# IMPACT OF MONETARY SHOCKS ON BANK LOANS AND DEPOSITS: EVIDENCE FROM BANKING CHARACTERISTICS IN AN EMERGING ECONOMY

Munib Badar *

* Asia e University Malaysia, Subang Jaya, Malaysia
Contact details: Asia e University Malaysia, 47500 Subang Jaya, Selangor, Malaysia

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## Abstract

This study examines how bank-specific characteristics shape the transmission of monetary policy to commercial banks' loan and deposit behavior. Using semi-annual panel data from 2001 to 2022, the analysis evaluates how liquidity, size, and capital influence banks' ability to absorb changes in the policy rate. The findings show that banks respond heterogeneously to monetary shocks, primarily due to differences in their balance sheet structures. Large and small banks experience more pronounced and persistent declines in both deposits and advances following policy tightening, while medium-sized banks exhibit comparatively muted adjustments. The evidence indicates that size is the most decisive factor governing banks' responsiveness, whereas liquidity plays a stronger role for medium-sized institutions. Capitalization appears to be a weaker differentiator, except for banks with low capital buffers, which display limited insulation against policy changes. Overall, the results suggest that monetary transmission is influenced by structural disparities across banks, with larger and smaller institutions being more sensitive to policy shifts. These insights underscore the need to account for bank heterogeneity when assessing monetary policy effectiveness and designing regulatory frameworks.

**Keywords:** Monetary Policy Rate, Bank's Deposit, Bank's Lending, Bank's Size, Bank's Assets, Bank's Capital

**Authors' individual contribution:** The Author is responsible for all the contributions to the paper according to CRediT (Contributor Roles Taxonomy) standards.

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## 1. INTRODUCTION

The interest rate channel of monetary transmission affects banks differently because they vary in how well they can shield their loan and deposit portfolios from monetary shocks. Bernanke and Blinder (1988) showed that a bank's asset composition at any given time is largely independent of such shocks. In other words, banks tend to respond in similar ways regardless of whether their assets are held mainly as loans or as securities (Bernanke & Blinder, 1988). On the contrary, Miller and Modigliani's (M-M) proposition (Miller, 1988) supports the idea as banks either increase other sources of funds or reduce assets to offset demand variations.

If the M-M proposition holds, banks should face no difficulty in raising funds. In reality, however, informational asymmetries persist, preventing banks from securing funds to the extent they desire. Banks, therefore, maintain liquid assets as a buffer to protect their loan supply. Monetary shocks typically affect deposits first, raising the marginal cost of funds and, for some banks, leading to adjustments in loan supply. The magnitude of this effect differs across institutions, with smaller and less capitalized banks generally finding it harder to obtain alternative funding sources.

Banks often attempt to retain their customers by delaying the pass-through of monetary shocks to borrowers immediately after a policy announcement. This strategy enhances the prospects of sustaining future loan supply. However, banks vary in their capacity to shield their lending portfolios from such shocks. These differences stem largely from bank-specific balance sheet characteristics such as liquidity, size, and capitalization. Smaller banks with limited liquidity and weaker capital positions face greater challenges in insulating their loan supply from monetary shocks (Ehrmann et al., 2001). These bank-specific abilities also indicate its financial health and elicit heterogeneous responses in its loan supply to monetary shocks (Ozsuca & Akbostanci, 2012).

Theoretical and empirical literature distinguishes the following three bank-specific characteristics (Brissimis et al., 2001):

Size: Small banks are exposed to higher information costs and external finance premiums than larger banks. Larger banks attract non-deposit funds easily after monetary tightening.

Capitalization: Poorly capitalized banks, like small banks, have less access to non-deposit funds, which compels them to cut back their loan supply more than well-capitalized banks.

Liquidity: Liquid banks can use their excess liquidity, placed in the form of cash and securities, to protect their loan supply more than illiquid banks.

Each of the above measures has its own advantages and limitations. Although size is often viewed as the most important indicator of a bank's capacity to expand lending, it can become less relevant when other factors, such as liquidity and capitalization, are taken into account (Worms, 2001).

Regarding capitalization, providers of external funds are generally more willing to lend to well-capitalized banks than to those with weaker capital positions. However, Worms argues that capitalization may also signal the riskiness of a bank's loan portfolio, making it uncertain whether well-capitalized banks should necessarily obtain cheaper external financing than poorly capitalized ones. This ambiguity, however, may be resolved when capital requirements explicitly account for risk (Worms, 2001).

Finally, liquidity plays a key role in determining how banks respond to monetary shocks. More liquid banks are generally less affected because they can draw on their liquid assets to sustain their loan portfolios. However, liquidity is also endogenously determined: banks that struggle to replace lost deposits with alternative funding sources tend to hold larger stocks of liquid assets in the first place.

Banks with low levels of liquid assets and capital are less able to shield their loan portfolios during periods of monetary tightening because they have limited capacity to draw on cash or sell securities already committed to riskier investments (Kashyap & Stein, 1995). As a result, small, less capitalized, and less liquid banks cannot insulate their loan portfolios during a monetary tightening. Because small banks have a low profit-making capacity, they increase their interest rates by smaller lags than those with more liquidity and capital. (Ehrmann et al., 2001). While a bank operated with a low capital asset ratio is sensitive to monetary shocks because such banks keep tiny margins while pricing their loans to compete with more prominent institutions (Van den Heuvel, 2002).

Several studies in Pakistan have reported similar findings. For instance, Ali et al. (2012) empirically examined the existence of a bank lending channel using borrower-level loan data. Their results indicate that both bank size and borrower characteristics influence loan pricing. They also found that, even with a comparable mix of strong and weak borrowers, smaller banks with more fragile balance sheets tend to respond more aggressively to changes in monetary policy (Ali et al., 2012). Along similar lines, Zaheer et al. (2013) found that small illiquid banks cut their lending less than other small banks with better liquidity. In contrast, big banks maintain their lending irrespective of their liquidity position (Zaheer et al., 2013).

The discussion above supports the notion that banks' loan supply contracts during periods of monetary tightening depend on bank-specific characteristics, such as size, liquidity, and capitalization. Most previous studies on monetary transmission have relied on aggregate data, which often masks variations at the individual bank level. Examining bank portfolios from a disaggregated perspective can reveal important insights that aggregate analysis overlooks. In the context of Pakistan, only a few studies have explored this, leaving an opportunity to provide contemporary empirical evidence from a bank-specific viewpoint. This study aims to address the research question:

*RQ: What is the impact of the monetary policy rate on a bank's loan supply based on cross-sectional characteristics such as size, liquidity, and capitalization?*

The primary objective is to examine how the monetary policy rate influences individual banks' loan supply according to these characteristics.

The findings of this research will add value for a wide array of stakeholders, i.e., regulators (State Bank of Pakistan [SBP] in the case of Pakistan), strategists and policymakers for the government (to determine the efficient and effective allocation of scarce resources), academicians, and scholars.

The rest of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 outlines the methodology employed in the empirical analysis. Section 4 presents the estimations and key inferences. Section 5 concludes the study.

