased since the adoption of LAF and monetary policy has been sensitive to inflation[10].

[10] However, given the short time period, to conserve the degrees of freedom, we estimate the models from 1996:1 onwards when quarterly GDP data became available.

Table 1: Variance Decomposition of Base Model: Non-agricultural non-government GDP Growth						
	1996:1 to 2011:1			2000:1 to 2011:1		
Variance Decomposition of DLGDP:						
Period	DLGDP	DLWPI	CMRSA	DLGDP	DLWPI	CMRSA
4	84.2	6.9	8.9	74.0	9.7	16.3
8	80.3	7.7	12.1	66.7	12.0	21.3
10	79.7	7.8	12.5	65.8	12.3	21.9
Variance Decomposition of DLWPI:						
Period	DLGDP	DLWPI	CMRSA	DLGDP	DLWPI	CMRSA
4	3.7	93.6	2.8	4.1	89.7	6.3
8	3.7	91.9	4.4	4.1	87.0	8.9
10	3.7	91.8	4.5	4.2	86.8	9.0
Variance Decomposition of CMRSA:						
Period	DLGDP	DLWPI	CMRSA	DLGDP	DLWPI	CMRSA
4	0.2	14.3	85.5	0.3	20.3	79.4
8	0.3	17.2	82.5	2.2	24.2	73.6
10	0.4	17.4	82.3	2.5	24.3	73.1

B. Channels of Transmission[11]

(i) Credit Channel

Credit channel works as an additional channel of transmission beyond the direct interest rate channel. Rise in interest rate following monetary tightening, besides reduction in demand for credit by raising the borrowing costs, can also impact GDP growth and inflation through curtailment of supply of credit by financial institutions. The importance of this channel would depend upon i) the degree to which monetary policy directly affects willingness of financial institutions to lend and ii) on the importance of number of borrowers who are dependent on financial institutions.

Even though the share of bank credit in total credit to commercial sector in India has increased over the years, non-bank sources continue to remain important. In fact, since the mid 2000s, there has been some reversal in the trend, reflecting manifold increase in capital mobilised through equity, bonds, convertible cumulative

11 As in the case of base model shown in Chart 1 in annex and also mentioned above, the standard error band shows that the impulse responses of GDP growth and inflation for most of the channels are found to be statistically significant for a number of lags. However, we do not report the error bands, as our focus is on the directions of the impacts and the differences of the impacts when a particular channel is alternatively opened and blocked.

preference shares and other instruments. Similarly, capital flows on account of greenfield FDI as well as external commercial borrowing have also shown significant rise in recent years. It is possible that even if bank credit gets restricted with the hike in policy rate, credit from non-bank sources could either negate or reinforce the impact on GDP growth and inflation. Thus, we consider two alternative measures of credit, *viz*., total non-food bank credit and total credit (both from banks and non-banks).

From the impulse responses shown in Charts 5 and 6, it is seen that both the measures of credit yield similar results[12]. A positive shock to interest rate leads to decline in credit growth from the second quarter, but persists for a long time. Irrespective of whether credit is made endogenous or exogenous, the impulse responses of GDP growth to shock in policy rate are quite similar up to the third quarter. However, the impact thereafter dissipates much faster when credit is exogenous as compared to when credit is endogenous. After 10 quarters, the accumulated response when credit channel is blocked is about 16.0 per cent lower than when it is allowed to operate, indicating significant operation of credit channel on GDP growth in India.[13] With total credit, the efficacy of credit channel is indicated to be more pronounced with accumulated response lower by about 25.0 per cent when the credit channel is blocked.[14] The impact on inflation occurs with a lag after the impact on GDP growth. However, as compared to the impact on GDP growth, the impact is less pronounced on inflation. When the credit channels are blocked, the accumulated response of inflation is lower by 14 per cent for non-food credit, while it is lower by 23 per cent for total credit[15].

[12] Unexplained sharp increased in both non-food and total credit in 2002:1 was controlled by including an exogenous dummy variable which was 1 on this date and zero otherwise.

[13] The corresponding gaps estimated using total GDP and non-agricultural GDP are higher at 20.0 per cent and 29.0 per cent, respectively.

[14] The corresponding gaps estimated using total GDP and non-agricultural GDP are also higher at 25.0 per cent and 32.0 per cent, respectively.

[15] The corresponding gaps estimated using total GDP and non-agricultural GDP are 15.0 per cent and 5.0 per cent for non-food credit, and 25.0 per cent and 9.0 per cent for total credit, respectively.

Chart 5: Impulse Responses of Non-food Credit, GDP and WPI to Policy Rate

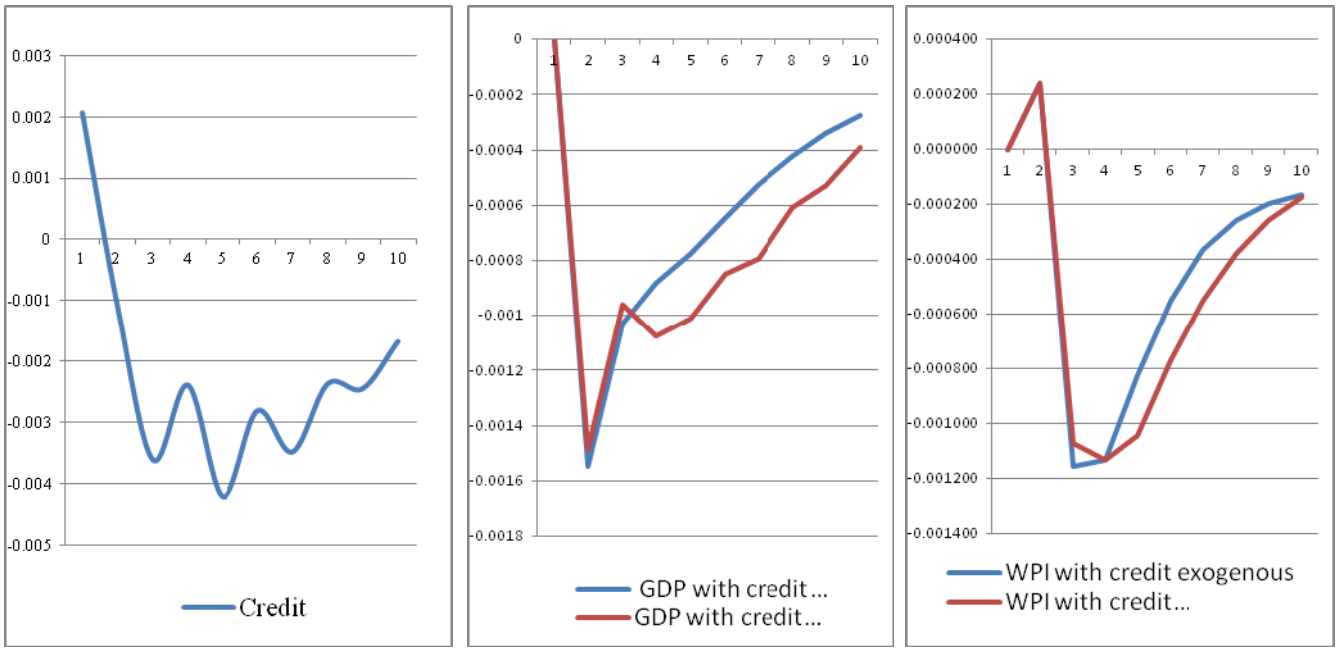
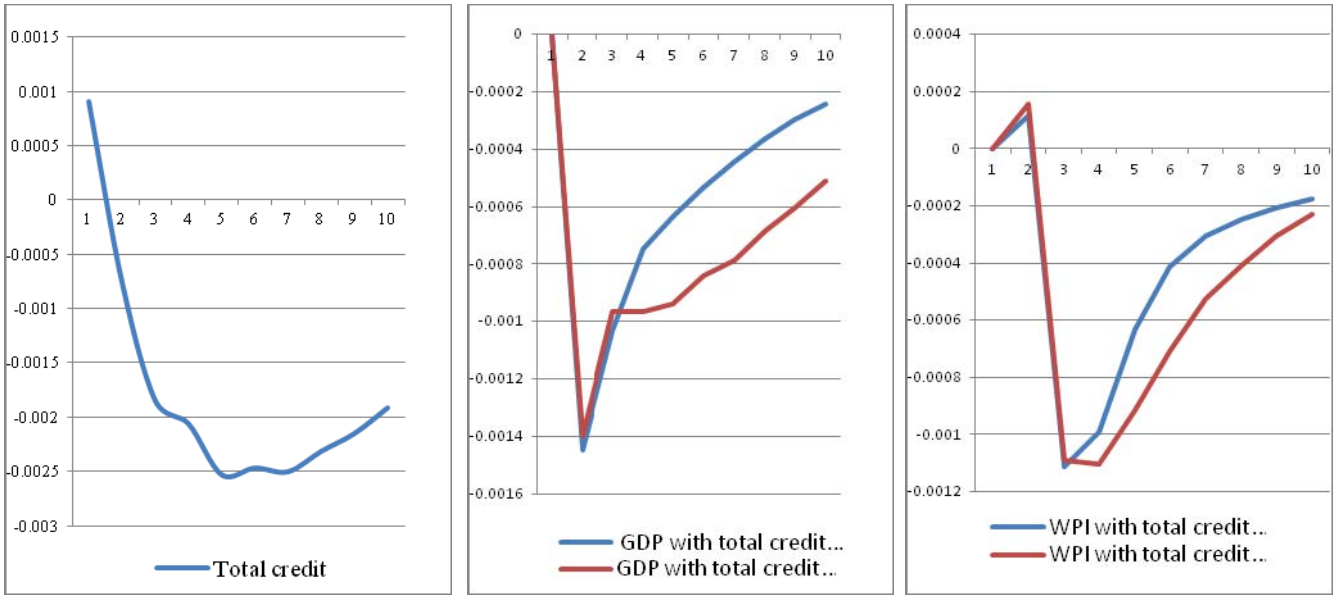


Chart 6: Impulse Responses of Total Credit, GDP and WPI to Policy Rate



(ii) Asset Price Channel

Monetary policy can affect GDP growth and inflation through fluctuations in asset prices. A tightening of monetary policy will make equity prices less attractive as compared with other alternative assets, such as bond, leading to fall in equity prices. When equity prices fall, firms may find it costly to replace capital – Tobin's *q* effect- and reduce investment. The decline in the asset prices will also have a net wealth

effect of reducing consumption demand for households and further dampen the earnings outlook of firms.

To analyse the asset price channel in India, we considered BSE SENSEX, which is one of the most popular index of Indian equity prices reported in the domestic and international markets. The impulse responses shown in Chart 7 reveal that a positive shock in policy rate expectedly leads to decline in equity prices, which peaks at the third quarter and dissipates slowly. Decline in GDP growth peaks in the second quarter by about 0.12 per cent below the baseline, but thereafter dissipates much faster when this channel is blocked by treating BSE SENSEX as exogenous. After 10 quarters, the accumulated response of GDP growth is lower by 30 per cent when the impact of the movement in equity prices is blocked than when it is allowed to operate[16].

