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BANK HETEROGENEITY IN INTEREST RATE PASS-THROUGH: A PANEL EVIDENCE FROM PAKISTAN

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ABSTRACT

This article examines the role of bank-level characteristics in determining the nature of interest rate pass-through from monetary policy rates to commercial banks' lending rates in Pakistan. Several bank-level factors, namely market size, liquidity, capitalisation, profitability, and competition level, were used in analysing the pass-through mechanism. This study utilised a dynamic heterogeneous panel technique, namely the Pooled Mean Group (PMG) estimation for the sample of 12 private commercial banks, over the time span 2003:Q2 to 2015:Q4. Banks of smaller size, large capital, and higher liquidity were significantly affecting the interest rate pass-through procedure. Thus, to improve monetary policy's transmission mechanism, Pakistan's central bank should limit bank capitalisation and draw out excess liquidity from the banking sector.

Keywords: interest rate pass-through, monetary policy transmission, bank heterogeneity, Pooled Mean Group, Pakistan

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INTRODUCTION

The stabilisation capacity of a central bank relies on the effectiveness of the monetary transmission mechanism. A typical monetary transmission process involves the financial intermediaries (i.e., commercial banks) to carry on monetary decisions for the real sector. Since the central bank holds the leverage to alter the short-term interest rates, it affects banks' lending rates and, subsequently, influences commercial banks' abilities to provide loans. In reality, the pass-through procedure from short-term interest rates to commercial banks' lending rates is often sluggish and incomplete. Due to the heterogeneity involved in banking structure, the commercial banks are commonly heterogeneous in terms of their market size, liquidity, capitalisation, profits and competition level. These financial rigidities act as a buffer against the monetary policy shocks.

This study examines the nature of interest rate pass-through in a developing economy (i.e., Pakistan) through bank heterogeneity as mentioned above. By uncovering the role of these bank-level characteristics, this study directly contributes to the relevant literature through assisting Pakistan's monetary policy committee in determining the factors responsible for incomplete pass-through and in suggesting the policy-relevant measures to adopt.

Previous studies on interest rate pass-through procedure were mainly concentrated on developing economies, particularly European countries, where the financial markets are relatively large and more developed. However, unlike these markets, the financial structure in developing economies is generally different in two ways. First, the financial markets in developing economies often comprise limited numbers of banks that reflect monopolistic behaviour. Second, their institutional framework is considered weak, which in turn increases the cost of bank loans leading to banks maintaining high lending rates (Mishra et al., 2012). The pass-through process thus may vary according to the given financial structure of the economy.

There is limited evidence on the role of bank heterogeneity in the pass-through procedure of developing and emerging countries. The scarcity of evidence is due to data limitations. Detailed bank-level data are required to undertake such comprehensive analyses, and these data sets are only accessible to monetary authorities. We addressed the literature gap by extending the evidence on the role of commercial banks' characteristics in interest rate pass-through.

Pakistan is an interesting case to study for two main reasons. First, the country has been part of the IMF's global financial sector reforms. The financial structure in Pakistan has shown reasonable progress since the IMF's financial

sector reforms in 1990. The reforms were intended to liberalise the sector through privatisations, strengthening the financial system by prudent regulations, and allowing the efficient disbursement of loans through consumer financing. As a result, the number of private commercial banks increased, thus enhancing banking competition and improved market concentration. Private commercial banks in Pakistan share 70% of total credit to the real sector, and it is the primary channel through which monetary policy can affect the real economy.[1] The second reason for undertaking this study is that Pakistan's central bank has been following the soft monetary policy since 2012 until recently by pushing the policy rate downwards from 10% to 6%. Despite the lowered policy rate during the expansionary phase of monetary policy, the lending rates are still high. The first indication of the policy rate's incomplete pass-through was the suppression of economic growth to below 6% of the annual target (Figure 1).

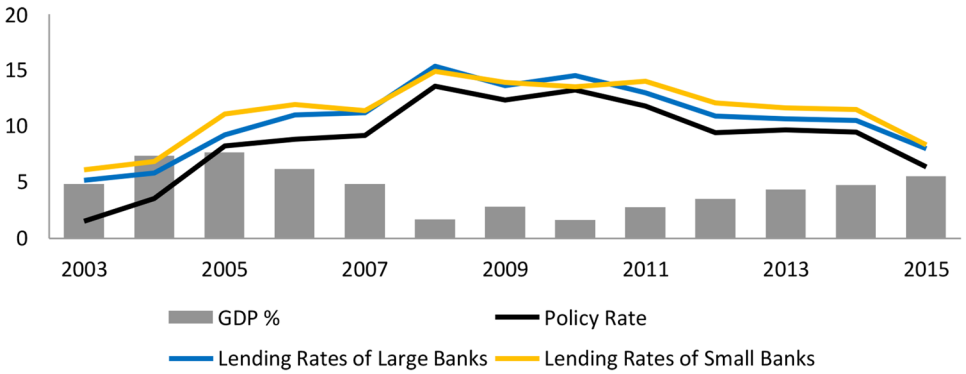

Figure 1. Interest rates in Pakistan

The findings of this study are based on the Pooled Mean Group (PMG) technique, using detailed bank-level data. The PMG approach is theoretically consistent in allowing the short-term bank-level heterogeneity in estimating the long-run pass-through parameters. Our results have shown that interest rate pass-through in Pakistan is significantly sluggish and incomplete, limiting the monetary policy's effectiveness. Further, we found that the banks of smaller size, large market capital and higher-level liquidity reduced the pass-through coefficient and decreased monetary policy's effects on lending rates. We however, failed to find any significant evidence on bank profitability and level of competition. It is advisable to soften the capital adequacy ratio and drain the excess liquidity through open market operations to improve the country's monetary policy transmission mechanism.

