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Should Central Bank Forget Reserve Requirements? Analysis of Policy Tool's Pass-through in Pakistan

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Abstract: *We investigated the effectiveness of the 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 managing the lending rate and stabilizing the exchange rate shocks, than discount rate. We, therefore, recommend central banks to not to ignore the reserve requirement ratio as an active policy tool, specifically when exchange rate is under speculative attack.*

JEL Classification: E5, E52, E58

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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 (Sharpe and Watts, 2013). This crisis, however, also has renewed interest in exploring the effectiveness of conventional monetary policy tool like reserve requirement ratios and policy interest rates. Often, effectiveness of the central bank's policy rate (discount rate) 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 interbank 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. 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).

We further extend this analysis to exchange rate as central banks often aim to stabilize the volatility of exchange rates. An analysis of the response of the exchange rate to a monetary policy shock improves further the understanding of monetary transmission mechanism (Disyatat and Vongsinsirikul, 2003; and Aleem, 2010). Like other central banks, SBP does not openly pay attention to the exchange rate however, McKinnon (1995), Clarida and Gertler (1997), and Clarida (2001) documented the interest of the central banks' in the exchange rate developments. The use of monetary policy tools in tandem with the speculative pressure on the Pakistan rupee-US dollar exchange rate often fuels perception of (de facto) fixed exchange rate policy employed by SBP. Our study evaluates the

effectiveness of required reserves ratio and discount rate in managing the exchange rate, which may improve further our understanding of 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 the policy rates to the retail rates in Pakistan.

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. 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. Besides exchange rate, the discount rate become endogenous to the lending rate in the long run, which limit its effectiveness as a central bank's policy tool. 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, 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. 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).

Practically, an increase in the reserve requirements reduces the availability of the liquid cash with the banks for retail business. The reduced liquidity may impact the profitability of the banks, as greater volume are required to be allocated as non-earning CRR or low earning SLR. Besides, this increases the price of the available liquidity in the interbank market. Increase in the interbank market rate, thus, forces the banks to increase their retail rates accordingly. For this reason reserve requirement is viewed as a direct policy tool, which policy makers restrain from using frequently due to its implication on the profitability of the financial intermediaries.

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

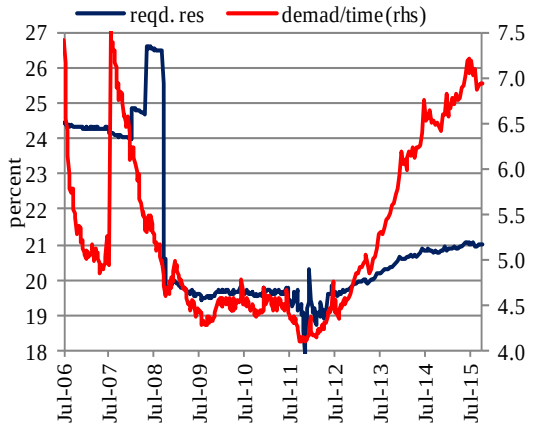
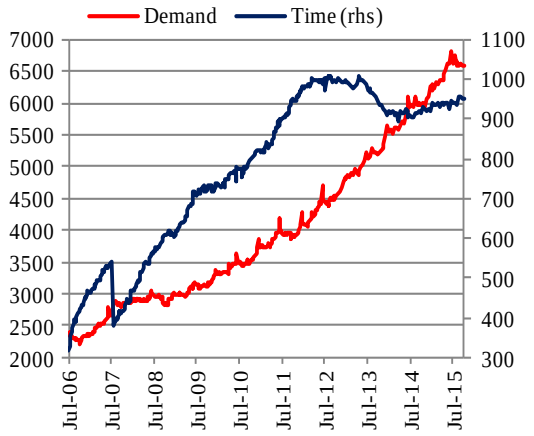


Figure 1B: Time & Demand Liabilities in Pakistan
(billion rupees)



Despite the fact that both CRR and SLR remained unchanged since November 2008, effective reserves requirement (weighted average of reserve requirement ratios on 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).[2] 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

[2] See Table A1 in Appendix

liability ratio (Figure 1A). This changed liability composition, once again, pushed the effective reserve requirements of banks substantially higher (see Figure 1A).

Nevertheless, the effectiveness of the SLR declined in recent years when banks parked their funds, more than the statutory requirements, in the government securities.[3] Private sector's perceived credit default risk increased as Pakistan experienced slowdown in economic activity after the global financial crisis. Consequently, 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 Pakistan's case, even it is possible that retail rates may have influenced the effective reserves requirement. For example, as time deposits are exempted from reserve requirements, increase in the deposit rate may increase the demand deposit and hence increase the effective reserve requirements for the banks.

In contrast to the reserve requirement, the policy rate passed through various phases between 2005 and 20015. Theoretically, increase in the policy rate is likely to increase the borrowing cost of the banks in the interbank market. This increase in the borrowing cost translates into the lending and the deposit rates. In short, 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 kept the reserve requirement ratios unchanged and conducted the monetary policy using the discount rate only.

