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The Effectiveness of Monetary Policy in Pakistan: The Role of the Required Reserve Ratio

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Abstract: This study tests the role of the required reserve ratio, as an additional monetary policy instrument, besides the interest rate, in the monetary transmission mechanism in Pakistan. For this purpose, besides the short-run interest rate, the required reserve ratio is included in the model to assess the response of the economy of Pakistan to the monetary policy shocks. For empirical analysis, monthly data for January 2000 to January 2017 is used by applying a vector autoregression (VAR) model in the presence of exogenous variables (VARX). The empirical results show that the interest rate shock is not fully transmitted to the economy, and even a tight monetary policy cannot effectively control credit to the private sector. A tight monetary policy shock using a short-term interest rate results in a two-month price puzzle. On the other hand, a positive shock to the required reserve ratio significantly influences inflation, output, credit in the private sector, interest rate spread, and even government expenditure. Therefore, it is recommended that the State Bank of Pakistan regularly adjust the reserve requirements on local currency deposits. The required reserve ratio should complement the policy rate to achieve the macroeconomic targets of the state bank of Pakistan.

Keywords: Monetary Policy; Required Reserve Ratio; VARX Model; MTM

1. Introduction

For an effective monetary policy, it is mandatory to choose the most appropriate monetary policy instrument, lag and time, which may be helpful to achieving macroeconomic targets. In developed countries, the financial system is sophisticated, and the conduct of monetary policy is more straightforward: the outcomes of the monetary policy shocks are less complicated. In developing countries like Pakistan, the monetary policy is not very effective because of the weak financial institutions, socio-economic factors, independence of the State Bank etc.

A consensus regarding the monetary policy instrument is to use the short-term interest rate to affect inflation and output level in developed economies. In contrast, the financial system in developing economies is fragile, and merely an interest rate is not sufficient, so the required reserve ratio can be used alongside employing monetary policy for fine-tuning macroeconomic activities in developing economies (Davoodi et al., 2013). In the early 2000s, when the IMF reforms in the monetary and financial sectors of developing economies were undertaken, most central banks switched to the use of the short-term interest rate as a monetary policy instrument by opting for market-based monetary mechanisms. This trend in the monetary policy formulation has led the policymakers to pay less attention to the required reserve ratio to complement the short-term interest rate as a monetary policy instrument in developing economies.

There is a scarcity of research that looks at the effectiveness of monetary policy in depth. In Pakistan, the relative importance of different monetary policy channels was investigated by (Agha et al., 2005). A similar attempt was undertaken by Hussain (2009) to quantify Pakistan's short and long-run monetary policy impacts. However, both studies used short-run interest rates as a monetary policy instrument. In a closed economy framework in Pakistan, (Alam & Waheed, 2006) performed research at the sectoral level to identify the most sensitive sector to monetary policy shocks for disaggregated monetary policy analysis.

Furthermore, these studies have only used direct monetary policy instruments: the short-run instrument, ignoring the indirect tool, the cash reserve ratio/necessary reserve ratio, which is critical in developing nations for monetary policy (Primus, 2016). This work aims to quantify an extra monetary policy tool, namely the required reserve ratio, in Pakistan's monetary response function. This technique has been proposed by (Primus, 2016b), (Davoodi et al., 2013), and others to improve the efficacy of monetary policy in small open developing countries.

2. Econometric Model and Methodology

Keeping in view the weak structure of the institutions of the economy of Pakistan, the Vector autoregression model in the presence of exogenous variables is employed to assess the monetary policy dynamics. This model is superior to the simple vector autoregression model. For a large set of variables, the vector autoregression raises the over-parameterization issue, mainly when the lag length is high, which creates the degree of freedom issues during estimation (Nicholson et al., 2017). By setting some of the variables as exogenous (supported by theory), the VARX model resolves the over-parameterization issue to some extent.

Keeping the objective (testing inclusion of the required reserve ratio as an indirect monetary policy instrument in complement with policy rate (money market rate as direct), this study employs VARX (Vector autoregression model in the presence of exogenous (foreign) variables has been used in the literature (Primus, 2016b) etc. This model is used in monetary policy analysis in the present study because the study's variables are subdivided into three blocks. These blocks include the blocks of fully interactive variables, the block of partial interactive variables and the block of fully exogenous variables.

Variables Description used in VARX Model

For the sake of simplicity, the variables of the study have been categorized into three blocks: the block of fully interactive variables, the block of the partially interactive variables and the block of the purely exogenous variables. The details of these blocks are reported below.

Fully interactive endogenous variables block

The variables included in this block are the growth rate of real GDP, which is used to represent the variations in aggregate demand and real economic activity for the economy of Pakistan. The second variable in this block is the inflation rate calculated by the log first difference of CPI for Pakistan.

