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### **Monetary Policy Effectiveness in Pakistan: An In-depth Analysis of Four Transmission Channels**

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**STATE BANK OF PAKISTAN**

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# Monetary Policy Effectiveness in Pakistan: An In-depth Analysis of Four Transmission Channels

Fida Hussain, Fayyaz Hussain and Kalim Hyder\*

## Abstract

This paper assesses the evolution and relative strength of different channels of monetary policy transmission mechanism, including interest rate, credit, assets price and exchange rate channels. We have used Structural Vector Autoregressive (SVAR) method on monthly data from 1991 to 2019 for this purpose. The results show that monetary policy effectiveness has improved over time. And the credit channel is a relatively more effective in transmitting the changes in monetary policy stance to the economy as compared to other channels.

**JEL Classification:** E52, E58, G12, G21

**Key Words:** Pakistan, monetary policy transmission channels, interest rate, exchange rate, credit, assets prices, SVAR, VECM, inflation.

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## **Non-technical Summary**

This paper attempts to assess the evolution and relative strength of different channels of monetary policy transmission mechanism, including interest rate, credit, assets price and exchange rate channels. We have used Structural Vector Autoregressive (SVAR) model to see the response of inflation and growth to changes in the monetary policy stance. The paper estimates all the channels in one single framework and then check the relative strength of each channel one by one by blocking all the other channels.

The study uses monthly data from January 1991 to June 2019. The starting period coincides with the financial sector liberalization in Pakistan. This is the period when SBP gradually moved towards the market based implementation of monetary policy by making adjustments in the discount rate, later introducing policy rate.

The results show that monetary policy effectiveness has improved over time; and the credit channel is a relatively more effective in transmitting the changes in monetary policy stance to the economy as compared to other channels. Both the exchange rate and asset price channels are relatively weak in overall transmission mechanisms.

In aggregate terms, one standard deviation (equivalent to 100 basis points) increase in the call money rate leads to around 0.20 percentage points reduction in inflation and around 0.30 percentage points reduction in growth of manufacturing index over three year horizon. The humped shape transmission takes the peak in almost six months. A similar shock of 100 basis points reduces the inflation by 0.10 and 0.09 percentage points through credit and exchange rate channels, respectively.

Our findings also imply that monetary policy transmission will be further strengthened going forward with market-determined exchange rate, prohibition of monetary financing of the budget deficits, and adoption of flexible inflation targeting (FIT).

## 1. Introduction

Monetary policy effectiveness has recently come under renewed inquiry, especially in the context of zero lower bound in post global financial crisis (Bernanke, 2020 and Rogoff, 2017). In developing countries like Pakistan, irrespective of the level of interest rates, questions are raised about efficacy of monetary policy in terms of controlling inflation. It is often argued that a more than one third of the CPI basket consists of food that weakens central bank's ability to control inflation. Moreover, presence of a weak transmission mechanism in a relatively volatile economic environment, fiscal dominance and low credibility of the central bank is also the subject of investigation in the literature.

In this backdrop, this study attempts to quantify the effectiveness of monetary policy in Pakistan in terms of evolution and relative strength of key transmission channels. The importance of exploring the monetary policy effectiveness and understanding the transmission have also become important in view of State Bank of Pakistan's (SBP) commitment to adopt flexible inflation targeting especially after recent amendments in SBP Act, which gives clarity in the central bank's objectives.

The existing literature on monetary policy transmission in Pakistan mainly focuses on one or other aspect of the transmission mechanism. The studies have, in general, used T-bill rate to proxy the policy rate (Agha *et. al.*, 2005 and Nizamani *et. al.*, 2016). Agha *et. al.* (2005) rely on simple VAR, while Nizamani *et. al.* (2016) consider SVAR with block-Exogeneity and non-recursive identification scheme. Moreover, these studies attempt to check transmission 'in aggregate' over the estimation period. Safia (2012) focuses on balance sheet channel only using the panel of firm level data of SMEs and large corporates.

This study attempts to improve upon the existing literature in several ways. First, this paper uses Structural Vector Auto Regression (SVAR), which provides the responses of the target variables, e.g. inflation and economic growth, to the identified structural unanticipated shocks to the policy variables. Moreover, we also control for the fiscal dominance (proxy by government borrowing from the banking system) and supply shocks (global prices of oil and food).

Second, we attempt to identify the episodes during which the transmission was relatively strong or weak over a longer estimation horizon. In other words, we aim to explore the evolution of monetary policy transmission over time.

Third, we consider call money rate to represent policy rate impulses instead of using T-bill rate as proxy of the policy rate.<sup>1,2</sup> It is worth highlighting that T-bill rate is now determined by the government. Though it broadly follows the market interest rates and the policy rate, yet it is not the one central bank of Pakistan attempts to influence or control directly through its monetary policy tools to achieve its objectives.

Fourth, we also estimate all the channels in one single framework and then check relative strength of each channels one by one by blocking all the other channels.

This paper uses monthly data from January 1991 to June 2019. The starting period coincides with the financial sector liberalization in Pakistan. This is the period when SBP moved gradually towards the market based implementation of monetary policy by making adjustments in the discount rate.

Our results show the credit channel as the strongest, consistent with the findings of previous studies. Both the exchange rate and asset price channels are relatively weak in overall transmission mechanisms. In aggregate terms, one standard deviation (equivalent to 100 basis points) increase in

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<sup>1</sup> We use call money rate instead of discount rate/SBP target rate to measure policy impulse because SBP was using ceiling and floor rates as well as CRR to control credit and money supply in the economy, while discount rate was kept unchanged for extended periods. In other words, discount rate was not reflecting the underlying monetary policy stance.

<sup>2</sup> T-bill rates by Nizamani et al (2016); Agha et al (2005);

the call money rate leads to around 0.20 percentage points reduction in inflation and around 0.30 percentage points reduction in growth of manufacturing index over three year horizon. The humped shape transmission takes the peak in almost six months. A similar shock of 100 basis points reduces the inflation by 0.10 and 0.09 percentage points through credit and exchange rate channels, respectively.

The rest of the paper is organized as follows. The next section presents conceptual framework, detailed methodology for measuring the relative strength of the four channels – interest rate or money, bank credit, exchange rate and assets price channels. Estimation results are discussed in Section 3 and the last section concludes the study.

## 2. Conceptual Framework and Methodology

Monetary policy transmission is a core area of research in monetary economics and is of prime importance to the policy makers, academic researchers, and analysts. The economic decision making regarding savings and investment, wages and prices through expectations channel, rely on the interest rate setting by the central bank. The research on the topic is now focusing on the quantification of channels through which monetary policy can have an impact on real sector of the economy, at least in the short run.

There is consensus in the literature that monetary policy generally works through four traditionally recognized channels – the interest rate (or money) channel, assets price channel, credit channel, and exchange rate channel. In nutshell, the central bank policies alter the supply of bank reserves, which affect the interest rate that banks charge for overnight borrowing and lending (typically to each other, in the form of money-market rates), and term premium across the maturity spectrum transmit these effects to the rate of return on long-term bonds.

Under the assumptions of price stickiness and rational expectations, movements in nominal rates affect long-term real interest rates, influencing the demand for a broad range of consumer and capital goods (Cottarelli and Kourelis, 1994; Gigineishvili, 2011; Sorensen and Werner, 2006; Mojon, 2003). This represents the interest rate channel. The term premium between long-term bonds on the one hand, and equities and real assets, on the other hand, affects stock market and real estate prices, which in turn affect household wealth and consumer spending, establishing the asset channel (Mishkin 1995, 2001).

Similarly, the wedge between assets denominated in domestic and foreign currencies affects the real exchange rate, which alters the composition of both consumption and investment spending between domestic and foreign goods. This constitutes the exchange rate channel (Dornbusch, 1990; Hafer, 1989; Taylor, 1995; Mishkin, 1995, 2001, 2008; Kamin, Turner, and Van ‘tdack, 1998; Loayza and Schmidt-Hebbel, 2002; and Dabla-Norris and Floerkemeier, 2006).

Finally, credit market frictions imply that some borrowers have access to funds only through bank credit, while others have to pay a premium over the risk-free rate that depends on their net worth (the external finance premium). The credit channel captures the dual effects; the effect of changes in the supply of banking system reserves on aggregate demand through changes in the terms on which bank customers have access to loans (the bank lending channel) as well as the effect of changes in the external finance premium – the balance sheet channel (Bernanke and Blinder, 1988; Bernanke, 1986; Gertler and Gilchrist, 1993; Kashyap and Stein, 1995; Peek and Rosengren, 1995, 1997; Romer and Romer, 1990; Bernanke and Gertler, 1995; Woodford, 2010); and money or credit (Bernanke and Gertler, 1995; Bernanke and Mihov, 1998; Ramey, 1993).<sup>3</sup>

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<sup>3</sup> Besides the four well known channels, the literature also identifies some non-conventional channels like expectations channel, cost channel (Blinder, 1987; Fuerst, 1992; Christiano and Eichenbaum, 1992; Christiano, Eichenbaum, and Evans, 1997; and Farmer, 1984, 1988a, b), deposit channel (Drechsler, Savov, and Schnabl, 2017) and redistribution channel (Auclert; 2019).

For this study for Pakistan, we use the approach of Bernanke and Blinder (1992) and Bernanke and Mihov (1998). In the start, a model for each channel (interest rates, credit, exchange rate and asset price) is specified separately with the objective to judge their performance. Then a general specification is provided that includes all the channels in one model. This provides the absolute as well as relative effectiveness of the channels. The four channels are estimated using SVAR. Further, the identification scheme is imposed following Bernanke and Blinder (1992).