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, such as Lim et al. (2011), Glocker and Towbin (2012), Palley (2004), and León and Quispe (2010) evaluated the effectiveness of the reserve requirement as a macro prudential instrument in reducing the systemic risk in developing economies. 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

[3] For detail see Omer *et al.* (2015).

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.

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
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.

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 smoothened the 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 auto regression (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 (see Table1). The findings of these studies, 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 [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 the data generating process of the variables involved in the model (Doojav and Kalirajan, 2016). Often policy intervention causes structural shift due to which conventional unit root tests may fail to reject the null hypothesis. To ascertain the stationarity of the series, all variables are subjected to unit root tests with structural shifts, as well.

Given the time period considered for this study, we suspected that more than one ship may have occurred in our data sample. For this reason, we opted for Clemente et al. (1998), which provides a robust unit root test that allows for two structural breaks. This test distinguishes two types of outliers: an additive outlier and an innovative outlier. The additive outlier test checks if there is a sudden change in the mean, while the innovative outlier test assess if the change is gradually taking place.

We employ the vector auto regressions (VAR) 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]. All variables in the VAR employed at level. As VAR methodology presumes that all regressors are endogenous and explained by their lags, an N variable VAR with p order can be is written in simplest form as,

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

where $Z_t = (z_{1t}, z_{2t}, ..., z_{Nt})'$ represents a vector of (Nx1) variables, $\Psi(L)$ is a lag polynomial of order p, while ξ_t is (*Nx1*) 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 show the short run pass-through of policy tools. However, we are interested in the long run coefficients as the policy shock transmits to the longer end of yield curve with some lags. Moreover, it is permanent impact of the policy shocks on the long term interest rates which helps households and the businesses to make their saving and investment decisions. The long-run pass-through coefficient $\hat{\beta}$ for the retail rates 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:

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

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 variability which limits their use 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 as a proxy for the monetary policy rate (Agha et al.,2005; Qayyum et al., 2006; Khawaja and Khan, 2008; Omer et al., 2015).[4]

[4] Speeches of Dr. Ishrat Hussain, former Governor of SBP, suggest 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.

Table 2. Result of Unit root test

	Without structural break tests				With structural break					
	Dickey-Fuller		Philips-Perron		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% Critical Value*										
No Break	-2.911	-3.476	-2.9	-3.463						
2-breaks					-5.490			-5.490		
***10% Critical Value*										
No Break	-2.590	-3.166	-2.585	-3.158						
2-breaks					-5.24			-5.24		

Notes: the null hypothesis of unit root tests is that the series has a unit root. Unit root test with structural breaks assumes either additive outlier (sudden break) in the series, or innovative outlier (break in trend). Break dates are given in the column Dates and should be read as month and year.

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 are reported by SBP as weighted averages of rates offered by banks on fresh loans and deposits. The volume of loan disbursed or deposit raised in any given month are used as weights. Moreover as variables used in the pass-through estimation are required to have same unit of measurement, we use the growth rate of the exchange rate.

6. Results:

The results of the conventional unit root tests and unit root test with structural breaks are reported in Table 2. 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 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

test again. The result suggests that the DGP of the lending rate series is stationary.[5] Therefore, for our full sample analysis, we treat lending rate as a stationary series.

Unit root test with structural breaks identified different breaks for different variables indicating that the central bank's different policy moves may have effected these variables differently. We incorporate only two shifts, the breaks in June 2008 and September 2011. Anecdotal evidences suggest that Pakistan's financial system may have witnessed a structural shift 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 in the discount rate by 150 bps, by SBP, 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 theirrisk perception of public and private credit. We include both shift and pulse dummies (change in the shift dummy) for incorporating these structural shifts in our models, following the recommendation of Glynn et al. (2007).

The detailed VAR estimates are provided in Tables A2, A3, and A4 (in the Appendix), 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. We used various diagnostic tests to validate our results, the detail of which is provided in Table A5, also in the Appendix. Though normality test rejected the null hypothesis that residuals are normal in most of the cases, the finding is not surprising given the limitation of these tests for short sample. We used non-parametric Kernel density estimation procedure to analyze the deviations from normality.[6] The kernel density estimates suggest that the residual's deviation from normality is generally marginal and can be ignored without significant implications on inferences.

The long-run pass-through estimates are provided in Table 3 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 October 2011. Though Omer et al., (2015) have identified and highlighted the

[5] 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.

[6] Kernel density estimator uses histograms to 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.

importance of the structural shift in June 2008, this study has identified another shift that occurred in October 2011 in financial market of Pakistan. This latter shift has changed the bank's perception of the risks related to the interest rate and private sector credit. Despite its significant role, this behavioral shift otherwise remained unnoticed until now. Ignoring these shifts may produce consequences on inferences on monetary transmission in Pakistan, if the data span covers 2008 and 2011.