LITERATURE REVIEW

The large stream of literature on the interest rate pass-through is concentrated on developed economies, mainly European countries. Since the beginning of a single currency union in Europe, more literature began to focus on the pass-through interest rate with the primary objective of analysing the impact of common monetary policy across Europe's economies. Most of the literature on the Eurozone reported on the sluggish or incomplete bank interest rate pass-through and found that it varies among different categories of interest rates offered over time. For instance, Mojon (2000) empirically showed that bank-level heterogeneity affects the interest rate pass-through in the Eurozone. The short-term bank rates were more reactive to money market rates than medium to long-term rates.

Similarly, Sorensen and Werner (2006) also reported the heterogeneity in the pass-through mechanism of harmonised interest rates in the Eurozone. Hofmann and Mizen (2004) found evidence of asymmetric adjustment of interest rates in the U.K. With growing evidence from these inquiries, the understanding of the sluggish interest rate pass-through gradually began to develop.

Sander and Kleimeier (2004, 2006) applied the monetary policy approach to study the interest rate pass-through in the wider Eurozone. The monetary policy approach in principle examines the relationship of monetary policy rate and bank retail rates more directly by assuming a stable yield curve. They concluded that interest rate pass-through in the Eurozone is subject to the heterogeneity of market performance, banking sector competition, macroeconomic factors, and monetary policy regimes. In contrast to the monetary policy approach, Bondt (2005) and Bondt et al. (2005) developed the fund approach's cost to examine pass-through interest rates. This Eurozone cost relates to the borrowing cost of funds acquired by banks from the money market. The monetary policy influences the money market rates so that the commercial banks will change their rates corresponding to the borrowed cost. Their study suggested a faster pass-through mechanism in the Eurozone following the single euro currency. Moreover, Egert et al. (2007) suggested that adaptation of euro currency will limit the role of heterogeneity in the adjustment process.

Since the global financial crisis, many studies have analysed the interest rate pass-through in Eurozone. Monetary policy rates went historically low in Eurozone to restore macroeconomic and financial stability. Borstel et al. (2016) have explored the interest rate pass-through from monetary policy rates to lending rates in the Eurozone during pre-crisis and post-crisis periods. They found that correlation between policy rates and bank lending rates were reduced

during crises due to increased risks. Similarly, Avouyi-Dovi et al. (2017) found that interest rate pass-through was weakened during most financial crises in the Eurozone countries. Recently Horvath et al. (2018) estimated the interest rate pass-through for the Eurozone throughout 2008–2016 using the heterogeneous panel technique PMG. They found the interest rate pass-through is incomplete for most of the loan categories in the Eurozone.

Apart from cross-country evidence, there are several studies focused on single country analyses. For example, Chionis and Leon (2006) found that interest rate pass-through is incomplete in Greece, even after joining the European monetary union. Graeve et al. (2007) thoroughly accounted for bank heterogeneities' role in modeling the interest rate pass-through in Belgium. The sluggish outcome was associated with transaction cost, price rigidities, and asymmetric information in the financial market. They suggested that incorporating the bank heterogeneity was vital to examine the effects of market rates. Their finding revealed that market size, higher liquidity, and well-capitalised banks were least responsive to changes in money market rates. Similarly, Gambacorta (2008) found bank heterogeneity, in terms of liquidity, capitalisation and relationship lending, as essential characteristics in defining the incomplete pass-through of bank rates in Italy. The studies that found incomplete bank retail rates pass-through on non-European countries were Liu et al. (2008) for New Zealand, Kovanen (2011) for Ghana, Bogoev and Petrevski (2012) for Macedonia, Rocha (2012) for Portugal, Zulkhibri (2012) for Malaysia, Makambi et al. (2013) for Kenya, Das (2015) for India, Matemilola et al. (2015) for South Africa and Liu (2019) for China.

Recent studies have focused on the importance of bank-level heterogeneous factors responsible for sluggish pass-throughs. For instance, Horvath and Podpiera (2012) have estimated the pass-through of bank interest rates in the Czech Republic. They employed the more robust estimation technique of heterogeneous panel cointegration, namely PMG estimation. The advantage of using this estimation is that it allows a higher degree of heterogeneity in the short-run while it imposes homogeneity conditions in the long run. Thus, it is a theoretically consistent and policy-relevant method. Apart from slow pass-through, they also revealed that the bank's specific characteristics like market size, liquidity, credit risks and capitalisation are important factors affecting the sluggishness from market rates to bank rates.

Following the same estimation technique, Jamilov (2015) extensively carried out the inquiry into the factors responsible for limited pass-through in Azerbaijan's small open economy. His study concluded that excess liquidity

and a higher level of capitalisation in the banking sector were the factors that significantly affected the sluggish pass-through of monetary policy to lending rates.

To have an effective transmission of monetary policy, the central bank should somehow limit the capitalisation and liquidity in the banking sector. Recently, Bennouna (2019) also found a high degree of heterogeneity in the interest rate pass-through among Moroccan banks. His findings were based on the heterogeneous panel cointegration technique of PMG and the mean group. Besides the bank-level heterogeneities, Perera and Wickramanayake (2016) accounted for cross-country heterogeneities in 122 countries. They found that bank retail rates were affected by macroeconomic, financial and central bank transparency factors.

Past literature related to interest rate pass-through in Pakistan has been relatively limited and mainly focused on macro-level analyses. There is no single study that has focused on pass-through using bank-level data. As mentioned earlier, bank-level heterogeneous factors have been consistently tested for limited pass-through so that important monetary policy implications can be identified. Specifically, previous studies that employed the transfer function approach, including Qayyum et al. (2005), had found that policy rate pass-through towards bank retail rates exhibited rigidity. Khawaja and Khan (2008) studied the pass-through for different categories of interest rates in Pakistan. They found that the pass-through of six months Treasury bill rate to bank lending and Pakistan's deposit rates was relatively slow or protracted. Mohsin (2011) used a panel cointegration technique to analyse the policy rate on four broad categories of banks. He showed that in all cases, the interest rate pass-through for retail rates was slow. Khan and Hanif (2012) also found evidence of sluggish and incomplete pass-throughs of retail bank rates in Pakistan using aggregate data. Similar findings were also shared by Fazal and Salam (2013).

