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Bank-Specific Determinants of Non-Performing Loans: Evidence from Uzbekistan's Banking Sector

Jonibek Rustamov

1. Lecturer, British Management University in Tashkent, PhD candidate, Banking and Finance Academy of the Republic of Uzbekistan

* Correspondence: j.rustamov@bmu-edu.uz

Abstract: This study investigates the determinants of non-performing loans (NPLs) in the banking sector of Uzbekistan. The primary objective is to assess the impact of macroeconomic conditions and bank-specific characteristics on loan quality. Using panel data, both Fixed Effects (FE) and Random Effects (RE) models are estimated, with clustered standard errors applied to address autocorrelation and heteroskedasticity. Robustness is ensured through the Hausman test, which supports the RE specification. The results show that macroeconomic factors such as GDP growth and inflation have no significant effect on NPLs. In contrast, cost inefficiency, diversification, and high loan-to-deposit ratios are positively associated with NPLs, reflecting weak monitoring, ineffective diversification, and aggressive lending practices. Capital adequacy and bank size exhibit negative and significant effects, confirming that well-capitalized and larger banks are more resilient to credit risk. Other variables, including coverage ratio, ownership, and profitability, display unstable or insignificant effects across models.

Keywords: non-performing loans, banking sector, panel data, fixed effects, random effects, capital adequacy, loan liquidity, diversification, inefficiency, economies of scale

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1. Introduction

A major challenge for banking systems around the world is NPLs. Growing NPLs, which are frequently caused by hazardous lending practices, reduce bank profitability, limit new lending, and raise the risk of financial crises [1] [2] [3]. NPLs are considered a crucial indicator of the soundness of the banking industry and credit risk because they directly represent the credit quality of loan portfolios. Policymakers and regulators therefore emphasize understanding the determinants of NPLs to safeguard financial development and efficiency [4].

In developing nations like Uzbekistan and other central Asian countries, where the banking industry is rapidly changing, this problem is especially pertinent. Monitoring NPLs has become more crucial due to financial liberalization, state-owned bank reforms, and the expansion of lending to individuals and companies. The region's policymakers stress that high NPL levels limit new lending, reduce bank profitability, and jeopardize financial stability, making the investigation of NPL drivers both pertinent and essential. While extensive studies exist for developed economies, limited evidence is available for transition economies such as Uzbekistan.

Based on the literature, several hypotheses have been proposed to explain the determinants of NPLs. The "bad management" hypothesis argues that poor managerial practices reduce cost efficiency and weaken loan underwriting and monitoring, thereby increasing NPLs [1] [5]. The "moral hazard" hypothesis highlights excessive risk-taking

when banks expect losses to be borne by others, leading to irresponsible lending behavior [6]. The “adverse selection” hypothesis suggests that borrowers with higher default risk are more likely to obtain loans, resulting in a pool of risky clients and higher credit losses [7]. The “economies of scale hypothesis” posit that larger banks may achieve efficiency gains, which reduce NPLs [8]. The “operational efficiency” hypothesis emphasizes that banks with higher profitability, measured by return on assets (ROA), are more capable of absorbing credit losses and maintaining asset quality, thereby lowering NPLs [9]. Finally, the “risk diversification paradox” hypothesis suggests that diversification of bank activities, while theoretically reducing risk, may in practice increase NPLs due to monitoring difficulties and loss of specialization [10].

This study builds on these theoretical foundations to empirically examine the determinants of NPLs in the banking sector. By testing these hypotheses, the research aims to provide evidence on how managerial practices, risk-taking behavior, profitability, bank size, and diversification shape credit risk, thereby offering insights for policymakers and practitioners concerned with financial stability. This study contributes by extending established NPL theories to a transition economy context, offering insights for both academic debate and policy design.

A growing body of literature has examined the determinants of NPLs, highlighting managerial practices, risk-taking behavior, bank size, profitability, and diversification as key factors. While extensive studies in developed economies have identified several determinants of NPLs, evidence from transition economies remains limited. This section reviews the main hypotheses proposed in the literature, including bad management, moral hazard, adverse selection, economies of scale, operational efficiency, and the risk diversification paradox.

