



DOI: [https://doi.org/10.71317/kjard.2.9\(s\).2026.715](https://doi.org/10.71317/kjard.2.9(s).2026.715)

Kashmir Journal of Academic Research and Development

Journal homepage: <https://rjsaonline.org/index.php/KJARD>



The Impact of Monetary Policy on Banks' Risk-Taking Behaviour in Pakistan: The Role of Basel III

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ARTICLE INFO

ABSTRACT

Received:

August 19, 2026

Revised:

August 29, 2026

Accepted:

September 14, 2026

Available Online:

September 29, 2026

Keywords:

Monetary Policy; Basel III; Bank Risk-Taking Behavior; System GMM; Financial Stability; Prudential Regulation; Pakistan Banking Sector.

JEL Classification: E52; E58;

G21; G28

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This study uses the data of 252 bank-years across 21 scheduled commercial banks in Pakistan covering the period of 2014 to 2025. It examines if alteration in the cash reserve requirement and in the interest-rate charged on loans are related to alteration in non-performing loans, as well as if Basel III liquidity protections change such connections. The non-performing loans as a proportion of gross advances are used to measure credit risk. Empirical design uses a combination of dynamic specifications and two-step System GMM to address issues of persistence, bank-specific unobservable, simultaneity and potential endogeneity in a single framework. Estimates reveal significant persistence in credit risk. Baseline equations show a varying relationship between the credit risk and reserve requirements and lending rates, with efficiency and profitability generally being negatively related to credit risk. There is no single direct effect that LCR and NSFR have in common in all the equations. Most importantly, the interaction estimates suggest that the sensitivity of credit risk to monetary conditions may vary by banks' prudential-liquidity stance. The evidence thus suggests an interdependence between the characteristics of the bank balance sheet, monetary transmission and liquidity regulation, rather than a uniform monetary-policy impact on bank risk.

Introduction

In addition to their role as intermediaries between savers and borrowers, banks are also the main balance-sheet channel that conveys policy signals to firms and households in a bank-dominated financial system. If monetary conditions change, they can

affect funding costs, loan rates, borrower's ability to repay, and the types of borrowers for the loans. These changes can impact portfolio quality, even in the case of an inflation or aggregate demand as the initial policy target. The risk-taking channel thus broadens the existing monetary-transmission channel, by looking not only at the amount of credit that banks are providing, but at how much risk banks are willing to hold (Agur & Demertzis, 2010; Borio & Zhu, 2012). If financing is cheap and there is plenty of liquidity, the quest for returns might lead to increased presence of low credit quality borrowers. On the other hand, more stringent requirements could limit new risk taking, while increased debt obligations could make old borrowers more vulnerable. This ambiguity implies that the monetary-policy-risk relationship is an empirical issue (Maddaloni & Peydró, 2011; Ioannidou et al., 2015).

This mechanism is compounded by the current regulatory landscape since the 2008 crisis. The aim of Basel III was to enhance banks' ability to withstand shocks via capital and liquidity measures. The innovations relevant to the present study are the Liquidity Coverage Ratio (LCR), and the Net Stable Funding Ratio (NSFR), both of which address short-horizon liquidity resilience, and a more durable funding structure respectively. These prerequisites can affect the willingness of a bank to increase its risky assets as the monetary conditions vary. A bank with more liquidity buffers may respond differently to a similar scenario than a bank lacking liquidity buffers. Thus, in this study prudential liquidity is not only considered as an extra control variable, but also as a possible conditioning variable in the monetary-policy transmission process (Rubio & Carrasco-Gallego, 2016). The answer is informative enough in Pakistan as commercial banks continue to play an active role in the financial intermediation process. Banks saw significant interest rate, inflation, reserve requirement, credit availability and asset quality changes, as well as ongoing implementation of Basel III, between 2014 and 2025.

Previous studies on bank performance and Pakistan-specific factors suggest that monetary conditions, bank capitalization, ownership, bank liquidity, and other bank-specific factors are associated with bank outcomes (Akhter, 2023; Hussain et al., 2021; Noreen et al., 2016). They demonstrate the importance of loan-loss provisioning for bank profitability (Ul Mustafa et al., 2012) and interconnected credit and liquidity risks along with solvency risks for banks in Pakistan (Qadir et al., 2025). These contributions show that risk is multi-dimensional, but they leave a more restricted question unanswered: does prudential liquidity alter the relationship between monetary-policy conditions and credit risk? To answer that question, the study splits up two dimensions of monetary policy. The constraint on bank liquidity captured by CRR reflects the reserve constraint while LIR reflects the price-of-credit constraint in lending markets. They are first estimated with respect to their association with credit risk under different bank controls, and then added in as interaction terms, as well as directly. This sequence allows for the empirical results to differentiate a monetary-policy association from a regulatory conditioning effect. The question is not whether a single instrument mechanically determines the level of banks' risk; it is whether the risk response that is observed is dependent on the prudential-liquidity framework or "regulatory stance" in which monetary policy is applied. A second contribution involves the interpretation. Instead, the empirical design relies on the actual liquidity indicators and interaction terms, and does not employ a pre/post dummy regulatory device. This allows to analyses whether banks with different prudential-liquidity positions have different risk associations when reacting to the same monetary-policy measure. An average regulatory coefficient may be a less informative conditional effect when the banking system is comprised of institutions with varying capitalization, profitability, liquidity and asset quality.