There is also a significant negative impact on inflation, which peaks in the fourth quarter. The dissipation of the impact is again much faster when this channel is blocked[17]. Consequently, when the channel is blocked, the accumulated response after 10 quarters is lower by about 37.0 per cent[18]. In other words, it is indicated that asset price channel is an important channel of monetary policy transmission in India.

Chart 7: Impulse Responses of Sensex, GDP and WPI to Policy Rate

[16] The corresponding gaps estimated using total GDP and non-agricultural GDP are 42.0 per cent and 39.0 per cent, respectively.
[17] However, we find the presence of price puzzle.
[18] The corresponding gaps estimated using total GDP and non-agricultural GDP are 66.0 per cent and 28.0 per cent, respectively.

(iii) Exchange Rate Channel

The strength of exchange rate channel in monetary policy transmission will depend on several factors such as the exchange rate policy which determines the responsiveness of exchange rate to monetary policy, degree of openness of the economy, elasticity of net imports to exchange rate fluctuations, degree of exchange rate pass-through to domestic prices, *etc*. Depending upon these factors, a shock to monetary policy can have differential impact on the time path of adjustments in real and nominal exchange rate. Thus, we consider both REER and NEER to check for the presence of exchange rate channel of monetary transmission[19].

From Chart 8, it may be seen that a positive shock to policy rate leads to immediate appreciation of REER, followed by an overall depreciation that dissipates in about 10 quarters. This overall depreciation may appear to be a contradiction to theory on exchange rate determination based on interest rate differentials. But in the Indian context, it is highly plausible that interest rate differentials do not play an important role in exchange rate determination. The debt component of capital inflows, which are sensitive to interest rate differentials, is understood to be small in India, as there is deliberate policy to restrict/discourage this component of capital inflows. Major portion of the capital inflows are accounted by equity inflows in the form of both portfolio and FDI. These inflows would be largely determined by the macroeconomic fundamentals such as the GDP growth, level of inflation, current account deficit, fiscal deficit, etc. Thus, a hike in call rate often associated with negative fundamentals and sentiments about the domestic economy in terms of inflationary pressure and the dampening effect on growth, could lead to slowdown in equity component of capital inflows or even their outflows, which overshadow any additional debt inflows caused by the interest rate hike. Therefore, on a net basis, it is likely that hike in policy rate leads to slowdown or decline in net capital inflows leading to currency depreciation, but with a lag.

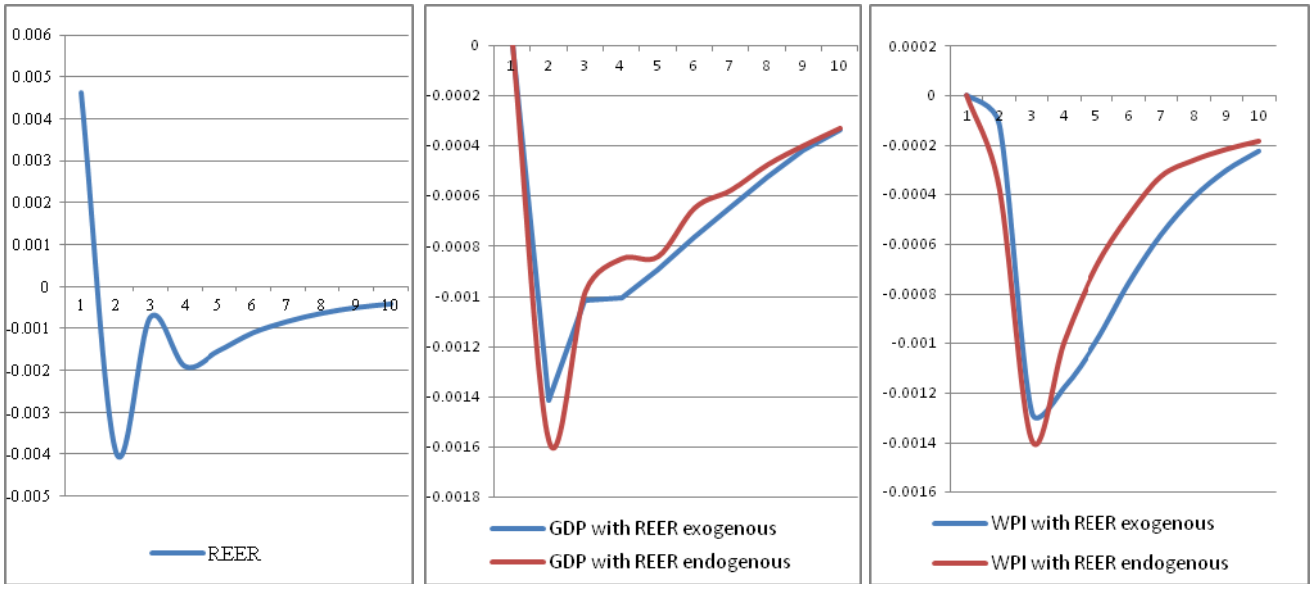
Whether exchange rate is endogenous or exogenous makes very little difference to the impulse response of GDP growth. The difference in accumulated response after 10 quarters is only about 5 per cent higher than when the channel is

[19] There was a sharp depreciation of over 15.0 per cent on quarter on quarter basis in both NEER and REER in 2007-08:4. This was controlled by including an exogenous dummy variable which is 1 on this date and zero otherwise.

blocked[20]. With regard to the impact on inflation, the difference, however, is significant. After the third quarter, the impact on inflation dissipates much faster when exchange rate channel is allowed to operate. After 10 quarters, the accumulated response of inflation is about 18.0 per cent lower when the channel operates than without[21]. Thus, it appears that though exchange rate channel of monetary policy transmission to GDP growth is either absent or weak, it has non-negligible impact on inflation by way of dampening the monetary policy impact. This follows as positive shock to policy rate leads to an overall depreciation of REER from the second quarter. While depreciation of REER may only marginally improve net exports, the increase in import prices and pass-through to domestic prices may dampen the negative impact of hike in policy rate on inflation.

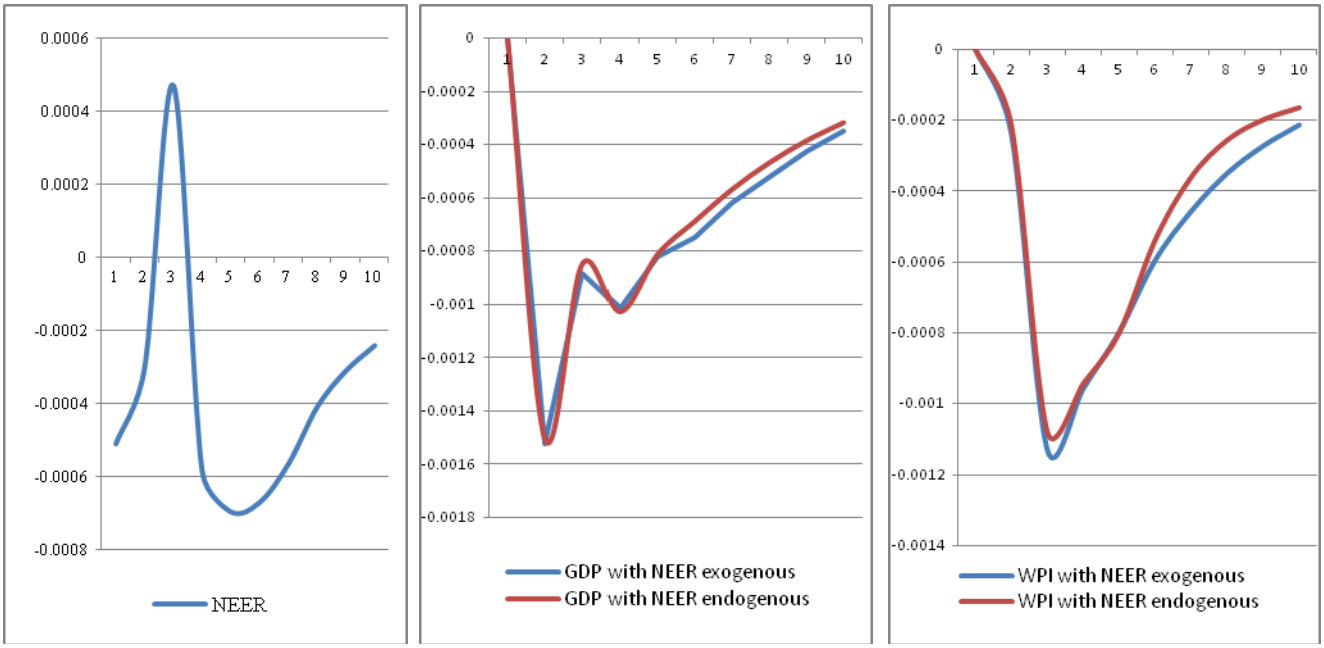
As shown in Chart 9, very similar results follow using NEER, except that NEER does not appreciate immediately as was seen in the case of REER. There is very little difference in the impact on GDP growth, but has a non-negligible monetary policy dampening impact on inflation.

Chart 8: Impulse Responses of REER, GDP and WPI to Policy Rate



[20] The differences are even much less for the estimates using total GDP and non-agricultural GDP at about 2.0 per cent and 3.0 per cent, respectively.
[21] The differences are lesser for the estimates using total GDP and non-agricultural GDP at about 14.0 per cent and 4.0 per cent, respectively.

Chart 9: Impulse Responses of NEER, GDP and WPI to Policy Rate



(iv) Direct Interest Rate Channel

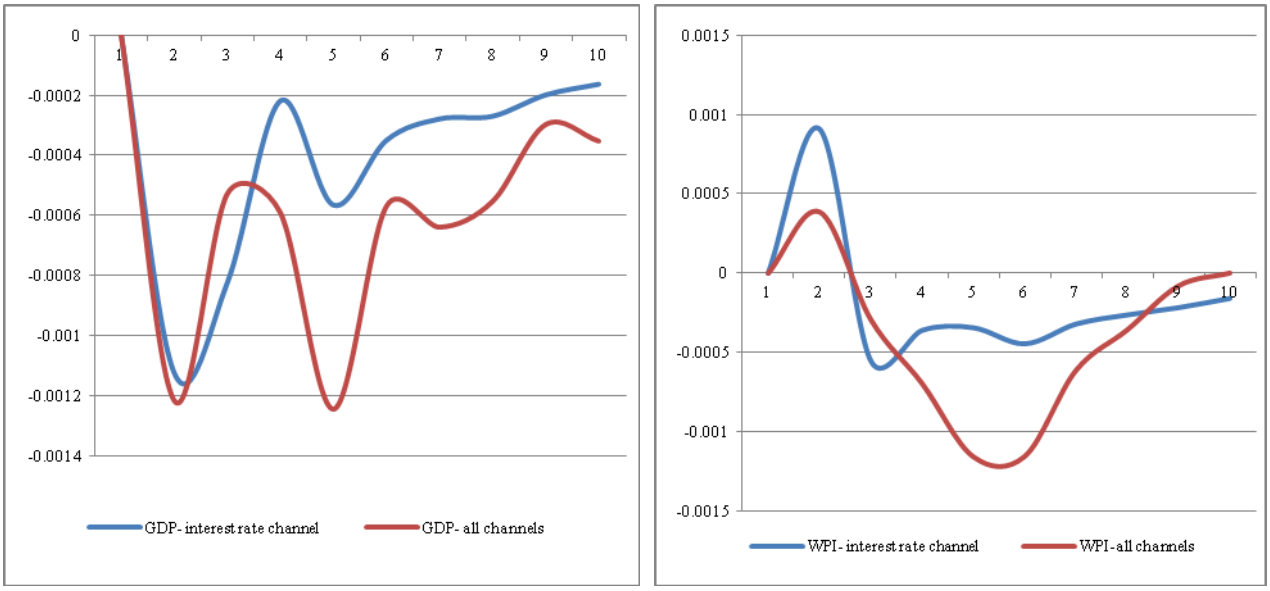
A rough way of observing the direct interest rate channel is in terms of the residual impact not explained by the three channels shown above. This can be done at least in two ways (for example, see Disyatat and Vongsinsirikul, 2003). First is by summing the unexplained portion of accumulated response by the three channels in the analysis above. Second is to augment the baseline SVAR by including all the three channels as endogenous variables at one time and compare the accumulated response with the corresponding response obtained by making all the three channels exogenous. It may, however, be noted that besides these four traditional channels, *viz*., interest rate, asset price, exchange rate and credit channel, there could be other channels of transmission. In fact, it is being argued that confidence channel since the global crisis has become an important channel of monetary transmission. Thus, the impact of direct interest rate channel in both the cases could contain the impact of other unexplained channels such as confidence channel[22].