The “bad management” hypothesis asserts that weak managerial practices and cost inefficiency contribute to higher NPLs. Empirical studies confirm that elevated cost-to-income ratios and operating inefficiency are strongly associated with future increases in NPLs, reflecting poor credit assessment, collateral appraisal, and monitoring [11] [12] [13]. Conversely, greater cost efficiency has been shown to reduce NPLs, underscoring the importance of managerial quality [14].

The “moral hazard” hypothesis emphasizes the role of capitalization and solvency. While higher equity-to-asset ratios generally indicate safer banks and lower NPLs [15] [16], other evidence suggests that stronger capitalization may encourage excessive risk-taking, particularly in large or state-owned banks [6] [13] [17]. This mixed evidence reflects the tension between prudential regulation and the “too-big-to-fail” phenomenon.

The “operational efficiency” hypothesis highlights profitability, often measured by return on assets (ROA), as a determinant of loan quality. More profitable banks tend to originate loans more prudently, resulting in fewer NPLs [13] [18]. A higher ROA is generally associated with stronger management and lower credit risk [19] [20], whereas declining profitability increases NPLs, consistent with risk-taking behavior and moral hazard.

The “adverse selection” hypothesis is reflected in liquidity indicators such as the loan-to-deposit ratio. A higher ratio often signals liquidity constraints and a preference for riskier loans, thereby increasing credit risk exposure [19]. Country-specific evidence on Chinese banks demonstrates that liquidity dynamics can produce divergent outcomes [14].

The “economies of scale” hypothesis considers bank size as a dual factor. Larger banks may benefit from diversification and efficiency gains, leading to lower NPLs [12]. However, the too-big-to-fail perspective suggests that size may encourage excessive risk-taking, with empirical studies showing both positive and negative associations depending on the period and institutional context [17] [6]. State-owned banks, despite higher capitalization, have often been linked to riskier lending practices [13].

Loan loss provisions are another widely used proxy for credit quality. A positive correlation between provisions and NPLs indicates that banks allocate higher reserves when anticipating defaults [13] [21]. Yet, other studies argue that higher coverage ratios reduce NPLs, as banks are better protected against losses [22] [23] [24].

Finally, the “risk diversification paradox” has produced inconclusive results. While some evidence suggests that diversification reduces risk and stabilizes loan portfolios [25], other studies find that diversification complicates monitoring and increases NPLs [26].

Turning to Uzbekistan, Isakov [27] provided an in-depth analysis of NPL determinants, emphasizing the role of banking reforms, managerial practices, and institutional changes in shaping credit risk and examined profitability and operational efficiency, highlighting their impact on loan quality. These contributions offer valuable insights into the Uzbek banking sector, yet the literature remains limited in scope and fragmented compared to developed economies. This study addresses this gap by extending global theories to the Uzbek context.

2. Materials and Methods

Quarterly panel data covering 30 state-owned and private commercial banks was compiled for the period from Q4 2020 to Q1 2025. A perfectly balanced panel was deliberately chosen to enable both static and dynamic analyses of NPL determinants.

Bank-specific indicators were drawn from two sources. The NPL ratio (NPLs to total loans), bank size (natural logarithm of total assets), loans-to-deposits ratio (LDR), and ownership structure were obtained from publicly available data of the Central Bank of Uzbekistan (CBU). Meanwhile, inefficiency (cost to income), capital adequacy – CAR (total regulatory capital to risk weighted assets), NPL coverage ratio (provisions to NPLs), diversification (non-interest income to total operating income), and return on assets (ROA) were calculated using confidential datasets provided by the CBU. Macroeconomic variables, namely real GDP growth and inflation, were collected from the official website of the Statistics Agency of the Republic of Uzbekistan.