The rest of the article is in four parts. In Section 2, the theoretical framework is advanced and evidence pertaining to the relationship between money and banking, money supply and bank risk-taking and Basel III is reviewed. The data and variable construction, the econometric specification and the System GMM procedure are detailed in Section 3. The descriptive and diagnostic evidence along with the dynamic-panel and interaction estimates are reported in Section 4. The results and conclusions are summarized in Section 5, followed by policy implications, limitations, and possible extensions.

Literature Review

Theoretical Foundation: Monetary Policy and the Risk-Taking Channel

This section introduces the theoretical background for monetary policy and the risk-taking channel. This section provides an introduction to the theoretical background in monetary policy and risk-taking channel. The theoretical starting point is that the quality of bank assets is as much determined by monetary policy as is their quantity. Standard transmission channels focus on the interest rates on borrowing, the supply of credit, investment, and aggregate demand (Bernanke & Gertler, 1995). That sequence is extended by the risk-taking viewpoint, which includes bank portfolio selection (Borio & Zhu, 2012). Lower rates can increase the relative appeal of more profitable assets and can ease screening requirements and thus widen the range of borrowers who can access loans (Agur & Demertzis, 2010; Adrian & Shin, 2010; Maddaloni & Peydró, 2011). Meanwhile, increased repayment capacity is likely to be of little benefit to existing borrowers.

Empirical Evidence from Advanced and Emerging Economies

Theory therefore does not mandate that all monetary instruments must be channeled through the same type of balance sheet and borrower channel: reserve requirements and lending rates can be implemented via either channel. Empirical Evidence from Developing Countries Both across and within banking systems, there is considerable evidence suggesting that there is a policy related risk channel. Altunbas et al., 2010, link long tenors with higher risk for banks, especially in situations of less capitalization. There is U.S. evidence that monetary easing is associated with changes in leverage and risk exposure (Dell'Ariccia et al., 2017; Weinhardt, Hussain, Mustafa, & Rawoof, 2025), and borrower-level studies indicate that policy conditions can impact loan pricing and the riskiness of borrowers who receive credit (Ioannidou et al., 2015). A similar result is found by Jiménez et al. (2014) who show that the reaction of the supply of credit to policy rates is sensitive to the balance-sheet of banks. This is significant for the current study since the monetary policy should not be assumed to produce the same risk response from institution to institution. Some factors influence the transmission process, such as capital, funding, liquidity, and regulation, particularly in emerging banking systems (Jiang & Yuan, 2022; Li & Zhang, 2025).

Basel III and the Monetary Policy-Regulation Nexus

The liquidity standards tackle two potential weaknesses: first, of the ability to cope with a short-term liquidity shock, and second, of the sustainability of funding over a longer time horizon (BCBS, 2011). LCR focuses on a cushion of liquid assets against stressed net cash outflows while NSFR focuses on the cushion of available stable funding against required stable funding. These restrictions can hamper aggressive maturity transformation or force banks to absorb liquidity cost in their balance sheet growth. A higher level of prudential positions tends to be correlated with higher levels of resilience, although the effects are different in various institutional settings and business cycles (Guidara et al., 2013; Giordana & Schumacher, 2017; Rubio & Carrasco-Gallego, 2016). The question is to which this variation is responsible for the interaction approach adopted here: Does the monetary-policy coefficient vary with the regulatory-liquidity position?

The Pakistani Banking Sector and Research Gap

Several components of the overall risk landscape have been researched in Pakistan, but not all together. Research has found associations between bank risk and capitalization, ownership structure, monetary conditions, and institutional characteristics (Akhter, 2023; Hussain et al., 2021; Noreen et al., 2016). In their article, "The Relationship between Profitability and Loan-Loss Provisioning", Ul Mustafa et al. (2012) show that there is a strong link between the management of credit quality and the profitability of banks. Qadir et al. (2025) offer evidence from multiple dimensions that proves that all three credit, liquidity and solvency risks need to be taken into consideration when assessing bank stability. Rather than asking whether bank characteristics are important, the question remains whether Basel III liquidity conditions systematically alter the relationship between monetary-policy indicators and credit risk. This paper combines estimation of LCR and NSFR with monetary-policy interactions and thus steps beyond a parallel discussion of policy and regulation to a test of their conditionality. From a conceptual point of view, this also connects the micro- and macro-prudential views. Realization of credit risk is done at the bank and borrower level, and monetary policy is common to the banking system. Basel III liquidity standards fall between these extremes as they limit balance sheets but seek to enhance the system's resilience. Consequently, testing interaction effects creates an empirical link between a common policy environment and a range of bank responses. This is particularly so in those economies where commercial bank lending plays a large role in the transmission of the money supply.