## 2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Kashyap and Stein (1995) conducted pioneering research on the bank lending channel using a disaggregated, bank-level approach. They investigated the impact of monetary tightening on loan supply and tested whether smaller banks respond in the same way as larger banks. Their findings showed that the loan supply of smaller banks decreased following a monetary shock, whereas larger banks were largely able to insulate themselves from such shocks. The study utilized panel data from the U.S. banking system covering the period from 1973 to 1991 (Kashyap & Stein, 1995). Their latter study revealed that the smallest in size and most illiquid banks are more responsive towards monetary shocks (Kashyap & Stein, 1997).

Along similar lines, a study examined banks' liquidity holdings over specific periods and found that banks with lower securities-to-asset ratios responded more strongly to monetary shocks than those with higher ratios. The study used panel data from U.S. banks spanning 1976 to 1993. It further revealed that illiquid small banks reduced their loan supply by 0.6 to 5.3 percent more than adequately liquid small banks in response to a one standard deviation monetary shock. (Kashyap & Stein, 2000).

Other studies have also considered various bank-specific characteristics. For example, variables such as liquidity, size, and capitalization were used to examine the differential effects of monetary shocks on bank loan supply using disaggregated data. The study employed the federal funds rate as a proxy for monetary shocks and found that smaller, undercapitalized banks are more significantly affected. The impact on loan supply varied according to the banks' asset size and capital leverage ratios. This research was conducted in the U.S. using data spanning 15 years, from 1980 to 1995 (Kishan & Opiela, 2000).

Capitalization, as a key indicator of a bank's strength in the financial market, has been highlighted in numerous studies. For example, one study found that well-capitalized banks have better access to non-deposit sources of financing compared to poorly capitalized banks. Consequently, the loan supply of undercapitalized banks tends to contract more than that of well-capitalized banks (Peek & Rosengren, 1995). Similarly, a study conducted in Italy found that a tight monetary policy reduced banks' lending capacity, with the impact being less pronounced for banks that were well-capitalized, relatively liquid, or had access to internal capital markets (Gambacorta, 2005).

Undercapitalized banks exhibited a stronger response, as confirmed by another study conducted during periods of monetary tightening. Additionally, this study found that the bank lending channel is significantly more pronounced in smaller economies compared to larger ones, based on data from European banks spanning 1991 to 1999. Consequently, undercapitalized banks were more sensitive to monetary shocks (Altunbaş et al., 2002).

Other studies also highlight bank capitalization as a key factor in withstanding monetary shocks. For instance, a study conducted in the U.S. using data from 1980 to 1995 examined loan growth across banks categorized by capitalization: small undercapitalized banks, small adequately capitalized banks, and small well-capitalized banks. The results indicated notable differences: small undercapitalized banks were more responsive to monetary shocks and did not appear to raise alternative funds to sustain their lending. Their time deposits, however, were largely unresponsive to such shocks. In contrast, well-capitalized banks were generally unaffected by monetary shocks when it came to raising alternative funds (Kishan & Opiela, 2000).

Similarly, cross-sectional differences were observed among Italian commercial banks using panel estimations. The study found that well-capitalized banks were able to insulate their loan supply from monetary shocks due to their easier access to uninsured funds. In contrast, the loan supply of smaller banks was significantly affected, as their balance sheets exhibited larger maturity mismatches between assets and liabilities compared to bigger banks. This study employed the model of Kashyap and Stein (1995) and obtained results using the generalized method of moments (GMM) approach recommended by Arellano and Bond (1991).

In addition to bank-specific characteristics, another study highlighted the role of bank consolidation in shaping banks' responses to monetary shocks. The findings indicate that high levels of bank consolidation tend to weaken the bank lending channel overall, but smaller banks respond more strongly. This study analyzed panel data from Asian and Latin American countries covering the period 1996 to 2006 (Olivero et al., 2011).

Several European studies have reported similar findings. For example, a survey in the Euro area found that less liquid banks responded more strongly to monetary shocks than their more liquid counterparts. While bank size and capitalization were generally less influential than liquidity, the bank lending channel was observed to be active in Germany, France, and Italy (Angeloni & Ehrmann, 2003).

In the Greek economy, banks' size and liquidity were found to be significant bank-level characteristics in insulating banks' loan supply from monetary shocks more than those banks smaller in size and liquidity (Brissimis et al., 2001). In Europe, another study with similar results examined bank lending channels for panel data derived from 1991 to 1999, classifying banks based on size and capitalization. This study used short-term interest rates as a proxy of monetary shocks, which confirmed that larger and more capitalized banks reacted less significantly than smaller and less liquid banks (Kishan & Opiela, 2000).

In the Euro system, small banks routinely deposit their excess liquidity with their parent institutions and rely on these funds to sustain their credit portfolios during periods of monetary tightening. The banking system as a whole provides additional resources to subsidiaries, helping them shield their loan supply from monetary shocks by addressing liquidity shortfalls through support from their parent institutions (Ehrmann & Worms, 2001).

Access to uninsured liabilities is unfolded as an important bank-level characteristic in a study facilitating banks to protect their loan supply from monetary shocks. It is investigated that those banks with better access to uninsured liabilities were found to protect their loan supply from monetary shocks more than those with limited access to uninsured liabilities. This study also concluded that small banks were more responsive in shrinking their loan portfolios than larger banks during monetary tightening (Kashyap & Stein, 1995).

The nature of trading ability is also found in helping banks to insulate their loan supply from monetary shocks. For example, it was revealed in a study that after controlling for size, capitalization, and other factors of the loan portfolios, publicly-traded banks were found to be more convenient in raising external funds, including time deposits, than those banks that are non-publicly-traded after receiving monetary shocks (Holod & Peek, 2007).

Some examples are quoted from studies conducted in developing countries, for instance, in Uganda, bank lending channels were found to be active on the basis of bank-level characteristics, i.e., capitalization and liquidity. This study used quarterly panel data from 2001 to 2012 to compile results by using the GMM approach (Opolot & Nampewo, 2014). Another study conducted in Jordan, Egypt, Morocco, and Tunisia revealed that less capitalized banks responded more significantly than those banks more capitalized towards monetary shocks. Likewise, size and liquidity were also found to be significant variables in shaping banks' loan supply towards monetary shocks (Ben Naceur et al., 2009).

In South Africa, another study also endorsed similar results where bank lending channels were found to be active, where the size of the banks is found to be a significant variable in shifting the loan supply curve to the right side. However, size could not influence banks' response to monetary shocks. This study used the repo rate as a proxy of monetary shocks for the panel data of private commercial banks (Mishi & Tsegaye, 2012).

In Pakistan, only a limited number of studies have examined bank lending channels in relation to bank-specific characteristics. For example, one study investigated the presence of credit channels and the intermediary role of banks using borrower-level loan data, covering both strong and weak borrowers at strong and weak banks. The study found that bank size and borrower type significantly influenced loan supply. Notably, small banks with weaker balance sheets were more responsive to monetary shocks (Ali et al., 2012). Similarly, another study conducted in Pakistan revealed that small banks with adequate liquidity reduced their lending portfolios relatively less than small banks with liquidity problems. However, large banks maintained their lending portfolios irrespective of liquidity position. This study used quarterly data by employing vector autoregression (VAR) to unfold a cross-sectional association between monetary shocks and bank loans, while GMM was employed to test panel characteristics of data (Zaheer et al., 2013).