Stationarity of the variables is an important issue pertaining to the time series data. Conventionally, the effectiveness of the monetary policy is evaluated by estimating the SVAR on the stationary variables. However, Mackinnon (1991) indicates that using the nonstationary variables in levels also provide the robust results as SVAR ignores the long-term relationship between the targeted variables and hence may induce omitted variable bias. In order to handle the issue of stationarity and provide consistent and robust results, the specification of the VAR of each channel as well as all channels combined are estimated by using the VECM, SVAR in levels and growth terms.

#### SVAR Models with Stationary Variables:

The methodology starts with the description of simple VAR with three endogenous covariates and three exogenous variables. Except call money rate, all the variables are seasonally adjusted and are in log form. SVAR with stationary variables consisting of large scale manufacturing (M), consumer price index (P), private sector credit (C), nominal effective exchange rate (N), share prices (A), World food price index (W), public sector borrowing from the banking system (B), and average international oil prices in US\$ per barrel (O) is specified as:

$$\Delta Y_t = \Gamma \Delta Y_{t-i} + \phi \Delta X_{t-j} + Z_t \quad (1)$$

$$\Delta Y_t = \begin{bmatrix} \Delta M_t \\ \Delta P_t \\ \Delta r_t \end{bmatrix}, X_t = \begin{bmatrix} \Delta W_t \\ \Delta B_t \\ \Delta O_t \end{bmatrix}$$

In case of endogenous and exogenous variables,  $i$  and  $j$  are the optimal lag length respectively by using the Akaike Criteria. We have applied recursive Cholesky decomposition to identify the SVAR for the estimation of interest rate channel. This ordering is based on the (Bernanke and Mihov, 1998). The identification scheme, the absolute and relative effectiveness procedure, is kept the same across all estimation procedures.

With the objective to evaluate the absolute effectiveness of each channel, the private sector credit (C), nominal effective exchange rate (N) and index of all share prices (A) of Pakistan stock exchange are included in the  $Y_t$  – the endogenous covariates vector separately one by one along with the prices and index of manufacturing production. After incorporation of the private sector credit (C), nominal effective exchange rate (N) and index of all share prices (A) in  $Y_t$ , these variables are separately included in the  $X_t$ , the vector of control variables and their lags, so that relative effectiveness of credit, exchange rate and asset prices can be evaluated.

To determine the relative strength of a specific channel of monetary policy, we use a simulation approach suggested by Ramey (1993), comparing the responses of real economic activity and price level to the structural innovations in the monetary policy in two set ups. First, treating a variable representing a specific channel (e.g. private sector credit) endogenous and second, treating the same variable representing a specific channel (e.g. private sector credit) exogenous. The comparison between the responses of two scenarios is a measure of relative strength of a specific channel.

In case of credit channel, the specification is improved by adding the log level of private sector credit in the vector  $Y_t$  as  $Y'_t = [M_t \ P_t \ r_t \ C_t]$ . The relative effectiveness of this channel is investigated by exogenizing the private sector credit by adding it into vector of exogenous variables

$(X'_t = [W_t \ B_t \ O_t \ C_t])$ . The budgetary borrowing from the banking system (B) is used to control for the impact of fiscal dominance.

In the similar patterns,  $Y'_t = [M_t \ P_t \ r_t \ E_t]$  for the absolute effectiveness of exchange rate channel and  $X'_t = [W_t \ B_t \ O_t \ E_t]$  for the relative effectiveness of this channel. Finally,  $Y'_t = [M_t \ P_t \ r_t \ A_t]$  and  $X'_t = [W_t \ B_t \ O_t \ A_t]$  are in the case of absolute and relative effectiveness of assets price channel.

After the recursive evaluation of absolute and relative strength of monetary policy transmission channels individually, a general specification is presented in which all the channels are investigated combined. In the first specification,  $Y'_t = [M_t \ P_t \ r_t]$  and  $X'_t = [W_t \ B_t \ O_t \ C_t \ E_t \ A_t]$ . Afterwards, each channel is endogenized by transferring  $C_t \ E_t \ A_t$  from the  $X'_t$  to  $Y'_t$ .

Importantly, we have also estimated the effectiveness of these channels over time. Following the above mentioned identification strategy, we estimate SVAR on the subsamples based on recursive flexible window estimation technique. These subsamples are drawn as follow. For the first estimation, we use first ten years (1991-2000). Then keeping the starting period fixed, we keep on extending the sample period by one year (12-months) till the end of our sample period (June 2019). Finally, we analyze monetary policy responses over time.

The estimation is performed on the stationary data without assuming any long term relationship between concerned variables. In order to test the robustness of our results, the same SVARs are estimated on the non-stationary variables. MacKinnon (1991) suggests that the results of impulse responses remain consistent and unbiased in the case of non-stationary data. Finally, the VECM models are also estimated on the first differences of the concerned variables along with the deviations from the long run equilibrium (the error correction term) and set of exogenous variables.

As a robustness check, we also obtained the monetary policy responses from SVAR estimation on non-stationary variables and vector error correction (VECM) estimates. These techniques are discussed as follow:

#### SVAR Models with non-Stationary Variables:

The SVAR with non-stationary variables consisting of large scale manufacturing (M), consumer price index (P), private sector credit (C), nominal effective exchange rate (N), share prices (A), World food price index (W), public sector borrowing from the banking system (B), and average international oil prices in US\$ per barrel (O) is specified as:

$$Y_t = \Gamma Y_{t-i} + \phi X_{t-j} + E_t, \quad (2)$$

$$Y_t = \begin{bmatrix} M_t \\ P_t \\ r_t \end{bmatrix}, X_t = \begin{bmatrix} W_t \\ B_t \\ O_t \end{bmatrix}$$

#### VECM Models with Nonstationary Variables:

Although Mackinon (1991) indicates that there would not be any issue for using the non-stationary variables in the estimation but we have also used the VECM model by employing the Johansson co-integration analysis for the search of long term relationship among the endogenous covariates. The deviations of the stationary variables from their long term relationship along with the optimal lags of these variables is considered in VECM specification.

$$Y_t = \Gamma Y_{t-i} + \phi X_{t-j} + E_t, \quad (3)$$



$$\Delta Y_t = \Gamma \Delta Y_{t-i} + \phi \Delta X_{t-j} + \alpha * \beta (E_{t-1}) + H_t,$$

$$Y_t = \begin{bmatrix} M_t \\ P_t \\ r_t \end{bmatrix}, X_t = \begin{bmatrix} W_t \\ B_t \\ O_t \end{bmatrix}.$$

The same procedure mentioned in the case of stationary variables is adopted for the VECM estimations to evaluate the absolute and relative effectiveness of monetary policy transmission channels.

**Data Analysis:** We use monthly data from January 1991 to June 2019.<sup>4</sup> As real GDP data is not available on desired frequency, therefore, we use Large-scale Manufacturing (LSM) index as indicator of real economic activity. Because SBP was not actively using the discount rate as policy rate during 1990s, the monetary policy was announced after every six months, which induced discreteness in the path of the policy rate. We, therefore, used call money rates as monetary policy impulse.<sup>5</sup> The other variables include consumer price index, public sector borrowing, private sector credit, nominal effective exchange rate, real effective exchange rate, stock market index of Pakistan stock exchange, global oil prices and world food price index. The data sources are the Statistical Bulletin of State Bank of Pakistan, Pakistan Bureau of Statistics, and International Financial Statistics of International Monetary Fund (IFS-IMF).

All the variables, except for interest rate, are log level and seasonally adjusted. Descriptive statistics are reported in the **Table 1**.

The time series properties of the series are given in Table 2. Except for real effective exchange rate, all the variable are non-stationary in log levels and are stationary at first differences. Therefore, monetary policy transmission channels can be explored using the Co-integration and SVAR procedures.

### 3. Results

Transmission of monetary policy shocks is evaluated on real economic growth and inflation measured by Consumer Price Index. The effectiveness of monetary policy is evaluated in three different ways. First, transmission of monetary policy impulses to the economy on aggregate basis; second, relative strength of the different monetary policy transmission channels such as credit, exchange rate and assets price; and third, effectiveness of monetary policy over time.

#### SVAR models with stationary variables:

Transmission channels of monetary policy are estimated by using the Structural VAR model mentioned in Eq. 1. The estimation results is presented in Figure 1. The upper panel (Figure 1a and Figure 1b), reports the absolute impulse responses of LSM growth and CPI inflation to unanticipated monetary policy shocks of 100 bps increase in interest rate. The absolute impact is derived by considering the channelizing variable (interest rate, credit, asset price and exchange rate) as endogenous.

Figure 1a shows the response of LSM growth to an unanticipated monetary policy shock over thirty six month horizon, along with 90 percent confidence bands. In response to 100 bps increase in policy rate, LSM growth declines by around 0.30 percentage points over the next eighteen months and then stabilizes at this level from there onward. The 90 percent confidence band suggests that these responses to monetary policy impulses remain statistically significant in most months of the given horizon.

<sup>4</sup> We have picked 1991 as the starting point for our estimation as SBP, the central bank of Pakistan, started to use market-based instruments to implement its monetary policy stance.

<sup>5</sup> We understand that call transactions constitute only around 7 percent to 8 percent of total interbank money market transaction, yet movements in call money rates are strongly correlated with the policy rate (SBP target rate or previous SBP reverse repo rate).

Figure 1b shows that in response to unanticipated monetary policy tightening by 100 basis points, CPI inflation decline by around 0.20 percentage points in the next two years. The middle panel of Figure 1 shows results for transmission channels, which are the accumulated impulse responses of the LSM growth and inflation due to unanticipated shocks in call money rate.

Figure 1(c) shows that a large part of transmission of monetary policy shock to the real economy takes place through credit channel followed by interest rate channel. Specifically, 100 basis points increase in call rate decrease LSM growth by around 0.15 percentage points through credit channel and around 0.06 percentage points through interest rate channel. Transmission of the same shock through assets price channel and exchange rate channel is 0.04 percentage points and close to 0.02 percentage points, respectively.