Model and Methodology

An annual balanced panel of 21 scheduled commercial banks over the period 2014-2025 is used in the empirical analysis. The resulting 252 bank-year observations enable variation to be analyzed both between institutions and over time. The series for banks are compiled from published financial statements and State Bank of Pakistan documents, while those of the monetary-policy variables are sourced from official documents of SBP. The macroeconomic controls are real GDP growth and inflation. Before estimation, extreme observations are minorized at the first and ninety-ninth percentiles. It is used to decrease the influence of extreme values, large or small, without omitting years or banks from the balanced sample. The dependent variable CR is the ratio of non-performing loans to gross-advances and thus reflects the deterioration of the quality of the loan portfolio. Two policy indicators are considered separately. CRR is indicative of the reserve requirement banks are set, and it applies to the amount of money that is immediately available, while LIR applies to the environment of the lending rate and the cost of credit. Capital Adequacy (CAR), Capitalization measure (CAP), Liquid assets to total assets (LQD), Operating efficiency (EFF), Return on equity (ROE) are among the bank-control set. GDP growth and consumer-price inflation account for common macroeconomic conditions. LCR and NSFR are the liquidity components of Basel III. It is helpful to use the two regulatory measures independently because short-term liquidity protection and stable long-term funding does not necessarily have the same impact on risk.

Econometric Model Specification

The empirical specification is dynamic because current credit risk may depend on its own recent history. Accordingly, a one-period lag of CR is included in the general model:

$$CR_{it} = \alpha_0 + \rho CR_{it-1} + \beta_1 MP_{it} + \gamma' Bank_{it} + \delta' Macro_{it} + \mu_i + \tau_t + \varepsilon_{it} \quad (1)$$

Here, CR_{it} is the credit-risk measure for bank i in period t and CR_{it-1} captures persistence. MP_t denotes either CRR or LIR. $Bank_{it}$ represents the vector of institution-specific controls, while $Macro_t$ contains GDP growth and inflation. Bank fixed heterogeneity is represented by μ_i , common time effects by τ_t , and ε_{it} is the idiosyncratic error term.

Model 1: Baseline Dynamic Model with Bank Efficiency

$$CR_{it} = \alpha_0 + \rho CR_{it-1} + \beta_1 MP_{it} + \beta_2 CAR_{it} + \beta_3 LQD_{it} + \beta_4 EEF_{it} + \beta_5 CAP_{it} + \beta_6 GDP_t + \beta_7 INF_t + \mu_i + \tau_t + \varepsilon_{it} \quad (2)$$

Model 2: Baseline Dynamic Model with Bank Profitability

$$CR_{it} = \alpha_0 + \rho CR_{it-1} + \beta_1 MP_{it} + \beta_2 CAR_{it} + \beta_3 LQD_{it} + \beta_4 ROE_{it} + \beta_5 CAP_{it} + \beta_6 GDP_t + \beta_7 INF_t + \mu_i + \tau_t + \varepsilon_{it} \quad (3)$$

Model 3: Extended Basel III Model with Bank Efficiency

$$CR_{it} = \alpha_0 + \rho CR_{it-1} + \beta_1 MP_{it} + \beta_2 CAR_{it} + \beta_3 LQD_{it} + \beta_4 EEF_{it} + \beta_5 CAP_{it} + \beta_6 LCR_{it} + \beta_7 NFCR_{it} + \beta_8 GDP_t + \beta_9 INF_t + \mu_i + \tau_t + \varepsilon_{it} \quad (4)$$

Model 4: Extended Basel III Model with Bank Profitability

$$CR_{it} = \alpha_0 + \rho CR_{it-1} + \beta_1 MP_{it} + \beta_2 CAR_{it} + \beta_3 LQD_{it} + \beta_4 ROE_{it} + \beta_5 CAP_{it} + \beta_6 LCR_{it} + \beta_7 NFCR_{it} + \beta_8 GDP_t + \beta_9 INF_t + \mu_i + \tau_t + \varepsilon_{it} \quad (5)$$

Models 5 and 6: Monetary Policy $\times$ Basel III Interaction Models

$$CR_{it} = \alpha_0 + \rho CR_{it-1} + \beta_1 MP_t + \beta_2 BasellIII_{it} + \beta_3 (MP_t \times BasellIII_{it}) + \gamma' Bank_{it} + \delta' Macro_{it} + \mu_i + \tau_t + \varepsilon_{it} \quad (6)$$

The coefficient on the interaction term, β_{α_3} , identifies whether the association between monetary policy and credit risk changes with the relevant Basel III liquidity condition. Models 5.1 and 5.2 combine the efficiency specification with CRR and LIR, respectively; Models 6.1 and 6.2 repeat the exercise using profitability. LCR and NSFR are retained as direct controls in the interaction regressions. Statistical significance of the interaction term is therefore interpreted as evidence that the monetary-policy effect is conditional on the regulatory liquidity measure.

