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Should Central Bank Forget Reserve Requirements? Assessment of Reserve Requirements in Transmitting SBP's Policy Shocks to Retail Interest Rates and Exchange Rate

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Should Central Bank Forget Reserve Requirements? Assessment of Reserve Requirements in Transmitting SBP's Policy Shocks to Retail Interest Rates and Exchange Rate

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Abstract

We have investigated the effectiveness of monetary policy tools, the discount rate and the reserve requirement ratio, in Pakistan by studying their pass through to the retail interest rates and the exchange rate. We find that the pass-through of the required reserve ratio to the retail rates and exchange rate is significant but incomplete. The pass through of discount rate; to the lending rate is complete; to the deposit rate is incomplete and; to the exchange rate is insignificant. Our results suggest that the required reserve is a more powerful tool for stabilizing the exchange rate shocks than discount rate. We, therefore, recommend State Bank of Pakistan to not to ignore the reserve requirement ratio as an active policy tool, specifically when exchange rate is under speculative attack.

Keywords: Interest rates, monetary policy, exchange rate

JEL Classification: E43, E52, F31

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Non-technical Summary

We have investigated the effectiveness of the monetary policy tools, the reserve requirement ratio and the discount rate, in Pakistan by studying their pass through to the retail interest rates and the exchange rate using monthly data from July 2004 to September 2015. Reserve requirement is composed of Cash Reserve Requirement (CRR) and Statutory Liquidity Requirement (SLR). Cash reserve requirement consists of non-remunerated deposits that banks have to keep at the central bank to back up their deposit holdings. Statutory liquidity requirement, on the other hand, refers to fraction of deposits that banks are required to maintain in the form of government securities or securities of government-owned enterprises.

Though the objective of SLR is to provide direct financing to the government, both ratios primarily aims at securing the solvency of the banks. Conventionally, central banks are cautious on frequently using the reserve requirement ratios, as regular changes are often seen as disruptive and are costly for the banks. Moreover, reserve requirement ratios act as a tax, promote financial disintermediation, and instill inflexibility in the monetary management which may amplify central bank's loss function.

However, recent global financial crisis renewed central banks' interest in the effectiveness of the reserve requirement ratios, as a monetary and macroprudential policy tool. Number of recent studies, specifically on Latin American countries, shows that reserve requirement ratio could be an effective policy stabilization tool. It plays important role in strengthening the pass through of the policy tools, helps in stabilizing and influencing the market rates, and moderate capital flows.

This paper contributes to the debate on effectiveness of reserve requirements using information from financial market of Pakistan. Specifically, this study attempts to answer the research question: what is the impact of the changes in the reserve requirements on the lending rate, the deposit rate and the exchange rate. Moreover, this paper extends the analysis to the other monetary policy tool, the discount rate.

During the analysis we observed that structural shifts had occurred in the interbank market of Pakistan in June 2008 and in September 2011 coinciding with the introduction of regulatory deposit floor rate and the surprise cut by SBP in the discount rate by 150 bps respectively. Therefore, we incorporated both dates in our modeling process.

Our findings suggest that the pass-through of the required reserve ratio to the retail rates and exchange rate is significant but incomplete. However, the required reserve rate's pass through to the lending rate shows improvement over the period. The pass through of discount rate to lending rate is complete while the same to deposit rate appears incomplete. Our results suggest that a required reserve is a more powerful tool for stabilizing exchange rate shocks than discount rate. Even if SBP is not actively changing reserve requirement ratio, the changing composition of liabilities may have prevented speculative attack on the exchange rate. Therefore, we recommend that SBP should not ignore the reserve requirement ratio as a policy tool.

1. Introduction

Recent global financial crisis allowed central banks to experiment with the unconventional monetary policy tools such as quantitative easing and negative interest rate policy. This crisis, however, also has renewed interest in exploring the effectiveness of conventional monetary policy tool like reserve requirement ratios and policy interest rates.[1] Often, effectiveness of the central bank's policy rate (discount rate)[2] is scrutinized through interest rate channel of monetary transmission mechanism; the debate on the effectiveness of the reserve requirement is a more recent phenomenon. For example, findings of Glocker and Towbin (2012) suggests reserve requirements become more effective when there is foreign currency debt in an small open economy with sticky prices and financial frictions. While discussing the results of the Glocker and Towbin (2012), Walsh (2012) notes that the loss function of the central bank reduces on using reserve requirements as an instrument of the monetary policy. Moreover, the optimal coefficients in a basic Taylor rule for the interest rate are very little affected when the reserve requirement is allowed to respond optimally to inflation and output.

Conventionally, central banks are cautious on frequently using the reserve requirement ratios. The notion was that the frequent change in the reserve requirements may be disruptive and costly for the banks as they are forced to hold a prescribed fraction of the deposits in the form of government papers and currency or deposits with the central bank. Reserve requirement ratios act as a tax, which constraints profit maximization objective of banks. Moreover, it promotes financial disintermediation, constrains monetary management and thus may amplify central bank's loss function.

This paper contributes to the debate on effectiveness of reserve requirement using information from financial market of Pakistan.[3] Specifically, this study attempts to answer the research questions: what is the impact of the changes in reserve requirements on lending rate, deposit rate and exchange rate? Moreover, this paper extends the analysis to other monetary policy tool, discount rate. Pakistan provides a special opportunity to assess the effectiveness of the two policy instruments that is central bank's policy rate and the reserve requirement as State Bank of Pakistan (SBP) imposes separate reserve requirements for time and demand liabilities (detail is in Section 2).