Figure 1d reports the results of transmission channels for inflation, the credit channel carries a large part of the transmission of monetary shock. A 100 basis points increase in policy rate reduces inflation by around 0.10 percentage points through credit channel and close to 0.09 percentage points through exchange rate channel.

The lower panel of the Figures 1c and 1d reports the relative strength of the monetary policy transmission channels. Following Ramey (1993), we compare the responses of real economic growth and inflation to structural innovations in the monetary policy under two scenarios. First, treating a variable representing a specific channel of monetary policy transmission (MPT) endogenous and second, treating the same variable representing specific channels of MPT as exogenous. The comparison between the responses of two scenarios is a measure of economic significance of a particular channel. Figure 1e shows the relative strength of transmission on real economic growth while Figure 1f shows the relative strength of transmission on inflation. In both the cases, credit channel emerges as the most significant transmitter of the monetary policy shocks. This is consistent with the findings of Agha *et al* (2005) and Safia (2016).

While financial channels i.e. interest rates, exchange rate and asset prices have immediate impact on growth, credit channel takes relatively longer (more than six months) to impact the real economy. In the response to any exogenous shock, the financial markets adjust more quickly as compared to the real sector of the economy. This is because of rigidities in the real sector that induce sluggishness in the impact of any exogenous shock. Transmission through credit channel is complete in almost 18 to 24 months. In case of inflation, the credit channel is the relatively more effective than exchange rate, interest rate and assets price channels.

Figure 2 depicts the responses of real activity and inflation to unanticipated monetary policy shocks over time. It can be observed from the Figures (2a-d) that monetary policy effectiveness has improved over time. For instance, impact of 100 basis points increase in policy rate on economic growth has improved from 0.01 percentage point reduction in June 2001 to around 0.04 percentage points decline in June 2019. Likewise, impact of 100 basis points increase in policy rate on inflation has improved from around 0.04 percentage points decline in June 2001 to around 0.075 percentage points decline in June 2019.

The estimates show that maximum impact of monetary policy on economic growth and inflation was observed during 2005-2006 and 2007-2008, respectively. During this period, 100 basis points increase in policy rate led to 0.10 percentage points fall in both growth and inflation. This could be because of stable macroeconomic environment i.e. high economic growth with low and stable inflation.

#### **4. Conclusions and Policy implications**

In this paper, we attempt to explore monetary policy transmission in Pakistan with a focus on three aspects. First, we aim to assess the overall effectiveness of monetary policy. Second, we examine the relative strength of various transmission channels. Third, we attempt to explore the evolution of

transmission channels or in other words, the specific timing of a particular channel becoming more (less) effective. We have used structural VAR with expanding flexible window estimation techniques. The main findings suggest that monetary policy has perceptible impact on inflation and growth. It takes almost 18 to 24 months for the impact of monetary policy to fully transmit to inflation. Most of this transmission takes place through credit channel, which is stronger as compared with interest rate, asset price and exchange rate channels.

The effectiveness of monetary policy, in terms of smooth transition to the control variable, has improved over time. This reflects improvement in monetary policy formulation and implementation procedures, and effective communication over time.

Our findings also imply that monetary policy transmission will be further strengthened going forward with market-determined exchange rate, prohibition of monetary financing of the budget deficits, and adoption of flexible inflation targeting (FIT).

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**Table 1: Descriptive Statistics of the Variables**

	Industrial production (LSM)	CPI	Call money rate	Public sector borrowing	Private sector credit	NEER	Stock price index	International oil prices	world food price index
Mean	4.17	4.08	8.72	13.20	13.54	5.26	7.43	3.36	4.12
Median	4.07	4.13	9.06	13.18	13.46	5.23	7.36	3.19	4.08
Maximum	4.80	4.85	20.03	14.43	14.93	5.80	9.60	4.85	4.86
Minimum	3.67	3.30	0.74	12.10	12.09	4.60	5.04	2.44	3.82
Std. Dev.	0.35	0.40	3.82	0.49	0.84	0.32	1.40	0.60	0.23
Skewness	0.55	-0.14	0.00	0.46	0.15	0.03	-0.15	0.73	1.24
Kurtosis	1.82	2.32	2.73	3.61	1.93	2.12	1.85	2.37	4.37
Jarque-Bera	24.88	5.15	0.70	11.65	11.64	7.42	13.32	23.81	76.53
Sum	950.84	930.93	1988.41	3010.28	3086.36	1199.84	1694.34	766.34	939.98
Sum Sq. Dev.	27.20	36.29	3317.62	53.88	160.04	23.18	445.82	82.53	11.53
Observations	228	228	228	228	228	228	228	228	228

**Table 2: Unit Root Tests for the Stationarity Properties of the Variables**

	ADF Stat	P-Val	ADF Stat	P-Val
	Log levels		1st Difference	
Industrial production index of large scale manufacturing	-1.71	0.74	-4.07	0.00
Consumer price index	-1.79	0.70	-6.12	0.00
Call money rate	-1.40	0.86	-8.15	0.00
Public sector borrowing	-0.69	0.97	-16.49	0.00
Private sector credit	-2.23	0.47	-2.95	0.04
Nominal effective exchange rate	-1.87	0.67	-12.43	0.00
Pakistan stock exchange index	-2.69	0.24	-14.93	0.00
International oil prices	-2.30	0.43	-5.43	0.00
World food price index	-1.50	0.83	-10.26	0.00

Figure 1 a: Accumulated Response of LSM growth to one S.D (100 bps) shock to policy rate

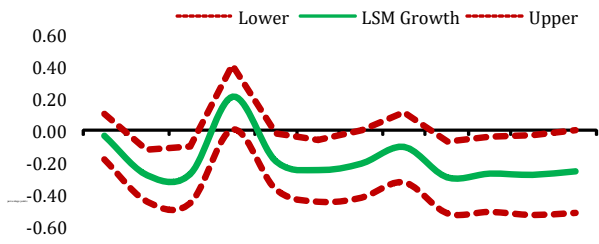


Figure 1 b: Accumulated Response of CPI inflation to one S.D (100 bps) shock to policy rate

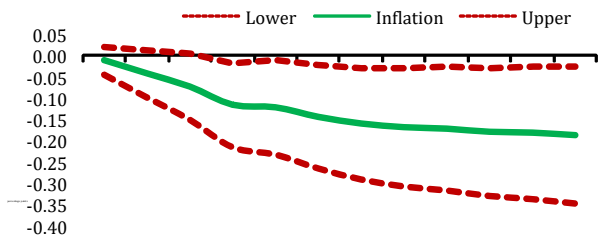


Figure 1c: Accumulated Response of LSM growth to one S.D (100 bps) shock to policy rate

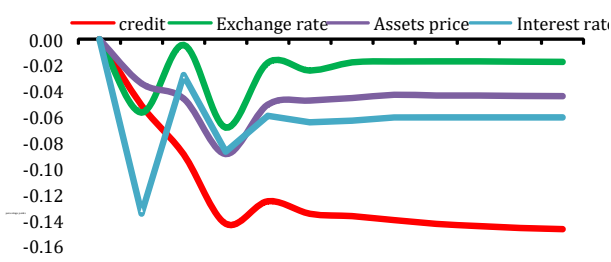


Figure 1d: Accumulated Response of Inflation to one S.D (100 bps) shock to policy rate

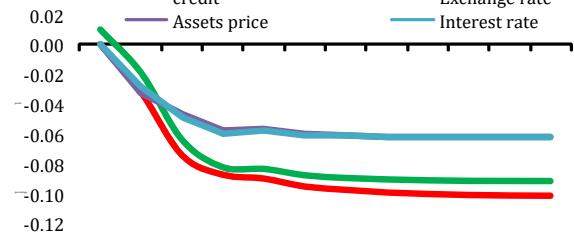


Figure 1e: Accumulated Response of LSM growth to one S.D (100 bps) shock to policy rate

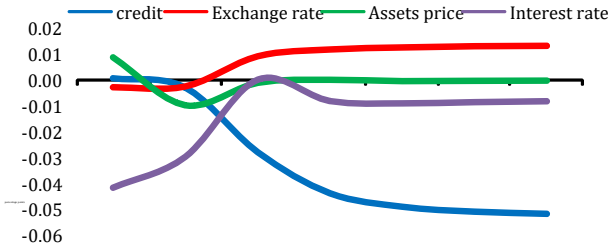
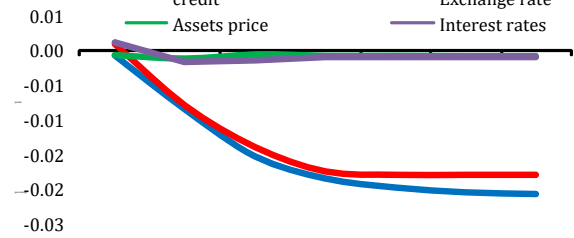
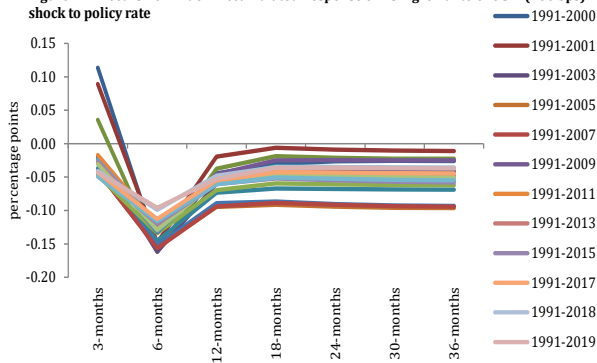