Some of the recent studies show that monetary policy transmission through the banking sector has long been a central concern in macroeconomic and financial research. The bank lending channel posits that changes in policy rates affect banks' balance sheets and funding conditions, which in turn influence their loan and deposit behavior. Recent studies increasingly emphasize that this transmission mechanism is heterogeneous, varying across banks depending on their size, liquidity, and capitalization (Gambacorta & Shin, 2018; Ciccarelli et al., 2013).

Bank size is widely recognized as a key determinant of banks' responsiveness to monetary policy shocks. Smaller banks are typically more dependent on deposit funding and face higher informational and financing constraints, making their lending activities more sensitive to changes in policy rates. Larger banks, while having greater access to wholesale funding and capital markets, may still exhibit strong reactions to policy shifts due to their scale and exposure to interest rate risk. Recent empirical evidence suggests that both small and large banks respond more strongly to monetary tightening than medium-sized banks, highlighting the non-linear effects of size on policy transmission (De Santis & Surico, 2013).

Liquidity conditions play a crucial role in shaping how banks absorb and transmit monetary policy shocks. Banks with higher liquidity buffers are generally better positioned to smooth lending and deposit adjustments during periods of monetary tightening. Conversely, banks with limited liquid assets are more likely to contract lending and deposits in response to rising policy rates.

Bank capitalization also influences the strength of monetary policy transmission. Well-capitalized banks are more resilient to tightening episodes, as stronger capital buffers allow them to absorb higher funding costs without significantly reducing credit supply. In contrast, under-capitalized banks tend to exhibit sharper contractions in lending following policy tightening. While higher capital ratios generally dampen policy sensitivity, recent findings suggest that capitalization alone may not fully insulate banks from monetary shocks, particularly during periods of financial stress (Gambacorta & Shin, 2018).

Beyond individual balance sheet characteristics, broader structural differences such as funding composition, market power, and balance sheet structure further shape the monetary transmission process. Research highlights that ignoring bank heterogeneity may lead to misleading conclusions about policy effectiveness, as aggregate responses often mask significant cross-bank variation (Ciccarelli et al., 2013). This strand of literature underscores the importance of bank-level analysis in understanding how monetary policy affects loan and deposit markets.

The literature provides strong evidence that monetary policy transmission is shaped by structural disparities across banks, particularly with respect to size, liquidity, and capitalization. Although existing studies have substantially advanced understanding of the bank lending and deposit channels, limited evidence exists on how these bank-specific characteristics jointly influence both loan and deposit behavior across different bank size categories over extended periods. Moreover, the literature highlights that banks' loan supply responds heterogeneously to monetary policy shocks depending on their balance sheet characteristics, with size, liquidity, and capital playing a decisive role in shaping these differential effects. Addressing these gaps is especially important in the context of Pakistan, where empirical evidence on bank-level heterogeneity in monetary policy transmission remains scarce. Motivated by these limitations, the present study examines heterogeneous bank responses to monetary policy using detailed panel data, offering new insights into the role of bank-specific characteristics in shaping monetary transmission.

The hypotheses of our study are stated as follows:

*H1: An increase in the monetary policy rate leads to a decrease in the loan and deposit supply of banks, based on their bank-specific characteristics (negative):*

*H1a: An increase in the monetary policy rate is negatively associated with loan supply if banks do not have adequate liquidity.*

*H1b: An increase in the monetary policy rate is negatively associated with loan supply if banks do not have adequate capitalization.*

*H1c: An increase in the monetary policy rate is negatively associated with loan supply if banks do not have adequate size.*

## 3. RESEARCH METHODOLOGY

Since 2001, thirty-seven banks have been operating in Pakistan, including public, private, and Islamic banks. For this study, however, a few banks were excluded for specific reasons: some were merged, others commenced operations after 2002, and certain banks were classified as specialized banks with a limited scope of lending and commercial activities due to missing information during our study period.

Our literature review indicates that three key bank-level characteristics, capitalization, liquidity, and size, significantly influence bank lending and the distributional effects of monetary transmission. Therefore, our analysis considers all three characteristics for Pakistani banks. Bank size is measured by the logarithm of total assets, while liquidity is calculated as the ratio of liquid assets to total assets (Ehrmann et al., 2001; Gambacorta, 2005).

The definition of liquidity varies across countries. For example, in France, liquidity is measured as the sum of cash and interbank deposits; in Germany, it includes cash, government securities, repurchase agreements, and short-term interbank deposits; similarly, in Spain, liquidity is defined using comparable components (Ehrmann et al., 2001). In Pakistan, the government relies heavily on banks to finance public debt through the issuance of government securities, which are preferred as a low-risk form of collateral. Consequently, liquidity is measured by cash, interbank lending, and short-term government securities. As a result, banks typically maintain around 17 percent of their assets in liquid form (Rahooja et al., 2014).

Capitalization is defined as a core capital that will compute the degree of capitalization (Bernanke et al., 1991). Core capital is defined as the sum of retained earnings and total capital. In Pakistan, monetary policy is announced bimonthly, with the policy rate serving as a key component of the monetary policy statement. Accordingly, the three-month Treasury bill rate is used as a proxy for monetary policy indicators.

Bank size is proxied by the logarithm of total assets, liquidity is measured as the ratio of liquid assets comprising cash, interbank lending, and securities to total assets, and capitalization is defined as the ratio of capital and reserves to total assets. All three variables are normalized with respect to their sample means across the banks.

The analysis employs semiannual data from 16 commercial banks operating in Pakistan over the period from June 2001 to December 2022. In addition, the consumer price index (CPI) and gross domestic product (GDP) are incorporated as indicators of real economic activity. Price dynamics are captured by the CPI, which reflects changes in the prices of goods and services consumed by households and serves as a standard measure of inflation. All variables, with the exception of short-term interest rates, are expressed in real terms, transformed into logarithms, and seasonally adjusted.