It was seen from above that, depending upon the alternative measures of credit and exchange rate, after 10 quarters, the accumulated responses of GDP growth from the three channels together accounted for about 45 to 55 per cent of the

[22] A similar exercise was carried out to analyse the importance of confidence channel in monetary transmission using business confidence index published by National Council of Applied Economic Research (NCAER). Using this index, however, we did not find any noticeable evidence on the operation of this channel.

total responses. In other words, about 50 per cent of the monetary transmission would be explained directly by the interest rate channel[23]. With regard to inflation, interest rate channel accounts for about one-third of the total accumulated responses after 10 quarters. The direct estimate obtained from the augmented SVAR shown in Chart 10 also confirms the importance of direct interest rate channel, which shows that after 10 quarters about two-thirds of the accumulated response of GDP growth and over 40 per cent of accumulated response of inflation could be attributed to interest rate channel.

Chart 10: Impulse Response of GDP and WPI to Policy Rate



VI. Conclusion

Using SVAR models on quarterly data for 1996-97:1 to 2011-12:1, the paper examined the relative importance of various transmission channels of monetary policy to GDP growth and inflation in India. To check for robustness of the results, three alternative measures of GDP, *viz.*, non-agriculture non-government GDP, non-agriculture GDP and total GDP have been used.

The paper finds that external exogenous factors prolong the impact of monetary policy transmission on GDP growth and inflation in India, while removing the problem of '*price puzzle*'. Among the various channels of transmission, interest rate channel, credit channel and asset prices channel are found to be important,

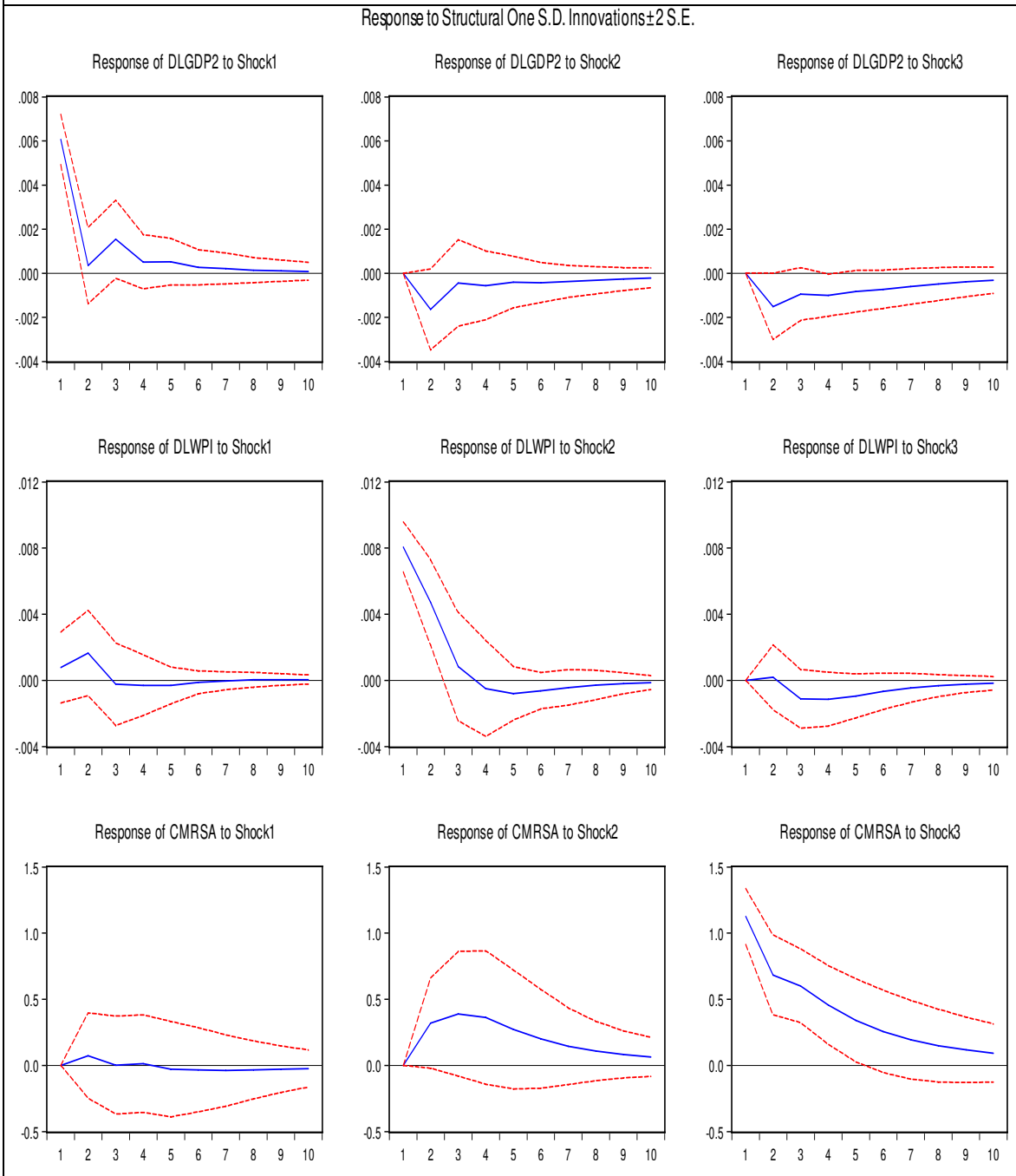
[23] Other alternative models based on total GDP and non-agricultural GDP also show similar results indicating the importance of traditional direct interest rate channel.

while exchange rate channel is found to be weak. A positive policy shock leads to contraction in credit with a lag of two quarters and subsequently impacts GDP growth and inflation negatively. The same monetary policy shock leads to decline in asset prices from the third quarter onwards and has pronounced negative impact on GDP growth and inflation. Exchange rate channel is found to have an insignificant impact on GDP growth, but has non-negligible impact on inflation. Interest rate channel is found to account for about half of total impact of monetary shocks on GDP growth and about one-third of total impact on inflation, indicating that interest rate channel is the most important channel for monetary policy transmission in India.