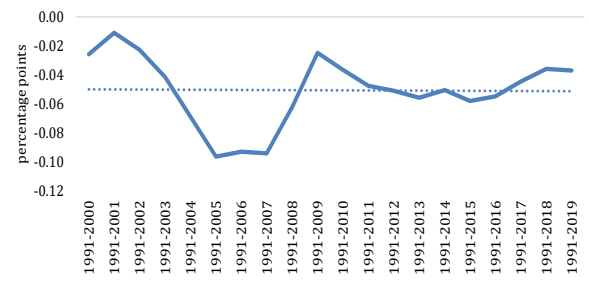
Figure 1f: Accumulated Response of Inflation to one S.D (100 bps) shock to policy rate



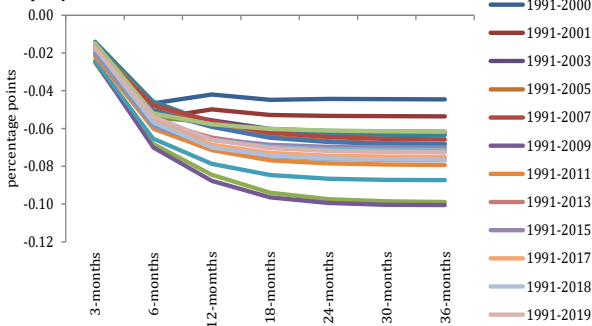
**Figure 2A: Recursive window Accumulated Response of LSM growth to one S.D (100 bps) shock to policy rate**



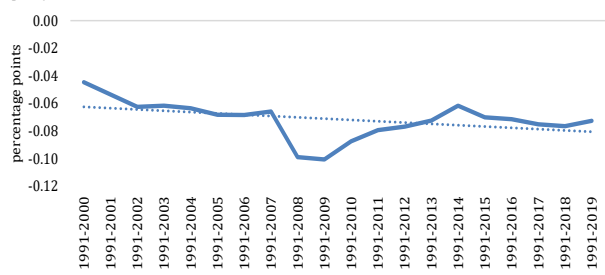
**Figure 2b: Recursive window accumulated response of LSM growth to one S.D (100 bps) shock to policy rate**



**Figure 2c: Recursive window accumulated response of inflation to one S.D (100 bps) shock to policy rate**



**Figure 2d: Recursive window accumulated response of inflation to one S.D (100 bps) shock to policy rate**





## Annexure

### SVAR with non-stationary variables:

Transmission channels of monetary policy are estimated by using the Structural VAR model mentioned in Eq. 1. The summary of results is presented in **Figure 3**. Impulse responses of prices and output to one standard deviation shock in the interest rates are reported in the **Table 3**. To conserve the space, the responses of selected months are reported.

The absolute impacts are derived by considering the channelizing variable as an endogenous and the absolute strength of the credit, exchange rate and asset price channel is examined by including the private sector credit, nominal effective exchange rate and Asset prices (Pakistan stock exchange index of stock prices in the SVARs. The relative strength is examined in the same way as mentioned in the methodology by comparing the role of channelizing variables after exogenizing those. Private sector credit, exchange rate and asset prices are considered as channelizing variables. The simple baseline model considered a SVAR of output (manufacturing), consumer prices and interest rate after controlling for exogenous variables.

### Money Channel:

Simple SVAR of three variables (economic activity, consumer prices and policy rate) is estimated. The identification approach of (Bernanke and Blinder 1992) is adopted and ordering is defined in a way so that the most endogenous variables, economic activity, is placed first followed by consumer prices and then policy rate.

A 100 bps shock to the policy rate results in some statistically insignificant adjustment in the economic activity during the first six months. This is mainly due to the rigidities in the real sector of the economy. Tightening of monetary stance results in shrinking economic activity after 6 month and the impact lasts till 18 months. Different pattern is observed in the case of consumer prices in which the impact of monetary tightening increases prices initially. The decline in prices is observed after the 10 months of a policy rate increase. A tightening of 100 bps of monetary policy reduces the logarithmic level of index of LSM and CPI by 0.64 and 0.12 percentage points, respectively. This indicates that the money or interest rate channel is effective in absolute terms.

Figure 3a: Accumulated Response of LSM to one S.D (100 bps) shock to policy rate

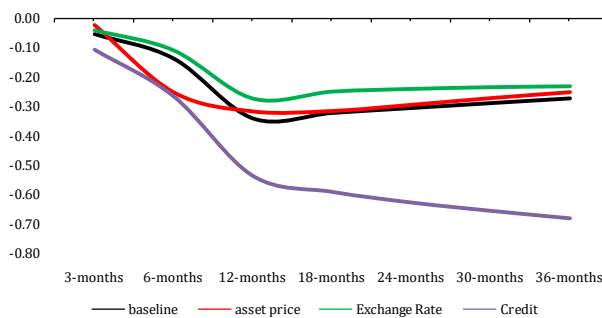


Figure 3b: Accumulated Response of prices to one S.D (100 bps) shock to policy rate

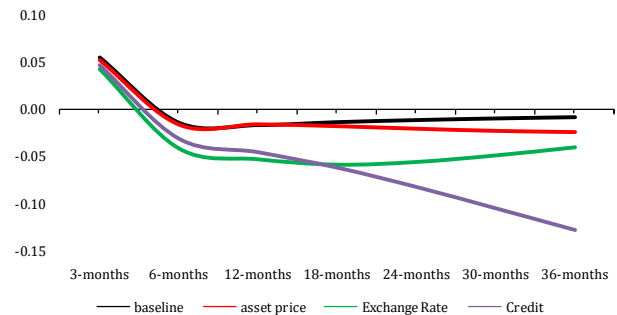


Figure 3c: Overtime response of LSM to monetary policy shock

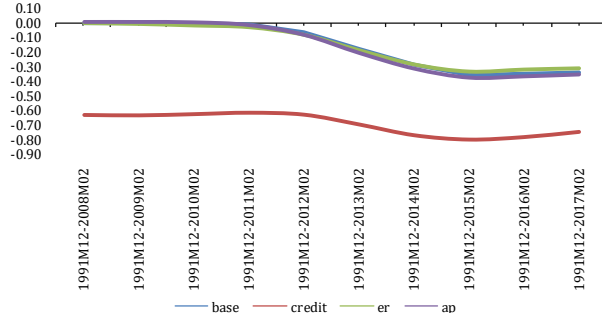
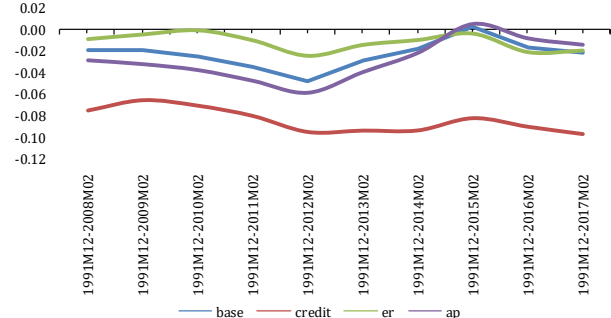
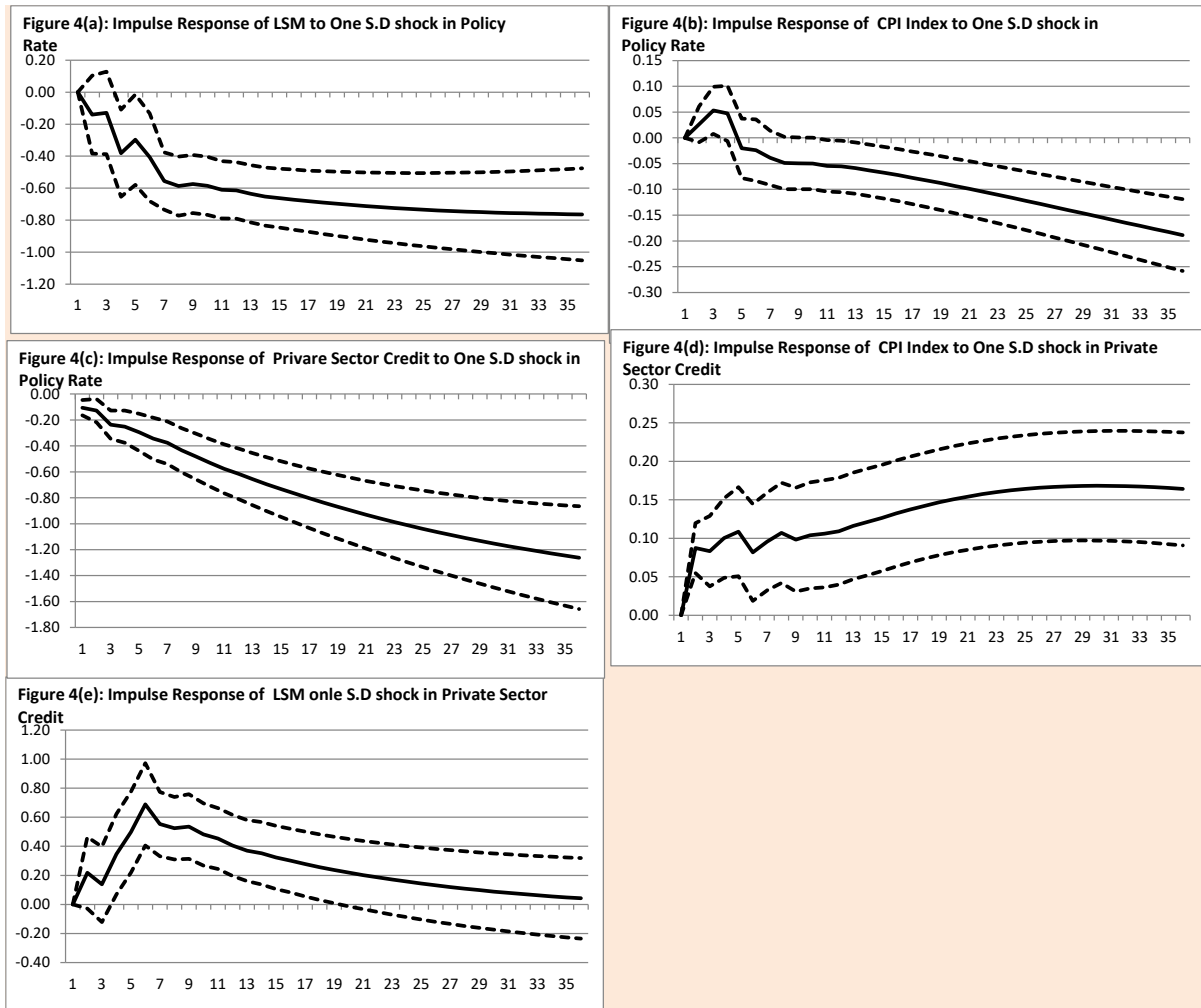