Overall, the literature on interest rate pass-through for Pakistan reported consistent findings on the mechanism. However, there is a dearth of studies in the literature related to factors responsible for this limited pass-through. As such this study may represent a first attempt to examine the bank-level factors that affect the smooth transition of interest rate changes from monetary policy to bank lending rates. With its enquiry made in this direction, the present study is therefore relevant to the national monetary policy implications. In addition, this study potentially extends the empirical evidence on the role of bank heterogeneity in emerging market economies.

METHODOLOGY

The theoretical underpinnings of the interest rate pass-through procedure are rooted in the loan markup theory proposed by Rousseas (1985). It deals with the adjustment of commercial bank's interest rates to the market interest rates. For instance, commercial banks often borrow from the money market to secure their lending process. The central banks can influence the market interest rates (first stage of pass-through), which affects the commercial banks' interest rates (second stage of pass-through). Bondt (2005) applied the cost of fund approach to this process and described the interest rate pass-through procedures as:

$$i = a_0 + a_1 r \tag{1}$$

In Equation (1), i is an individual bank's lending rate, r is the cost of borrowed loans (i.e., market interest rate), a_0 is a constant markup and a_1 is a pass-through coefficient, which depends on the demand elasticity of deposits and loans with respect to the bank interest rate. If the demand for deposits and loans is not fully elastic, then the parameter a_1 is expected to be less than one ($a_1 < 1$). Secondly, a_1 will also be less than one if banks have some degree of market power, namely size, profit, liquidity, capital and competition level (Sander & Kleimeier, 2004).

The theoretical relationship in Equation (1) can be represented in panel long run autoregressive distributed lag ARDL (p,q) as:

$$i_{i,t} + a_i + \sum_{i=1}^{p} a_i i_{i,t-1} + \sum_{i=0}^{q} b_i r_{t-i} + \varepsilon_{i,t} \tag{2}$$

Following the explanation through the law of one price laid out by Horvath and Podpiera (2012), bank pricing policies are homogenous in the long run but heterogonous in the short run. This is because central banks allow individual banks to practice independent short-run policy in setting up their interest rate to maintain competitiveness in the banking sector. However, these banks have to comply with the essential requirement in the long run, which abides them to follow the central bank's policy in the long run. Following this fact, Equation (2) can be represented in the form of the PMG estimator as suggested by Pesaran et al. (1999). By definition, the PMG technique allows the short run heterogeneity in the model while maintaining the homogeneity of long-run parameters.

Thus, Equation (2) can be rewritten as follows:

$$\Delta i_{i,t} = \theta_i (i_{i,t-1} - \delta_1 r_{t-1}) + \sum_{i=1}^{p} \gamma_i \Delta i_{i,t-i} + \sum_{i=0}^{q} \lambda_i \Delta r_{t-i} + \varepsilon_{i,t} \quad (3)$$

In Equation (3), i is the lending rate of each bank, θ_i is the coefficient of error correction term commonly known as the speed of adjustment from the long run deviation, i.e., $(i_{i,t-1} - \delta_1 r_{t-1})$, where, δ_1 is the long-run coefficient of pass-through, and it is given as:

$$\delta_1 = \frac{\sum_{i=0}^{q} b_i}{1 - a_1}$$

If $\delta_1 = 1$ then it is regarded as complete pass-through of policy rate, i.e., r_t. The $\delta_1 < 1$ shows the incomplete pass-through of the policy rate to the bank lending rate. There are several factors of incomplete pass-through, including the market power exercised by the commercial banks and the economy's weak financial structure. More generically, we represent, δ_1 = f (Macroeconomic factors, Financial Strength, Market Power). The objective of this study is to explore these factors and determine the nature of interest rate pass-through in Pakistan.

To achieve the objective stated above, and following the recent studies of Leroy and Lucotte (2016) and Jamilov (2015), Equation (3) can be extended as follows:

$$\begin{aligned} \Delta i_{i,t} = {} & \theta_i \eta_{i,t-1} + \sum_{i=1}^{p} \gamma_i \Delta i_{i,t-i} + \sum_{i=0}^{q} \lambda_i \Delta r_{t-i} + \sum_{i=0}^{r} \varphi_i \Delta m_{t-i} \\ & + \sum_{i=0}^{s} \omega_i \Delta s_{i,t-i} + a_i + \varepsilon_{i,t} \end{aligned} \quad (4)$$

Equation (4) is the baseline model for the estimation of the interest rate past through. Where, $i_{i,t}$ is the bank-specific lending rate, $\eta_{i,t-1} = i_{i,t-1} - \delta_1 r_{t-1}$, a_i is the bank-specific effects and $\varepsilon_{i,t}$ is the error term. The cointegration is established only when the error term is negative and statistically significant. The r_t represents the monetary policy rate and m_t is the vector of macroeconomic variables (i.e., GDP growth, inflation rate). According to Cottarelli and Kourelis (1994), Egert et al. (2007), Gigineishvili (2011), and Sander and Kleimeier (2004), the macroeconomic variables such as economic growth and inflation rate are some of the factors that affect interest rate adjustments. The factor $s_{i,t}$ is the bank-specific interest rate spread which is used to represent the financial system's strength. The higher the interest rate spread the weaker is the financial system, and vice versa (Handa, 2009).