Annex Chart 1

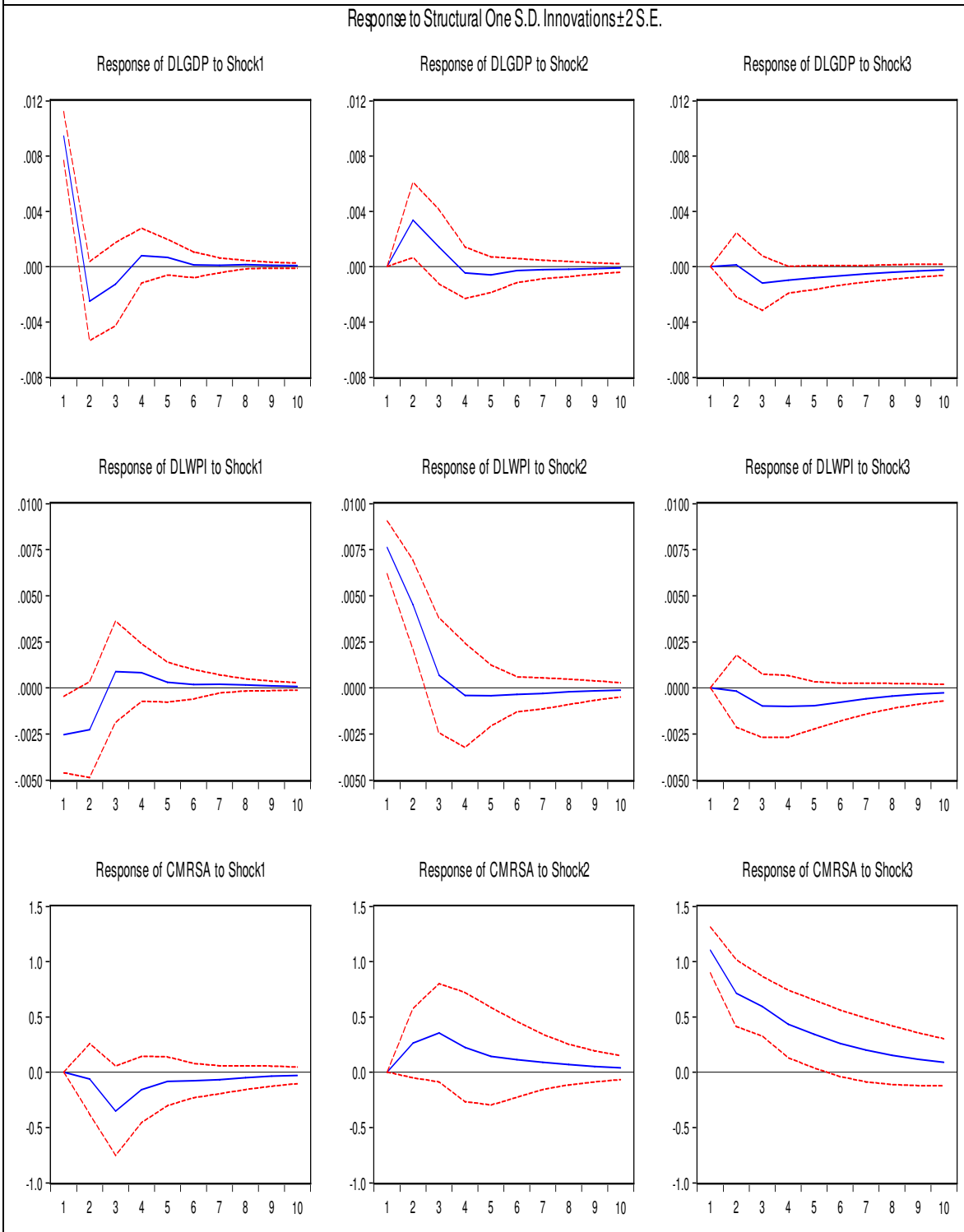
A. Baseline SVAR model

Annex Chart 1: Impulse Responses - non-agricultural non-government GDP



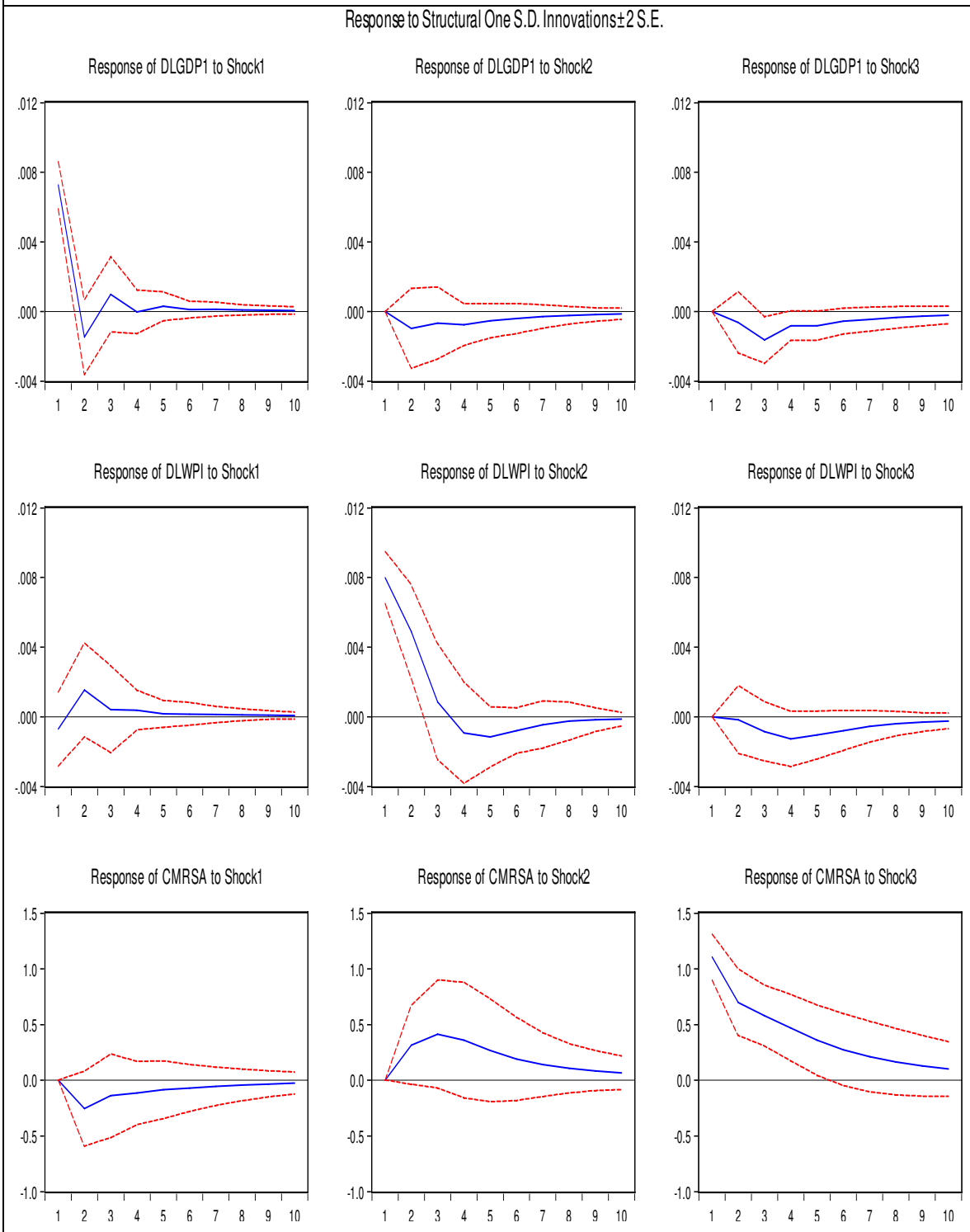
Shock1=DLGDP; Shock2=DLWPI; and Shock3=CMRSA

Annex Chart 2: Impulse Responses - Total GDP



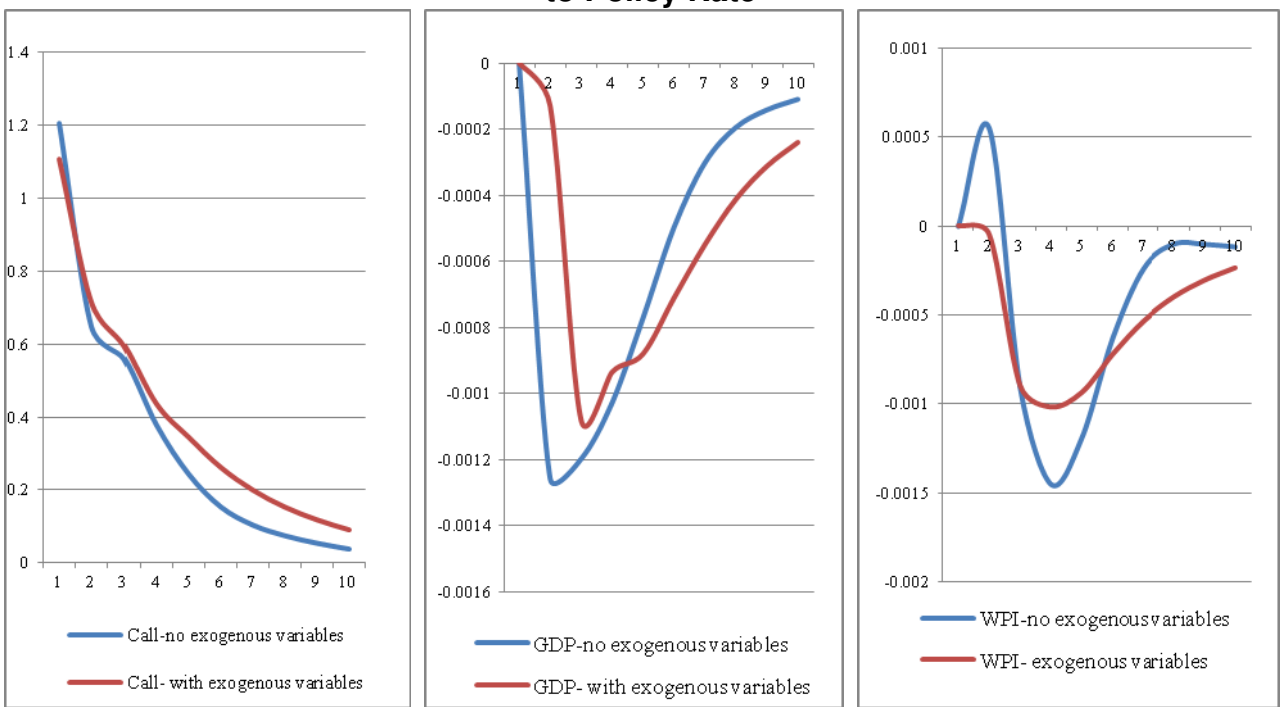
Shock1=DLGDP; Shock2=DLWPI; and Shock3=CMRSA

Annex Chart 3: Impulse Responses- non-agricultural GDP

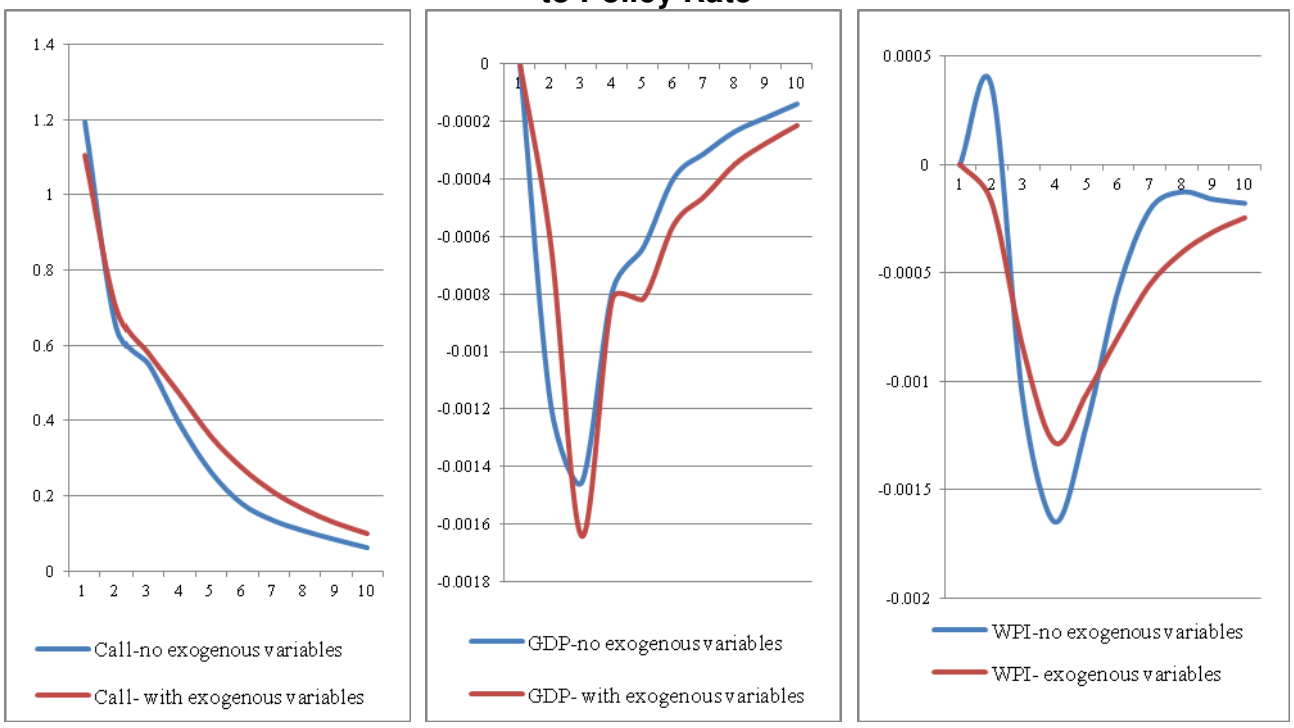


Shock1=DLGDP; Shock2=DLWPI; and Shock3=CMRSA

Annex Chart 4: Impulse Response of Total GDP Growth and WPI Inflation to Policy Rate



Annex Chart 5: Impulse Response of Non-agricultural GDP Growth and WPI Inflation to Policy Rate