Figure 3d: Overtime response of CPI Inflation to monetary policy shock



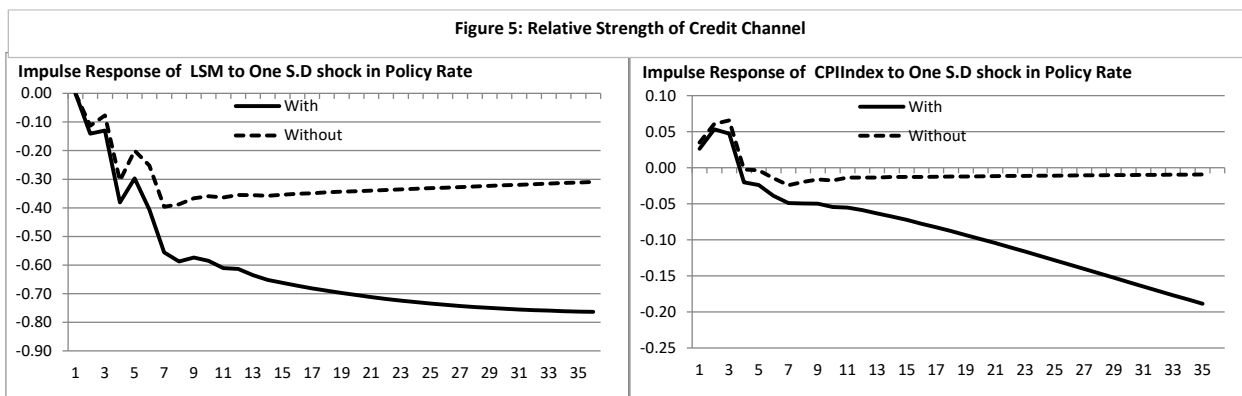
### Credit Channel:

With the inclusion of private sector credit in the vector of endogenous variables of interest rate channel, the effectiveness of the monetary policy improves (**Figure 4**). An increase of 100 bps in interest rates reduces the economic activity (LSM) and consumer prices by 0.80 and 0.19 percentage points, respectively. In response 100 bps increase in interest rate, private sector credit drops by 0.30 percentage points. Further, any unanticipated shock in the prices and economic activity increase the demand of credit by the private sector.



### Strength of Credit Channel:

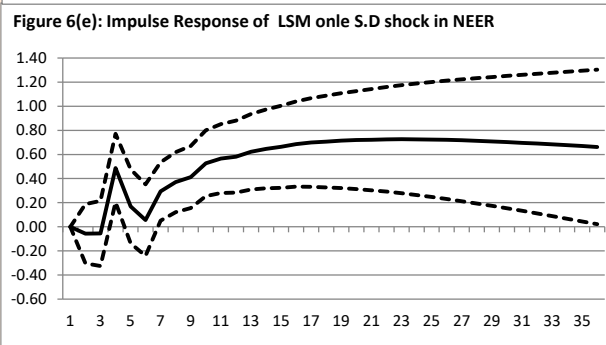
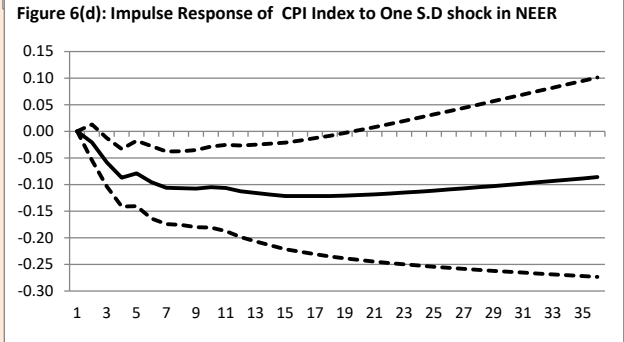
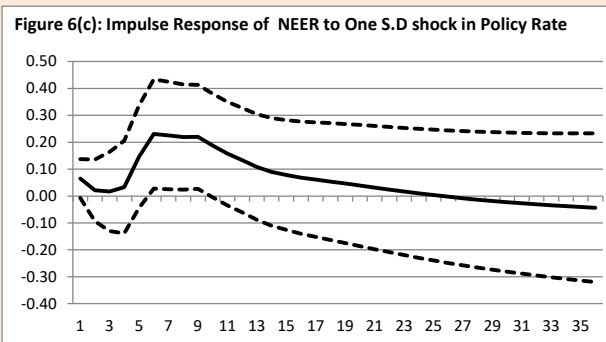
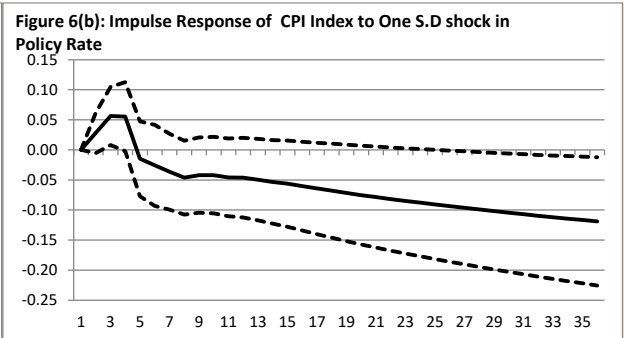
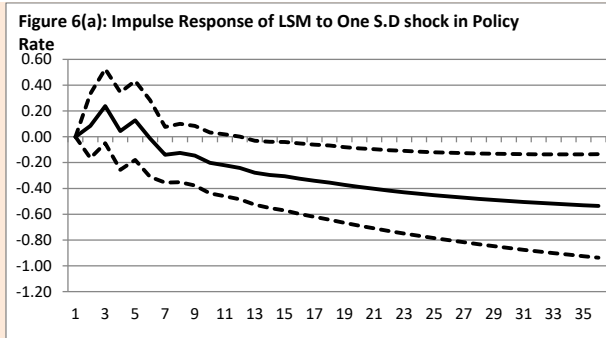
In order to evaluate the relative strength of the credit channel, the impulse responses are compared by including private sector credit along with the economic activity, prices and interest rates as endogenous covariate and by considering private credit as an exogenous variable. The relative strength can be seen from **Figure 5** which indicate that this channel is highly effective in relative terms.



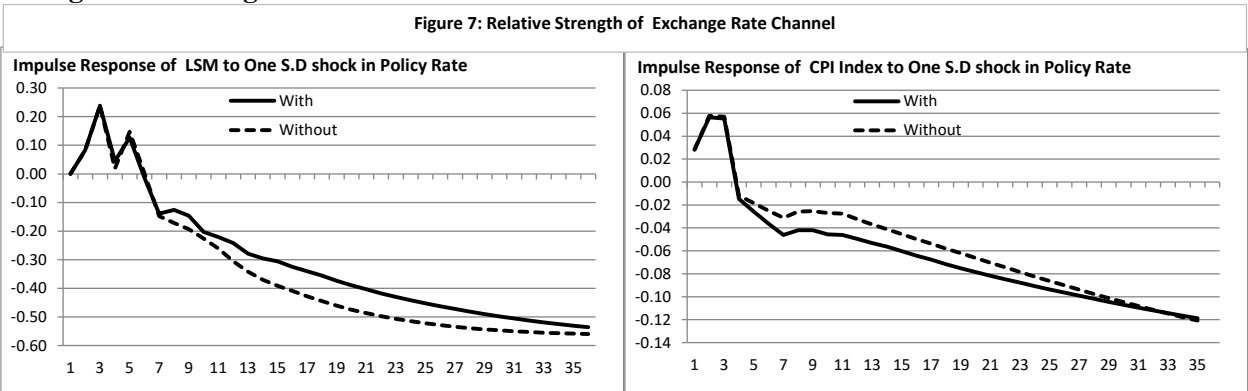
**Exchange Rate Channel:**

Any movement in the exchange rate impacts the economy from both the demand and supply sides. For instance, demand for imports contracts in response of depreciation of the currency. On the other hand, depreciations increase the landed prices of inputs such as machinery and energy. This brings forth the supply shock in the economy by increasing the cost of production. These demand and supply side impacts of the changes in interest rates are represented in the graphs by using the exchange rate as channelizing variable.

The absolute performance of exchange rate channel shows that the economic activity and prices reduce by 0.54 and 0.12 percentage points in response to an increase in the policy rate (**Figure 6**). The relative strength of exchange rate channel is examined by comparing the impulse responses of the SVAR estimated with the endogenous and exogenous nominal effective exchange rate. The relative strength of the channel is weak that may be due to the weak exogeneity of the exchange rates in Pakistan, which may be due to administered prices (**Figure 7**).