Partially interactive variables block

The first[1] variable included in this block is the monetary policy instrument—the short-term interest rate, which is the money market rate in the case of Pakistan. It is assumed that the State Bank of Pakistan uses the short-term interest rate using a Taylor (Taylor, 1993) type rule. In the Taylor type rule, the short-run interest rate is set subject to a given price level, output growth, and lag values. As an experiment, the required reserve ratio has been included as an alternative monetary policy instrument besides the money market rate, which can directly affect real economic activity. To set the required reserve ratio, the SBP investigates its lag value. The required reserve ratio in the case of Pakistan is the minimum Reserve Requirement of the State Bank of Pakistan, which is mandatory to be kept by the scheduled banks.

The second variable in this block is the prime lending rate which is not different from the commercial bank loan rates. The prime lending rate interacts with almost all the variables in the model except the world oil prices and non-fuel world CPI. The third variable in this block is interest rate spread. The interest rate spread is the difference between the commercial bank's loan and deposit rates. The

fourth variable included in this block is the real effective exchange rate. The real effective exchange rate can be calculated by the nominal effective exchange rate to be deflated by the US CPI. The real effective exchange rate interacts with almost all variables except world oil prices in non-fuel world CPI. This variable has been taken in the Log form. The fifth variable in this block is a loan to the private sector. The inclusion of this variable is mandatory because credit is used to fund the economic activities in the economy, which is an essential channel of the monetary transmission mechanism. Apart from world oil prices and non-fuel world prices, credit to the private sector interacts with almost all the variables in the model.

The sixth variable is government expenditure. This variable is included to capture the demand pressure in the economy in response to variations in output growth, policy rate, exchange rate, non-fuel world prices, world oil prices and its fast value. The last two variables in this block are non-fuel world CPI and world oil prices. These variables are included to introduce the external sector and its impact on domestic variables. The inclusion of the non-fuel world CPI is mandatory in the model because the economy of Pakistan is small and open and is strongly influenced by the global variations in the non-fuel price level. The world oil prices are included to capture the variation in energy prices in the domestic economy. The non-fuel world CPI depends on its past value in world oil prices. However, both variables are not affected by the domestic variables because the home economy is small. The lag value of all these variables in this block affects the variables included in the block of fully interactive variables: inflation and economic growth.

It is important to note that monthly data on loans to the private sector by the commercial banks (LL_prv), government expenditure (lg_exp, which is used as a proxy for aggregate demand in Pakistan) and interest rate spread (Spread) is not available. So following the work of (Primus, 2016) and (Bikker et al., 2010; Marini & Di Fonzo, 2012), these variables have been transformed from annual time series to monthly time series data by applying (Denton, 1971) the interpolation method.

[1] The order of the variables comes from the VARX model presented in equation 3.2 matrix A

Table 1 Key Variables for VARX Model

S .No	Block	Variables	Abbreviation	Definitions	Source
1	I	Commodity Price	lwcp	World Commodity Index	WDI
2		World Oil Price	lwop	World Oil Price	IFS
3	II	GDP	lipi_sa	Industrial Production Index, log	IFS
4		Inflation	infl	Inflation Rate, percent	IFS
5	III	MMR (RRR for the experiment)	mmr_sa	Money Market Rate, percent	IFS
6		Bank liquidity to bank assets ratio	bl_ba	Bank liquidity to bank assets ratio, ratio	WDI
7		Exchange rate	lrer_sa	Real effective exchange rate, log	IFS
8		commercial Bank loan Rate	loan_r	Commercial banks' lending rate, rate	WDI
9		interest rate spread	spread	The difference between the lending rate and t-bill6	WDI
10		Private sector Credit	ll_prv	Credit to the private sector, log	WDI
11		Government Expenditure	lg_exp	Government Expenditure, log	IFS

Strictly exogenous variables block

This block consists of three variables, namely.

a) A constant or Intercept
b) A Time Trend.
c) And to overcome the issue of seasonality, the seasonal adjustment would be incorporated to capture seasonal effects from the monthly time series of the variables.

3. Theoretical motivation for the inclusion of variables

The variable reported in table 1 is sufficient to capture the characteristics of a small open economy and to examine the monetary transmission mechanism in a developing economy like Pakistan. Two key instruments are exercised to examine the monetary policy effectiveness in the case of Pakistan. Normally, the country's central banks acquire information about the inflation rate plus economic growth and set the monetary policy instruments as per the requirement of the prevailing macroeconomic conditions. That is why the Taylor type monetary policy framework is followed in this study. Changes in the policy rate are expected to impact the long-term interest rate in the banking sector directly. The policy shock to the interest rate is likely to translate into bank lending rates and interest rate spread in the banking system. The required reserve ratio is considered for the present study as an alternative monetary policy instrument that is expected to directly impact the commercial banks' lending capability. It is also mandatory to note the inclusion of the excess reserves with the commercial banks in Pakistan's monetary policy reaction function. The required reserve ratio directly impacts the excess reserves with the commercial banks, which has a close link with the lending capacity of the commercial banks. That is why the required reserve ratio can be used to control the liquidity pressure with commercial banks.