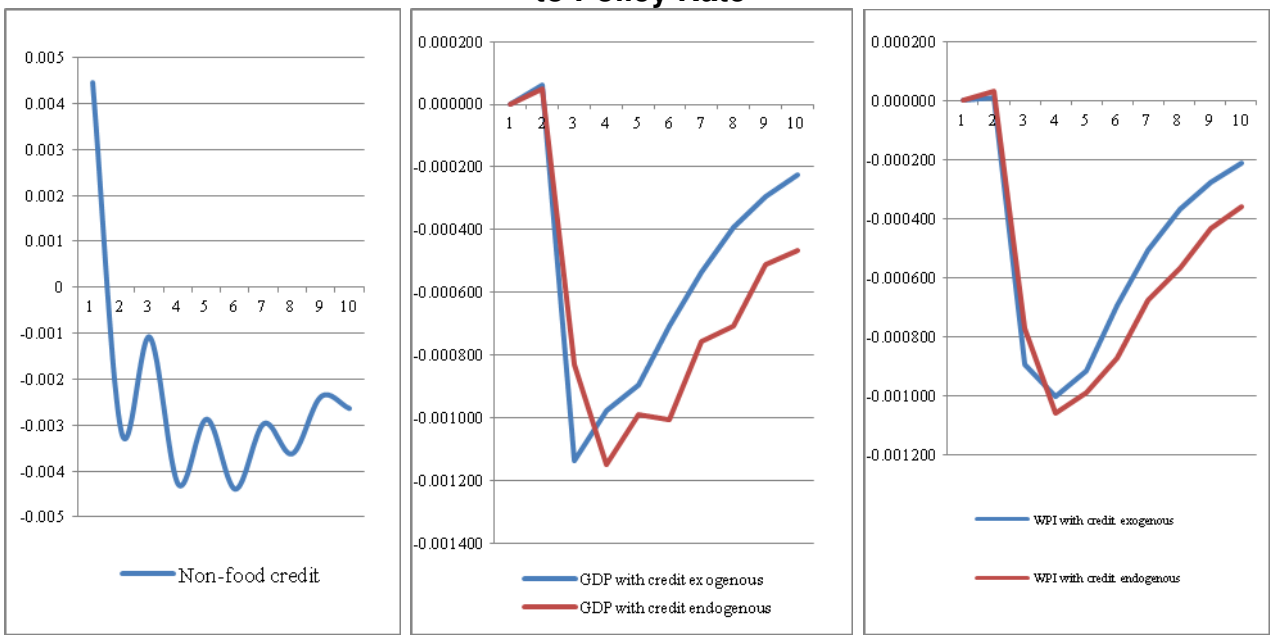
Annex Table 1: Variance Decomposition of Baseline Model: Total GDP Growth						
	1996:1 to 2011:1			2000:1 to 2011:1		
Variance Decomposition of DLGDP:						
Period	DLGDP	DLWPI	CMRSA	DLGDP	DLWPI	CMRSA
4	87.8	10.1	2.2	77.4	14.5	8.1
8	85.7	10.4	3.9	73.5	15.4	11.2
10	85.5	10.5	4.0	73.2	15.4	11.4
Variance Decomposition of DLWPI:						
Period	DLGDP	DLWPI	CMRSA	DLGDP	DLWPI	CMRSA
4	11.5	86.6	1.9	12.2	81.9	5.9
8	11.4	84.9	3.7	11.6	76.6	11.8
10	11.4	84.7	3.8	11.6	76.5	11.9
Variance Decomposition of CMRSA:						
Period	DLGDP	DLWPI	CMRSA	DLGDP	DLWPI	CMRSA
4	4.2	9.2	86.6	2.2	15.3	82.6
8	4.4	9.9	85.6	3.2	16.4	80.4
10	4.5	10.0	85.5	3.2	16.3	80.4

Annex Table 2: Variance Decomposition of Baseline Model: Non-agricultural GDP Growth							
	1996:1 to 2011:1				2000:1 to 2011:1		
Variance Decomposition of GDP:							
Period	DLGDP	DLWPI	CMRSA		DLGDP	DLWPI	CMRSA
4	90.7	3.2	6.1		86.0	2.7	11.2
8	88.0	4.0	8.0		77.3	5.2	17.4
10	87.8	4.1	8.1		76.7	5.4	17.9
Variance Decomposition of DLWPI:							
Period	DLGDP	DLWPI	CMRSA		DLGDP	DLWPI	CMRSA
4	3.3	94.1	2.5		7.7	86.3	5.9
8	3.3	92.1	4.6		7.3	81.2	11.5
10	3.3	91.9	4.8		7.3	80.8	11.9
Variance Decomposition of CMRSA:							
Period	DLGDP	DLWPI	CMRSA		DLGDP	DLWPI	CMRSA
4	3.5	14.5	82.0		3.0	16.6	80.4
8	3.6	16.9	79.5		3.1	19.3	77.7
10	3.6	17.0	79.4		3.1	19.4	77.5

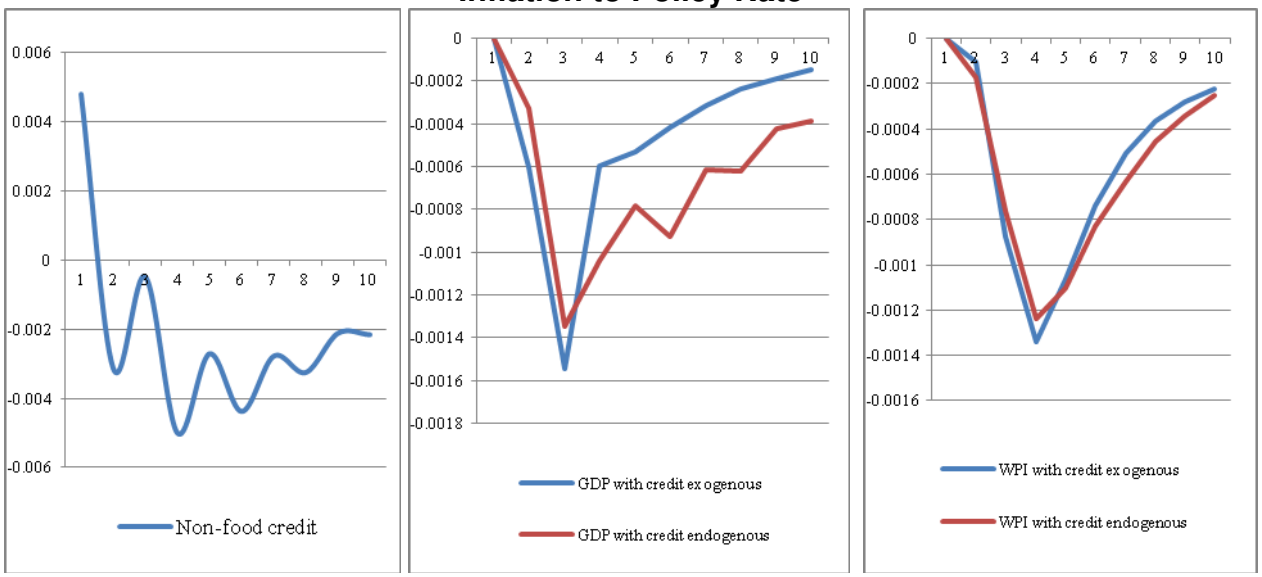
I. Credit Channel

a) Non-food Credit

Annex Chart 6: Impulse Response of Total GDP Growth and WPI Inflation to Policy Rate

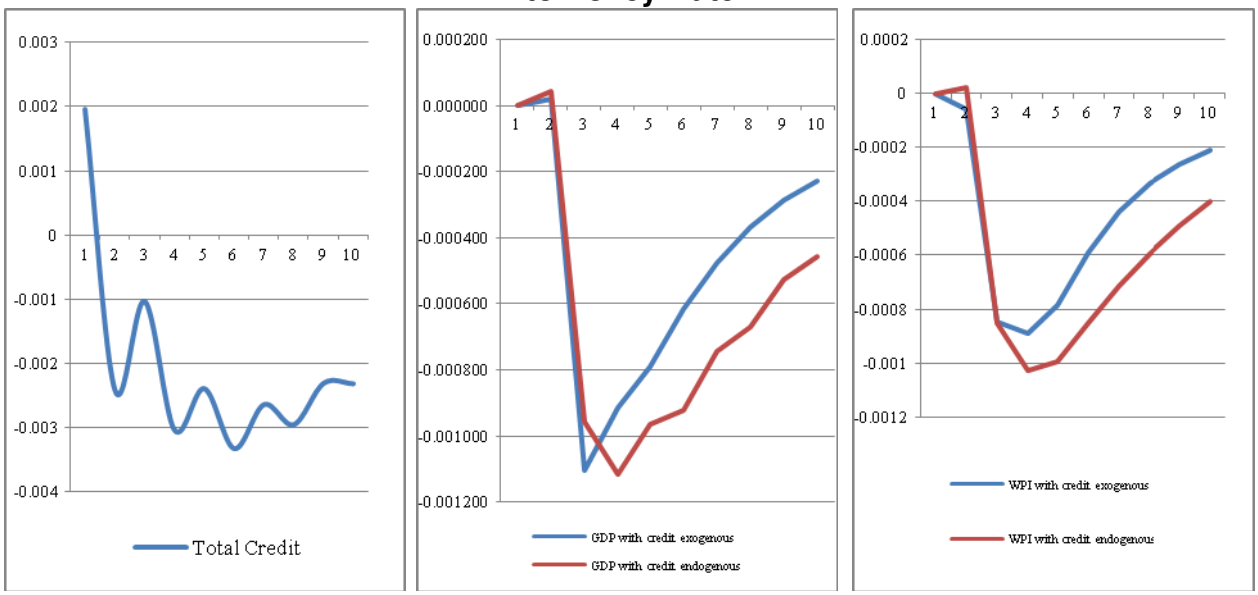


Annex Chart 7: Impulse Response of Non-agricultural GDP Growth and WPI Inflation to Policy Rate

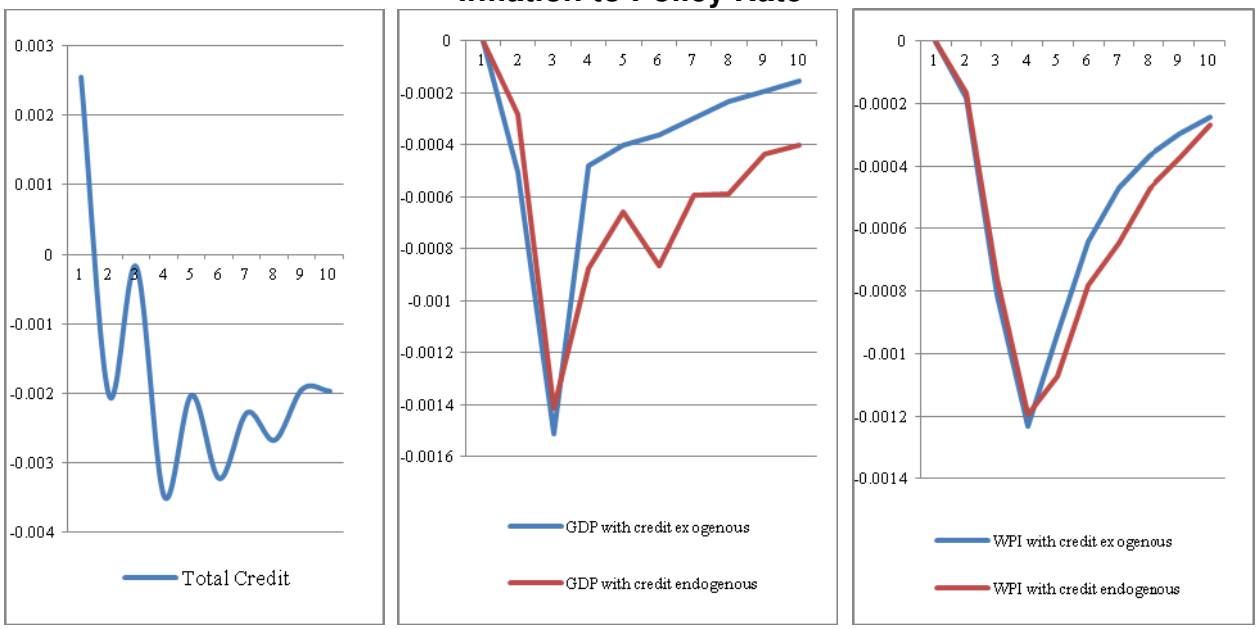


b) Total Credit

Annex Chart 8: Impulse Response of Total GDP Growth and WPI Inflation to Policy Rate