**Table 1.** Review of dependent and independent variables

| *Dependent variables* | | *Relationship* | *Code* | *Independent variables* | *Sources* | *Econometric model used by various authors* |
|---|---|---|---|---|---|---|
| Bank-specific lending | Total assets ↓ - , ↑ + | - | *SIZE* | | Kashyap and Stein (1995, 1997), Kishan and Opiela (2000), Peek and Rosengren (1995), Gambacorta (2005), Altunbaş et al. (2002), Olivero et al. (2011), Angeloni and Ehrmann (2003), Brissimis et al. (2001), Holod and Peek (2007), Mishi and Tsegaye (2012), Ciccarelli et al. (2013) | Securities to asset ratio, impulse response functions [IRFs] (Kashyap & Stein, 2000); GMM suggested by Arellano and Bond (1991) (Gambacorta & Mistrulli, 2004; Opolot & Nampewo, 2014; Ben Naceur et al., 2009; Ali et al., 2012); VAR and GMM (Zaheer et al., 2013); Dynamic panel data estimators (fixed effects or system GMM) to exploit bank-level heterogeneity and handle endogeneity, and impulse response analysis (Ciccarelli et al., 2013) |
| | Liquidity ↓ - , ↑ + | | *LIQ* | | | |
| | Capitalization ↓ - , ↑ + | | *CAP* | | | |
| Bank-specific deposit | Total assets ↓ - , ↑ + | - | *SIZE* | | | |
| | Liquidity ↓ - , ↑ + | | *LIQ* | | | |
| | Capitalization ↓ - , ↑ + | | *CAP* | | | |
| | | + | *TB3* | Three-month treasury bill rate | | |
| | Gross domestic product | - | *GDP* | | | |

This study employs secondary data obtained from published sources of the State Bank of Pakistan (SBP, www.sbp.org.pk); therefore, no additional authorization is required for data access. The analysis evaluates the effectiveness of various banking channels in the monetary transmission mechanism using statistical software such as Microsoft Excel and EViews. The empirical framework incorporates regression, vector autoregression (VAR), vector error correction model

(VECM), impulse response functions (IRFs), and generalized method of moments (GMM) techniques, which remain relatively underexplored in the existing literature. Hypotheses are formally specified through econometric equations, and cross-sectional differences are assessed by comparing the effects of key variables.

The study adopts the VAR methodology introduced by Sims (1980), which treats all variables as endogenous and is therefore atheoretical in nature. The VAR framework is widely used in empirical monetary economics to examine the effects of monetary shocks on real output and prices. Prior studies support the application of variance decomposition and impulse response analysis within the VAR framework to assess the role of the credit channel in influencing macroeconomic variables such as output and inflation (Agha et al., 2005; Baig, 2011; Bernanke & Blinder, 1992; Hussain et al., 2009).

IRFs trace the dynamic response of endogenous variables to exogenous monetary shocks, typically represented by changes in policy instruments such as interest rates. This study focuses on the response of real output to a one-standard-deviation shock in the interest rate. Variance decomposition complements the IRFs analysis by quantifying the contribution of individual shocks to the forecast error variance of each endogenous variable.

A VAR model captures linear interdependencies among multiple time series by expressing each variable as a function of its own lagged values and those of other endogenous variables. Identification is achieved through Cholesky decomposition, which imposes a recursive ordering to orthogonalize innovations. Model specification depends on the time-series properties of the data. When variables are cointegrated, a VECM is employed to capture long-run relationships; otherwise, the VAR is estimated in differences. As noted by Sims (1980) and Sims et al. (1990), estimating a VAR in levels with non-stationary variables does not bias estimators but may reduce efficiency.

VAR models are primarily designed to capture dynamic relationships among variables rather than to ensure estimator efficiency. When variables are integrated of the same order and cointegrated, a VECM is preferred, as it provides efficient estimates while preserving information about long-run equilibrium relationships. If cointegration is absent, imposing such restrictions may lead to biased estimates and misleading impulse responses; therefore, an unrestricted VAR in first differences is more appropriate when variables are stationary after differencing. Although ECM and VECM frameworks are commonly used to analyze short-run dynamics and adjustment speeds (Sims, 1980). Researchers caution against relying solely on statistical tests when choosing model specifications, emphasizing the role of economic reasoning (Ramaswamy & Sløk, 1998).

IRFs derived from the VECM are used to evaluate the short-run pass-through of policy rate shocks to deposit and lending rates. IRFs provide insights into the magnitude and persistence of dynamic responses in multivariate models. Responses are classified along two dimensions: 1) magnitude declines of less than or greater than 1% in deposit or lending rates following a one-standard-deviation policy rate shock, and 2) duration, whether rates reach their minimum within a specified period or decline further thereafter.

Because the inclusion of lagged dependent variables may induce endogeneity and violate ordinary least squares (OLS) assumptions, fixed- or random-effects estimators may be biased and inconsistent. To address this issue and account for money market conditions, the study employs the GMM estimator. The Arellano–Bond and Blundell–Bond GMM frameworks provide consistent and efficient estimates, thereby enhancing the robustness of the empirical results (Arellano & Bond, 1991; Blundell & Bond, 1998).

GMM is estimated at first differences to see stationarity and the order of integration of the variables, which may be found integrated at any level, say the first level. Order of integration at first difference will allow us to get rid of the individual effects and obtain unbiased and consistent results, as also referred to by the study of Beņkovskis (2008).

Further, to check the validity and consistency of the instruments, we shall be employing a few tests that were also proposed by the work of Arellano and Bond (1991). Consistency of our estimates depends on whether the disturbance follows a moving average [MA (1)] and no second-order autocorrelation exists. Therefore, autoregression [AR (1) and (2)] is used to check autocorrelation. Further Sargan test is employed to test the validity of the instruments.

A model in equational form defines every hypothesis in our analysis. Impact variables were compared in order to examine and evaluate cross-sectional differences.

The following VAR model is identified as follows (Den Haan, 2000):

$$X_t = \alpha + u_1 t + \sum_{l=1}^{L} \beta_t X_{t-1} + \varepsilon_t \tag{1}$$

$X_t$ denotes the vector of endogenous variables, $t$ is the time index, and $L$ is the lag order of the panel VAR model. The procedure entails estimating the specified equation and generating K step-ahead forecasts for the variables in $X_t$. These forecasts are then used to compute K period forecast errors by comparing realized values with their corresponding in-sample predictions. The lag structure is selected using Schwarz's Bayesian Information Criterion (Schwarz, 1978), with a minimum of two lags imposed to balance model adequacy and sample size preservation:

$$X_t = [GDP \rightarrow CPI \rightarrow B \rightarrow R] \tag{2}$$

where $B$ — bank (banking lending channel and associated variables); $R$ stands for rate (proxy of monetary policy rate).

Since the focus is on identifying the bank lending channel, panel VAR will be employed on disaggregated data. For this purpose, we used data on credit and deposit supplied by banks based on the heterogeneity of the banks after receiving the monetary shock. Hence, in total, various VARs will be estimated.

This study utilizes the specification employed by Kashyap and Stein (1995), which is used to produce the results by many other authors. For example, various authors use the modified form of the Kashyap and Stein model to generate results (Gambacorta & Marques-Ibanez, 2011; Gambacorta & Mistrulli, 2004; Ben Naceur et al., 2009; Opolot & Nampewo, 2014; Simpasa et al., 2015).