To gain insight into the bank-specific factors responsible for incomplete pass-through, Equation (4) is augmented to include bank characteristics one by one as independent regressors:

$$\Delta i_{i,t} = \theta_i \eta_{i,t-1} + \sum_{i=1}^{p} \gamma_i \Delta i_{i,t-i} + \sum_{i=0}^{q} \lambda_i \Delta r_{t-i} + \sum_{i=0}^{r} \varphi_i \Delta m_{t-i} + \sum_{i=0}^{s} \omega_i \Delta s_{i,t-i} + \sum_{i=0}^{t} \psi_i \Delta c_{i,t-i} + \sum_{i=0}^{u} \zeta_i \Delta p_{i,t-i} + a_i + \varepsilon_{i,t} \quad (5)$$

Where, $c_{i,t}$ comprises the set of variables for bank-level characteristics (i.e., size, level of capital, liquidity, profit and competition), and represents the market power exercised by the banks. The factor $p_{i,t}$ is the interaction term, which represents the interaction between monetary policy and bank-level characteristics. The interaction term is used to measure the efficacy of monetary policy transmission.

The past literature identifies the market power indicators of size, level of capital, liquidity, profit and competition as the most common determinants of interest rate pass-through. For example, Berger (1995) and Claeys and Vander (2008) highlighted the importance of bank size since banks with a larger market share can charge higher lending rates to maintain their market dominance. As such bank size can affect efficiency and pass-through. Bank liquidity level is another essential factor for limiting the interest rate pass-through because banks with a higher level of liquid assets can easily absorb the policy shocks compared to less liquid banks. Hence, the higher the liquidity, the lower the pass-through effects and vice versa (Horvath & Podpiera, 2012; Jamilov, 2015). Brock and Franken (2003) proposed that large capitalised banks are usually risk-averse than less sbanks.

Banks with more capital are cautious in investing than low capitalised banks, which conversely are keen to accept riskier investments to gain higher profits. Therefore, the pass-through for low capitalized banks should be higher than for more capitalized banks (Kashyap & Stein, 2000). Similarly, profitability is one of the critical determinants of interest rate pass-through since the banking sector is profitability and positively associated with the degree of accepting risks (Gigineishvili, 2011; Ozdemir & Altinoz, 2012). Therefore, banks with higher profits are often risk-takers, and they are expected to witness a complete pass-through. Finally, banking sector competition is also included in the analysis following those of previous studies by Cottarelli and Kourelis (1994), Mojon (2000), and Sander and Kleimeier (2004).

Data and Variables

The data set used in this paper was quarterly data spanning 2003:Q2 to 2015:Q4. The panel data set comprised 12 private commercial banks. The total of 21 local private commercial banks are operating in Pakistan in 2015, as documented in the annual report of the State Bank of Pakistan (SBP), and these banks contribute around 70% share in total credit to the private sector. However, due to limitations in the data set of some banks, this study was able to utilise data from only 12 local private banks which comprise both large and small banks. The panel data on individual banks were sourced from SBP, while macroeconomic data were obtained from the IMF's International Financial Statistics.

The dependent variable of the lending rate ($i_{i,t}$) is represented by the weighted average lending rates (WALR), which is reported for each of the commercial banks by the SBP. The commercial banks offer loans in many categories. Each loan category is provided with different interest rates. The SBP thus computes the WALR by weighting the interest rates for the corresponding amount of loan disbursed by each bank. The interest rate spread ($s_{i,t}$) is the difference between the WALR and weighted average deposit rates (WADR).

The variables representing bank characteristics of size, liquidity, capitalisation and profitability were computed in the following way. The characteristic of size represents each bank's relative share in the pool of assets for all 12 banks (i.e., Assets of *i*-th bank/sum of all banks assets).[2] Liquidity represents the ratio between each bank's current and total assets (i.e., current assets of *i*-th bank/total assets of the *i*-th bank). Similarly, capitalisation is represented by the share of market capital of the corresponding bank's total assets (i.e., the market capitalisation of *i*-th bank/total assets of the *i*-th bank). Finally, profitability is described by the returns on assets (i.e., net income of *i*-th bank/total assets of the *i*-th bank).

Banking sector competition is represented by the Herfindahl-Hirschman Index (HHI). The HHI shows the level of market concentration, and this study followed the standard formula of HHI in constructing the level of concentration for the sample.[3] The HHI above 0.18 shows a highly concentrated market with the implication of the monopolistic market. However, HHI below 0.10 indicates an unconcentrated market, or in other words, a competitive market. Any number between 0.1 to 0.18 is considered to indicate a moderately concentrated market. Figure 2 shows the HHI on the right and interest rate spread on the left. To analyse the effects of concentration on the pass-through, the HHI is incorporated in the baseline model, where it is the same for all banks but differs across time.

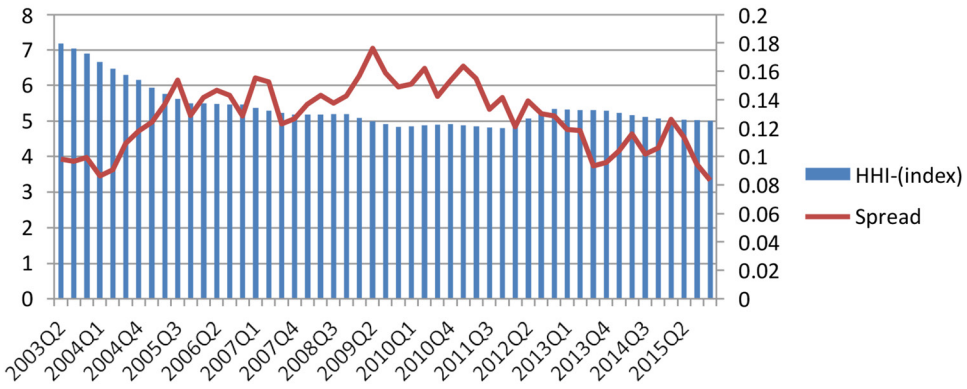

Figure 2. Banking sector concentration and interest rate spread in Pakistan

The six months Treasury bill rate is used to proxy the monetary policy rate (r_t) in this study.[4] The remaining macroeconomic variables of GDP show the growth in GDP. The macroeconomic variables of GDP growth and inflation rate are taken as the control variables for the baseline model. A detailed description of the variables is provided in Appendix A.