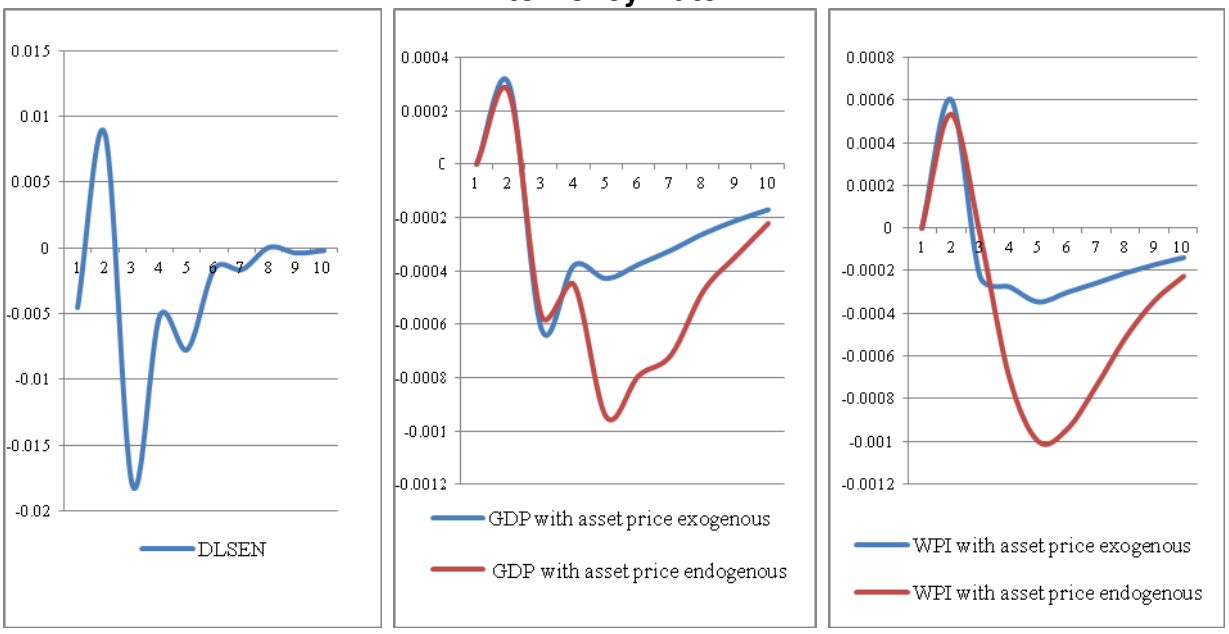


Annex Chart 9: Impulse Response of Non-agricultural GDP Growth and WPI Inflation to Policy Rate

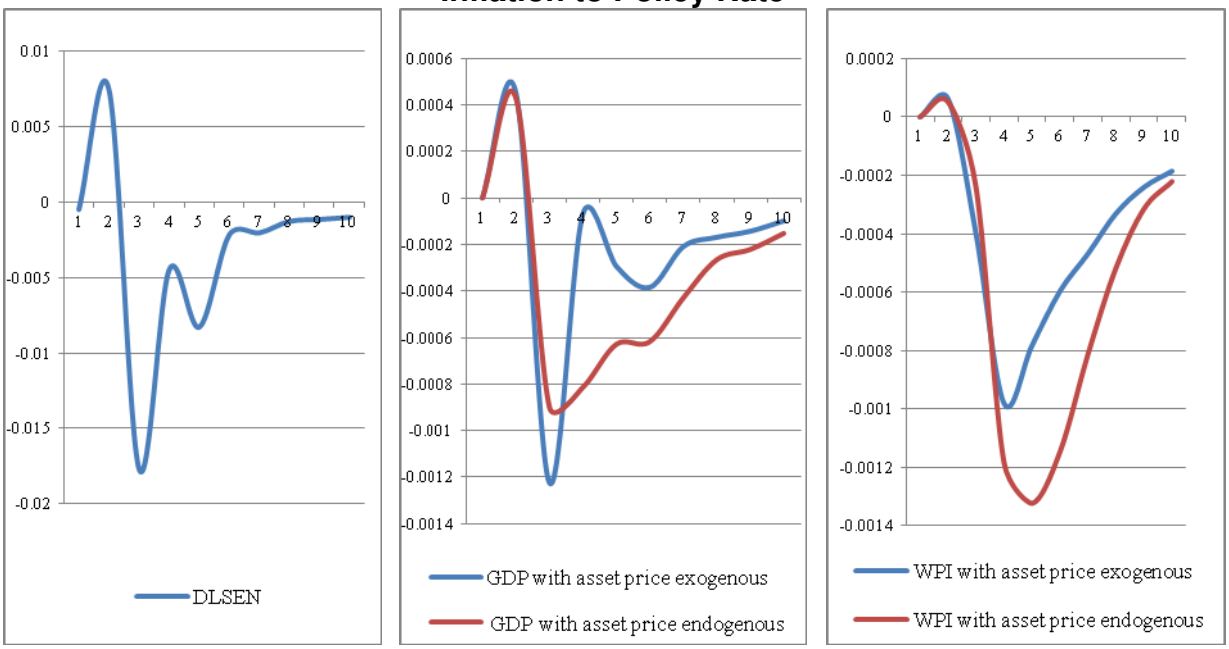


II. Asset Price Channel

Annex Chart 10: Impulse Response of Total GDP Growth and WPI Inflation to Policy Rate



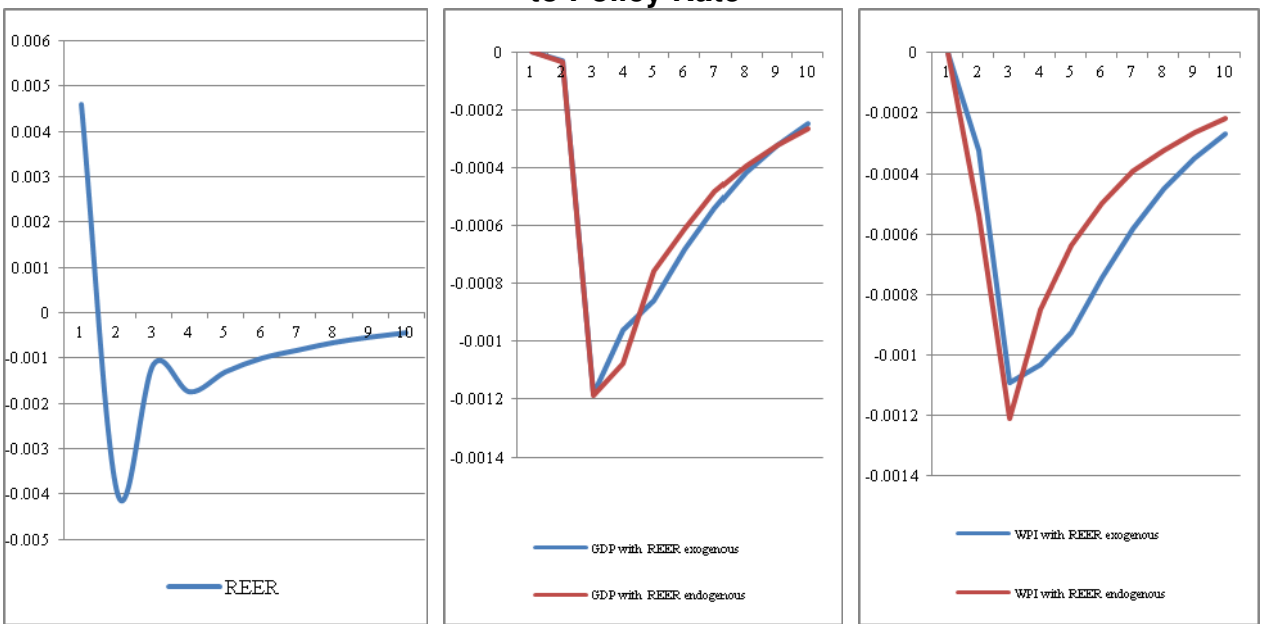
Annex Chart 11: Impulse Response of Non-agricultural GDP Growth and WPI Inflation to Policy Rate



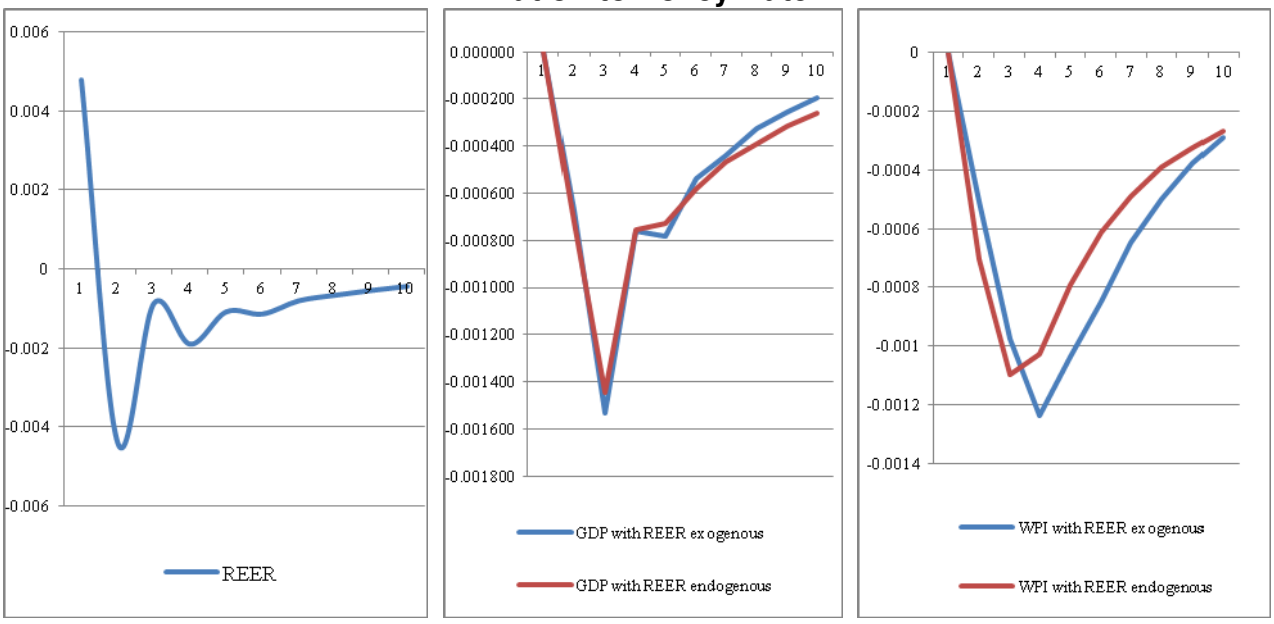
III. Exchange Rate Channel

a) REER

Annex Chart 12: Impulse Response of Total GDP Growth and WPI Inflation to Policy Rate