The exchange rate's inclusion is essential because the exchange rate establishes a link between the home country and the rest of the world via the expectations channel of the monetary transmission mechanism. Variation in the exchange rate of the country has critical applications for the international trade of the home country and the rest of the world. Such implications depend on the exchange rate pass-through effects in the economy—the exchange rate co-moves with interest

rate shock. Variation in interest rate followed by the exchange rate leads affects the demand for local currency and, hence, affects capital flows in the economy.

It is also essential to include some variables from the fiscal side because decisions of the government can affect the effectiveness of the monetary policy. So, government expenditure as a percentage of GDP has been included in the analysis. Variation in the interest rate and exchange rate also impacts government expenditure because changes in the interest rate affect the interest payments on government debts. To make the economy susceptible to external shocks, world oil prices and non-fuel world CPI have been included in our model. These factors directly affect key variables such as output growth, inflation, and government expenditure.

Overall, this model captures the interaction between the real sector (which is captured by the output and inflation rate), the banking sector (which is the key sector to launch credit to the private sector), excess reserve with the commercial banks, prime lending rate and interest rate spread are included. The external sector, which is represented by the real effective exchange rate, the monetary authority, which uses two types of monetary policy instruments: the short-term interest rate and the required reserve ratio and last but not the least, the government sector, which includes the fiscal operations of the government that is the government expenditure as a percentage of GDP.

4. VARX Model

Following Lutkepohl (2006), let $y_t = [y_{1t}, ..., y_{kt}]'$ be the vector of K endogenous variables and $x_t = [x_{1t}, ..., x_{Mt}]'$ be the vector of M exogenous variables. The endogenous variable contains fully interactive and partially interactive variables. Let D be the vector that contains deterministic variables such as intercept, a linear trend, and seasonal dummy variables. Let the A, B and C be the coefficient matrices and $u_t = [u_{1t}, ..., u_{Kt}]'$ be the K*th* dimension vector of the error terms. Then the vector autoregression model in the existence of exogenous variables, that is, the variables in the external sector (VARX), can be specified as

$$y_t = A_1 y_{t-1} + ... + A_p y_{t-p} + B_0 x_t + ... + B_q x_{t-q} + C.D_t + u_t \quad (1)$$

In the VARX model, following the work of (Primus, 2018), restrictions[2] Are being imposed following the theoretical relationships between macroeconomic variables in the analysis. This model, therefore, allows asymmetries between variables and, therefore, the number of parameter estimates will be reduced. The reduction in the number of parameter estimates would help to overcome the degree of freedom, which would help estimate efficient parameter estimates. Moreover, the vector autoregression model in the presence of the external sector presented by exogenous variables helps derive impulse responses and variance decomposition to analyze the intensity of domestic and foreign shocks that affect the economy of Pakistan in the given sample period.

For the empirical analysis, optimal lag length criteria, this study would follow the Akaike Information Criterion (AIC)[3]. The reduced form structural vector autoregression model in the presence of the external sector is given by:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + C.D_t + u_t \quad (2)$$

[2] Discussed in the form of interactive variables block, partially interactive variables block, and the block of exogenous variables and Theoretical motivation given in the subsequent heading.

[3] Literature supports the AIC criterion for monthly data, SBC for annual data and HQ for quarterly data

The short-term interest rate (MMR) is taken as a monetary policy instrument in the baseline model. Following the work of (Primus, 2016a), the A matrix is restricted. [4]as:

$$\begin{bmatrix} a_{1,1} & a_{1,2} & a_{1,3} & a_{1,4} & a_{1,5} & a_{1,6} & a_{1,7} & a_{1,8} & a_{1,9} & a_{1,10} & a_{1,11} \\ a_{2,} & a_{2,2} & a_{2,3} & a_{2,4} & a_{2,5} & a_{2,6} & a_{2,7} & a_{2,8} & a_{2,9} & a_{2,10} & a_{2,11} \\ a_{3,1} & a_{3,2} & a_{3,3} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{4,1} & a_{4,2} & a_{4,3} & a_{4,4} & a_{4,5} & a_{4,6} & a_{4,7} & a_{4,8} & a_{4,9} & 0 & 0 \\ a_{5,1} & a_{5,2} & a_{5,3} & a_{5,4} & a_{5,5} & a_{5,6} & a_{5,7} & a_{5,8} & a_{5,9} & 0 & 0 \\ a_{6,1} & a_{6,2} & a_{6,3} & a_{6,4} & a_{6,5} & a_{6,6} & a_{6,7} & a_{6,8} & a_{6,9} & 0 & 0 \\ a_{7,1} & a_{7,2} & a_{7,3} & a_{7,4} & a_{7,5} & a_{7,6} & a_{7,7} & a_{7,8} & a_{7,9} & 0 & 0 \\ a_{8,1} & 0 & a_{8,3} & 0 & 0 & a_{8,6} & 0 & a_{8,8} & 0 & a_{8,10} & a_{8,11} \\ a_{9,1} & a_{9,2} & a_{9,3} & a_{9,4} & a_{9,5} & a_{9,6} & a_{9,7} & a_{9,8} & a_{9,9} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{10,10} & a_{10,11} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{11,11} \end{bmatrix} \begin{bmatrix} lipi_{t-p} \\ \inf l_{t-p} \\ mmr_{t-p} \\ loan\_r_{t-p} \\ spread_{t-p} \\ lrer_{t-p} \\ l\_priv_{t-p} \\ \lg\_\exp_{t-p} \\ ler_{t-p} \\ \ln fcp_{t-p} \\ lwop_{t-p} \end{bmatrix}$$

Note: $a_{ij}\ (i\ j = 1,2)$ represents coefficients of endogenous variables in vector $y\ \ p = 1,2$ in this model. The second experiment includes the required reserve ratio in the model, which depends only on its lag value. For the required reserve ratio, rearrange the ratio placing the $\underline{rrr_t}$ after the mmr_t.