System GMM Estimation Strategy

The selection of two-step System GMM is obvious, as it is a mechanism that is utilized when the structure of the data is appropriate and the research question requires such analysis. You have to have a lagged dependent variable in your specification because credit risk is persistent, but you can't include it in the specification because it is also correlated with the bank-specific component of the disturbance in a conventional fixed-effects dynamic panel. Some balance-sheet regressors might also be related to risk, along with the balance sheet. Together with the balance sheet, some regressors may be determined jointly with risk. The difficulties are overcome by system GMM which simultaneously estimates the transformed equation and level equation, and uses instruments from appropriate dated internal values, as in Arellano and Bover (1995) and Blundell and Bond (1998). This framework is especially helpful here as it allows for persistence, unobserved heterogeneity, and possibly reverse causality to be handled simultaneously in the same estimator, instead of any ad hoc corrections.

$$\Delta CR_{it} = \rho \Delta CR_{it-1} + \beta' \Delta X_{it} + \Delta \varepsilon_{it}$$

Identification depends on the validity of the lag structure used as instruments. In the differenced equation, earlier levels provide instruments under the required orthogonality assumptions; the system component supplements them with moment conditions for the level equation. The diagnostic emphasis is therefore placed on serial correlation and over-identifying restrictions. The AR(2) test is especially important because second-order correlation in the differenced residuals would undermine the use of deeper lags as instruments. Sargan statistics are reported for the over-identifying restrictions.

Instrument counts are kept under review because an unnecessarily large instrument set can overfit endogenous variables and weaken specification tests (Roodman, 2009).

Variable Description and Measurement

Table 1. Variable Definitions, Measurement, and Sources

Variables	Symbol	Measures	Source/References
Credit Risk	CR	Non-performing Loans / Gross Advances	Akhter, 2023; C Zheng et al., 2017)
Cash Reserve Ratio	CRR	CRR (%) as set by State Bank of Pakistan	(Hussain et al., 2021)
Lending Interest Rate (%)	LIR	Used as bank/Bank Lending Rate	(Anwar et al., 2024; Khan et al., 2016)
Net Stable Funding Ratio (%)	NSFR	ASF / RSF $\geq$ 100%	Basel III (BIS, 2010)
Liquidity Coverage Ratio (%)	LCR	High11-Quality Liquid Assets / 30-day Net Outflows $\geq$ 100%	Basel III (BIS, 2010)
Capital Adequacy Ratio	CAR	(Tier 1 + Tier 2 Capital) / Risk Weighted Assets	(Ridwan & Mayapada, 2022)
Capitalization	CAP	Equity / Total Assets	Laeven & Levine (2009), Berger & Bouwman (2013)
Efficiency	EFF	Operating Expenses / Operating Income	Berger & Mester (1997), Altunbas et al. (2007)
Return on Equity	ROE	Net Income / Shareholders' Equity	Zheng et al. (2023)
Liquidity Position	LQD	Liquid Assets / Total Assets	Vázquez & Federico (2015)
GDP growth (annual %)	GDP1	Annual growth in real Gross Domestic Product	(Akhter, 2023; (Rahman & Adnan, 2020)
Inflation, consumer prices (annual %)	INFR	Annual rate of inflation	Akhter, 2023; (Khan et al., 2023))

Source: Author's compilation based on the reference data and literature review.

Empirical Results and Discussion

The empirical discussion is organized to separate data characteristics from model-based evidence. Descriptive statistics first establish the extent of cross-bank and time-series variation. Correlations and VIFs are then used as preliminary checks on linear association among regressors, while panel unit-root results document the treatment of the variables in estimation. The dynamic specifications are subsequently evaluated with serial-correlation and over-identification diagnostics. Only after these

checks are the System GMM coefficients interpreted. This ordering is important as the diagnostics reported are crucial for providing a reasonable support of the underlying dynamic specification and instrument strategy, which are meaningful for the ordering.

Descriptive Statistics

The frequency distribution of the variables are summarized in table 2 with means, standard deviations, and ranges.

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CR	252	9.098	7.709	0	51.221
CRR	252	5.250	0.434	5	6
LIR	252	11.647	3.127	8.21	17.72
CAR	252	16.80	4.904	5.383	38.51
CAP	252	6.833	3.015	-1.887	24.312
EFF	252	2.563	2.158	-11.424	16.576
ROE	252	14.984	23.097	-48.997	336.023
LQD	252	7.997	2.714	3.094	25.402
GDP1	252	3.793	2.326	-1.274	6.574
INFR	252	10.039	7.635	2.529	30.768

Source: Author's Estimation

Notes: Max = maximum value, Min = minimum value, S.D. = standard deviation and Obs. = observations.