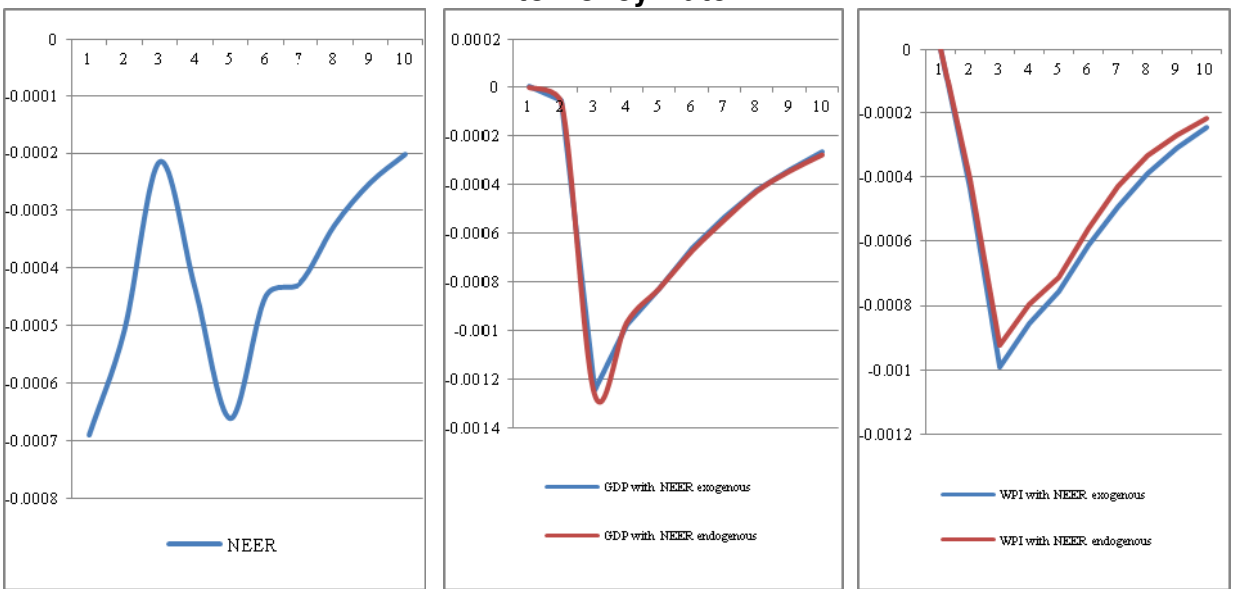


Annex Chart 13: Impulse Response of Non-agricultural GDP Growth and WPI Inflation to Policy Rate

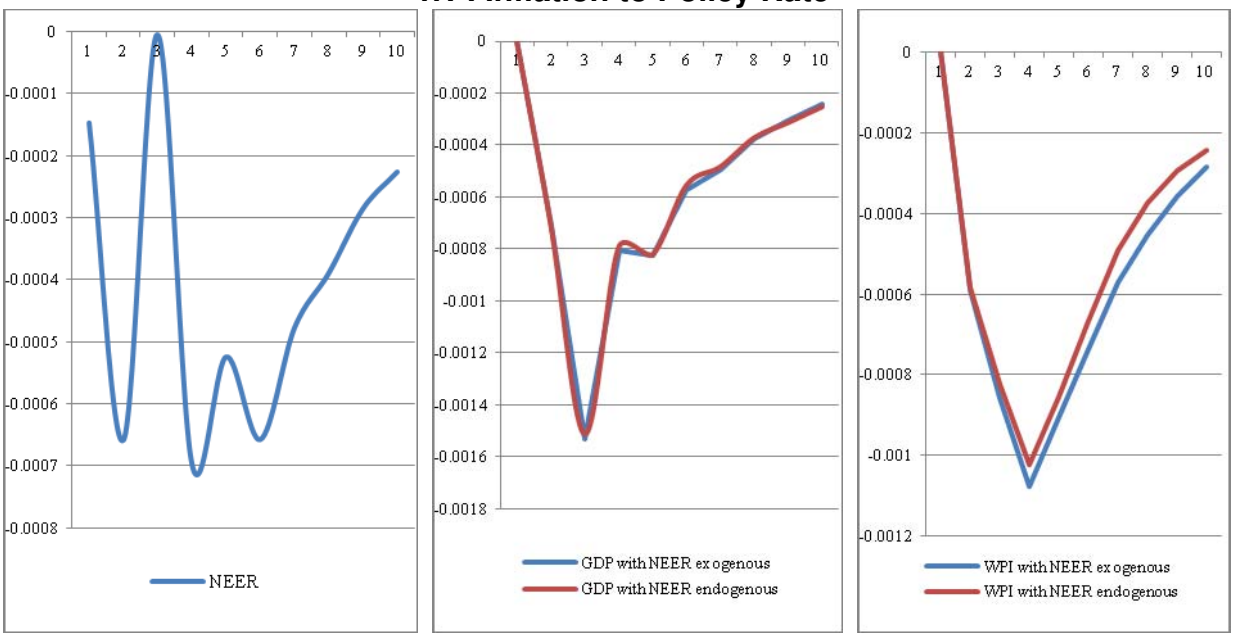


b) NEER

Annex Chart 14: Impulse Response of Total GDP Growth and WPI Inflation to Policy Rate

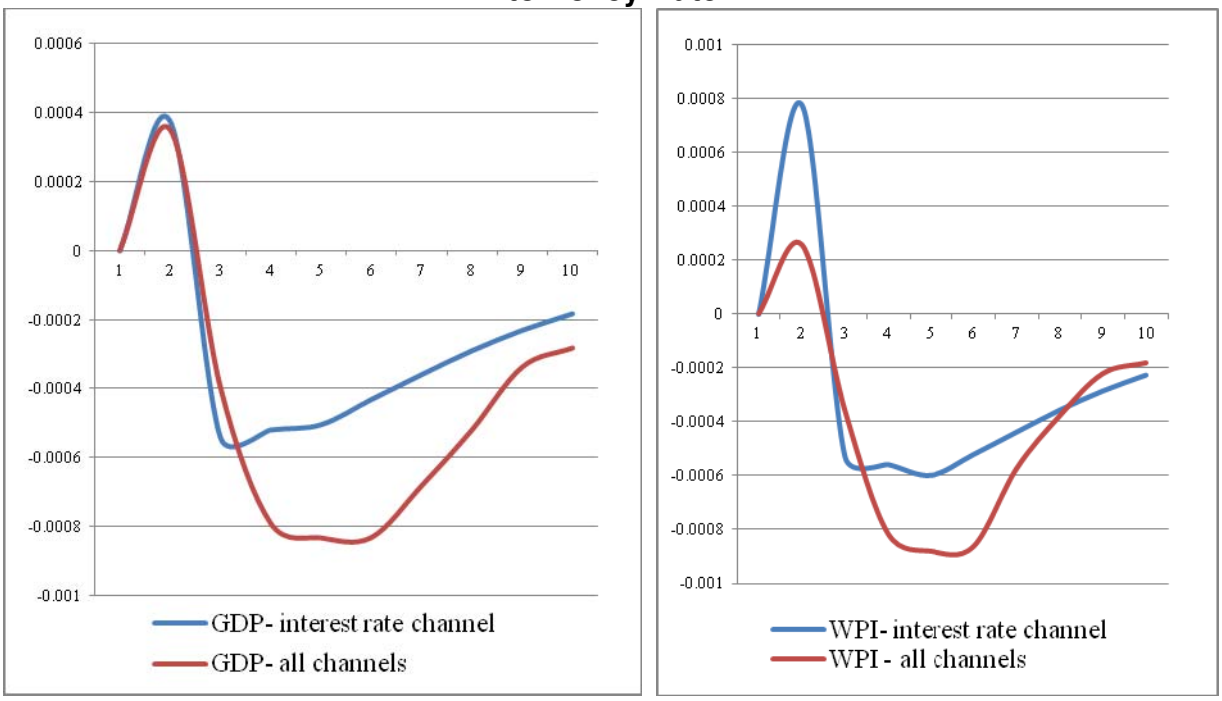


Annex Chart 15: Impulse Response of Non-agricultural GDP Growth and WPI Inflation to Policy Rate

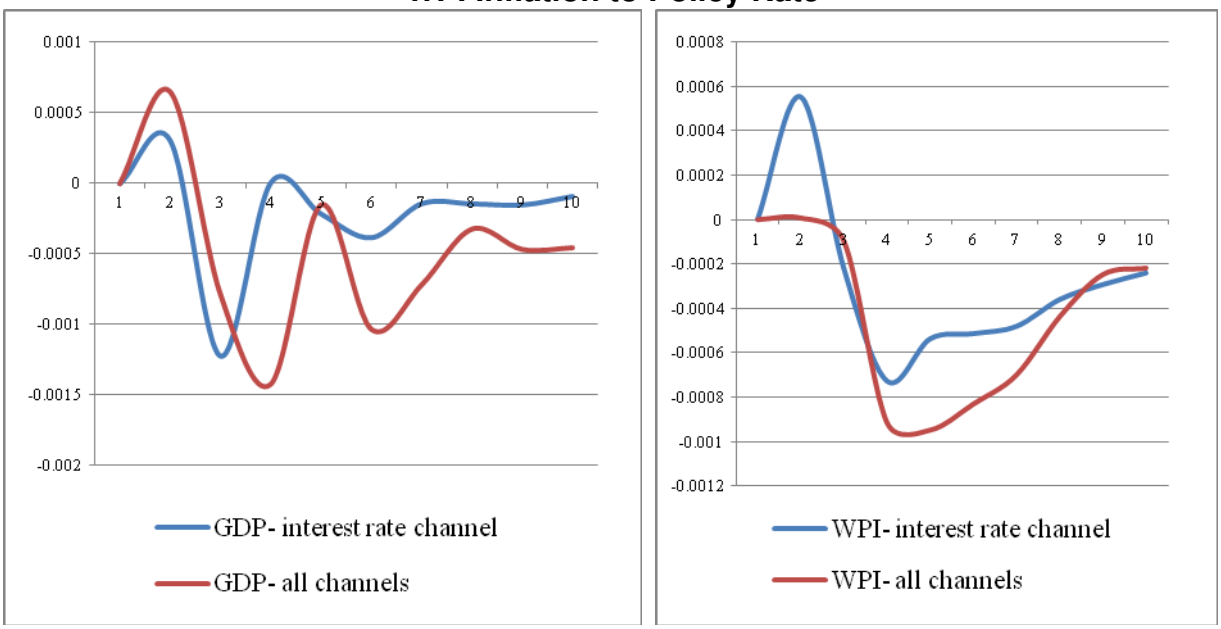


IV. Direct Interest Rate Channel

Annex Chart 16: Impulse Response of Total GDP Growth and WPI Inflation to Policy Rate



Annex Chart 17: Impulse Response of Non-agricultural GDP Growth and WPI Inflation to Policy Rate



References:

Acosta-Ormaechea, Santiago and David Coble [2011]. "Monetary transmission in dollarized and non-dollarized economies: The cases of Chile, New Zealand, Peru and Uruguay", *IMF Working Paper No.11/87*, International Monetary Fund.