The model presented by Kashyap and Stein (1995) was designed to precisely evaluate the results of banks' reactions to monetary shocks. In addition, this model includes interaction terms that combine monetary shock with bank-specific characteristics:

$$\Delta ln\ l_{it} = \mu_i + \sum_{j=1}^{4} \alpha_j \Delta ln\ l_{it-j} + \sum_{j=1}^{4} \beta_j \Delta TB3_{t-j} + \sum_{j=1}^{4} \gamma_j Y_{it-j} \Delta TB3_{t-j} + \delta\ Y_{it-j} + \sum_{j=1}^{4} \varphi_j \Delta ln\ GDP_{it-j} + \sum_{j=1}^{4} \varphi_j X_{t-j} + \varepsilon_{it} \quad (3)$$

$$\Delta ln\ d_{it} = \mu_i + \sum_{j=1}^{4} \alpha_j \Delta ln\ d_{it-j} + \sum_{j=1}^{4} \beta_j \Delta TB3_{t-j} + \sum_{j=1}^{4} \gamma_j Y_{it-j} \Delta TB3_{t-j} + \delta\ Y_{it-j} + \sum_{j=1}^{4} \varphi_j \Delta ln\ GDP_{it-j} + \sum_{j=1}^{4} \varphi_j X_{t-j} + \varepsilon_{it} \quad (3)$$

with $i$ = 1…N, and $t$ = 1…T, and where N = number of banks; $l_{it}$ = loans of bank $i$ in period $t$; $d_{it}$ = deposits of bank $i$ in period $t$; $TB3$ = three months treasury bill rate; $Y_{it-j}$ = bank specific characteristics, i.e., size, liquidity and capitalization; $GDP_{it}$ = real gross domestic product; $X_{it}$ = inflation (CPI).

The above model's lag length is kept at four to bring white noise residuals. Then, after employing the augmented Dickey-Fuller test (ADF), variables are integrated at order 1. Kashyap and Stein (1995) also use this approach to avoid spurious correlations.

The above equation incorporating intercept $\mu_i$ which is bank-specific, allowing fixed effects across banks. Two variables representing real activity are induced in the model to control the demand effect, which allows us to detect cyclical movements and isolate monetary policy shocks. To further bring the distributional effects of monetary shocks among banks, bank-specific variables, i.e., size, liquidity, and capitalization, are used in the above model.

## 4. ESTIMATION AND INFERENCES

To further bring the distributional effects of monetary shocks among banks, bank-specific variables, i.e., size, liquidity, and capitalization, are used in the above model.

### 4.1. Results produced from impulse response functions

Figures 1, 2, and 3 display the dynamic responses of real advances and real deposits of large, medium, and small banks to monetary policy shocks. Consistent with the findings of Kashyap and Stein (1995), positive policy rate shocks exert a stronger effect on the lending of small banks compared with that of larger banks. This evidence supports the presence of a bank lending channel (Kashyap & Stein, 1995, 2000). The results demonstrate substantial heterogeneity in how banks adjust their balance sheets following an increase in the policy rate.

Examining the IRFs for large banks in Figure 1 shows that deposits initially rise over the first four quarters, reflecting their broader depositor base and stronger funding capacity during periods of monetary tightening. After the fifth quarter, deposits gradually decline and eventually stabilize near their initial level, whereas lending contracts immediately continue falling until roughly the seventh quarter, and then begin a mild recovery.

For medium-sized banks, as illustrated in Figure 2, both deposits and lending decline immediately following the monetary shock. Lending remains subdued for about eight quarters before stabilizing around the tenth quarter.

The IRFs for small banks in Figure 3 reveal a delayed deposit response, with deposits falling from the second quarter onward and stabilizing around the sixth quarter. Lending, however, drops sharply right after the shock and stays below its initial level throughout the entire horizon.

Taken together, these IRFs indicate that bank size plays a crucial role in determining the magnitude, direction, and persistence of banks' responses to monetary tightening.