The sample has meaningful heterogeneity and not the clustering around a common bank profile. The credit risk of the assets on the books is heavily skewed by asset quality issues, with a mean of 9.098 and a range from 0 to 51.221, across institutions and years. Also, policy variables fluctuate over the sample and profitability and efficiency show especially high variability. The differences between the average capital and the average liquid assets are also significant across observations, with average capital held at CAR and average liquid assets held at LQD being 16.80 and 7.997, respectively. Such dispersion is empirically useful because the dynamic panel estimates are identified not from a single macroeconomic episode, but from multiple episodes of differences across the various bank conditions, with the policy and macroeconomic environments varying over these episodes.

Correlation Analysis

Table 3. Pearson Correlation Matrix

Variable	CR	CRR	LIR	CAR	CAP	EFF	ROE	LQD	GDP	INF
CR	1.0									
CRR	-0.0368	1.0								
LIR	0.0429	0.5516	1.0							
CAR	-0.0763	-0.0317	-0.0098	1.0						
CAP	0.0091	-0.2207	-0.0388	-0.0124	1.0					
EFF	-0.0019	0.1117	0.1178	0.0275	0.0708	1.0				
ROE	-0.0421	0.0464	0.0716	0.0263	-0.1964	-0.1004	1.0			
LQD	0.1285	-0.1904	-0.0847	0.0004	0.0697	0.0193	-0.0200	1.0		
GDP	-0.0406	0.0017	-0.4532	-0.1494	0.0277	-0.0424	-0.0339	-0.1	1.0	
INF	-0.0046	0.7582	0.8649	0.0075	-0.1433	0.0996	0.0755	-0.1005	-0.4973	1.0

Source: Author's Estimation

Pairwise correlations provide an initial description rather than a test of the hypotheses. Most coefficients are moderate, but LIR and inflation are strongly positively correlated (0.8649). Because policy rates and inflation commonly move together over parts of a monetary cycle, this relationship deserves attention when coefficients are interpreted jointly. The subsequent VIF analysis is therefore used to assess whether the multivariate specifications display problematic linear dependence. Credit risk

itself has only small bivariate correlations with most regressors, reinforcing the need for a dynamic multivariate framework in which persistence and simultaneous covariates can be taken into account.

Unit Root and Diagnostic Tests

Stationarity is examined before the dynamic-panel regressions using the Levin-Lin-Chu panel unit-root procedure. Table 4 reports the corresponding statistics and p-values. On the basis of those reported probabilities, the variables are treated as level-stationary, $I(o)$, in the subsequent estimations.

Table 4. Levin-Lin-Chu (LLC) Panel Unit Root Test

Variables	Statistics	Probability	Results
CR	-3.1904	0.001	$I(o)$
CRR	-3.6857	0.001	$I(o)$
LIR	-8.992	0.00	$I(o)$
CAR	-1.695	0.05	$I(o)$
CAP	-5.2502	0.00	$I(o)$
EFF	-4.9641	0.00	$I(o)$
ROE	-17.9292	0.00	$I(o)$
LQD	-7.0574	0.00	$I(o)$
GDP1	-8.406	0.00	$I(o)$
INFR	23.4419	0.00	$I(o)$
Author's Estimation			

The reported LLC probabilities lead to rejection of the unit-root null for the variables included in the models, so estimation proceeds in levels. For inflation, the LLC statistic is retained exactly as generated by the underlying output and should be interpreted together with its reported probability.

Multicollinearity Test

Potential collinearity among regressors is evaluated through variance inflation factors. Across the specifications in Table 5, mean VIFs lie between 1.50 and 3.29, while the largest individual value is 9.36 in Model 5.2. These values do not cross the commonly used benchmark of 10, although the interaction models naturally produce larger VIFs and therefore merit more careful coefficient interpretation.

Table 5. Variance Inflation Factor (VIF) Results

Model	Mean VIF	Max VIF
M1.1	2.43	5.78
M1.2	2.44	5.81
M2.1	2.00	4.36
M2.2	1.50	2.61
M3.1	2.46	6.53
M3.2	1.97	4.37
M4.1	2.24	5.94
M4.2	2.26	6.40
M5.1	2.98	8.33
M5.2	3.29	9.36
M6.1	2.37	6.83
M6.2	2.43	7.1

Source: Author's Estimation

Taken as a whole, the VIF evidence does not point to severe multicollinearity. The comparatively larger values in models containing interaction terms are not unexpected because a product term is algebraically related to the variables from which it is constructed.

Serial Correlation and Instrument Validity Tests

The dynamic-panel specifications are subjected to serial-correlation and over-identification diagnostics. Arellano-Bond tests are reported for first- and second-order autocorrelation, and the Sargan statistic is used to examine the over-identifying restrictions implied by the instrument set.