Moreover, we extend our analysis to exchange rate given central banks in several emerging economies aim to stabilize exchange rates. A better understanding of monetary transmission mechanism requires an analysis of the response of the exchange rate to a monetary policy shock (Disyatat and Vongsinsirikul, 2003; and Aleem, 2010). SBP, like other central banks, does not overtly pay attention to the exchange rate. However, central banks' interest in the exchange rate developments is well documented by McKinnon (1995), Clarida and Gertler (1997), and Clarida (2001). The use of monetary policy tools in tandem with the speculative pressure on the Pakistan rupee-US dollar exchange rate often foments impression that the SBP uses a de facto fixed exchange rate policy. This paper evaluates the effectiveness of required reserves and discount rate in managing the exchange rate, which is likely to bring clarity in understanding the exchange rate channel of monetary policy pass-through in Pakistan. The interest rate channel of monetary policy is also explored in this study to the extent of pass through of policy interest rates to retail interest rates in Pakistan.

[1] Conventionally, central bank uses three policy instruments, the discount interest rate (charged at the discount window borrowings), required reserve ratios, and the open market operations (OMOs) to manage the quantity of the non-borrowed reserves (Walsh, 2012).
[2] SBP 'Target rate' is new policy tool adopted by the SBP effective May 2015. It replaced the discount rate.
[3] This study is heavily influenced by Omer *et al.* (2014).

This study is very close to the work done in Omer et al. (2014). However, it is distinct in many ways: focus of this paper is to evaluate the pass-through of the reserve requirement to the retail rates and the exchange rate, while Omer et al. (2014) focused on evaluating the impact of the excess liquidity on pass through of the monetary policy tools; with specific attention to the discount rate. Moreover, this paper uses extended sample size, expanding the sample to as late as September 2015, while Omer et al. (2014) used the sample ending on July 2011. Financial market in Pakistan has evolved considerably in last couple of year, as policy formulation has become objectively oriented towards strengthening the monetary policy transmission mechanism.[4]

We use monthly data from July 2004 to September 2015 and Vector Auto Regression (VAR) methodology to assess the effectiveness of monetary policy tools. Our findings suggest that the pass-through of the required reserve ratio to the retail rates and exchange rate is significant but incomplete. However, the required reserve ratio's pass through to the lending rate shows improvement over the period. The pass through of discount rate to lending rate is complete while the same to deposit rate is found to be incomplete. Our results suggest that a required reserve is a more powerful tool for stabilizing exchange rate shocks than the use of discount rate. Even if SBP is not actively changing reserve requirement ratio, the changing composition of banks' liabilities may have prevented speculative attack on the exchange rate in Pakistan. We, therefore, conclude that it is not possible for SBP to overlook the reserve requirement ratio as a policy tool. Moreover, our results indicate that structural shifts have occurred in the interbank market of Pakistan in June 2008 and in September 2011. Ignoring these breaks can bias the results.

Rest of the paper is structured as follows. The next section discusses monetary policy in Pakistan, while section 3 reviews the relevant literature. Section 4 outlines the methodology and section 5 describes the data employed. Section 6 analyzes the results obtained and section 7 concludes.

2. Monetary Management in Pakistan during 2004-2015

SBP's main policy tool is discount rate (policy rate) which is also known as reverse repo rate. In May 2015, SBP replaced the discount rate with a new policy rate 'SBP target rate', which moves within SBP's defined interest rate corridor[5]. We use 6 month treasury bills rate to proxy discount/policy rate for analysis. Reserve requirement ratio will be discussed subsequently in more detail with the deliberation on the policy initiatives.

Until November 2008, SBP actively used reserve requirement as a policy tool. Reserve requirement is composed of Cash Reserve Requirement (CRR) and Statutory Liquidity Requirement (SLR). Cash reserve requirement consists of non-remunerated deposits that banks have to keep at the central bank to back up their deposit holdings. This ratio is typically used to manage the interbank liquidity. Statutory liquidity requirements (SLR), on the other hand, refers to fraction of deposits that banks are required to maintain in the form of government securities or securities of government-owned enterprises. Though the objective of SLR is to provide direct financing to the government, both ratios primarily aims at securing the solvency of the banks. The compulsory reserve requirement imposes an implicit tax on the banking system as it could provide the public sector an indirect source of financing often at below market rates (Molho, 1992).[6]

[4] Introduction of interest rate corridor (IRC) and more recently, 'SBP target policy rate' indicates increased objectivity in the monetary policy formulation.
[5] Interest rate corridor was introduced in August 2009 to stabilize the money market interest rate.
[6] Only SLR provides a source of financing for government in case of Pakistan.

Despite the fact that both CRR and SLR remained unchanged since November 2008, effective reserves requirement (actual percentage of weighted average of demand and time liabilities), keep changing almost every second week as shown by the Figure 1A. Since 22nd July 2006, SBP imposed separate reserve requirements for time and demand liabilities to encourage banks to mobilize long-term time deposits, and to put upward pressure on the money market rates (SBP, 2006).[7] To supplement its initiative, SBP exempted time liabilities from cash reserve requirement from 4th August 2007. The time liabilities, since these policy initiatives increased substantially, however the unexpected 150 bps cut in discount rate in October 2011 invoked a reversal (Figure 1B). Perhaps, market read the October 2011's discount rate cut as the end of tightening phase of monetary policy, thereby instilling expectation of the interest rate reversal. Consequently, banks became less interested in raising term deposits to avoid higher borrowing costs (Figure 1B). Also declining time deposit and increasing demand deposit sharply increased the demand to time liability ratio (Figure 1A). This changed liability composition, once again, pushed the effective reserve requirements of banks substantially higher (see Figure 1A).