**Figure 1.** Impulse response functions of monetary shocks into large size bank's lending and deposits

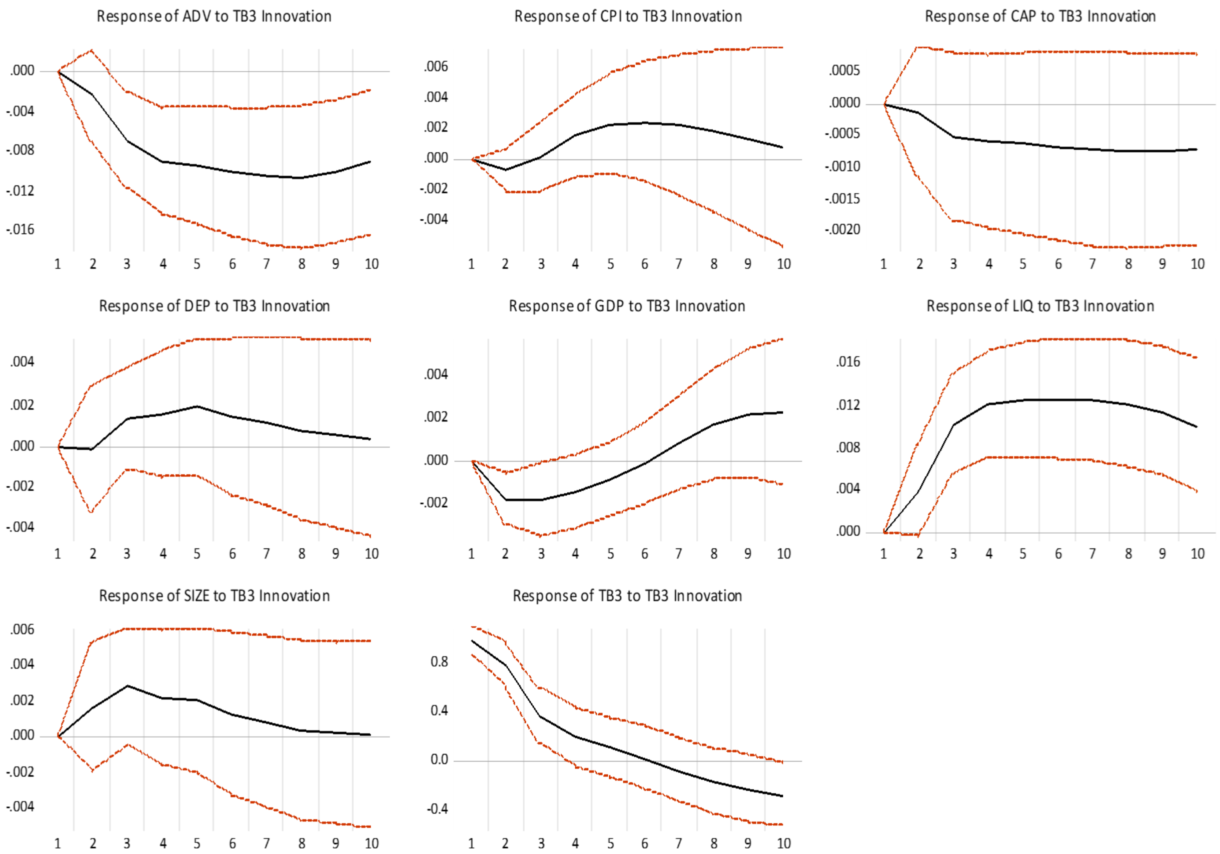



**Figure 2.** Impulse response functions of monetary shocks into medium size bank's lending and deposits

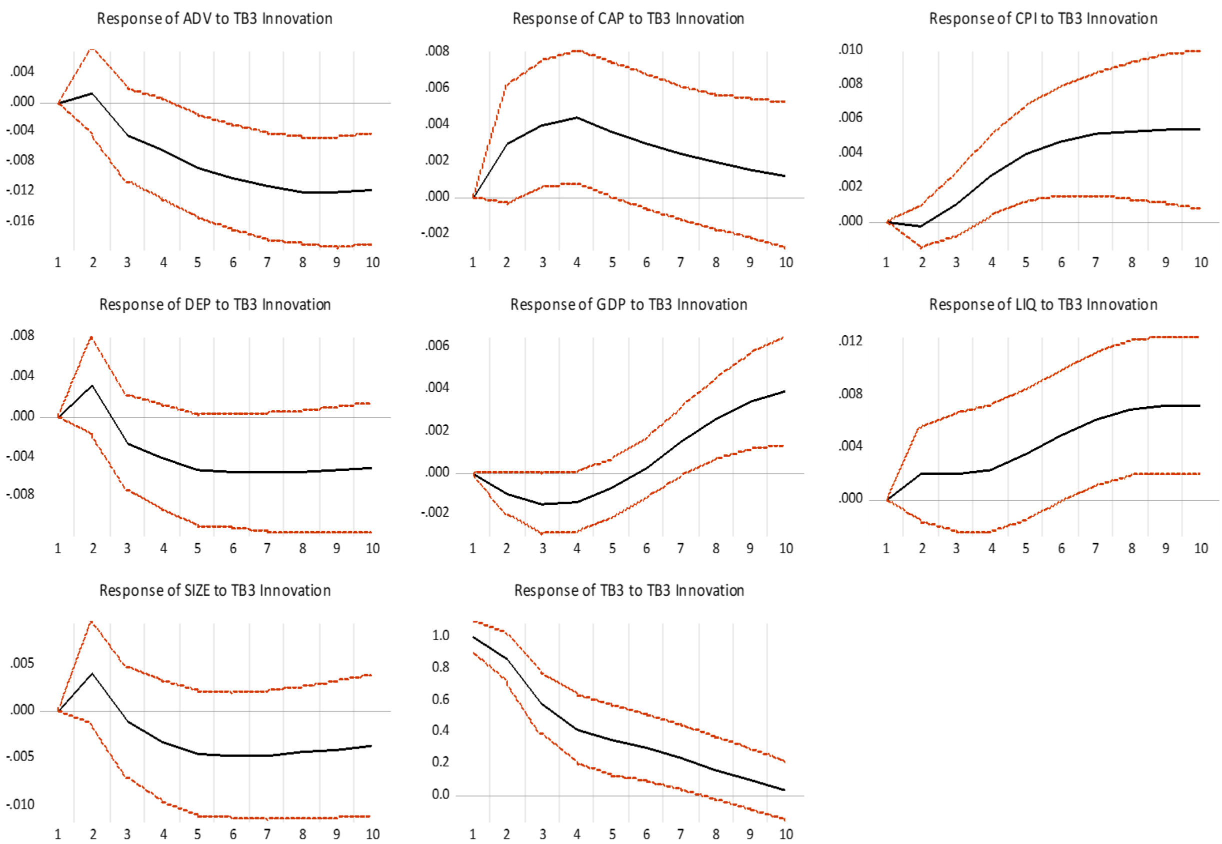
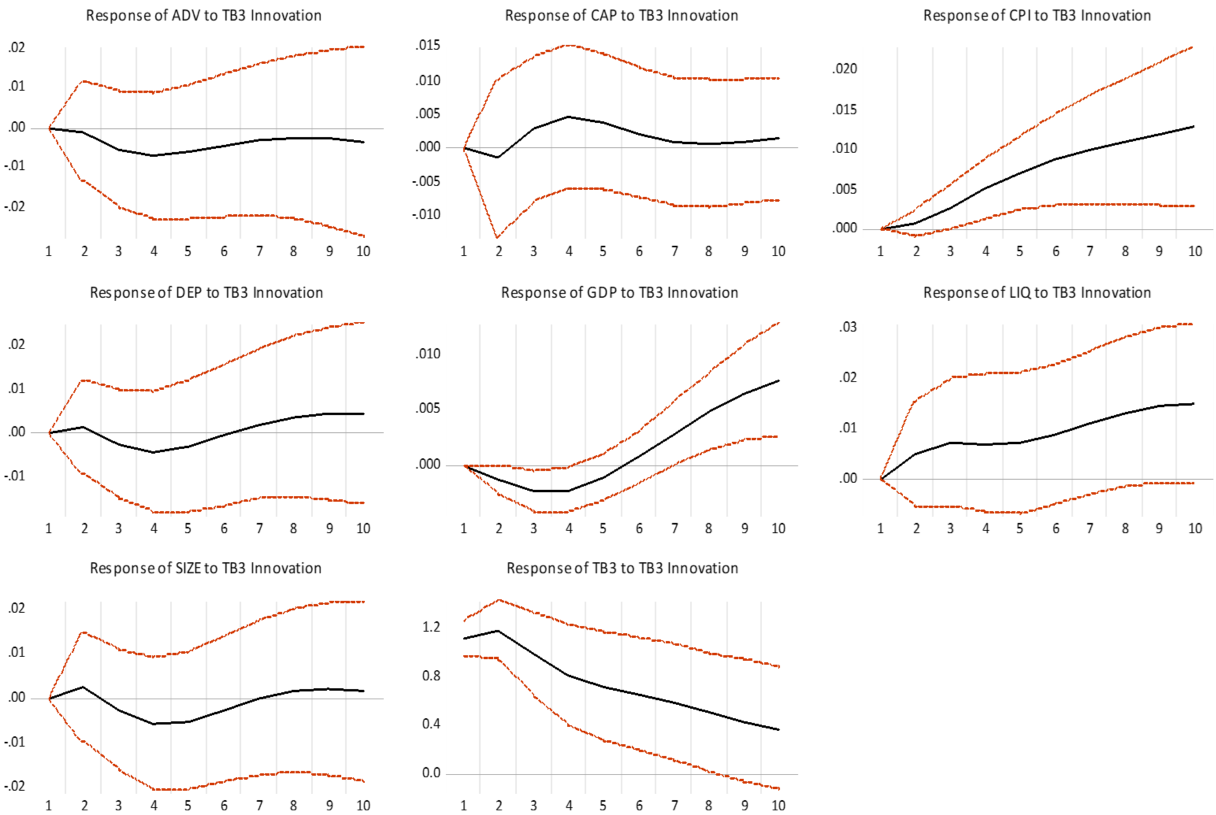


**Figure 3.** Impulse response functions of monetary shocks into small size bank's lending and deposits




## 4.2. Panel estimation

Panel estimations (Tables 2–4) offer deeper insights into how bank-specific characteristics — size, liquidity, and capitalization — influence the long-run elasticity of loans and deposits with respect to the policy rate. Because the dependent variables include both deposits and loans, the results capture the full structure of the bank lending channel. Each characteristic is assessed separately to identify its unique contribution to the heterogeneity in monetary transmission.