EMPIRICAL RESULTS

Results of the unit root tests are provided in two separate tables. The panel unit root tests are given in Appendix B, whereas the unit root test for time dimension variables is shown in Appendix C. We followed Im et al. (2003) for the panel unit root test. The crucial aspect of this test is that it allows the heterogeneity of autoregressive coefficients. The test results in Appendix B show that most of the panel's variables are integrated of order one except for interest rate spread (IRS), which is stationary at levels. Appendix C reports the results for time series variables from the widely used Augmented Dickey-Fuller (ADF) unit root test. The test reports that most of the variables are integrated of order one except for inflation rate found to be stationary at levels. The PMG was estimated based on the ARDL model, and we relied on Akaike Information Criterion (AIC) to choose the lag length of the ARDL model by setting four as a maximum lag order.

Full Sample Results

The long-run coefficients from PMG estimations are reported in Table 1. These results are the main findings from the baseline model. First and foremost, the interest rate pass-through coefficient is positive and statistically significant.

This implies that the 1% increase in the monetary policy rate will only lead to a 0.76% reaction to commercial bank's lending rates, a clear indication of incomplete pass-through of monetary policy. It further implies that around 25% of monetary policy change does not affect Pakistan's real economy. Moreover, the coefficients of GDP growth and inflation rate are the same as expected. The negative coefficient of GDP suggests that as the growth picks up, the lending rate goes down; this implies that as the economy grows, lenders' confidence also moves along.

Table 1
Baseline model of PMG estimation

	Monetary policy rate	GDP	Inflation	Interest rate spread	ECT
Coefficient	0.763	−0.323	0.391	0.174	−0.507
Standard error	0.027	0.150	0.049	0.049	0.054
p-value	0.000	0.031	0.000	0.000	0.000

The positive coefficient of the inflation rate indicates the overheating economy. As inflation rises, the risk associated with lenders is higher, increasing the economy's lending rates. The positive coefficient of interest rate spread implies that an increase in the financial weakness can also trigger the lending rate upwards, which is also expected. Finally, the error correction term is negative and statistically significant, suggesting cointegration among the variables. The error correction parameter of −0.5 indicates that, on average, it takes around two quarters to bring the lending rates back to their long-run equilibrium.

The bank-level short-run heterogeneity is given in Table 2. It also presents the bank-specific speed of adjustment through the error correction term corresponding to all 12 banks. The heterogeneity in each bank's adjustment is visible, and it is worth noticing that the speed of adjustment across all banks varies from as slow as −0.2 to as fast as −0.9.

As discussed in the previous section, PMG imposes the homogeneity condition in the long-run coefficient while only allowing for the heterogeneity in short-run parameters. Conversely, Mean Group (MG) estimation allows the long-run and short-run coefficients to be heterogeneous. Therefore, to test whether PMG or MG estimator is more suitable, we conduct the Hausman test suggested by Pesaran et al. (1999) and Blackburne and Frank (2007). The test results are reported in Appendix D. The Hausman test failed to reject the null hypothesis, indicating that the PMG estimations were more efficient than MG estimations. Therefore, further analysis of the main results will be

based on PMG estimations. The complete results for MG estimation are also reported in Appendix E, and it confirms that banks in Pakistan are significantly heterogeneous in passing on the policy rate.

Table 2
Bank heterogeneities in short run

Bank code	ECT	Standard error	*p*-value
Bank 1	−0.535	0.085	0.000
Bank 2	−0.683	0.106	0.000
Bank 3	−0.233	0.079	0.003
Bank 4	−0.459	0.065	0.000
Bank 5	−0.701	0.142	0.000
Bank 6	−0.346	0.082	0.000
Bank 7	−0.504	0.103	0.000
Bank 8	−0.474	0.109	0.000
Bank 9	−0.447	0.108	0.000
Bank 10	−0.380	0.118	0.001
Bank 11	−0.387	0.096	0.000
Bank 12	−0.940	0.134	0.000

Note: These results are taken from the baseline model with heterogeneous bank-specific lending rates.

In analysing the bank heterogeneities in the pass-through procedure, the bank-specific characteristics were included one by one in the baseline model. Tables 3 to 7 summarise the main results, including bank characteristics of size, capitalisation, liquidity, profit and competition as separate independent variables. In Table 3, all the macroeconomic variables in bank size have similar signs with baseline results. While the pass-through coefficient has increased to 0.82%, the bank size has a negative coefficient. It implies that the larger banks in Pakistan tend to charge lower rates. It is important to note that the interaction term's coefficient for bank size is positive and statistically significant. The interaction between monetary policy and bank size suggests that given the monetary policy, the increase in bank size will, in turn, increase the monetary policy effects on lending rates, indicating the improvement in the transmission of monetary policy. This finding was further validated in sub-sample analyses, which are discussed in a later section.

In Table 4, the coefficient of bank capitalisation is shown to be insignificant. However, its interaction with monetary policy is negative and significant. These findings suggest that given the monetary policy to increase bank

capitalisation, its effects on lending rates will further be reduced. The implication is that monetary policy efficacy is only higher for banks with a lower level of capital.

Similarly, in Table 5, the bank level of liquidity is found to be positive and significant. The banks with a high level of liquidity tend to charge higher lending rates. In comparison, the interaction term between monetary policy and bank liquidity is negative and significant. This shows that the monetary policy is only effective on banks with a low level of liquidity. It is also worth noticing that the pass-through coefficient has drastically reduced to 0.41% during the presence of a bank-level of liquidity. Furthermore, there is no significant relationship between bank-level profit and bank-level competition (Tables 6 and 7), which indicates that profits and banking competition do not play any role in defining lending rates in Pakistan.

Table 3
Baseline model with bank level of size

	Monetary policy rate	GDP	Inflation	Interest rate spread	Bank size	Monetary policy rate*bank size
Coefficient	0.824	−0.364	0.386	0.175	−1.527	0.131
Standard error	0.040	0.145	0.047	0.030	0.747	0.045
p-value	0.000	0.012	0.000	0.000	0.041	0.004

Note: The dependent variable is a bank-specific lending rate. The interaction between monetary policy and bank-level characteristics is presented in the last column of each table.