5. Empirical Results

In this section, the sets of fully interactive, partially interactive, and exogenous variables have drawn inferences from the multivariate Granger causality test, generalized impulse response function, and forecast error variance decomposition. The impulse response function has been analyzed by giving one standard deviation shock to the policy rate in the experiments. The analysis starts by testing the time-series properties of the variables in the analysis. The details of the analysis are reported below.

Unit Root and Seasonality Tests

Before starting the estimation of the VARX model, it is mandatory to carry out a unit root and seasonal root tests. The unit root test is essential to know about the order of integration, whereas the seasonal root test is essential to test seasonality in the data set. For this purpose, the Augmented Dickey-Fuller test has been applied for the unit root test, and the Canova-Hansen test has been used to test seasonality in the time series. The results from ADF and Canova-Hansen tests are reported in Table 2 below.

[4] The restriction is based on the variable's description and theoretical motivation between the variables given above.

Table 2 Unit Root (ADF) and Seasonal Root (Canova-Hansen Test) Tests

	Level		First Difference		Order of Integration	Seasonal Root Test		
Variables	Lag	P-Value	Lag	P-Value	I()	LM Stat	LM Sig. Level	Seasonal Root
LWOP	1	0.355	0	0.000	I(1)	2.9502	2.75	Yes
LWCP	2	0.495	0	0.000	I(1)	2.9502	2.75	Yes
LIPI	15	0.831	14	0.000	I(1)	3.8739	2.75	Yes
INFL	2	0	10	0.000	I(0)	2.0004	2.75	No
MMR	10	0.61	12	0.000	I(1)	1.7689	2.75	No
LRER	2	0.565	1	0.000	I(1)	1.6101	2.75	No
LOAN_R	1	0	0	0.004	I(0)	1.6112	2.75	No
RRR	1	0.088	0	0.041	I(1)	2.9447	2.75	Yes
SPREAD	1	0.006	0	0.012	I(0)	2.7545	2.75	Yes
LL_PRV	13	0.02	12	0.035	I(0)	0.6322	2.75	No
LG_EXP	1	0.702	0	0.014	I(1)	4.3517	2.75	Yes
LERS	2	0.221	7	0.000	I(1)	0.4536	2.75	No

able 2 reveals that the commercial banks' lending rate (Loan_r), spread, inflation rate (infl) and log of loans to the private sector are stationary at the level and integrated of order zero. In contrast, the rest of the variables are integrated of order one because they are stationary at first difference. Moreover, from the Canova-Hansen test results, the LM (lagrangian Multiplier) test statistic value is greater than the LM significance level value for world commodity price (LWCP), log of world oil prices (LWOP), log of industrial production index (LIPI), required reserve ratio (rrr), interest rate spread (spread) and log of government expenditure (LG_exp), so these variables have a seasonality issue. These variables are seasonally adjusted by (Sax, 2018) Census X-13 method. The seasonally adjusted graphs of the variables are reported in Appendix D.

Multivariate Granger Causality Test in VARX Blocks

The VARX model reports as many blocks as the number of fully and partially interactive variables in the VARX set-up. The multivariate granger causality test helps to confirm the causal link between each variable (in the set fully or partially interactive) with the rest of the variables in the concerned block. The multivariate Granger causality test results are reported in Table 3 below.