Figure 1A: Changes in Req. Reserves and Demand & Time Liabilities Ratios

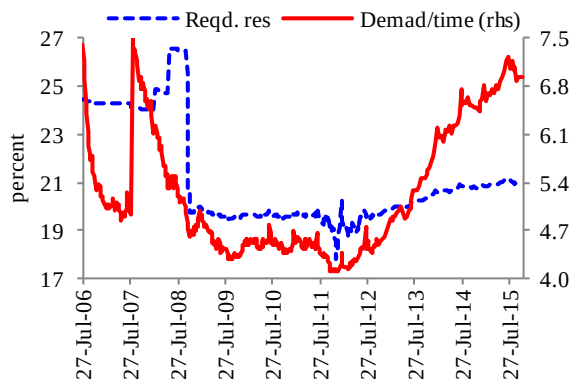
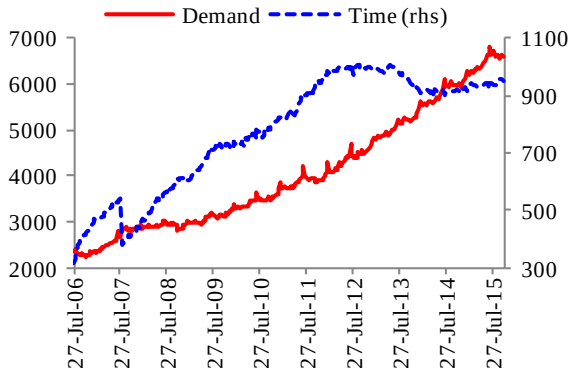


Figure 1B: Time & Demand Liabilities in Pakistan
(billion rupees)



Nevertheless, the effectiveness of the SLR declined in recent years when banks parked their funds, more than the statutory requirements, in the government securities.[8] Private sector's perceived credit default risk increased when Pakistan experienced slowdown in economic activity after the global financial crisis. Therefore, instead of lending to the private sector banks preferred investing in the risk free government securities. Therefore, we used SLR for computing effective reserve requirement to attain actual variability in the reserve requirement.

In short, between 2004 and 2015, the monetary policy in Pakistan passed through various phases. SBP tightened aggressively its monetary policy till September 2008 when required reserve ratios and the discount rate were raised on a number of occasions (see Table A1 in Appendix). However both policy instruments witnessed a gradual decline in their magnitude since then. Moreover by 1st November 2008, reserve requirement ratios were relaxed to end December 2005 level; when monetary policy stance was easy. Since November 2008, SBP became cautious on using the reserve requirement ratios and conducted the monetary policy using the discount rate only.

[7] see Table A1 in Appendix
[8] For detail see Omer *et al.* (2015).

3. Literature Review

In line with the scope of this paper, the review of literature is confined to the financial part of the monetary policy transmission mechanism. That is, how changes in the required reserve ratios and the policy interest rate effects retail lending and deposit interest rates, and exchange rate in the economy.

Recently, a number of studies evaluated the effectiveness of the reserve requirement as a macroprudential instrument in reducing the systemic risk in developing economies (Lim et al., 2011; Glocker and Towbin, 2012; Palley, 2004; and León and Quispe, 2010). However, studies evaluating the reserve requirement as a monetary policy tool are not in abundance. Among the available studies, Vargas et al. (2010) finds that in Colombia the pass-through from reserve ratios to deposit and lending interest rates is important. Their finding suggests that in an inflation-targeting regime, reserve requirements plays effective role in reinforcing monetary policy transmission and should be used as a policy instrument by the inflation targeting central banks. Moreover, they justify the use of required reserves when standard and less costly policy instruments become ineffective in maintaining price or financial stability.

Montoro and Moreno (2011), while discussing the recent experience of three Latin American economies, notes that the adjustment in reserve requirements may have helped interbank rates to stabilize and influenced market rates in a way that moderated the capital flows in the respective economies. The reserve requirement adjustment may also have helped to smooth credit growth during the expansionary and contractionary phases of the economic and financial cycle. However, these authors view reserve requirement with caution due to its distortionary effect. In contrast, Evandro and Takeda (2011) conclude that the policy induced change in reserve requirements leads to a contraction in credit to households, especially from smaller banks in Brazil.

Glocker and Towbin (2012a) use a structural vector autoregression (SVAR) framework to identify policy interest rate and reserve requirements shocks. They find that the discretionary tightening of either instrument leads to a decline in domestic credit, but their effects on macroeconomic aggregates differ. The study argues that the tightening of reserve requirements induces a depreciation of the exchange rate and has inflationary effects. Walsh (2012) on deliberating the findings of the Glocker and Towbin (2012a), notes that the loss function of the central bank reduces on using reserve requirements as an instrument of the monetary policy. Moreover, the optimal coefficients in a basic Taylor rule for the interbank rate are hardly affected when the reserve requirement is allowed to respond optimally to inflation and output.

Literature on monetary transmission mechanism in Pakistan is confined mostly to studying the interest rate channel. Majority of these studies reported complete pass-through of SBP policy rate to the lending rate and no or incomplete pass-through to the deposit rate. We refer to Omer et al. (2014) for detailed review of literature on the interest rate pass-through of the policy rate.

Rest of this section reviews the recent literature on Pakistan discussing the transmission mechanism of reserve requirement and/or policy rate (discount rate). Table 1 shows the recognized studies on Pakistan investigating the monetary policy tool's pass through to retail rates. The table suggests that the most of the studies evaluating the transmission mechanism in Pakistan assessed only interest rate channels. Only Omer et al. (2014) has investigated the pass-through of the reserve requirements to the retail rates and reported that these pass through are significant but incomplete. Their findings show that almost 23 percent of a shock to required reserve passes to the lending rate in the long run. The pass through to the deposit rate is slightly higher and almost 32 percent of this shock passes to the

deposit rate in the long run. Moreover, their findings suggest that pass through of the required reserve to exchange rate is also significant but incomplete.