Table 4
Baseline model with bank level of capitalisation

	Monetary policy rate	GDP	Inflation	Interest rate spread	Capitalisation	Monetary policy rate*capitalisation
Coefficient	0.758	−0.311	0.354	0.219	4.165	−0.797
Standard error	0.025	0.135	0.043	0.027	4.142	0.367
p-value	0.000	0.021	0.000	0.000	0.315	0.030

Table 5
Baseline model with bank level of liquidity

	Monetary policy rate	GDP	Inflation	Interest rate spread	Liquidity	Monetary policy rate*liquidity
Coefficient	0.418	−2.229	0.304	0.212	3.026	−0.320
Standard error	0.064	0.130	0.047	0.028	0.557	0.059
p-value	0.000	0.080	0.000	0.000	0.000	0.000

Table 6
Baseline model with bank level of profitability

	Monetary policy rate	GDP	Inflation	Interest rate spread	Profitability	Monetary policy rate*liquidity
Coefficient	0.718	−0.288	0.361	0.175	−0.120	2.273
Standard error	0.036	0.139	0.047	0.030	0.146	1.859
p-value	0.000	0.039	0.000	0.000	0.410	0.221

Table 7
Baseline model with bank level of competition

	Monetary policy rate	GDP	Inflation	Interest rate spread	HHI (competition)	Monetary policy rate*HHI
Coefficient	0.724	−0.272	0.311	0.211	0.028	−0.005
Standard error	0.093	0.149	0.051	0.031	0.173	0.007
p-value	0.000	0.069	0.000	0.000	0.871	0.432

Sub-Sample Results

In order to validate the full sample results, the groups of banks were divided into two categories of bank's characteristics. For example, the bank characteristic of size was divided into large and small banks; similarly, large capitalised banks and small capitalised banks for the given bank capital level. The same was conducted for liquidity and profitability. This sub-sample analysis will allow insight into the bank heterogonous effects on the lending rate pass-through. In order to segment the banks according to each characteristic, the median threshold method was employed. The banks' groups above the threshold were labelled as large, and groups of banks below the threshold were labelled as small.

There are equal numbers of banks in small and large size category, i.e., six banks each. However, for all other categories there are five banks in large and seven banks in small category.

Tables 8 to 11 present results from the sub-samples. In terms of bank size, the pass-through coefficient is shown positive and statistically significant in both large and small banks and there is a difference in pass-through between them (Table 8). The small banks are disinclined to pass-through the monetary policy rate to lending rates compared to large banks. This finding validated previous results from full samples, which established that monetary policy transmission was improved with increased bank size. Although it is surprising to see the sluggish pass-through from small banks, it can be viewed as a fundamental finding for Pakistan's banking sector, where small banks face difficulty to comply with the operational requirements set by the central bank of Pakistan.

Results from the group of banks with large and small level of market capitalisation are summarised in Table 9. Again, the results are found to be consistent with those from full sample findings. Banks with a higher level of capitalisation are sluggish in passing on the monetary policy rate to the real sector. Conversely, banks with smaller level of capital proved more efficient in passing on the monetary policy rate to lending rates. These results are expected, and they are shown to be mostly consistent with those reported in past literature which indicated that less capitalised banks exhibit complete pass-through.

Table 10 summarises the full sample findings for a higher and lower level of liquidity, which shows that the monetary policy is effective for the banks with a lower level of liquidity. It can be seen that the pass-through coefficient possesses a substantial difference between both categories of banks. The higher the liquidity, the lower is the pass-through coefficient and vice versa. This finding is again consistent with those in the literature which established that higher liquid banks can dampen the effects of monetary policy shocks. Hence, Pakistan's monetary authorities must control excess liquidity in the banking sector to improve monetary policy's transmission mechanism. Table 11 reports the results for banks with small and large profitability. Although there was no significant result found in terms of bank-level of profit on the interest rate pass-through in Table 6, the analyses were carried out on this category for the sake of sub-sample results. Interestingly, it is shown that banks with a lower level of profits are slightly sluggish in the pass-through procedure. It implies that enormous profits callout banks to exhibit complete pass-through and vice versa.

Table 8
Sub-sample analysis for bank size

Interest rate pass-through in large banks					
	Monetary policy rate	GDP	Inflation	Interest rate spread	ECT
Coefficient	0.779	−0.393	0.481	0.183	−0.526
Standard error	0.037	0.204	0.069	0.046	0.093
p-value	0.000	0.054	0.000	0.000	0.000
Interest rate pass-through in small banks					
Coefficient	0.738	−0.290	0.259	0.183	−0.543
Standard error	0.036	0.205	0.063	0.043	0.065
p-value	0.000	0.156	0.00	0.000	0.000

Table 9
Sub-sample analysis for bank capitalisation

Interest rate pass-through in large capitalisation banks					
	Monetary policy rate	GDP	Inflation	Interest rate spread	ECT
Coefficient	0.776	−0.373	−0.185	−0.329	−0.669
Standard error	0.037	0.251	0.161	0.145	0.050
p-value	0.000	0.139	0.250	0.024	0.000
Interest rate pass-through in small capitalisation banks					
Coefficient	0.864	−0.833	0.552	0.176	−0.586
Standard error	0.028	0.166	0.066	0.040	0.095
p-value	0.000	0.000	0.000	0.000	0.000

Table 10
Sub-sample analysis for bank liquidity

Interest rate pass-through in large liquidity banks					
	Monetary policy rate	GDP	Inflation	Interest rate spread	ECT
Coefficient	0.645	−0.743	0.386	0.076	−0.531
Standard error	0.046	0.254	0.081	0.055	0.087
p-value	0.000	0.003	0.000	0.165	0.000
Interest rate pass-through in small liquidity banks					
Coefficient	0.823	−0.397	0.440	0.155	−0.607
Standard error	0.307	0.099	0.071	0.043	0.076
p-value	0.000	0.000	0.000	0.000	0.000