Table 6. Arellano–Bond Serial Correlation Test Results

Variables	Order (1)		Order (2)	
	Z	Prob > Z	Z	Prob > Z
M1.1	-1.453	0.146	0.359	0.720
M1.2	-1.449	0.147	0.184	0.854
M2.1	-1.379	0.168	0.296	0.767
M2.2	-1.4293	0.153	0.214	0.831
M3.1	-1.887	0.059	-0.915	0.360
M3.2	-1.870	0.062	-0.839	0.402
M4.1	-2.397	0.017	0.180	0.857
M4.2	-3.530	0.004	-0.459	0.646
M5.1	-2.136	0.033	-1.131	0.258
M5.2	-1.682	0.093	-0.743	0.457
M6.1	-1.564	0.118	-0.708	0.479
M6.2	-1.662	0.097	-0.808	0.419

Source: Author's Estimation

Table 6 presents the Arellano-Bond diagnostics. Evidence for AR(1) differs across models and is not significant in every specification. The more consequential result for the consistency of System GMM is AR(2): none of the reported models shows statistically significant second-order serial correlation. On this criterion, the lag structure used for the instruments is not contradicted by the residual diagnostics.

Table 7. Sargan Test Results

Variables	chi2	Prob > chi2
M1.1	10.504	1.00
M1.2	10.112	1.00
M2.1	9.688	1.00
M2.2	15.562	1.00
M3.1	8.265	1.00
M3.2	9.372	1.00
M4.1	9.354	1.00
M4.2	11.448	1.00
M5.1	7.247	1.00
M5.2	6.279	1.00
M6.1	5.390	1.00
M6.2	5.0715	1.00

Source: Author's Estimation

The Sargan results in Table 7 fail to reject the over-identifying restrictions in every reported specification. This is consistent with the proposed instrument set, although the uniformly large p-values warrant caution. Instrument validity is therefore assessed alongside the AR(2) evidence and the deliberate control of instrument count rather than from the Sargan statistic in isolation.

System GMM Estimation Results

Two-step System GMM is applied to the dynamic credit-risk equations to address endogenous regressors, unobserved bank heterogeneity, and heteroskedasticity. The baseline specifications, M1.1 through M2.2, estimate the monetary-policy relationship without Basel III liquidity variables. The extended and interaction models then introduce LCR, NSFR, and their moderating terms.

Base Model with Efficiency (M1.1 and M1.2)**Table 8. Base Model with Efficiency (Credit Risk)**

	Model 1.1	Model 1.2
Variables	MP = CRR	MP = LIR
CR	0.695 (0.083) ***	0.839 (0.067) ***
CRR	0.921 (0.396) **	-
LIR	-	-0.253 (0.099) ***
CAR	-0.01 (0.001) ***	-0.001 (0.002) ***
LQD	-0.216 (0.665) ***	-0.106 (0.027) ***
EFF	-0.299 (0.088) ***	-0.371 (0.048) ***
CAP	0.880 (0.303) ***	0.294 (0.091) ***
GDP1	-0.328 (0.047) ***	-0.207 (0.0325) ***
INFR	-0.0623 (0.017) ***	0.126 (0.051) ***
CONST	-4.048 (2.108) **	3.539 (0.732) ***

*** p < .01, ** p < .05, * p < .10. Source: Author's Estimation

The efficient form baseline estimates are the most striking in terms of their persistence; the coefficient on the lagged form of the CR is positive and statistically significant in both policy specifications. But the two monetary indicators are not exactly the same. Current credit risk is positively related with CRR, while LIR is negatively and significantly related with current credit risk in Model 1.2. This difference is in line with the notion that lending-rate conditions and constraints act differently. Efficiency is negatively related to credit risk in both equations, and CAR is also negative and significant. Capitalization is good in these specifications. The sign of GDP growth and inflation switches in the two policy equations, making the coefficients more a statement about macroeconomic conditions than persistent effects.

Base Models with Profitability (M2.1 and M2.2)**Table 9. Base Model with Profitability (Credit Risk)**

	Model 2.1	Model 2.2
Variables	MP = CRR	MP = LIR
CR	0.818 (0.016) ***	0.749 (0.043) ***
CRR	1.052 (0.232) ***	-
LIR	-	-0.074 (0.014) ***
CAR	-0.001 (0.002) ***	-0.001 (0.002) ***
LQD	-0.109 (0.055) **	-0.135 (0.025) ***
ROE	-0.159 (0.006) ***	-0.028 (0.004) ***
CAP	0.423 (0.100) ***	0.276 (0.130) **
GDP1	-0.326 (0.0198) ***	-0.196 (0.023) ***
INFR	-0.0694 (0.105) ***	0.044 (0.014) ***
CONST	-4.013 (1.122) ***	2.915 (1.253) **

*** p < .01, ** p < .05, * p < .10. Source: Author's Estimation

Persistence is not affected when one replaces "Efficiency" with "Profitability". Lagged CR still positive and significant in Table 9, CRR positive in the reserve-based model, LIR negative in the lending-rate model. ROE is a negative correlate of credit risk across both specifications, which suggests that profits are correlated with lower credit risk measured after remaining covariates are controlled for in the observations. CAR has been negative but capitalization is positive. Again the macroeconomic parameters are specific to the policy. The robustness of the main sign pattern across alternative bank-performance controls offers a helpful check on the robustness of the main sign pattern prior to the inclusion of Basel III variables.