Table 1. Literature on Interest Rate Pass through to Retail Rates in Pakistan

Study	Period	Instrument	Method	Pass through estimates			
				Short run		Long run	
				Lending rate	Deposit rate	Lending rate	Deposit rate
Omer *at al.* (2014)	2004:07-2011:12	6-m TB rate	VAR	0.343*	0.267**	0.928*	0.586
		Required reserves		0.065*	0.099*	0.232*	0.322*
Fazal and Salam (2013)	2005:06 - 2011:05	6-m TB rate	VECM	0.3727*	0.3058*	0.887*	0.657*
Hanif and Khan (2012)	2001:07 - 2011:08	1-wk KIBOR	ARDL	0.3	0.13	0.91	0.64
Mohsin (2011)	2001:11 - 2011:03	DR	PC	0.1	0.16	0.2	Nil
Khawaja and Khan (2008)	1991:06 -2008:06	TB rate	TFA	Nil	Nil	0.43[3]	0.164
Qayyum et al. (2006)	1991:03 -2004:12	TB rate	TFA	Nil	0.18	0.41[2]	0.223[1]
SBP (2005)	1999:07-2006:06	TB cut-off rate	ARDL	0.198	0.044	0.987	0.444

*significant at 5 percent.
TB: Treasury Bill, DR: Discount Rate, KIBOR: Karachi Interbank Offered Rate, ARDL: Auto Regressive Distributed Lags, TFA: Transfer Function Approach, PC: Panel Cointegration. VAR: Vector Auto Regression, VECM: Vector Error Correction Mechanism, Nil indicates no pass through detected.

[1] Pass through to the saving deposit rate (deposit with less than 6-month maturity), while long-run pass through takes around 3 years to complete. [2] No short-run pass through and long-run pass through requires one and half to two years to complete. [3] Long-run pass through requires one to one and half years. [4] Long-run pass through requires one year.

The findings of most of the studies investigating the interest rate channel of monetary transmission mechanism, except for Mohsin (2011), suggest that the discount rate pass-through in the long run is almost complete for the lending rate, but sticky and often incomplete for the deposit rate. Interestingly, findings of recently concluded studies [Omer et al. (2014); Fazal and Salam (2013) and; Hanif and Khan (2012)] are consistent in reporting around 90 percent pass through of interest rate to the lending rate and around 60 percent pass through to the deposit rate in the long run. In contrast, the studies concluding in 2000s or earlier reported much lower estimates of interest rate pass through indicating that perhaps these pass through are strengthening over time due to imposition of regulatory deposit rate. SBP advised the banks to pay a minimum return of five percent on all savings products from 1st June 2008. The regulatory deposit rate increased to 6 percent on May 01, 2012.

4. Model and Methodology

Time series data are generally subjected to unit root tests to explore the stationarity of the variables involved in the model. Often policy intervention causes structural shift due to which conventional unit root tests fail to reject the null hypothesis. To ascertain the order of integration of the variables under study, the variables are subjected to unit root tests with structural shifts.

We employ the vector auto regressions (VAR) methodology for estimating the relationships between the policy tools (the required reserves and the discount rate) and the impact variables (the lending rate, the deposit rate, and the (growth rate of) exchange rate). We use levels of all variables in the VAR. The VAR methodology presumes that all regressors are endogenous, where variables are explained by their lags. A VAR for N variables of order p is written as

$$Z_t = \mu + \Psi(L)Z_{t-p} + \xi_t, \quad (1)$$

where $Z_t = (z_{1t}, z_{2t}, ..., z_{Nt})'$ represents a vector of (N×1) variables, $\Psi(L)$ is a lag polynomial of order p, while ξ_t is (N×1) unobservable zero mean white noise vector process. The optimal lag length k is selected using the HQ criterion (Lütkepohl and Kratzig, 2004). The coefficients of the first lag of the policy tools of the VAR estimates shows the immediate impact of changes in the policy tool, generally termed as the short-run pass-through of policy tools. The long-run pass-through coefficient $\hat{\beta}$ for the impact variable is found by aggregating and normalizing the short-run coefficients. To illustrate this for a bivariate VAR system with two lags, such as:

$$\begin{pmatrix} Z_{1t} \\ Z_{2t} \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix} + \begin{pmatrix} \Psi_{11}^1 \Psi_{12}^1 \\ \Psi_{21}^1 \Psi_{22}^1 \end{pmatrix} \begin{pmatrix} Z_{1t-1} \\ Z_{2t-1} \end{pmatrix} + \begin{pmatrix} \Psi_{11}^2 \Psi_{12}^2 \\ \Psi_{21}^2 \Psi_{22}^2 \end{pmatrix} \begin{pmatrix} Z_{1t-2} \\ Z_{2t-2} \end{pmatrix} + \begin{pmatrix} \xi_{1t} \\ \xi_{2t} \end{pmatrix}$$

we compute the long-run coefficient by:

$$\hat{\beta}_1 = \frac{\sum_{p=1}^{2} \Psi_{12}^p(L)}{1 - \sum_{p=1}^{2} \Psi_{11}^p(L)} \quad (2)$$

where $\Psi_{11}(L)$ are the coefficients of the lagged dependent variable and $\Psi_{12}(L)$ are the coefficients of the explanatory variables of interest.

5. Data

Generally, monetary policy instruments lack enough variability to be used in a meaningful empirical analysis. Reserve requirements as well as discount rate, typically suffer from this problem. We use the effective reserve requirements as a proxy which is a weighted average of the cash reserve requirements and the statutory liquidity requirements. Following the literature on monetary policy transmission in Pakistan, we use the 6-month Treasury bill rate (6MTBR) as a proxy for the monetary policy rate (Agha et al., 2005; Qayyum et al., 2006; Khawaja and Khan, 2008; Omer et al., 2014 & 2015).[9]

We use monthly data from July 2004 to September 2015 as data on the incremental lending and deposit rates are available since July 2004 only. The lending and the deposit rates used are weighted averages of rates offered by banks on new loans and deposits, using amounts as weights, in any given month. We use the growth rate of the exchange rate, as the pass-through estimation requires that variables used have the same unit of measurement. All data have been kindly provided by the SBP.