Aleem, Abdul [2010]. "Transmission mechanism of monetary policy in India", *Journal of Asian Economics*, 21, 186-197.

Allen, Franklin and Kenneth Rogoff [2010]. "Asset prices, financial stability and monetary policy", http://fic.wharton.upenn.edu/fic/papers/11/11-39.pdf.

Al-Mashat, R. [2003]. Monetary policy transmission in India: Selected issues and statistical appendix, Country report no. 03/261, International Monetary Fund.

Amarasekar, C. [2008]. "The impact of monetary policy on economic growth and inflation in Sri Lanka". *CBSL Staff Studies*, 38, No 1&2.

Ando, Albert, and Franco Modigliani [1963]. "The 'life-cycle' hypothesis of saving: aggregate implications and tests," *American Economic Review*, 53, 55–84.

Angeloni, Ignazio, Anil K Kashyap, Benoît Mojon and Daniele Terlizzese [2003]. "Monetary transmission in the euro area: does the interest rate channel explain all?", *NBER Working Paper No. 9984*, National Bureau of Economic Research.

Bayangos, Veronica B. [2010]. "Does the bank credit channel of monetary policy matter in the Philippines?", available at www.bis.org/repofficepubl/arpresearch201003.12.pdf

Bean, Charles, Jens Larsen and Kalin Nikolov [2002]. "Financial frictions and the monetary transmission mechanism: theory, evidence and policy implications", *ECB Working Paper No.113*, European Central Bank.

Bean, Charles; Matthias Paustian, Adrian Penalver and Tim Taylor [2010]. "Monetary policy after fall", paper presented at Jackson Hole Symposium Wyoming, September 16.

Bernanke, Ben S. [1986]. "Alternative explanations of the money-income correlation," Carnegie-Rochester Conference Series on Public Policy, Elsevier, Vol. 25, 49-99.

Bernanke, Ben S. and Alan S. Blinder [1988]. "Credit, money, and aggregate demand", *American Economic Review* Papers and Proceedings, 78, 435-439.

Bernanke, Ben and Alan Blinder [1992]. "The federal funds rate and the channels of monetary transmission", *American Economic Review*, 82, 901-21.

Bernanke, Ben and Mark Gertler [1995]. "Inside the black box: the credit channel of monetary transmission", *Journal of Economic Perspectives*, 9, 27-48.

Bernanke, B. [2010]. “Monetary policy and the housing bubble,” Speech to the Annual Meeting of the American Economic Association, Atlanta, Georgia, http://www.federalreserve.gov/newsevents/speech/bernanke20100103a.htm.

Bernanke, Ben S. [2011]. “The economic outlook and macroeconomic policy”, Speech at the National Press Club, Washington, D.C., February 3.

Bhaumik, S. K., Vinh Dang and Ali M. Kutan. [2010]. “Implications of bank ownership for the credit channel of monetary policy transmission: evidence from India”, *William Davidson Institute Working Paper Number 988*, University of Michigan.

Bhattacharya, Rudrani, Ila Patnaik and Ajay Shah [2011]. “Monetary policy transmission in an emerging market setting”, *IMF Working Paper No.11/5*.

Boivin, Jean, Michael T. Kiley and Frederic S. Mishkin [2010]. “How has the monetary transmission mechanism evolved over time?”, *NBER Working Paper No. 15879*, National Bureau of Economic Research.

Cecchetti, Stephen G., Marion Kohler and Christian Upper [2009]. “Financial crises and economic activity”, Paper presented at Jackson Hole Symposium Wyoming, August 10-11.

Christiano, L. J., M. Eichenbaum, M., and C. Evans [1999], “Monetary policy shocks: What have we Learned and to what end?” in J. B. Taylor, and M.Woodford, ed., Handbook of Macroeconomics, Elsevier Science, North Holland.

Christiano Lawrence, Roberto Motto and Massimo Rostagno [2008]. “Shocks, structures or monetary policies? The Euro Area and US after 2001”, *Journal of Economic Dynamics and Control*, 32, 2476-2506.

Curdia, Vasco and Michael Woodford [2010a]. “The central-bank balance sheet as an instrument of monetary policy”, *NBER Working Paper No. 16208*, National Bureau of Economic Research.

Curdia, Vasco and Michael Woodford [2010b]. “Conventional and unconventional monetary policy”, *Federal Reserve Bank of St. Louis Review*, Vol. 92, No. 4, July-August.

De Fiore, Fiorella [1998]. “The transmission of monetary policy in Israel”, *IMF Working Paper No. WP/98/114*, International Monetary Fund.

Disyatat, Piti and Pinnarat Vongsinsirikul [2003]. “Monetary policy and the transmission mechanism in Thailand”, *Journal of Asian Economics*, 14.

Edwards, Franklin and Frederic S. Mishkin [1995]. “The decline of traditional banking: implications for financial stability and regulatory policy”, *NBER Working Papers No. 4993*, National Bureau of Economic Research.

European Central Bank [2010]. “Monetary policy transmission in the Euro Area, a decade after the introduction of the Euro”, *ECB Monthly Bulletin*, May.

Friedman, Milton, and Anna Jacobson Schwartz [1963]. “*A monetary history of the United States, 1867-1960*”, Princeton University Press.

Hung, Le Viet [2007]. “A Vector Autoregression (VAR) Analysis of the monetary transmission mechanism in Vietnam”, available at http://www.grips.ac.jp/vietnam/VDFTokyo/Doc/35LVHung18Aug07Paper.pdf

Joyce, Michael, Matthew Tong and Robert Woods [2011]. “The United Kingdom’s quantitative easing policy: design, operation and impact”, *Quarterly Bulletin 2011 Q3*, Bank of England.

Kabundi A., and Nonhlanhla, N. [2011]. “Assessing monetary policy in South Africa in a data-rich environment”, *South African Journal of Economics*, 79, 91-107.

Khundrakpam, Jeevan Kumar [2011]. “Credit channel of monetary transmission in India - how effective and long is the lag?”, *RBI Working Paper No. WPS (DEPR): 20/ 2011.*

Loayza, Norman and Klaus Schmidt-Hebbel [2002]. “Monetary policy functions and transmission mechanisms: an overview”, available at http://www.bcentral.cl/estudios/banca-central/pdf/v4/001_020Gallego.pdf.

Meltzer, Allan H. [1995]. “Monetary, credit and (other) transmission processes: a monetarist perspective,” *Journal of Economic Perspectives*, 9, 49-72.

Mishkin, Frederic S. [1995]. “Symposium on the monetary transmission mechanism”, *Journal of Economic Perspectives*, 9, 3-10.

Mishkin, Frederic S. [1996]. “Channels of monetary transmission and lessons for monetary policy”, *NBER Working Paper No.5464*, National Bureau of Economic Research.

Mishkin, Frederic S. [2001]. “The transmission mechanism and the role of asset prices in monetary policy”, *NBER Working paper No.8617,* National Bureau of Economic Research.

Mishra, Prachi, Peter J. Montiel and Antonio Spilimbergo [2010]. “Monetary transmission in low income countries”, *CEPR Discussion Paper No.DP7951*.

Mohanty, D. [2012]. “Evidence on interest rate channel of monetary policy transmission in India”, paper presented at the Second International Research Conference at the Reserve Bank of India, February 1-2.

Mohanty, M. S. and Philip Turner [2008]. “Monetary policy transmission in emerging market economies: what is new?”, *BIS Papers No.35,* Bank of International Settlements.

Mukherjee, Sanchita and Rina Bhattacharya [2011]. “Inflation targeting and monetary policy transmission mechanisms in emerging market economies”, *IMF Working Paper No. WP/11/229*, International Monetary Fund.

Ncube, Mthuli and Eliphas Ndou [2011]. “Monetary policy transmission, house prices and consumer spending in South Africa: an SVAR approach”, *Working Paper No. 133*, African Development Bank Group.

Obstfeld, Maurice and Kenneth Rogoff [1995]. “The mirage of fixed exchange rates”, *Journal of Economic Perspectives*, 9, 73-96.

Pandit, B.L, Ajit Mittal, Mohua Roy and Saibal Ghosh [2006]. “Transmission of monetary policy and the bank lending channel: analysis and evidence for India”, *DRG Study No.25*, Reserve Bank of India.

Pandit, B. L. and Pankaj Vashisht [2011]. “Monetary policy and credit demand in India and some EMEs”, *ICRIER Working Paper No.256*.

Patra, Debabrata Michael and Muneesh Kapur [2010]. “A monetary policy model without money for India”, *IMF Working Paper No.10/183*, International Monetary Fund.

Ramey, Valerie A. [1993]. “How important is the credit channel in the transmission of monetary policy?”, *NBER Working Paper No. 4285*, National Bureau of Economic Research.

Romer, C. D. and Romer, D. H. [1990]. “New evidence on the monetary transmission mechanism”, *Brookings Paper on Economic Activity*, 1, 149-213.

Reserve Bank of India [1985]. Report of the committee to review the working of the monetary system (Chairman: S. Chakravarty), Bombay.

Reserve Bank of India [1998]. Report of the working group on money supply: analytics and methodology of compilation (Chairman: Dr. Y.V. Reddy), June.

Reserve Bank of India [2005]. Report on currency and finance, 2003-04.

Reserve Bank of India [2011]. Report of the working group on operating procedure of monetary policy (Chairman: Deepak Mohanty).

Singh, Kanhaiya and Kaliappa Kalirajan [2007]. “Monetary transmission in post-reform India: an evaluation”, *Journal of the Asia Pacific Economy*, 12, 158–187.

Smets, Frank and Raf Wouters [2002]. “An estimated dynamic stochastic general equilibrium model of the Euro Area”, *ECB Working Paper No.171*, European Central Bank.

Taylor, John B. [1995]. “The monetary transmission mechanism: an empirical framework”, *Journal of Economic Perspective*, 9, 11-26.

Taylor, John B. and John C. Williams [2010]. “Simple and robust rules for monetary policy”, *NBER Working Paper No.15908*, National Bureau of Economic Research.

Tobin, J. [1969]. "A general equilibrium approach to monetary theory", *Journal of Money Credit and Banking,* 1, 15–29.

Trichet, Jean-Claude [2011]. Introductory statement to the press conference, European Central Bank, Frankfurt, February 3.

Walsh, Carl E. [2009]. “Using monetary policy to stabilize economic activity”, Paper presented at Jackson Hole Symposium Wyoming, August 10-11.

Yellen, Janet L. [2011]. “Unconventional monetary policy and central bank communication” Speech at the University of Chicago Booth School of Business U.S. Monetary Policy Forum, New York, New York, February 25.