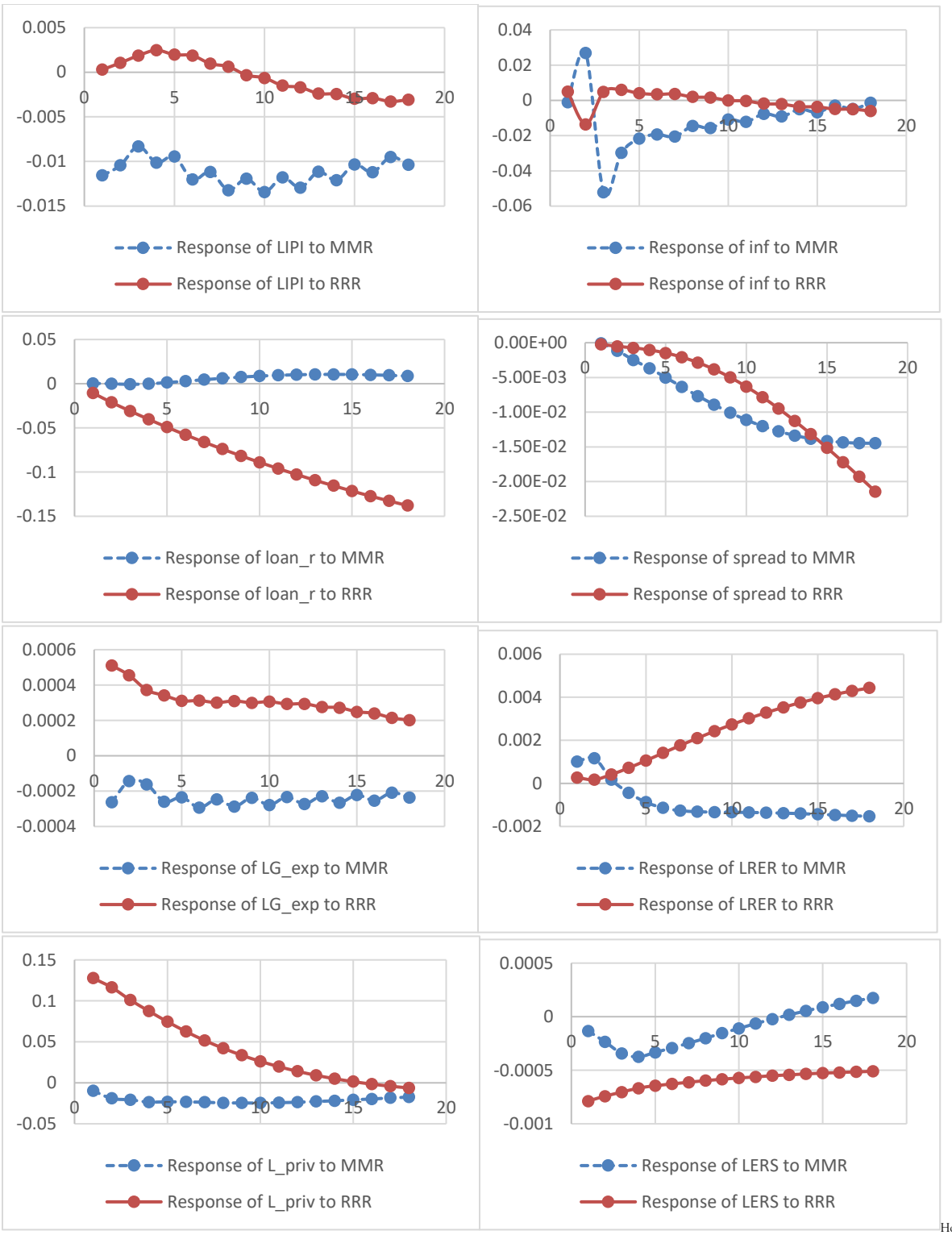
Table 3 Multivariate Granger Causality Test (in the VARX framework)

Dependent Variables	Independent Variables									
	LIPI_SA	INFL	MMR	RRR	LOAN_R	SPREAD_SA	LRER	LL_PRV	LG_EXP_SA	LERS
LIPI_SA	--	0.06	2.35	**19.56**	0.12	3.07	2.34	**14.66**	**4.98**	**8.04**
INFL	**5.72**	--	**7.29**	0.35	**14.01**	**4.7**	1.71	2.58	**5**	2.75
MMR	**45.44**	4.11	--	--	--	--	--	--	--	--
RRR	3.14	**17.04**	1.28	--	**6.3**	3.73	**17.5**	3.38	**7.36**	--
LOAN_R	1.77	1.86	2.89	**7.78**	--	1.66	**17.79**	**9.32**	1.96	--
SPREAD_SA	4.14	1.05	4.56	**5.99**	**5.11**	--	**7.53**	**6.22**	0.17	--
LRER	**6.9**	1.56	**11.53**	1.29	2.54	4.57	--	0.61	**18.11**	--
LL_PRV	**5**	--	0.39	--	--	0.29	--	--	--	1.82
LG_EXP_SA	**16.56**	**5.62**	**6.38**	1.41	1.74	0.11	**5.24**	1.07	--	--
LERS	--	--	--	--	--	--	--	--	--	--

Table 4.2 reports Chi-square statistics where bold values represent statistically significant values

Table 3 reports the multivariate Granger causality test in the framework of the vector autoregression model in the presence of exogenous variables. It is clear from the table that the output level is Granger cast by the bank liquidity to the bank asset ratio, loan to the private sector, government expenditure and excess reserves with the commercial banks in Pakistan. Inflation, however, is Granger caused by the output level, policy rate, loan rate, interest rate spread and government expenditure in the second block. These results confirm that the inclusion of the bank liquidity to bank asset ratio as an additional monetary policy instrument is valid. In the third block, the policy rate is affected by none of the variables except the output level. The bank liquidity ratio Granger causes the output level, influencing the inflation rate.