6. Results

Table 2 provides the results of the conventional unit root tests, as well as unit root tests that allows for structural breaks. The results suggest that except for lending rate all variables are level stationary. For instance, the null hypothesis of unit root is rejected at five percent level of significance for the deposit rate (Dickey-Fuller test) and for the required reserves (innovative outlier test). However, the null

[9] Speeches of Dr. Ishrat Hussain, former Governor of SBP, suggested that 6m Treasury bill rate was used for benchmarking purposes during his tenure; which also substantiate its use as a proxy for the policy rate.

hypothesis of unit roots cannot be rejected for the lending rate. This is in contrast to the widely accepted notion that interest rates are level stationary. To test the robustness of the result, we dropped a few observations and then conducted the unit root test. The result suggests that the DGP of the lending rate series is stationary.[10] Therefore, for our full sample analysis, we treat lending rate as a stationary series.

Table 2. Unit root test results

	Without structural break				**With structural break**					
	Dickey-Fuller test		**Philips-Perron test**		**Additive outlier test**			**Innovative outlier test**		
	No trend	**Trend**	**No trend**	**Trend**	**Stats**	**No of breaks**	**Dates**	**Stats**	**No. of breaks**	**Dates**
Lending rate	-1.812	-1.360	-2.391	-1.557	-3.505	2	Jul-08, May-12	-3.999	2	Mar-08, Jun-12
Deposit rate	-2.9*	-2.139	-2.752**	-1.87						
Discount rate	-2.107	-1.460	-2.988*	-1.783						
Required reserves	-1.949	-2.207	-2.142	-2.408	-3.492	2	Nov-08, Apr-13	-5.518*	2	Mar-08, Aug-08
Exchange rate growth	-2.823**	-2.831	-9.272*	-9.24						
**5% C. V*										
No break	-2.911	-3.476	-2.9	-3.463						
2-breaks					-5.490			-5.490		
***10% C.V.*										
No break	-2.590	-3.166	-2.585	-3.158						
2-breaks					-5.24			-5.24		

Notes: The additive outlier test assumes a sudden break while the innovative outlier test assumes a break in trend. The null hypothesis of the ADF or PP test is that the series has a unit root, while for the Clemente et al. (1998) test the null is that the series has a unit root with structural breaks. Dates indicate break dates and should be read as month and year.

The break dates identified by the unit root tests are different for each variable indicating that different policy moves by the central bank may have had different impacts on these variables. We incorporate only two shifts, the breaks in June 2008 and September 2011. Anecdotal evidences suggest that a structural shift has occurred in the financial system of Pakistan on these dates. For instance on 1st June 2008, SBP imposed a five percent minimum regulatory deposit rate, to be paid to the depositors, on all savings products. Moreover after May 2008, SBP relaxed the reserve requirements, which remains almost unchanged since November 2008 (Omer et al., 2015). The central bank is conducting its monetary policy since then using the discount rate only (see Table A1 in Appendix). The second break date captures the impact of surprise cut by SBP in the discount rate, by 150 bps, in October 2011. As SBP mostly focuses on the demand management, this 150 bps cut was related to relaxing the supply side constraints, which led to the reversal in the financial market's interest rate expectation (see Section 2 for details). Moreover following the improvements in the macroeconomic indicators, this cut may have forced banks to revise their risk perception of public and private credit. Following Glynn et al. (2007), we include both shift and pulse dummies (change in the shift dummy) for treating the structural shifts in our VAR models.

Tables A2, A3, and A4 (in the Appendix) present the detailed estimates of the VAR models showing the short-run (the upper panel) and long-run (the lower panel) impact of the changes in policy rates on the lending rate, the deposit rate, and the exchange rate respectively. Various diagnostic tests are

[10] Philips-Perron unit root test on data 2004:07 -2011:07 suggest that the lending rate is level stationary at 10 percent level of significance.

applied to each model, the results of which are provided in Table A5, also in the Appendix. Although the assumption that the residuals are normally distributed is often rejected, we analyze deviations from normality using a non-parametric Kernel density estimation procedure.[11] The kernel density estimates suggest that the residuals deviation from normality is generally marginal and can be ignored without significant implications on inferences.

Table 3: Long run Estimates for Interest Rate Pass Through For Policy Tools

Dependent variable	**Lending rate**	**Deposit rate**	**Exchange rate**
	Policy tool: required reserve		
Model #	1	2	3
Required reserve ratio	0.4792**	0.3018*	-0.3249*
	[0.085]	[0.002]	[0.000]
Intercept	0.752	-1.5703	7.1036*
	[0.901]	[0.467]	[0.001]
Break Dummy – June 2008	3.952*	3.1397*	-1.2191*
	[0.000]	[0.000]	[0.008]
D(Break– June 2008)	12.6964**	-0.427	1.6487
	[0.065]	[0.811]	[0.397]
Break dummy – Aug 2011	-5.2921*	-1.9715*	0.2764
	[0.000]	[0.000]	[0.461]
D(Break – Aug 2011)	1.452	1.3877	1.8587
	[0.732]	[0.411]	[0.297]
	Policy Tool: Interest Rate		
Model #	4	5	6
6MTBR	0.9037*	0.4892*	-0.0226
	[0.000]	[0.001]	[0.876]
Intercept	2.8089**	1.0297	-0.1205
	[0.016]	[0.422]	[0.921]
Break dummy – June 2008	0.0629	0.6359	-0.1941
	[0.924]	[0.396]	[0.806]
D(Break– June 2008)	7.7251*	3.9208**	-1.7914
	[0.016]	[0.098]	[0.400]
Break dummy – Aug 2011	-1.693**	-0.9455	0.0826
	[0.006]	[0.133]	[0.889]
D(Break – Aug 2011)	-0.7656	0.8407	2.5141
	[0.676]	[0.694]	[0.252]

Notes: *, **, indicates significance at 5 and 10 percent levels respectively. The coefficients are long-run pass-through estimates of shocks to the regressors (policy variable and excess liquidity) on the impact variables (lending rate, deposit rate, and exchange rate) as calculated by Equation 2.