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 percentage point 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, the above result suggests that 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. Banks prefer demand deposits and control the inflow of the time deposits in a declining interest rate environment, though it increases their operational cost. Moreover, banks may be finding it hard to sell to the increase in cost to the retail consumers as declining interest rate instills an expectation of lower retail price on loanable funds.

The coefficient of models (4) in Table 3 shows the long run discount rate's pass-through 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.

Importantly, our result also provides evidence of the long run pass-through of lending rate's shocks to the discount rate. The lower panel of Table A2 [model (1), and (4) in grey] shows the result for the model, in which lending rate explains the discount rate. This result suggests that the discount rate may not remain exogenous in long run when it comes to lending rate. Contrary to the discount rate, the reserve requirement ratio appears exogenous to the lending rate, as long run impact of the lending rate cannot be substantiated.

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 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 in literature as detailed in Table 1.

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**
Discount rate	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 estimates of long-run pass-through of policy shocks on the impact variables i.e., lending rate, deposit rate, and exchange rate, as shown by Equation 2.

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 percentage point 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. Moreover, these results suggest 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. The low

pass-through of the reserve requirement ratio also substantiates the role of the regulatory deposit rate.

Our result do not find any long run impact of the deposit rate on either required reserve ratio or discount rate, as shown in the lower panel of Table A3 [model (2), and (5) in grey].

6.3 Pass-through to the exchange rate

The pass-through of required reserves to the (growth in) exchange rate is shown with Model (3) in Table 3. A growth in exchange rate suggest deprecation in Pak rupee while a decline in the exchange rate indicates the appreciation of the Pak rupee against US dollar. The coefficient is significant at the five percent indicating that one percent increase in required reserves ratio appreciates Pakistan rupee against the US Dollar by 0.33 percentage point. This result is very different from the findings of Models (6) in Table 3 which show the insignificant long-run pass-through of the discount rate to the exchange rate. More precisely, the discount rate has no influence on the exchange rate in the long run.

The lower panel of Table A4 (model (3), and (6) in grey) shows the results for the long run impact of the exchange rate on the monetary policy tools. These estimates failed to provide any significant evidence of long run pass-through in this reverse direction, like deposit rate.

Given its significant impact, the reserve requirement is better tool to deal with the speculative pressure on the exchange rate from policy perspective, 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'. At least in its philosophy, interest rate targeting 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 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 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. However, required reserves ratio's pass through to the lending rate is weakly significant indicating that banks prefer absorbing the shocks to the reserve requirement. Not surprisingly, the pass through of the discount rate to the lending rate is complete while the same to deposit rate appears incomplete. Nevertheless, the discount rate also become effected due to the movement in the long run, which limit its effectiveness as a central bank's policy tool.

Besides, our results suggest that the required reserve is a more powerful policy tool for

stabilizing exchange rate shocks than the discount rate, specifically for Pakistan. Pakistan has limited capital account convertibility, which limits banks' ability to invest in the foreign assets. When the SBP increases reserve requirements, anecdote suggests that the 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 influences the 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.

Our result indicates that structural shifts have occurred in the interbank market of Pakistan in June 2008 and in September 2011. More specifically, this study has identified the significant shift that occurred in October 2011 in financial market of Pakistan which may have changed the bank's perception of the risks associated with the banking sector. Ignoring these important 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 when both instruments are used simultaneously. We believe that the conditional estimates of the pass-through will be not be very different from ours. Second, the 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 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

Notes: The figures in CRR and SLR columns are percent of time and demand liabilities while figures with discount rate are in percent.

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: Auxiliary regression showing the reverse direction of relationship is shown in Gray columns. No. of lags should be read as (dependent variables and policy/impact variable). * and ** indicates 5 and 10 percent level of significance, respectively. HQ and AIC are Hannan-Quinn and Akaike Information Criteria, respectively. Equation 2 shows the calculation of long-run pass-through.

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: Auxiliary regression showing the reverse direction of relationship is shown in Gray columns. No. of lags should be read as (dependent variables and policy/impact variable). * and ** indicates 5 and 10 percent level of significance, respectively. HQ and AIC are Hannan-Quinn and Akaike Information Criteria, respectively. Equation 2 shows the calculation of long-run pass-through.

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: Auxiliary regression showing the reverse direction of relationship is shown in Gray columns. No. of lags should be read as (dependent variables and policy/impact variable). * and ** indicates 5 and 10 percent level of significance, respectively. HQ and AIC denotes respectively Hannan-Quinn and Akaike Information Criteria. Equation 2 shows the calculation of long-run pass-through.

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 serial correlation, Breusch-Godfrey test, up to 12 lags is used. The stability of coefficients in VAR model is checked with Eigen value stability conditions, which requires the Eigen value of matrix A to be strictly less than one (Lütkepohl, 2005). The normality of residuals is tested using the Jarque-Bera test. The kernel density estimates suggest that the residuals deviation from normality is generally marginal and can be ignored without significant implications on inferences.