Table 11
Sub-sample analysis for bank profitability

Interest rate pass-through in large profitable banks					
	Monetary policy rate	GDP	Inflation	Interest rate spread	ECT
Coefficient	0.880	−1.129	0.667	0.332	−0.592
Standard error	0.396	0.225	0.086	0.042	0.095
p-value	0.000	0.000	0.000	0.000	0.000
Interest rate pass-through in small profitable banks					
Coefficient	0.810	−0.748	0.435	0.149	−0.605
Standard error	0.029	0.170	0.070	0.045	0.074
p-value	0.000	0.000	0.000	0.001	0.000

Asymmetric Interest Rate Pass-Through

Results for the asymmetric monetary policy pass-through are presented in Table 12. Monetary authorities must know the magnitude of pass-through during the expansionary and contractionary monetary policy to control the internal balance for a country. The interest rate adjustment can be different in both policy conduct scenarios, which is attributed to the risk associated with the policy shocks. For this analysis, the monetary policy rate was separated into two categories. First, the expansionary policy was the cumulative sum of negative changes in the policy rate. Second, the cumulative sum of positive changes in the policy rate represented the contractionary monetary policy. Both negative and positive changes were replaced with the monetary policy rate in the baseline model. The results show that the pass-through coefficient of contractionary policy is higher than that of expansionary policy. This implies that Pakistan's central bank may encounter stickiness in lending rates during the attempt to boost the country's economic activity. However, during times of economic stress, the policy rate may exhibit a complete pass-through towards lending rates.

Table 12
Interest rate pass-through in asymmetric monetary policy

	Contractionary monetary policy	Expansionary monetary policy	GDP	Inflation	Interest rate spread	ECT
Coefficient	0.907	0.631	−2.049	0.426	0.129	−0.521
Standard error	0.049	0.057	0.610	0.049	0.032	0.058
p-value	0.000	0.000	0.001	0.00	0.000	0.000

CONCLUSION

This study has empirically examined the interest rate pass-through from policy rate to lending rates in Pakistan by using the dynamic heterogeneous panel techniques, namely the PMG method, to allow the bank heterogeneity in the pass-through procedure.

The new findings can be summarised as follows. First, this study has significantly found an incomplete interest rate pass-through that limits Pakistan's monetary policy effectiveness. This study found that larger banks marginally increase the policy pass-through in contrast to smaller banks in Pakistan with regards to bank-level characteristics. However, the results are surprisingly in line with past findings related to small open economies (e.g., Horvath & Podpiera, 2012; Jamilov, 2015). Secondly, it was shown that higher capitalisation of banks reduces the pass-through effects. Smaller capitalised banks are found more reactive to policy changes, thus improving the monetary policy transmission. The most important finding regarding bank characteristics is bank liquidity. The results showed that banks with a higher level of liquidity reduce the pass-through coefficient significantly, and it also decreases the monetary policy effects on lending rates. Hence, the monetary policy efficacy is higher on the banks with a lower level of liquidity. Furthermore, this study found no significant evidence on interest rate pass-through regarding bank profitability and competition in the banking sector of Pakistan.

Finally, another significant finding from this study is that the pass-through exhibits asymmetry effects of monetary policy on Pakistan's lending rates. It is worth noting that if the SBP decides to pursue an easy monetary policy to increase the growth prospects, the policy changes may unfortunately encounter stickiness in lending rates. Hence, monetary policy's lending rate channel is somehow less useful during the expansion relative to the contractionary period.

Two important policy implications are drawn from the findings of this study. First, to improve the monetary policy effectiveness, the SBP should revisit the capital requirements from commercial banks to strengthen the monetary policy transmission. Second, based on findings, this study proposes that SBP take further measures to drain the excess liquidity from the banking sector to improve monetary policy's transmission mechanism. Further, as a direction for future study, it would be interesting to explore interest rate pass-through on different categories of individual bank loans according to the sub-sector of economic activity, such as agriculture, consumer and industrial sector. It is crucial for the SBP to understand further how their monetary policy changes reflect the individual bank's loans (bank-lending channel) according to the

economic activity's sub-sector. The SBP can also investigate how effective their interest rates policy is in influencing the bank loan according to the economy's sub-sector. Another suggestion for future study is to examine the balance sheet channel of monetary policy and study how monetary policy changes through interest policy affect firm-investment spending in Pakistan. These crucial future studies may assist the SBP in evaluating the bank-lending channel and balance sheet channel as the transmission mechanism of monetary policy.

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NOTES

1. SBP's Annual Banking Statistics of Pakistan 2015.
2. We followed Jamilov (2015) for calculating the relative share of each bank within our sample of 12 banks.
3. $HHI = \sum_{i=1}^{n} S_i^2$, where n is the number of banks, S is the market share of the i-th bank.
4. The overnight policy rate (Repo rate) is the official policy rate of the SBP. The official rate is announced after every two months. The six months Treasury bill rate is auctioned after every second week and the SBP is responsible for conducting the auction. The Treasury bill rate therefore provides the nominal anchor for the financial market in Pakistan. Past literature and the active intervention of the SBP in money market suggest that the six months Treasury bill rates are the appropriate choice to proxy the monetary policy stance in Pakistan.