Table 3 provides the long-run pass-through estimates and will be discussed in sub-sections, subsequently. The upper panel shows the estimates for the required reserves while the lower panel shows the estimates for policy interest rate. It is important to note that the dummies for the structural breaks are significant in most of the cases supporting our argument that structural shift had occurred in the interbank market of Pakistan in June 2008 and in September 2011. Therefore, studies on monetary transmission in Pakistan may produce misleading inferences by ignoring these shifts if the data span covers 2008 and 2011.

[11] Kernel density estimators, similar to histograms, approximate the density $f(x)$ from observations on x. The data are divided into non-overlapping intervals, and counts are made of the number of data points within each interval.

6.1 Pass-through to the lending rate

Model (1) in Table 3 shows the estimate for the long-run pass-through from required reserves to the lending rate. The required reserve coefficient is 0.48 and significant only at 10 percent level, indicating that only 0.48 percent of the unit shock to the required reserves is weakly transmitted to the lending rate in the long run. The low and incomplete long-run pass-through of required reserves to the lending rate is understandable.

Intuitively, the lending rate should be more responsive to the changes in the operational cost i.e., the required reserves. However in this case, banks preferred absorbing increase in the reserve requirement instead of passing to the consumers. As discussed in Section 2, change in the reserve requirement is sourced from the changing composition of demand and the time liabilities. More precisely, effective reserve requirement increases when demand liability increases and/or time liability decreases. In a declining interest rate environment, banks prefer to accept demand deposits, which invite reserve requirements, and resists time deposits, which is free of reserve requirement (see Table A1 in Appendix). By doing so, bank are mitigating interest rate risk specifically following the rate cut in August 2011, albeit by paying cost in terms of increased reserve requirement.

The coefficient of models (4) in Table 3 shows the long run pass-through of the discount rate to the lending rate. The pass though of policy interest rate to the lending rate is complete and significant at the five percent level. Nearly 0.91 percentage-points of a unit shock to the discount rate significantly passes to the lending rate in the long run.[12]

6.2 Pass-through to the deposit rate

Model (2) in Table 3 shows the long-run pass-through of required reserve to the deposit rate, which is low and significant. Almost 0.30 percentage point of a unit shock to required reserves passes to the deposit rate in the long run. Our deposit rate's pass through estimate is consistent with the findings of Omer et al. (2014), which despite using relatively shorter data span, reported that 32.2 percent of shock to reserve ratio passes to the deposit rate in the long run.

Models (5) in Table 3 show that the pass-through of the discount rate to the deposit rate is significant at five percent level. The result suggests that almost 49 percent of a shock to the discount rate passes to the deposit rate. Our result of discount rate's pass through to deposit rate is consistent with the findings of Fazal and Salam (2013); and Hanif and Khan (2012), which reported significant but relatively higher pass through. Our result suggests that the pass through of the discount rate may have improved in Pakistan over the years perhaps, due to imposition of the regulatory deposit rate.[13]

[12] The lower panel of Table A2 (model (1), and (4) in grey) shows the results for the model in which the causality runs in the opposite direction. These results suggest that the lending rate effects the discount rate only in the long run which is not surprising. Monetary policy may not remain exogenous in long run. Contrary to the discount rate, long run impact of the lending rate on the reserve requirement ratio cannot be substantiated with the results.

[13] The lower panel of Table A3 (model (2), and (5) in grey) shows the results for the model in which the causality runs in the opposite direction. These results suggest that neither discount rate nor the reserve requirement ratio affects the deposit rate in the long run.

6.3 Pass-through to the exchange rate

Model (3) in Table 3 shows the pass-through of required reserves to the (growth in) exchange rate. The coefficient is significant at the five percent. A one percent increase in required reserves ratio leads to a 0.33 percentage point appreciation in Pakistan rupee against the US Dollar. This result is very different from the outcome of Models (6) in Table 3 which show the long-run pass-through estimates of the discount rate to the exchange rate is insignificant. More precisely, the discount rate has no influence on the exchange rate in the long run.[14]

From policy perspective, given its significant impact, the reserve requirement is better tool to deal with the speculative pressure on the exchange rate, whereas the discount rate appears completely ineffective in preventing such attacks. We do not see this dynamics changing anytime soon with the introduction of the interest rate corridor and new 'Target policy rate', as interest rate targeting, at least in its philosophy, is least concerned with the volatility in the exchange rate. Moreover, our result is in sharp contrast to the widely perceived notion among the policy makers that monetary tightening by raising discount rate (policy interest rate) helps in stabilizing the exchange rate.

7. Conclusion

We have investigated the effectiveness of the monetary policy tools in Pakistan by studying their pass through to the retail interest rates (the lending rate and the deposit rate) and the exchange rate, using monthly data from July 2004 to September 2015. Our findings suggest that the pass-through of the required reserves to the retail rates is significant but incomplete. Nevertheless, required reserves ratio's pass through to the lending rate is weakly significant indicating that banks prefer absorbing the shocks to the reserve requirement, specifically in a declining interest rate scenario. Not surprisingly, the pass through of the discount rate to the lending rate is complete while the same to deposit rate appears incomplete.