On the other hand, the policy rate Granger causes the output level as well; however, the influence of the policy rate over inflation is not very significant. The bank liquidity relative to the bank asset ratio is Granger caused by the loan rate, the real effective exchange rate, and the government expenditure for the given sample period. On the other hand, the loan rate is affected by bank liquidity relative to bank asset ratio, real effective exchange rate, and loan to the private sector. On the other hand, interest rate spread is affected by bank liquidity relative to bank asset ratio loan rate, real effective exchange rate and loan to the private sector in the case of Pakistan. Moreover, the real effective exchange rate is Granger caused by output level, policy rate and government expenditure. The loan to the private sector is Granger caused by the output level only, and the government expenditure is Granger caused by the output level, inflation, policy rate and the real effective exchange rate.



Horizontal axis reports months that's eighteen months period for impulse response function. This IRF is the author's own sketch.

Figure 1: Response to Generalized One S.D. Innovation ±S.E. to MMR and RRR

Figure 1 reports the responses of the macroeconomic variables, including industrial production index (used as a proxy for national output), inflation, loan to the private sector, interest rate spread, commercial bank lending rate, government

expenditure, real effective exchange rate and excess reserves with the commercial banks. The monetary policy instruments tested here are the money market rate as the policy rate and the required reserve ratio set by the State Bank of Pakistan. A one Standard deviation shock to the ratio of reserve needed increases output up to four months and starts declining thereafter. The same situation appears in the case of one standard deviation shock to the policy rate, where the response of output to is fluctuated after increasing for three months. The rest of the impact of the contractionary monetary policy on production, using both the monetary policy instrument, is contractionary. It means the response of output to both the monetary policy instruments follows almost the same pattern.

The response of inflation to the contractionary monetary policy shock to the policy rate is explosive for two months, reflecting the price puzzle and drastically declining after converging to the long-run equilibrium path after a year. The response of inflation to a positive shock to the required reserve ratio is contractionary for 2 months and starts rising after that insignificantly. The response of inflation to the rrr[5] however, it goes against the response of inflation to a positive shock in the policy rate, thus solving the price puzzle[6]. It means that the policy rate appears to be an insufficient policy instrument to control inflation by tightening monetary policy in Pakistan in the given sample period. This result confirms the findings of Hayat (2017) that there are issues such as overdue statutory amendments of the State Bank of Pakistan Act 1954, political pressure on SBP etc., that stand in the way of conducting effective monetary policy in Pakistan.

A positive shock to the policy rate leads to an increase in the commercial bank loan rate significantly. An increase in the commercial bank loan rate reduces the lending capacity of the commercial banks, which improves the transmission of monetary policy and the ability of the central bank to control credit to the private sector. Similarly, a positive shock to the required reserve ratio leaves a contractionary effect on the commercial bank loan rate. In this case, the policy rate appears more effective to adopt a tight monetary policy in Pakistan. Tight monetary policies, using both monetary policy instruments, that is, the policy rate and the required reserve ratio, decline the interest rate spread[7] With the commercial banks. The decline in spread narrows down the difference between the deposit rate and commercial banks' lending rate, which curtails the commercial banks' interest to advance loans. Therefore, both the monetary policy tools appear more effective in controlling the country's real economic activity.

A positive to the policy rate appreciates the exchange rate for 2 months and falls after that. An increase in the interest rate attracts capital inflow thereby appreciating the exchange rate. A positive shock to the required reserve ratio restricts the commercial banks to advance loans augmenting the contractionary monetary policy shock caused by raising the policy rate, thus indirectly causing the exchange rate appreciation.

Contractionary monetary policy, using both instruments, leads to reduced loans to the private sector. A positive shock to the policy rate has an insignificant effect on government expenditure. However, an increase in the required reserve ratio contracts the government expenditure in the given sample period. Contractionary monetary policy by raising the policy rate by one standard deviation reduces excess reserves with commercial banks for four months and starts rising after that. However, a shock to the required reserve ratio has almost an insignificant effect on excess reserves with commercial banks. The response of the government expenditure to the interest rate is volatile. It is almost negligible, whereas the reaction of the government expenditure to a positive to the required reserve ratio is contractionary and long-lasting. Moreover, the response of the excess reserves with the commercial banks to a positive shock to the monetary policy rate is contractionary for a period of 4 months and starts rising thereafter. However, the response of the excess reserves with the commercial bank to a tight monetary policy via the required reserve ratio is insignificant.

[5] Abbreviation of required reserve ratio is peroxided by the commercial bank liquidity relative to the commercial bank total assets ratio.

[6] The increase in prices is in response to a positive shock to the policy rate (tight monetary policy), contrary to the economic theory. For details, see (Davoodi et al., 2013).

[7] The difference between the commercial bank loan and deposit rate.