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APPENDICES

Appendix A

Variable descriptions

Variable	Description	Source
Lending Rate (LR)	Dependent Variable. It is represented by the weighted average landing rates of individual bank.	State Bank of Pakistan
Tbill	The six months treasury bill rate is used to proxy the monetary policy rate.	IMF's International Financial Statistics
GDP	It is the gross domestic production of Pakistan and it is used as the macroeconomic control variable.	IMF's International Financial Statistics
Inflation Rate	It is the year-on-year inflation rate and used as the macroeconomic control variable in the estimation model.	IMF's International Financial Statistics
Interest Rate Spread (IRS)	It is the difference between weighted average lending rates and weighted average deposit rates of individual bank.	State Bank of Pakistan
HHI	It is the Herfindahl-Hirschman Index of market concentration for all the sample banks in this study.	Authors own calculation
Size	Bank size. It represents the assets of each bank divided by the sum of all bank assets.	State Bank of Pakistan
Capitalisation	Bank level of capital. It represents the market capital of each bank divided by its total assets.	State Bank of Pakistan
Liquidity	Bank level of liquidity. The current assets of each bank divided by its total assets.	State Bank of Pakistan
Profitability	Bank profits. It is given as the returns on assets of each bank.	State Bank of Pakistan

Appendix B

Panel unit root test results based on IPS (Im et al., 2003)

Variables	With trend		Without trend	
	Statistics	*p*-value	Statistics	*p*-value
LR	1.822	0.965	−0.824	0.204
Δ LR	−16.033***	0.000	−15.194***	0.000
IRS	−8.175***	0.000	−7.184***	0.000
ΔIRS	−17.943***	0.000	−17.878***	0.000
Size	−1.256	0.104	−3.968***	0.000
Δ Size	−5.479***	0.000	−4.601***	0.000
Cap	−0.670	0.251	−0.391	0.347
Δ Cap	−4.799***	0.000	−4.017***	0.000
Liquidity	0.276	0.608	−2.370***	0.008
Δ Liquidity	−6.302***	0.000	−5.209***	0.000
Profit	0.084	0.533	−2.017**	0.021
Δ Profit	−6.642***	0.000	−6.227	0.000

Note: *** indicates the significance at 1% level, ** indicates the significance at 5% level and * for the significance at 10% level. The lag lengths were determined by the Akaike information criterion (AIC).

Appendix C

Augmented Dickey Fuller (ADF) unit root test results for time series

Variables	With trend		Without trend	
	Statistics	*p*-value	Statistics	*p*-value
Tbill	−1.372	0.856	−2.549	0.110
Δ Tbill	−4.852***	0.001	−3.911***	0.003
GDP	−0.802	0.958	−1.661	0.443
ΔGDP	−3.233*	0.090	−2.788*	0.067
Inflation	−4.367***	0.005	−4.221***	0.001
Δ Inflation	−8.975***	0.000	−9.027***	0.000
HHI	−3.094	0.119	−3.436**	0.014
Δ HHI	−5.686***	0.000	−5.581***	0.000

Note: *** indicates the significance at 1% level, ** indicates the significance at 5% level and * for the significance at 10% level. The lag lengths were determined by the Akaike information criterion (AIC).

Appendix D

Hausman Test for PMG vs MG

Dependent Variable: *Lending Rate*	PMG Estimation				Mean Group Estimation				Hausman Test
	Monetary Policy Rate	GDP	Inflation	Interest Rate Spread	Monetary Policy Rate	GDP	Inflation	Interest Rate Spread	Statistics
Coefficient	0.763	−0.323	0.391	0.174	0.753	−0.678	0.371	0.279	5.46
Std. Error	0.027	0.150	0.049	0.049	0.048	0.249	0.057	0.070	NA
p-value	0.000	0.031	0.000	0.000	0.000	0.006	0.000	0.00	0.243

Note: The null hypothesis for the Hausman test is Ho: PMG estimation is appropriate

Appendix E

Results from MG estimations

Bank code	Monetary Policy Rate	GDP	Inflation	Interest rate spread	ECT
Bank 1	0.716 [0.091] (0.000)	−0.598[0.537] (0.266)	0.668[0.188] (0.000)	0.118[0.101] (0.242)	−0.524[0.096] (0.000)
Bank 2	0.660[0.064] (0.000)	0.378[0.332] (0.254)	0.303[0.114] (0.008)	0.324[0.120] (0.007)	−0.818[0.135] (0.000)
Bank 3	0.931[0.308] (0.003)	−2.070[1.701] (0.224)	0.356[0.409] (0.384)	0.367[0.389] (0.345)	−0.270[0.100] (0.007)
Bank 4	0.850[0.089] (0.000)	−0.569[0.636] (0.371)	0.389[0.131] (0.003)	0.027[0.143] (0.849)	−0.476[0.079] (0.000)
Bank 5	0.732[0.504] (0.00)	−0.240[0.283] (0.396)	0.207[0.095] (0.030)	0.325[0.599] (0.000)	−0.947[0.155] (0.000)
Bank 6	1.057[0.103] (0.000)	−1.575[0.516] (0.002)	0.221[0.174] (0.204)	−0.004[0.131] (0.972)	−0.415[0.095] (0.000)
Bank 7	0.816[0.096] (0.000)	0.035[0.575] (0.006)	0.781[0.193] (0.000)	0.287[0.084] (0.001)	−0.567[0.107] (0.000)
Bank 8	0.695[0.094] (0.000)	−0.593[0.481] (0.218)	0.087[0.136] (0.522)	0.329[0.131] (0.012)	−0.798[0.164] (0.000)
Bank 9	0.864[0.147] (0.000)	−2.285[0.831] (0.006)	0.262[0.289] (0.365)	0.165[0.253] (0.514)	−0.606[0.140] (0.000)
Bank 10	0.401[0.113] (0.000)	−0.509[0.603] (0.399)	0.399[0.195] (0.041)	0.849[0.181] (0.000)	−0.656[0.138] (0.000)
Bank 11	0.722[0.104] (0.000)	−0.385[0.556] (0.489)	0.276[0.122] (0.025)	0.021[0.106] (0.839)	−0.651[0.132] (0.000)
Bank 12	0.587[0.092] (0.000)	0.271[0.412] (0.510)	0.499[0.132] (0.000)	0.546[0.165] (0.001)	−0.931[0.147] (0.000)

Note: Values in [] brackets are standard errors and values in parenthesis () are *p*-values