Our results suggest that the required reserve is a more powerful policy tool for stabilizing exchange rate shocks than the discount rate. Pakistan has limited capital account convertibility, which limits banks' ability to invest in the foreign assets. When the SBP increases reserve requirements, banks substitute their foreign currency holdings with cash liquidity or government securities. This limits room for banks' to maneuver in the foreign exchange market. Even if the central bank is not actively changing the reserve requirement ratio, the changing composition of liabilities due to increase in demand and/or decrease in time liabilities change effective reserve requirements. Probably, this ingrained reserve requirement effectiveness may have prevented speculative attacks on the exchange rate in recent past. It is not surprising that exchange rate remained more or less stable since 2008. We, therefore, conclude that it is not advisable for the state Bank of Pakistan to overlook the reserve requirement ratio as a policy tool.

Moreover, the result indicates that structural shifts have occurred in the interbank market of Pakistan in June 2008 and in September 2011. Therefore, studies ignoring these shifts may produce misleading inferences on monetary transmission in Pakistan if their data span covers 2008 and 2011. Finally, some caveats are in order. First, our results do not show an isolated picture of the impact of any of the monetary policy tool. Central banks sometime use both required reserve ratio and the policy rate simultaneously, and it is not useful to study the impact of any of them in isolation. Second, the

[14] The lower panel of Table A4 (model (3), and (6) in grey) shows the results for the model in which the causality runs in the opposite direction. These results suggest that neither discount rate nor the reserve requirement ratio effects the exchange rate in the long run.

literature on monetary policy pass-through suggests that pass-through is often different for positive and negative changes in the policy tools. We leave this issue of (possibly) asymmetric pass-through for future research.

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Appendix

Table A1. Changes in policy instruments since 2005

Date	CRR				SLR		Discount Rate
	Demand liabilities		Time liabilities		Demand liabilities	Time liabilities	
	Weakly average	Daily minimum	Weakly Average	Daily minimum			
31-Dec-05	5.0	4.0	5.0	4.0	15.0	15.0	9.0
22-Jul-06	7.0	4.0	3.0	1.0	18.0	18.0	
29-Jul-06							9.5
19-Jan-07	7.0	6.0	3.0	2.0			
1-Aug-07							10.0
4-Aug-07	7.0	6.0	0.0	0.0	18.0	18.0	
2-Feb-08	8.0	7.0					10.5
24-May-08	9.0	8.0			19.0	19.0	12.0
30-Jul-08							13.0
11-Oct-08	8.0	7.0					
18-Oct-08	6.0	5.0					
1-Nov-08	5.0	4.0					
13-Nov-08							15.0
21-Apr-09							14.0
15-Aug-09							13.0
25-Nov-09							12.5
2-Aug-10							13.0
30-Sep-10							13.5
30-Nov-10							14.0
1-Aug-11							13.5
10-Oct-11							12.0
13-Aug-12							10.5
8-Oct-12							10.0
12-Oct-12	5.0	3.0					
17-Dec-12							9.5
11-Feb-13							9.5
24-Jun-13							9.0
16-Sep-13							9.5
18-Nov-13							10.0
17-Nov-14							9.5
26-Jan-15							8.5
24-Mar-15							8.0
25-May-15							7.0
14-Sep-15							6.5

The table provides the chronological order of changes in policy instruments.

Table A2: Estimates of Policy Impact on Lending Rate

Model #	(1)	(1)	(4)	(4)
Dependent variable	**Lending rate**	**Required reserve**	**Lending rate**	**Discount rate**
Policy tool	Required reserve	Lending rate	Discount rate	Lending rate
Lag selection criteria	HQ	HQ	HQ	HQ
No of lags	(1,1)	(1,1)	(3,3)	(3,3)
Lending rate (-1)	0.9245*	-0.0301	0.8272*	0.2565*
	[0.000]	[0.579]	[0.000]	[0.002]
Lending rate (-2)			-0.1489	-0.0937
			[0.181]	[0.389]
Lending rate (-3)			0.1480**	-0.0759
			[0.074]	[0.348]
Discount rate (-1)			0.3617*	1.0752*
			[0.000]	[0.000]
Discount rate (-2)			-0.0904	-0.4305*
			[0.458]	[0.000]
Discount rate (-3)			-0.1142	0.1953*
			[0.200]	[0.025]
Required reserves (-1)	0.0362	0.8725*		
	[0.030]	[0.000]		
Intercept	0.0568	3.3778*	0.4882*	0.5652*
	[0.904]	[0.000]	[0.013]	[0.003]
Break_1	0.2983*	-0.5419*	0.0109	0 .2481*
	[0.018]	[0.038]	[0.924]	[0.027]
D(break_1)	0.9583*	0.8937	1.3427*	0.6887*
	[0.005]	[0.202]	[0.000]	[0.023]
Break_2	-0.3994*	0.1066	-0.2943*	-0.2244*
	[0.000]	[0.625]	[0.002]	[0.018]
D(break_2)	0.1096	-0.1364	-0.1331	-0.8080*
	[0.738]	[0.840]	[0.670]	[0.008]
Long run Pass-Through Coefficients				
Discount rate			0.9037*	
			[0.000]	
Required reserves	0.4792**			
	[0.085]			
Lending rate		-0.2357		0.5430*
		[0.582]		[0.002]

Notes: Gray columns indicate the auxiliary regression showing the reverse direction of presumed relationship. No. of lags read as (dependent variables, policy/impact variable, excess liquidity). * and ** respectively indicates significance at 5 and 10 percent level. HQ and AIC indicates Hannan-Quinn and Akaike Information Criteria respectively. Long-run pass-through estimates are based on Equation 2.