### *4.2.1. Size*

The results of our analysis indicate that monetary tightening has a negative effect on loan supply. However, the interaction between monetary policy and bank size shows a significant moderating influence on this decline. The corresponding probability values fall within acceptable ranges and are statistically significant, suggesting that medium-sized banks are, to some extent, able to shield their loan portfolios from adverse monetary shocks. Large banks typically act as net lenders in the interbank market, while small banks tend to be net borrowers. The significant probability values for both large and small banks indicate that loan supply is, to some degree, an increasing function of bank size. Overall, the loan market in Pakistan appears to have a stationary or at least a tendency toward a stationary size distribution (Topi & Vilmunen, 2001).

This implies that the loan market is not monopolized solely by large banks. Consequently, during adverse monetary shocks, the loan supply of both large and small banks declines more sharply than that of medium-sized banks. Regarding deposits, the results suggest that bank size is an important determinant of how monetary shocks influence deposit behavior in Pakistan. Both large and small banks face challenges in maintaining steady deposit inflows, despite their broader branch networks. In contrast, medium-sized banks appear relatively unaffected by monetary tightening when mobilizing deposits. Their consistent efforts to expand and recover deposit portfolios enable them to insulate their funding base from adverse movements in the policy rate. Although large banks hold a substantial share of total deposits, their funding requirements are also sizable. They maintain relatively high advances-to-deposits ratios alongside comparatively low liquid-assets-to-deposits ratios (State Bank of Pakistan, 2018). The significant probability values for both large and small banks indicate a strong association between their deposit portfolios and changes in the monetary policy rate.

**Table 2.** Size effects

| Variable | Coefficient | Std. error | t-statistic | Prob. |
|---|---|---|---|---|
| ***Panel A:*** | | | | |
| ***Large banks' size effect on advances*** | | | | |
| *GDP* | -0.038507 | 0.57439 | -0.06704 | 0.9466 |
| *TB3* | -0.000258 | 0.006895 | -0.037452 | 0.9702 |
| *CPI* | 0.195625 | 0.369438 | 0.529521 | 0.5972 |
| *SIZE* | 0.552082 | 0.265265 | 2.08125 | 0.0392 |
| ***Medium banks' size effect on advances*** | | | | |
| *CPI* | 0.310026 | 0.705693 | 0.439321 | 0.6609 |
| *GDP* | -1.300156 | 2.098687 | -0.619509 | 0.5363 |
| *TB3* | -0.026304 | 0.022013 | -1.194908 | 0.2335 |
| *SIZE* | 1.40333 | 1.214889 | 1.155109 | 0.2494 |
| ***Small banks' size effect on advances*** | | | | |
| *CPI* | 0.711635 | 0.677222 | 1.050814 | 0.2955 |
| *GDP* | -0.997258 | 0.865492 | -1.152245 | 0.2516 |
| *TB3* | -0.017314 | 0.01017 | -1.702439 | 0.0914 |
| *SIZE* | 0.856319 | 0.35188 | 2.433556 | 0.0165 |
| ***Panel B:*** | | | | |
| ***Large banks' size effect on deposits*** | | | | |
| ***Variable*** | ***Coefficient*** | ***Std. error*** | ***t-statistic*** | ***Prob.*** |
| *CPI* | 0.182658 | 0.193694 | 0.943022 | 0.3472 |
| *GDP* | -0.440847 | 0.301149 | -1.463884 | 0.1454 |
| *TB3* | -0.004626 | 0.003615 | -1.279546 | 0.2027 |
| *SIZE* | 1.059809 | 0.139077 | 7.620322 | 0 |
| ***Medium banks' size effect on deposits*** | | | | |
| *CPI* | 0.538248 | 0.651282 | 0.826444 | 0.4095 |
| *GDP* | 1.310895 | 1.93687 | 0.676811 | 0.4993 |
| *SIZE* | 0.095602 | 1.121216 | 0.085266 | 0.9321 |
| *TB3* | 0.012824 | 0.020316 | 0.631247 | 0.5286 |
| ***Small banks' size effect on deposits*** | | | | |
| *CPI* | 0.517901 | 0.34115 | 1.518103 | 0.1317 |
| *GDP* | -0.127638 | 0.435991 | -0.292753 | 0.7702 |
| *TB3* | -0.002644 | 0.005123 | -0.516154 | 0.6067 |
| *SIZE* | 0.793584 | 0.177259 | 4.476974 | 0 |

### *4.2.2. Liquidity*

The increase in the monetary policy rate is negatively associated with the growth of advances and deposits. Highly liquid banks support the growth in advances as per the philosophy of the bank's lending channels (Kashyap & Stein, 1995, 2000). The estimation, which we performed, as shown in Table 3, shows that monetary policy affected the advances or loan supply of medium-sized liquid banks. Probability values of small and large liquid banks are not found to be significant, whereas only medium-sized liquid banks have significant probability values, which implies that lending of medium-sized banks is affected by the monetary shocks. As far as the bank deposits are concerned whether affected by the monetary shocks based on the large, medium or small sized liquidity, our results again showed a less significant relationship between deposits based on liquidity position and monetary shocks which implied that banks in Pakistan hunted deposits where volume of their liquidity positions did not affect their deposit hunting capacity even with a change in monetary policy rate.

**Table 3.** Liquidity effects (Part 1)

| Variable | Coefficient | Std. error | t-statistic | Prob. |
|---|---|---|---|---|
| ***Panel A:*** | | | | |
| ***Large banks' liquidity effect on advances*** | | | | |
| *GDP* | 0.399466 | 0.43882 | 0.910318 | 0.3642 |
| *TB3* | 0.003957 | 0.005608 | 0.70557 | 0.4816 |
| *CPI* | 0.874128 | 0.541587 | 1.614012 | 0.1087 |
| *LIQ* | -0.806825 | 0.615587 | -1.31066 | 0.192 |
| ***Medium banks' liquidity effect on advances*** | | | | |
| *CPI* | 0.561864 | 0.701106 | 0.801396 | 0.4238 |
| *GDP* | 1.561097 | 0.826235 | 1.889411 | 0.0602 |
| *TB3* | 0.019676 | 0.0098 | 2.00765 | 0.046 |
| *LIQ* | -1.341228 | 0.514915 | -2.604754 | 0.0099 |
| ***Small banks' liquidity effect on advances*** | | | | |
| *CPI* | 4.652684 | 10.44623 | 0.445393 | 0.6569 |
| *GDP* | -5.673062 | 18.0831 | -0.313722 | 0.7543 |
| *TB3* | -0.10505 | 0.307807 | -0.341284 | 0.7335 |
| *LIQ* | 3.014474 | 10.54514 | 0.285864 | 0.7755 |