Extended Models with Basel III (M3.1 and M3.2)**Table 10. Extended Model with Basel III and Efficiency (Credit Risk)**

	Model 3.1	Model 3.2
Variables	MP = CRR	MP = LIR
CR	0.062 (0.148) ***	0.871 (0.083) ***
CRR	1.908 (0.395) ***	-
LIR	-	0.079 (0.040) **
CAR	-0.001 (0.002) ***	-0.001 (0.002) ***
LQD	-0.192 (0.068) ***	-0.135 (0.090)
EFF	-0.370 (0.075) ***	-0.312 (0.044) ***
CAP	1.572 (0.0406) ***	0.265 (0.136) **
LCR	-0.011 (0.004) ***	0.009 (0.002) ***
NSFR	0.021 (0.006) ***	-0.017 (0.005) ***
GDP1	-0.316 (0.036) ***	-0.176 (0.036) ***
INFR	-0.058 (0.019) ***	-0.043 (0.022) **
CONST	-13.714 (4.212) ***	2.237 (2.307)

*** p < .01, ** p < .05, * p < .10. Source: Author's Estimation

The longer lasting efficiency models question whether the basic relationships remain even with the addition of regulatory liquidity explicitly. In fact, the answer is mostly yes: the so-called credit-risk persistence still exists, CRR is positive in Model 3.1 and negative in Model 3.2 for the LIR. The sign of the coefficient of the LCR is not the same as the sign of the coefficient of the NSFR in both equations. Not only is that a finding of great practical significance, as it serves as a warning against viewing Basel III liquidity as a monolithic treatment, but it also raises issues of practical importance. There may be interaction between short-horizon liquid-asset protection and longer-horizon funding stability in the portfolios of banks and with the specific monetary indicator used. In both extended efficiency equations, GDP growth is negatively related to CR.

Extended Models with Basel III and Profitability (M4.1 and M4.2)**Table 11. Extended Model with Basel III and Profitability (Credit Risk)**

	Model 4.1	Model 4.2
Variables	MP = CRR	MP = LIR
CR	0.611 (0.132) ***	0.567 (0.092) ***
CRR	-1.168 (0.290) ***	-
LIR	-	-0.111 (0.053) **
CAR	-0.001 (0.007)	-0.001 (0.0002) **
LQD	0.120 (0.124)	-0.058 (0.095)
ROE	-0.181 (0.001) ***	-0.176 (0.034) ***
CAP	0.839 (0.359) **	0.233 (0.157)
LCR	-0.006 (0.001) ***	0.013 (0.003) ***
NSFR	0.021 (0.008) ***	-0.008 (0.005)
GDP1	0.105 (0.058) *	-0.236 (0.027) ***
INFR	0.244 (0.024) ***	0.084 (0.035) **
CONST	3.436 (1.725) **	5.042 (2.264) **

*** p < .01, ** p < .05, * p < .10. Source: Author's Estimation

The Basel III based on profitability specifications tell the similar story. The results regarding lagged risk remain positive; the effect of the regulatory-liquidity variables differs among the equations and is not constant. The sign of the relationship of ROE to respect credit risk is negative, and the signs of the relationship of CAR and capitalization are generally similar to the baseline profitability models. The changing GDP coefficient indicates that the macro controls should not be interpreted without specification. Combined with Table 10, these estimates point to a more important empirical result: the relationship between policy risk and regulatory liquidity might not be the same, but rather whether it is conditioned by regulatory liquidity.

Interaction Models: Monetary Policy x Basel III (M5.1 and M5.2)**Table 12. Monetary Policy × Basel III Interaction Model with Efficiency (Credit Risk)**

	Model 5.1	Model 5.2
Variables	MP = CRR	MP = LIR
CR	1.143 (0.131) ***	0.666 (0.142) ***
CRR	-2.226 (0.789) ***	-
LIR	-	-0.109 (0.111)
CAR	-0.0001 (0.003)	-0.001 (0.0002) ***
LQD	0.0007 (0.191)	-0.239 (0.181)
EFF	-0.539 (0.149) ***	-0.262 (0.045) ***
CAP	-0.217 (0.650)	0.995 (0.551) *
GDP1	0.126 (0.096)	-0.183 (0.038) ***
INFR	0.085 (0.034) ***	0.062 (0.046)
LCR	-0.0081 (0.001) ***	-0.011 (0.004) ***
NSFR	0.017 (0.010) *	0.004 (0.005)
MP*Basel III	-0.411 (0.105) ***	-0.056 (0.048)
CONST	11.668 (5.112) **	1.823 (1.618)

*** p < .01, ** p < .05, * p < .10. Source: Author's Estimation

The efficiency specifications conditioning test is given in Table 12. The interaction term of monetary-policy × Basel III is negative in both equations and it is reported in Model 5.1 to be significant at the desired level. In the case of a negative interaction, the marginal effect of the monetary indicator on the credit risk would reduce when the condition of prudential liquidity would increase, ceteris paribus. The direct LCR and NSFR coefficients are still specification dependent and the interaction should not be interpreted as indicative of a general trend of all liquidity measures being independent risk reducers. Rather, the findings here show a variation in the policy-risk slope with the regulatory context.