Table A3: Estimates of Policy Impact on Deposit rate

Model #	(2)	(2)	(5)	(5)
Dependent variable	**Deposit rate**	**Required reserve**	**Deposit rate**	**Discount rate**
Policy tool	Required reserve	Deposit rate	Discount rate	Deposit rate
Lag selection criteria	HQ	HQ	HQ	HQ
No of lags	(1,1)	(1,1)	(2,2)	(2,2)
Deposit rate (-1)	0.7614*	-0.0247	0.5288*	0.0366
	[0.000]	[0.760]	[0.000]	[0.597]
Deposit rate (-2)			0.2750*	0.0201
			[0.002]	[0.773]
Discount rate (-1)			0.2069**	1.1448*
			[0.051]	[0.000]
Discount rate (-2)			-0.1109	-0.2544*
			[0.284]	[0.002]
Required reserves (-1)	0.0720*	0.8758*		
	[0.001]	[0.000]		
Intercept	-0.3746	3.1164*	0.2021	0.7395*
	[0.447]	[0.000]	[0.371]	[0.000]
Break_1	0.7491*	-0.5806*	0.1248	0.2324*
	[0.000]	[0.045]	[0.396]	[0.045]
D(break_1)	-0.102	0.922	0.7695**	0.7258*
	[0.813]	[0.191]	[0.057]	[0.022]
Break_2	-0.4704*	0.161	-0.1856**	-0.2900*
	[0.000]	[0.394]	[0.089]	[0.001]
D(break_2)	0.3311	-0.1771	0.165	-0.8030*
	[0.428]	[0.795]	[0.691]	[0.014]
Long run Pass-Through Coefficients				
Discount rate			0.4893*	
			[0.001]	
Required reserves	0.3018*			
	[0.002]			
Deposit rate		-0.1985		0.5164
		[0.767]		[0.108]

Notes: Gray columns indicate the auxiliary regression showing the reverse direction of presumed relationship. No. of lags read as (dependent variables, policy/impact variable, excess liquidity). * and ** respectively indicates significance at 5 and 10 percent level. HQ and AIC indicates Hannan-Quinn and Akaike Information Criteria respectively. Long-run pass-through estimates are based on Equation 2.

Table A4:Estimates of Policy Impact on Exchange Rate

Model #	(3)	(3)	(6)	(6)
Dependent variable	**Exchange rate**	**Required reserve**	**Exchange rate**	**Discount rate**
Policy tool	Required reserve	Exchange rate	Discount rate	Exchange rate
Lag selection criteria	HQ	HQ	HQ	HQ
No of lags	(1,1)	(1,1)	(2,2)	(2,2)
Exchange rate (-1)	0.1748*	-0.0487	0.1838*	0.0148
	[0.045]	[0.282]	[0.033]	[0.454]
Exchange rate (-2)	0.1282	0.1185*	0.1751*	-0.0476*
	[0.136]	[0.008]	[0.042]	[0.016]
Discount rate (-1)			-0.0608	1.1598*
			[0.861]	[0.000]
Discount rate (-2)			0.0463	-0.2276*
			[0.887]	[0.002]
Required reserves (-1)	-0.7076*	0.9330*		
	[0.000]	[0.000]		
Required reserves (-2)	0.4812*	-0.0464		
	[0.004]	[0.594]		
Intercept	4.9512*	2.7658*	-0.0773	0.6503*
	[0.003]	[0.001]	[0.921]	[0.000]
Break_1	-0.8497*	-0.5715*	-0.1245	0.2069**
	[0.014]	[0.001]	[0.806]	[0.075]
D(break_1)	1.1491	0.9215	-1.1486	0.6961*
	[0.385]	[0.180]	[0.406]	[0.028]
Break_2	0.1927	0.1631	0.0529	-0.2733*
	[0.464]	[0.233]	[0.889]	[0.002]
D(break_2)	1.2955	-0.1636	1.612	-0.8395*
	[0.286]	[0.796]	[0.240]	[0.007]
Long run Pass-Through Coefficients				
Discount rate			-0.0226	
			[0.876]	
Required reserves	-0.3249*			
	[0.000]			
Exchange rate		-0.8587		-0.4842
		[0.259]		[0.237]

Notes: Gray columns indicate the auxiliary regression showing the reverse direction of presumed relationship. No. of lags read as (dependent variables, policy/impact variable, excess liquidity). * and ** respectively indicates significance at 5 and 10 percent level. HQ and AIC indicates Hannan-Quinn and Akaike Information Criteria respectively. Long-run pass-through estimates are based on Equation 2.

Table A5. Diagnostic Checks of the Estimated Relationship

Model #	(4)	(5)	(6)	(1)	(2)	(3)
Dependent variable	**Lending rate**	**Deposit rate**	**Exchange rate**	**Lending rate**	**Deposit rate**	**Exchange rate**
Policy instrument	Discount rate			Required reserve		
Serial correlation	3.599	1.59	1.857	0.732	1.808	0.813
	[0.462]	[0.810]	[0.762]	[0.947]	[0.770]	[0.937]
Normality	19.453	21.623	286.061	11.383	22.126	48.892
	[0.000]	[0.844]	[0.000]	[0.003]	[0.000]	[0.000]
EV Stability Condition	Yes	Yes	Yes	Yes	Yes	Yes

Notes: For VAR models, serial correlation is tested using the LM test. For checking stability of VAR models, Eigen value stability conditions are applied which requires that the Eigen value of matrix A should be strictly less than one (Lütkepohl, 2005). The serial correlation test is the Breusch-Godfrey test up to 12 lags. The normality of residuals is tested using the Jarque-Bera test.