### Strength of Exchange Rate Channel



### Asset Price Channel:

The impact of the monetary policy through the capital market is also worth explaining. An increase in the policy rate leads to reduction in the economic activity and prices by 0.66 and 0.13 percentage points (**Figure 8**). However, the relative strength of this channel is weak in case of economic activity but seems reasonable in the case of price (**Figure 9**).

Figure 8(a): Impulse Response of LSM to One S.D shock in Policy Rate

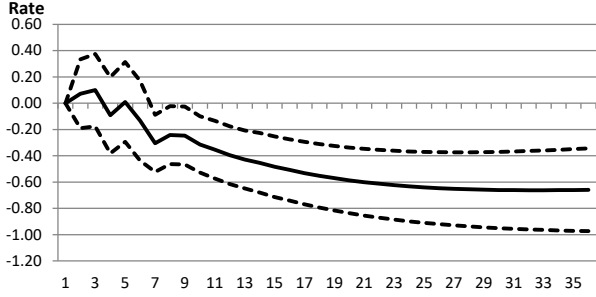


Figure 8(b): Impulse Response of CPI Index to One S.D shock in Policy Rate

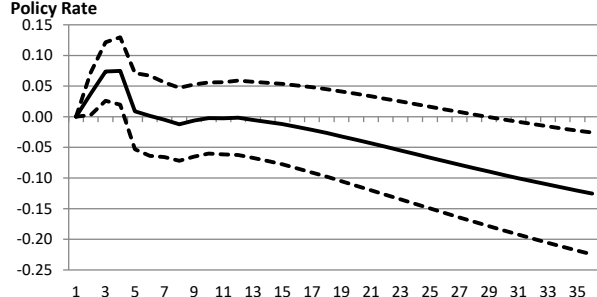


Figure 8(c): Impulse Response of Pakistan Stock Exchange to One S.D shock in Policy Rate

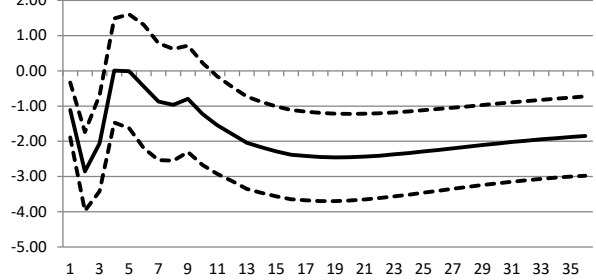


Figure 8(d): Impulse Response of CPI Index to One S.D shock in Pakistan Stock Exchange

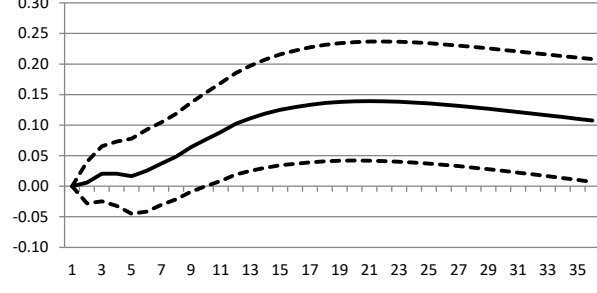
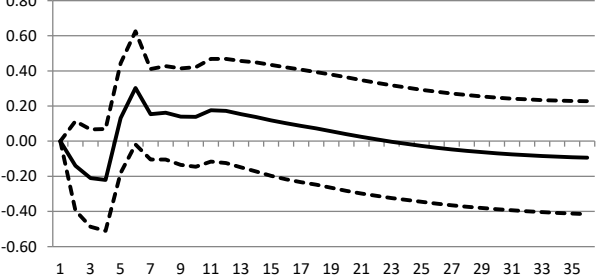
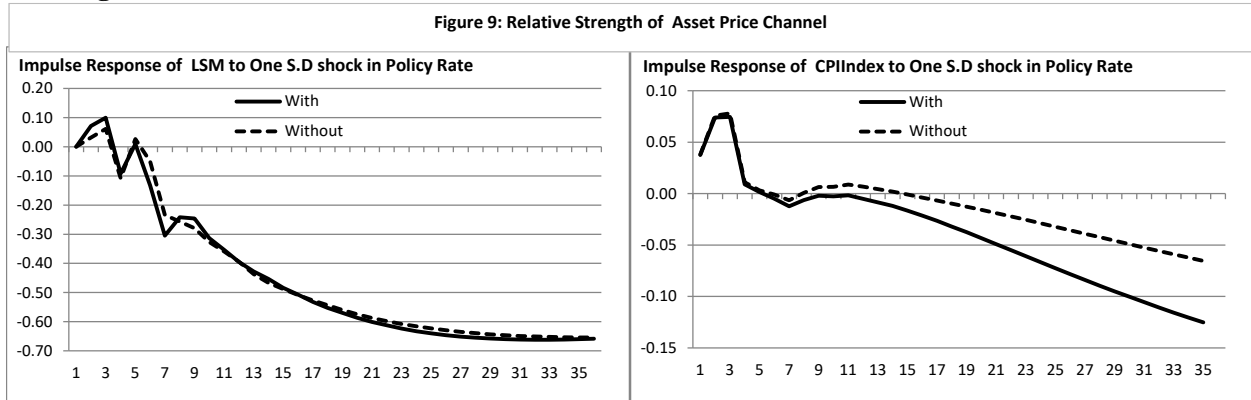


Figure 8(e): Impulse Response of LSM to one S.D shock in Pakistan Stock Exchange

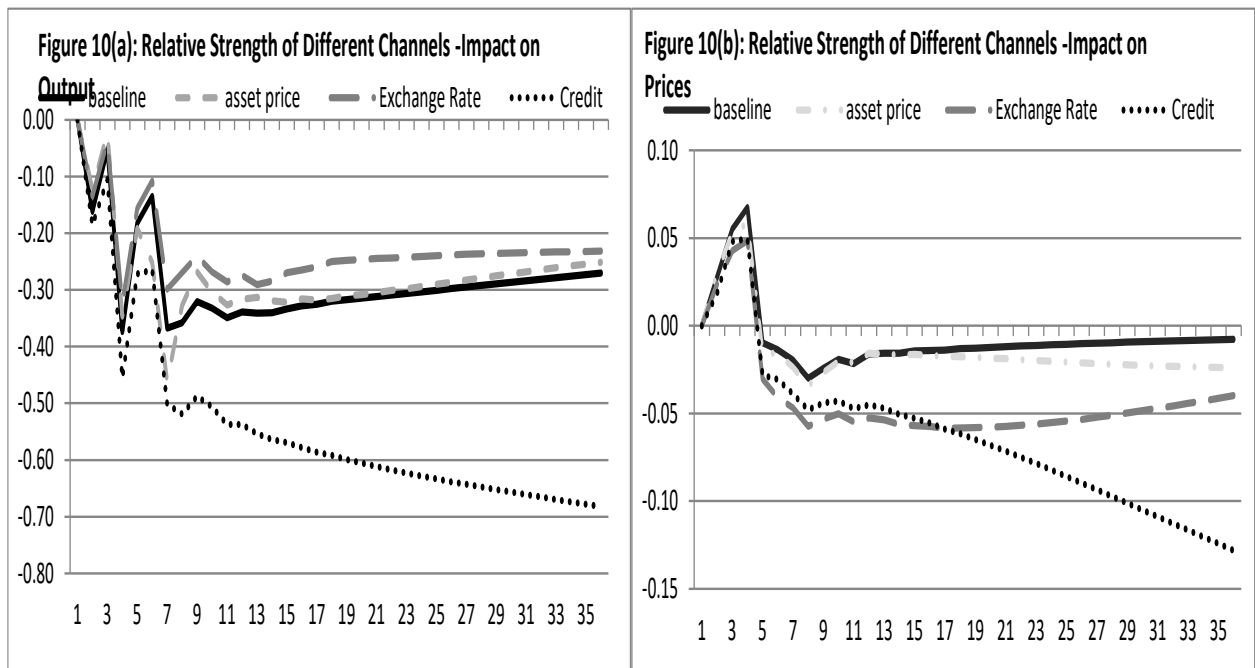


## Strength of Asset Price Channel



## Relative Strength of Monetary Policy Channels:

Instead of examining the effectiveness of each channel in a recursive manner, an SVAR is specified that incorporate all the channel simultaneously. The estimate of relative strength of each channel is reported by applying the same procedure of considering the core variable of the channel as endogenous and exogenous. The result of the impulse responses (**Figure 10**) in this general model further confirm that the credit channel is the strongest channel of monetary policy transmission mechanism: one standard deviation shock to interest rate results in a reduction of 0.68 and 0.13 percentage points in economic activity and prices over next 36 months.