Interaction Models with Profitability (M6.1 and M6.2)**Table 13. Monetary Policy × Basel III Interaction Model with Profitability (Credit Risk)**

	Model 6.1	Model 6.2
Variables	MP = CRR	MP = LIR
CR	0.683 (0.162) ***	0.754 (0.136) ***
CRR	-1.993 (0.915) **	-
LIR	-	-0.173 (0.108)
CAR	0.0003 (0.0002)	-0.0006 (0.00009)
LQD	-0.120 (0.196)	-0.047 (0.167)
ROE	-0.148 (0.026) ***	-0.144 (0.019) ***
CAP	0.968 (0.438) **	0.895 (0.360) ***
GDP1	-0.056 (0.026) **	-0.847 (0.020) ***
INFR	0.161 (0.047) ***	0.128 (0.049) ***
LCR	-0.068 (0.004)	-0.006 (0.003) **
NSFR	0.025 (0.009) ***	0.014 (0.008) *
MP*Basel III	-0.081 (0.052)	-0.131 (0.034) ***
CONST	5.725 (4.482)	-0.951 (1.617)

*** p < .01, ** p < .05, * p < .10. Source: Author's Estimation

Profitability interaction models are reiterative of the conditional interpretation. Both equations have negative interaction coefficients, but varying degrees of significance. ROE remains to be negatively correlated with credit risk and the direct regulatory coefficients are different. This is an informative combination: An unstable direct effect coefficient for a regulatory variable may impact the manner in which the other variable is linked to risk. The interaction estimates thus confirm that

monetary policies and prudential policies are complementary aspects of the bank-risk environment, not complementary or redundant aspects of bank balance-sheet conditions.

Four patterns stand out across Tables 8–13. First, the positive lagged coefficients indicate that there is a carry-over effect of credit risk from one year to the next. Second, the signs of CRR and LIR are different in general, as are the signs of the channels through which these two work. Third, in the reported specifications, the higher the reported efficiency or profitability, the lower the credit risk. Fourth, LCR and NSFR do not seem to have a uniform positive relationship with risk but the negative interaction terms suggest that prudential liquidity can affect the relationship between monetary conditions and credit risk. These are model-based relationships, only to be understood within the estimating equations' identifying assumptions of the System GMM.

Conclusion and Policy Implications

The relationship between monetary policy and credit risk in Pakistan is explored by emphasizing the regulatory aspect. Estimated with 21 scheduled commercial banks for 2014–2025, it is a dynamic System GMM model that includes alternative monetary indicators, bank characteristics, macroeconomic controls, Basel III liquidity measures and interaction terms. From the reported estimates three conclusions can be drawn. The credit risk is also persistent which implies that the portfolio quality of this year is related to last year to a certain extent. Thus, the monetary-policy coefficients generated by the different monetary-policy channel specifications suggest that the choice of policy channel is important. Finally, the direct impact of LCR and NSFR are not homogenous, while a few interaction estimates are negative. Overall, the evidence suggests a conditional relationship between monetary policy and risk, in which prudential liquidity conditions the strength of the relationship. This angle allows a monetary and prudential perspective to be incorporated into the empirical framework of the provisioning, profitability, credit risk and liquidity risk studies carried out on monetary and prudential conditions in Pakistan.

Policy Implications

The results are of interest for monetary and supervisory authorities. The changes in reserves availability and in the lending conditions can also be accompanied by changes in the quality of the loan portfolio; therefore, any changes in the policy should be considered together with macroeconomic stabilization and financial-stability considerations. For supervisors, the interaction results mean that the usefulness of liquidity requirements depends on their direct coefficient, as well as their impact on banks' reactions to monetary conditions. Banks, on the other hand, have an incentive to maintain the sound liquidity planning, profitability, operational efficiency, and capital strength because these elements of their balance sheet influence how external policy conditions get passed into risk. The findings call for a more nuanced approach of coordination rather than a one-size-fits-all reaction: prudential buffers should build resilience and not smother productive intermediation. Limitations and Future Research.

Limitations and Future Research

The conclusions are subject to a number of limitations. First, the regulatory analysis focuses on Basel III liquidity indicators and it does not jointly model the leverage ratio, capital-conservation buffer, or the countercyclical capital buffer. Second, annual data can mask within-year changes in monetary conditions and bank portfolios; shorter transmission lags may be found using higher frequency data. Third, unusual macroeconomic episodes occurred in the 2014–2025 window, such as the COVID-19 period and marked changes in inflation and interest rates. Explicit regime breaks or crisis interactions could be explored in future research. Third, interaction terms for CRR–LCR, CRR–NSFR, LIR–LCR, and LIR–NSFR would help to isolate which regulatory dimension is responsible for moderation. Lastly, benchmarking with other emerging economies with strong banking sectors may shed light on whether the Pakistan experience is unique or is indicative of a cross-country trend in the monetary-prudential channels of transmission.

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