Table 4 Forecast Error Variance Decomposition

Period	LIPI	INFL	MMR	RRR	LOAN_R	SPREAD	LRER	LL_PRV	LG_EXP	LERS	LWCP	LWOP
Variance Decomposition of LIPI												
6	83.33	0.15	1.21	0.12	0.42	0.18	6.35	0.29	0.28	0.19	2.5	4.98
12	68.66	0.52	4.39	0.16	0.96	1.25	8.13	0.74	0.78	0.14	4.31	9.97
18	60.56	0.7	5.46	0.48	1.08	2.25	7.68	0.93	1.16	0.11	6.87	12.73
Variance Decomposition of INFL												
6	0.48	83.42	5.37	0.17	2.48	1.21	0.12	0.62	0.82	1.19	2.31	1.8
12	0.73	79.9	6.56	0.18	2.73	1.4	0.12	0.61	0.93	1.53	3.06	2.25
18	0.79	77.84	6.61	0.29	3.52	1.38	0.18	0.61	1	1.57	3.61	2.59
Variance Decomposition of MMR												
6	3.18	1.67	94.91	0	0.08	0.04	0	0.02	0.01	0.02	0.04	0.03
12	3.05	1.97	94.29	0	0.12	0.18	0	0.03	0.05	0.16	0.11	0.03
18	3.11	2.02	93.77	0.01	0.15	0.26	0.01	0.03	0.09	0.33	0.17	0.05
Variance Decomposition of RRR												
6	0	0.03	0.32	99.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0	0.03	0.32	99.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0	0.03	0.32	99.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Variance Decomposition of Loan_r												
6	0.11	0.64	0.05	23.84	73.71	0.39	0.35	0.02	0.79	0.1	0	0.01
12	0.34	0.91	0.31	26.07	65.85	1.34	3.03	0.19	1.85	0.04	0.01	0.06
18	0.49	0.93	0.32	27.73	59.38	2.49	5.39	0.5	2.27	0.15	0.05	0.31
Variance Decomposition of Spread												
6	0.63	0.11	1.55	0.17	43.62	53.13	0.04	0.3	0.15	0.28	0	0.01
12	2.68	0.03	3.04	0.8	42.16	48.19	0.31	0.84	0.46	1.35	0	0.15
18	4.02	0.02	3.51	2.33	40.96	43.56	0.61	1.16	0.8	2.49	0.04	0.51
Variance Decomposition of LRER												
6	4.33	2.62	1.66	1.75	1.48	7.55	74.66	1.28	0.28	4.23	0.14	0.03
12	15.78	2.12	1.83	10.93	1.35	12.74	48.99	1.17	0.51	3.56	0.18	0.83
18	20.6	1.63	1.75	21.6	0.89	12.88	33.93	0.85	0.6	2.23	0.23	2.81
Variance Decomposition of LL_PRV												
6	0.04	0.55	2.86	61.02	3.13	0.33	1.09	30.89	0.02	0.03	0.03	0.01
12	0.08	0.45	5.79	55.91	5.84	0.75	0.97	29.73	0.27	0.03	0.04	0.13
18	0.08	0.43	7.63	52.85	6.9	1	1.17	28.82	0.55	0.06	0.14	0.37
Variance Decomposition of LG_EXP												
6	4.85	0.08	1.38	6	6.07	5.26	1.48	28.85	42.14	0.06	3.75	0.08
12	9.26	0.14	2.07	7.05	5.52	4.13	2.73	25.68	38.16	0.66	4.43	0.15
18	9.4	0.16	3.15	8	5.15	4.19	3.12	24.42	36.29	1.04	4.77	0.31
Variance Decomposition of LERS												
6	0.68	0.18	5.04	28.54	6.94	1.55	9.93	3.4	4.38	39.32	0	0.04
12	2.85	0.14	4.49	29.78	9.03	1.03	15.37	2.52	3.02	31.48	0.01	0.29
18	6.16	0.2	3.56	30.34	8.99	0.86	17.65	2.22	2.35	26.63	0.09	0.96

Table 4 reports the forecast error decomposition of the variables included in the model. It is clear from the table that output is mainly affected by production itself, the policy rate, exchange rate, world commodity prices and world oil price. The forecast error variance of inflation is primarily explained by inflation itself, the policy rate, loan rate, world commodity prices and the world oil price index. It means that foreign shocks significantly contribute to influencing the macroeconomic variables, namely prices and output. The policy rate is mainly influenced by the policy rate itself, output, and inflation. Required reserve ratio is influenced by none of the variables except its own lags. The most important determinants of loan rate are the required reserve ratio, loan rate itself, exchange rate and government expenditure. The output mostly influences interest rate spread, policy rate, required reserve ratio, loan rate, spread itself and excess reserves with the commercial banks. The exchange rate is influenced by output, inflation, required reserve ratio, interest rate spread, exchange rate itself and excess reserves with the commercial banks. Loan to the private sector is influenced by the policy rate, the required reserve ratio, the commercial bank loan rate and the loan to the private sector itself. The government expenditure is influenced by the output level, the policy rate, the required reserve ratio, commercial banks' loan rate, interest rate spread, exchange rate, loan to the private sector, the government expenditure itself and world commodity prices. Ultimately, excess reserves with the commercial banks are influenced by the output level, the policy rate, required reserve ratio, the loan rate, exchange rate, loan to the private sector, the government expenditure, and excess reserves with the commercial bank itself.