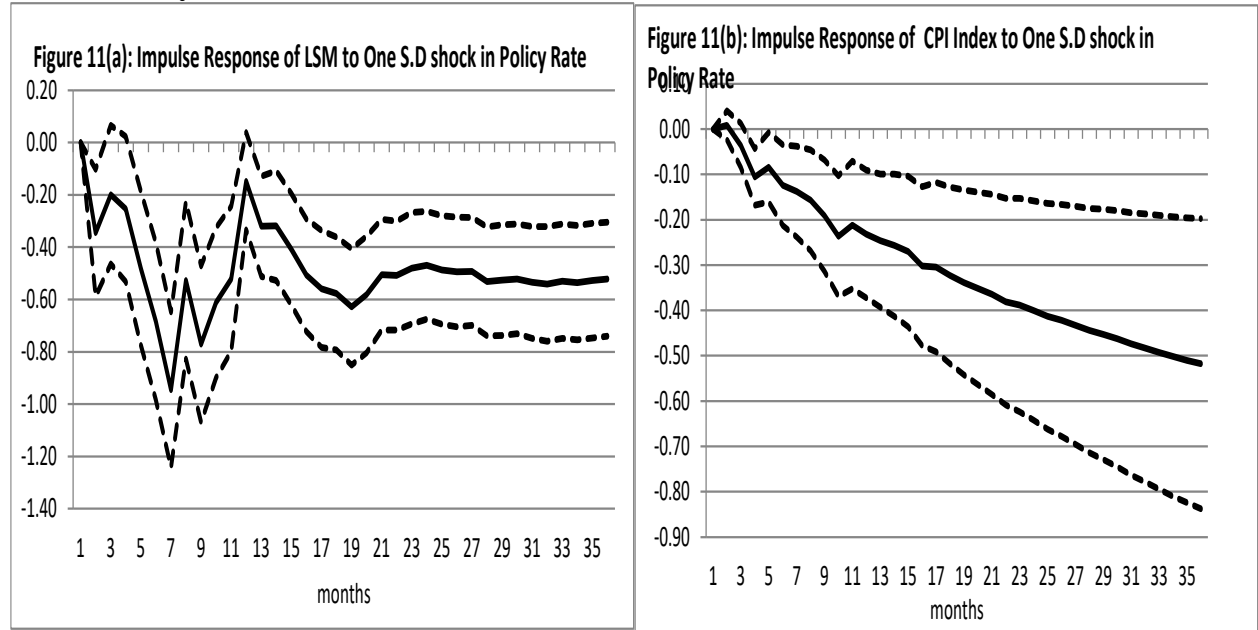


### Results of VECM models:

The causation between non-stationary variables indicates the existence of long run relationship. Therefore, vector error correction model, which does not ignore the long run relationship between variables, is also estimated (Tran, N., 2018).

<b>Table 3: Estimation Results of VECM model with Non-stationary Variables</b>											
		<b>3m</b>		<b>6m</b>		<b>12m</b>		<b>24m</b>		<b>36m</b>	
<b>VECM</b>		<b>LSM</b>	<b>Prices</b>	<b>LSM</b>	<b>Prices</b>	<b>LSM</b>	<b>Prices</b>	<b>LSM</b>	<b>Prices</b>	<b>LSM</b>	<b>Prices</b>
Recursive Channel specification											
Money/r Channel	Absolute	-0.25	-0.11	-0.95	-0.14	-0.32	-0.25	-0.49	-0.41	-0.52	-0.52
	Relative										
Credit	Absolute	-0.21	-0.10	-0.91	-0.11	-0.33	-0.19	-0.66	-0.27	-0.80	-0.32
	Relative	-0.01	0.00	-0.12	-0.02	-0.25	-0.05	-0.44	-0.07	-0.55	-0.08
Exchange rate	Absolute	-0.05	-0.07	-0.63	-0.04	-0.09	-0.07	-0.14	-0.10	-0.13	-0.11
	Relative	0.27	0.02	0.34	0.06	0.34	0.14	0.42	0.26	0.48	0.34
Asset prices	Absolute	0.17	-0.10	-0.72	-0.12	-0.05	-0.23	-0.25	-0.42	-0.33	-0.56
	Relative	0.38	0.01	0.20	0.00	0.22	-0.02	0.19	-0.06	0.15	-0.10
Combined Channel Specification.											
Money/r Channel	Relative	0.00	-0.08	0.00	-0.08	0.00	-0.08	0.01	-0.08	0.01	-0.08
Asset prices	Relative	0.15	-0.11	0.04	-0.13	0.07	-0.13	0.08	-0.12	0.08	-0.12
Exchange rate	Relative	0.10	-0.11	0.01	-0.12	0.04	-0.15	0.06	-0.16	0.06	-0.16
Credit	Relative	-0.03	-0.09	-0.03	-0.09	-0.08	-0.10	-0.09	-0.09	-0.10	-0.09

### VECM Money Channel





## Credit Channel

Figure 12(a): Impulse Response of LSM to One S.D shock in Policy Rate

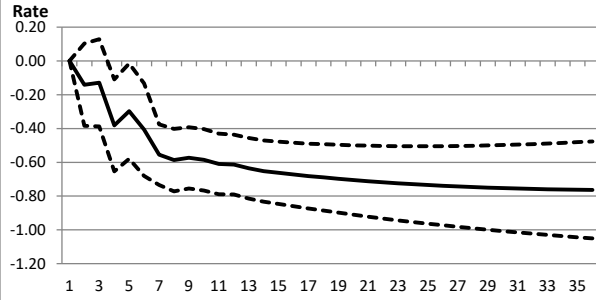


Figure 12(b): Impulse Response of CPI Index to One S.D shock in Policy Rate

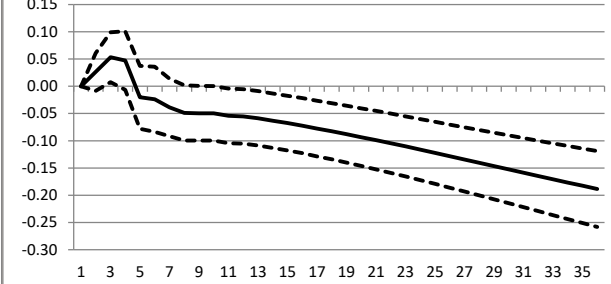


Figure 12(c): Impulse Response of Private Sector Credit to One S.D shock in Policy Rate

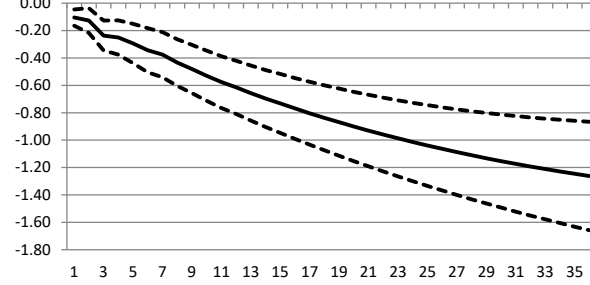


Figure 12(d): Impulse Response of CPI Index to One S.D shock in Private Sector Credit

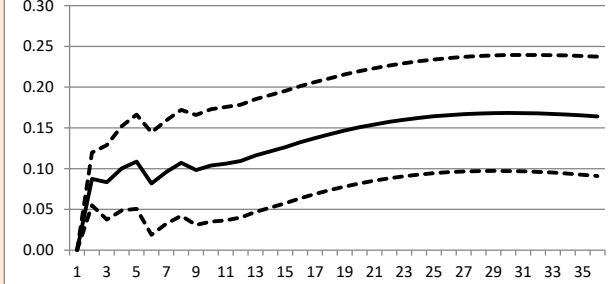
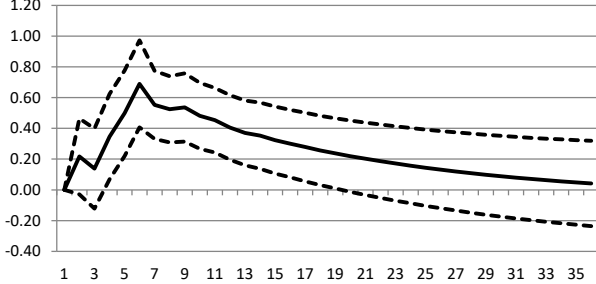
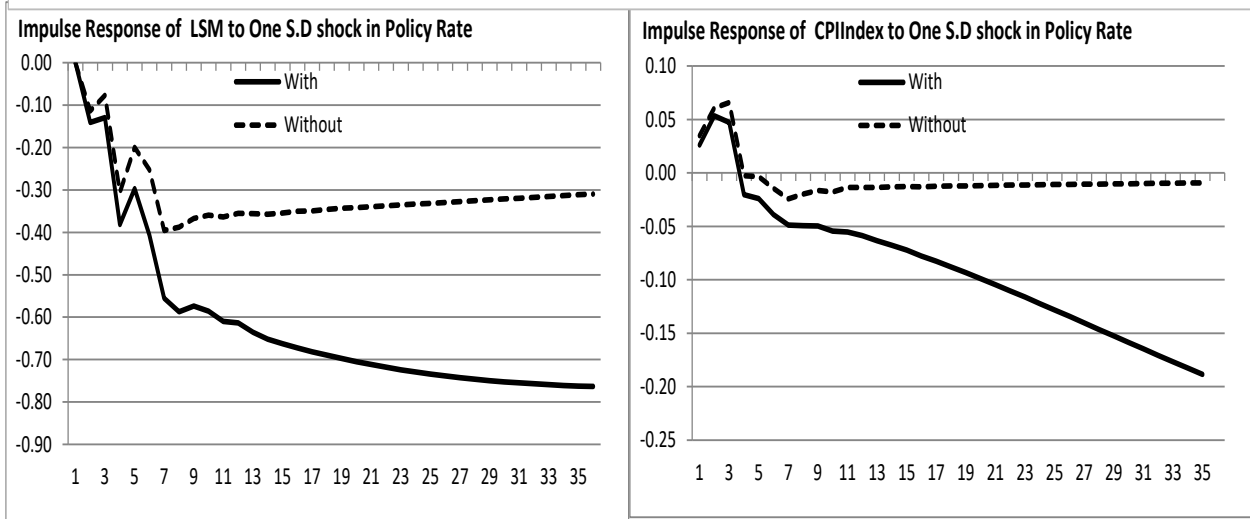