**Table 3.** Liquidity effects (Part 2)

| *Panel B:* | | | | |
|---|---|---|---|---|
| ***Large banks' liquidity effect on deposits*** | | | | |
| ***Variable*** | ***Coefficient*** | ***Std. error*** | ***t-statistic*** | ***Prob.*** |
| *CPI* | 0.474581 | 0.851016 | 0.557664 | 0.5779 |
| *GDP* | 0.768869 | 1.126066 | 0.682792 | 0.4958 |
| *TB3* | 0.006267 | 0.009617 | 0.651729 | 0.5156 |
| *LIQ* | 0.188127 | 0.207286 | 0.907573 | 0.3656 |
| ***Medium banks' liquidity effect on deposits*** | | | | |
| *CPI* | 0.556561 | 0.683389 | 0.814414 | 0.4163 |
| *GDP* | 1.627724 | 0.805356 | 2.021123 | 0.0446 |
| *TB3* | 0.02222 | 0.009553 | 2.32601 | 0.021 |
| *LIQ* | -0.486653 | 0.501904 | -0.969615 | 0.3334 |
| ***Small banks' liquidity effect on deposits*** | | | | |
| *CPI* | 5.746921 | 1276072 | 0.45036 | 0.6533 |
| *GDP* | -7.154711 | 22.08964 | -0.323894 | 0.7466 |
| *TB3* | -0.130873 | 0.376005 | -0.348062 | 0.7284 |
| *LIQ* | 4.286107 | 1288154 | 0.332733 | 0.7399 |

### *4.2.3. Capitalization*

As far as capitalization is concerned, the monetary policy rate continued to affect the advances of large and small capitalized banks adversely. The results of our analysis revealed that excess capital does not guarantee a stable position of loan supply during monetary shocks. As far as the bank deposits are concerned, they are affected by the monetary shocks based on the large, medium, or small size of capitalization. Capitalization is not a characteristic of banks that helps in insulating the loan supply during monetary tightening.

Capitalization results indicate that monetary tightening adversely affects the lending activities of both large and small capitalized banks. Contrary to expectations, excess capital does not guarantee insulation from declines in loan supply, possibly due to risk aversion or shifts in credit demand during contractionary policy cycles. Deposit behavior shows limited sensitivity to capitalization, as banks remain committed to deposit mobilization regardless of their capital position. Small-capitalized banks exhibit the greatest vulnerability, with both lending and deposits responding more sharply to policy shocks, reflecting weaker risk absorption capacity. Compared to size and liquidity, capitalization proves to be a relatively weaker determinant of banks' responses to monetary policy, although it still contributes to explaining cross-bank differences in adjustment patterns. These findings highlight that capital buffers alone do not fully shield banks from monetary tightening and must be complemented by stronger liquidity and balanced size-related advantages.

**Table 4.** Capitalization effects

| *Panel A:* | | | | |
|---|---|---|---|---|
| ***Large banks' capitalization effect on advances*** | | | | |
| ***Variable*** | ***Coefficient*** | ***Std. error*** | ***t-statistic*** | ***Prob.*** |
| *CAP* | 0.1417 | 1.485002 | 0.095421 | 0.9241 |
| *GDP* | 0.21514 | 0.221777 | 0.97007 | 0.3336 |
| *TB3* | 0.004016 | 0.003187 | 1.260115 | 0.2096 |
| *CPI* | 0.71854 | 0.170107 | 4.224053 | 0 |
| ***Medium banks' capitalization effect on advances*** | | | | |
| *CAP* | -1.222411 | 0.976808 | -1.251434 | 0.2122 |
| *CPI* | 0.396369 | 0.850304 | 0.466149 | 0.6416 |
| *GDP* | 1.456644 | 1.094542 | 1.330826 | 0.1847 |
| *TB3* | 0.007255 | 0.016284 | 0.445536 | 0.6564 |
| ***Small banks' capitalization effect on advances*** | | | | |
| *CPI* | 1.34573 | 0.797037 | 1.688415 | 0.094 |
| *GDP* | -0.234908 | 0.992132 | -0.236771 | 0.8133 |
| *CAP* | -0.472338 | 0.235945 | -2.001898 | 0.0476 |
| *TB3* | -0.008576 | 0.012441 | -0.68932 | 0.492 |
| *Panel B:* | | | | |
| ***Large banks' capitalization effect on deposits*** | | | | |
| ***Variable*** | ***Coefficient*** | ***Std. error*** | ***t-statistic*** | ***Prob.*** |
| *CAP* | -0.269173 | 1.323772 | -0.203337 | 0.8392 |
| *TB3* | 0.000913 | 0.007856 | 0.11617 | 0.9077 |
| *CPI* | 1.093075 | 0.437569 | 2.498062 | 0.0136 |
| *GDP* | 0.066455 | 0.520523 | 0.12767 | 0.8986 |
| ***Medium banks' capitalization effect on deposits*** | | | | |
| *CAP* | -1.392162 | 1.041094 | -1.337211 | 0.1826 |
| *CPI* | 0.371132 | 0.906265 | 0.409518 | 0.6826 |
| *GDP* | 1.82976 | 1.166576 | 1.568487 | 0.1183 |
| *TB3* | 0.024565 | 0.017356 | 1.415394 | 0.1585 |
| ***Small banks' capitalization effect on deposits*** | | | | |
| *CPI* | 1.129302 | 0.763273 | 1.479552 | 0.1417 |
| *GDP* | 0.579401 | 0.950103 | 0.60983 | 0.5432 |
| *TB3* | 0.005122 | 0.011914 | 0.429915 | 0.6681 |
| *CAP* | -0.346024 | 0.22595 | -1.531421 | 0.1284 |

## 5. CONCLUSION

This study examined the role of bank-specific characteristics, size, liquidity, and capitalization in shaping the responses of commercial banks to monetary policy shocks in Pakistan. It is witnessed that banks, which are smaller in size, liquidity, or capital, struggled in insulating their loan supply from monetary shocks (Ehrmann et al., 2001). These bank-specific abilities also indicated its financial health and brought heterogeneous responses of their loan supply against monetary shocks (Ozsuca & Akbostanci, 2012). The findings indicate that monetary tightening has heterogeneous effects across banks, reflecting differences in their ability to insulate loan and deposit portfolios from policy shocks. Large and small banks experienced more pronounced declines in both deposits and advances, while medium-sized banks showed relatively greater resilience. These results suggest that bank size is a decisive factor in determining the magnitude and persistence of responses, whereas liquidity is particularly significant for medium-sized banks. Capitalization, in contrast, emerged as a weaker distinguishing factor, except for small-capitalized banks, which struggled to maintain stability in lending and deposits under monetary tightening.

The practical implications of these findings highlight the importance of bank-level balance sheet management in mitigating the impact of monetary shocks. Banks' strategies, such as delaying the transmission of rate changes to borrowers, appear to help preserve customer relationships and stabilize future lending capacity. The study also reveals that the loan market in Pakistan maintains a stationary size distribution, indicating that large banks do not monopolize credit, and that heterogeneity in bank responses is essential for effective monetary transmission. This research has several limitations. The analysis relies on semi-annual data, which may mask short-term adjustments, and does not incorporate emerging digital or microfinance banks. Additionally, risk profiles of banks and evolving fiscal conditions, such as government securities auctions, were not included but may influence deposit and loan responses. Future research could address these limitations by using quarterly or higher-frequency data, including microfinance and digital banks, and incorporating risk characteristics to better understand differential responses to monetary policy. Such studies would provide a more nuanced understanding of the mechanisms through which monetary policy impacts bank behavior and financial stability.

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