It is clear from the table that most of the macroeconomic variables such as loan rate, exchange rate, loan to the private sector, government expenditure and excess reserves with the commercial banks are influenced by the required reserve ratio, which signifies the role of the required reserve ratio in the set of monetary policy instruments for Pakistan. Required reserve ratio helps to influence loans to the private sector, the government expenditure, excess reserves with the commercial banks and the exchange rate in the case of Pakistan.

6. Results Discussion

The response of the output to the rrr and the policy rate is similar, except the response output response is to the policy rate fluctuates after rising for three months. This evidence is in line with (Onyukwu et al., 2011), where it was concluded that the response of output in a market based monetary policy fluctuates in Nigeria. The response of inflation to rise to tight monetary policy shock reflects price puzzle[8]in case of Pakistan is in line with the findings of (Munir & Javid, 2011) and (Mangla & Hyder, 2017; Nizamani et al., 2016). The response of inflation to the required reserve ratio in tight monetary policy action is contractionary, which helps to solve the issue of the price puzzle somehow. The contribution of the required reserve ratio to fluctuate inflation and output is far less than the contribution of the policy rate. This result is in line with the findings of (Primus, 2016a) but contrary to (Ramlogan, 2007). Tightening monetary policy, using both the monetary policy instruments, including the required reserve ratio and money market rate, reduce the interest rate spread of the commercial banks in the case of Pakistan. This result is in line with the findings of (Glocker & Towbin, 2012; Montoro & Moreno, 2011; Primus, 2018; Tovar Mora, Garcia-Escribano, & Vera Martin, 2012).

7. Conclusions

From table 2 the bank asset relative to the bank liquidity ratio as an additional monetary policy instrument is not redundant. The reason is that the evidence reveals that bank liquidity relative to bank asset ratio Granger causes the output level. Whereas the output level Granger causes is inflation in the given sample period. It means that bank liquidity relative to the bank asset ratio directly influences output level and indirect inflation rate in the given sample period in Pakistan. It is tightening monetary policy using both the monetary policy instruments that is the required reserve ratio and the policy rate decline output after a rise of four months. This evidence reveals the slow transmission of the policy shock to the output level. The contribution of the required reserve ratio to influence output and inflation is less than

[8] The increase of inflation to positive shock to the policy rate contrary to economic theory is called the price puzzle. Price puzzle was initially identified by (Sims, 1992).

the contribution of the policy rate. A positive shock to the policy rate increases the loan rate of the commercial banks, reducing the lending capability of the commercial banks. However, the response of the commercial banks' loan rate to the required reserve ratio is reversed in this case. During contractionary monetary policy, using both the monetary policy instruments, the policy rate and the required reserve ratio, leads to a decline in the interest rate spread for the commercial banks. An increase in the required reserve ratio induce commercial banks to reduce deposit rate and increase loan rate[9].Exchange rate co-moves with the interest rate for 2 months and starts declining thereafter. However, the required reserve ratio persistently appreciates the exchange rate for a long period of time[10]. Increase in both monetary policy instruments: the required reserve ratio and policy rate reduce loans to the private sector by the commercial banks. Contractionary monetary policy using the required reserve ratio as the monetary policy instrument slightly reduces government expenditure. However, the influence of the policy rate on government expenditure declines after three months and fluctuates thereafter. The impact of the policy rate reduces the excess reserves with the commercial banks, thus controlling and enhancing the credit channel's efficiency. The impact of the required reserve ratio on the excess reserves with the commercial banks is expansionary. The variance decomposition analysis shows that the external shocks such as non-fuel commodity price and world oil price shocks have a significant contribution to the fluctuation of inflation and output in small, open, developing economies like Pakistan.

8. Recommendations

It has been observed that there is a weak transmission of interest rate shock to the economy because of the high liquidity in the financial system of Pakistan. From the analysis of the impulse response function, it has been observed that a positive shock to the interest rate puts less pressure on the commercial bank loan rate, which fails to control credit to the private sector. Moreover, the interest rate is found to be less effective in controlling price stability in the economy because of the price puzzle raised by the shock of the interest rate. On the other hand, the required reserve ratio has been that a positive to the required reserve ratio during contractionary monetary policy leads to a significant fall in output, credit to the private sector, prices, interest rate spread, and government expenditure. Therefore, it is recommended that the State Bank of Pakistan regularly adjust the reserve requirements on local currency deposits. To improve the transmission mechanism of monetary policy and achieve macroeconomic stability, the use of blunt monetary policy instruments with indirect monetary policy tools can be helpful. Furthermore, the required reserve ratio helps resolve the price puzzle problem that arises from the interest rate shock while tightening the monetary policy in Pakistan. So the required reserve ratio can be used to complement the interest rate for the monetary policy of Pakistan.

[9] During contractionary monetary policy, the central bank increases the required reserve ratio where the commercial banks have increased the deposit rate to meet the desired level of liquidity. On the other hand, the commercial banks must raise the loan rate to maintain the implemented required reserve ratio (Keyra Primus, 2018).

[10] An increase in interest rate increases the demand for domestic currency, which appreciates the exchange rate.

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