Figure 12(e): Impulse Response of LSM onle S.D shock in Private Sector Credit



## Strength of Credit Channel

Figure 13: Relative Strength of Credit Channel



## Exchange Rate Channel

Figure 14(a): Impulse Response of LSM to One S.D shock in Policy

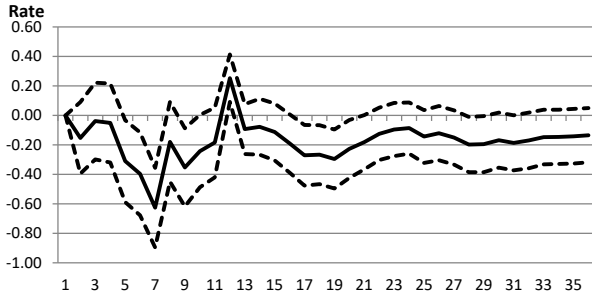


Figure 14(b): Impulse Response of CPI Index to One S.D shock in Policy Rate

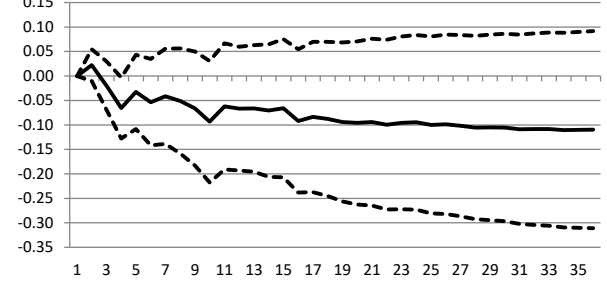


Figure 14(c): Impulse Response of NEER to One S.D shock in Policy Rate

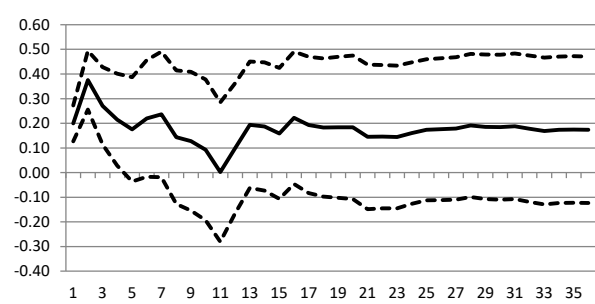


Figure 14(d): Impulse Response of CPI Index to One S.D shock in NEER

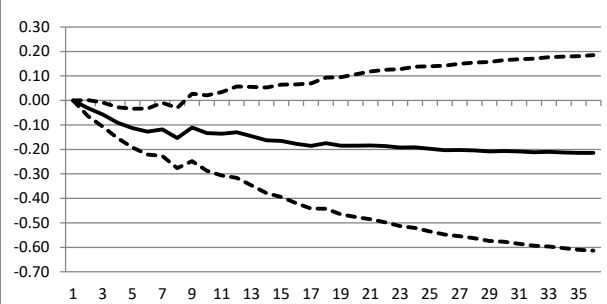
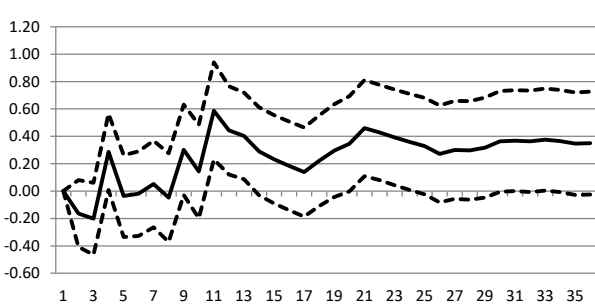


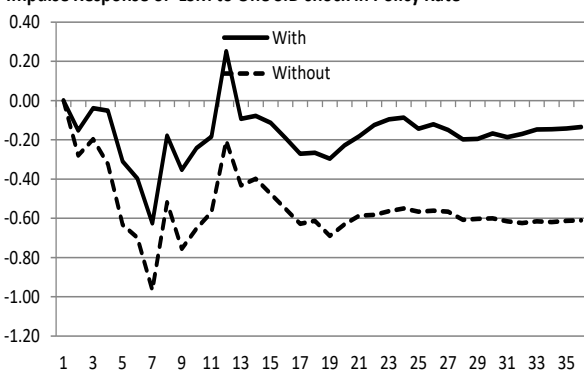
Figure 14(e): Impulse Response of LSM onle S.D shock in NEER



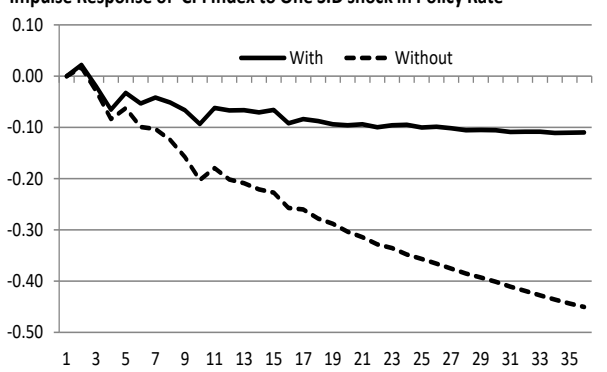
## Strength of Exchange Rate Channel

Figure 15: Relative Strength of Exchange Rate Channel

Impulse Response of LSM to One S.D shock in Policy Rate



Impulse Response of CPI Index to One S.D shock in Policy Rate



## Asset Price Channel

Figure 16(a): Impulse Response of LSM to One S.D shock in Policy Rate

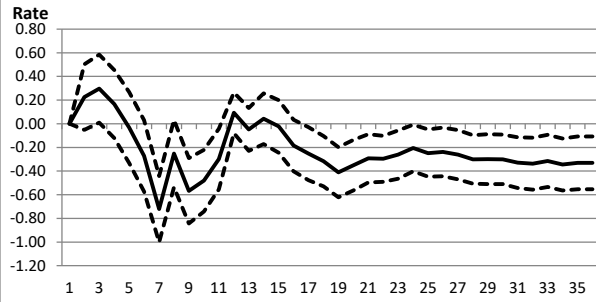


Figure 16(b): Impulse Response of CPI Index to One S.D shock in Policy Rate

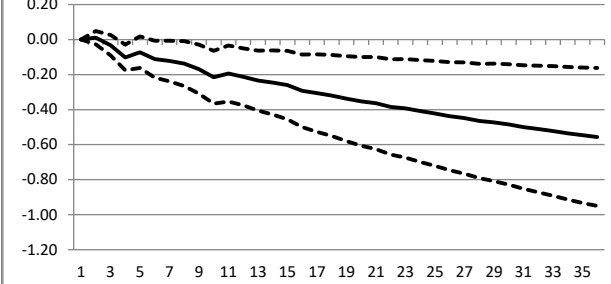


Figure 16(c): Impulse Response of Pakistan Stock Exchange to One S.D shock in Policy Rate

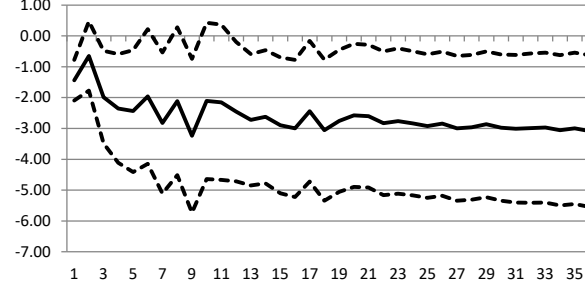


Figure 16(d): Impulse Response of CPI Index to One S.D shock in Pakistan Stock Exchange

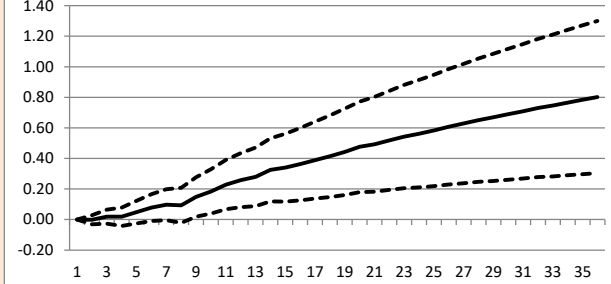
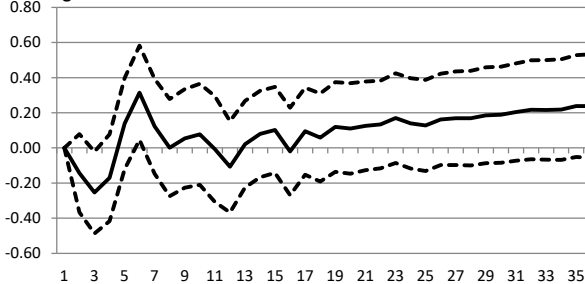


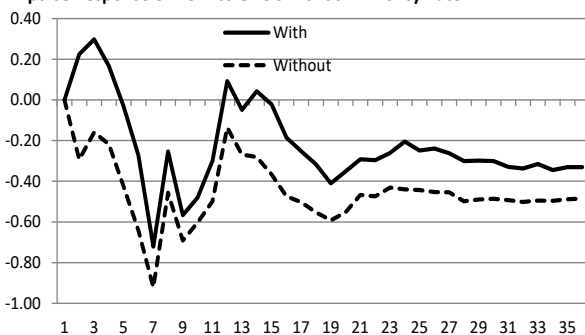
Figure 16(e): Impulse Response of LSM onle S.D shock in Pakistan Stock Exchange



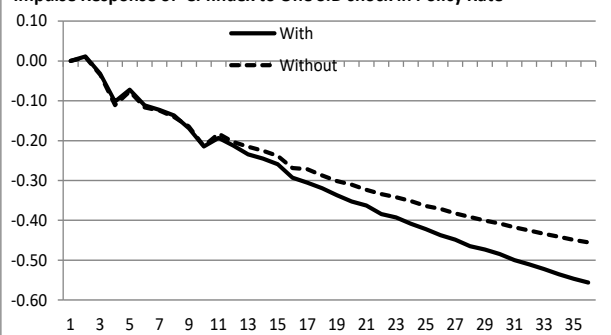
## Strength of Asset Price Channel

Figure 17: Relative Strength of Asset Price Channel

Impulse Response of LSM to One S.D shock in Policy Rate



Impulse Response of CPI Index to One S.D shock in Policy Rate



## Relative Strength of Monetary Policy Channels