For static panel estimation, the Fixed Effects (FE) and Random Effects (RE) approaches were employed, as they allow for the identification of unobserved heterogeneity. The Hausman test was applied to verify the consistency of RE assumptions and to guide the choice between FE and RE. This methodological framework has been widely adopted in prior studies examining macroeconomic and bank-level drivers of NPLs, including Louzis, Vouldis and Metaxas [5], Klein [15], Ghosh [13], Us [17], Kryzanowski, Liu and Zhang [28], Ferreira [26] and others.

The FE model common form is as follows:

$$y_{it} = \alpha + \beta X_{it} + \gamma_t + \mu_i + \varepsilon_{it} \quad (1)$$

where, α – overall intercept;

β – coefficient vector;

X_{it} – a vector of explanatory variables;

γ_t –time fixed (time-variant) effect;

μ_i – individual fixed effect or random effect;

ε_{it} – idiosyncratic error.

The static specification incorporating the dependent variable together with all explanatory factors in this study is presented in Equation (2):

$$\begin{aligned} \text{NPL ratio} = & \beta_1 L. GDPgrowth + \beta_2 L. Inflation + \beta_3 L. Inefficiency + \beta_4 L. CAR + \\ & \beta_5 L. Banksize + \beta_6 L. Coverage + \beta_7 L. Diversification + \beta_8 L. ROA + \beta_9 L. LDR + \\ & \beta_{10} Ownership + \gamma_t + \mu_i + \varepsilon_{it} \end{aligned} \quad (2)$$

where γ_t –year dummies;

μ_i – individual fixed or random effect;

ε_{it} – idiosyncratic error.

The study evaluates the following central propositions:

H1: Macroeconomic indicators, specifically real GDP growth and inflation, exert a significant influence on the NPL ratio.

H2: Cost inefficiency is positively linked to NPLs, consistent with the *bad management hypothesis*.

H3: Under the *skimping hypothesis*, cost inefficiency shows a negative association with NPLs.

H4: Banks with weaker capitalization tend to exhibit higher NPL ratios, supporting the *moral hazard hypothesis*.

H5: Larger bank size is inversely related to NPLs, in line with the *economies of scale hypothesis*, where improved monitoring and risk management reduce credit risk.

H6: Lower provisioning coverage signals weaker buffers against loan losses, amplifying the adverse impact of NPLs through the *prudential risk management mechanism*, consistent with the *bad management hypothesis*.

H7: Greater diversification is associated with higher NPLs, reflecting inefficient diversification strategies and reinforcing the *bad management hypothesis* via the *diversification channel*.

H8: Reduced profitability (ROA) correlates with higher NPLs, supporting the *bad management hypothesis* through the *operational efficiency channel*.

H9: A positive relationship between the loan-to-deposit ratio (loan liquidity) and NPLs indicates heightened risk-taking and potential *adverse selection*, reinforcing the *bad management hypothesis* through the *liquidity risk channel*.

H10: State-owned banks are more prone to risk-taking compared to privately owned banks.

The analysis faced two main econometric issues: autocorrelation and heteroskedasticity. To address these, clustered standard errors were applied in both FE and RE specifications. Quarterly dummies were initially introduced to capture seasonality, but as they proved insignificant, they were excluded. Instead, yearly dummies were incorporated to control unobserved macroeconomic shocks.

For robustness, both FE and RE models were estimated, and the Hausman test was conducted to determine the appropriate specification. The test result ($p = 0.506$) indicated that the RE model was consistent; therefore, the RE model was re-estimated using clustered standard errors to ensure reliable inference (see Table 3).

Stationarity of all continuous variables was verified using the Levin–Lin–Chu panel unit root test, which confirmed that the variables were stationary. Multicollinearity was assessed through the Variance Inflation Factor (VIF), with all values below the conventional threshold of 10 and a mean VIF of 4.98, indicating no serious multicollinearity concerns.

3. Result

Table 1 summarizes the variables across 540 observations. The average NPL ratio is 0.067, with wide variation (max 0.966). Macroeconomic indicators are relatively stable, with GDP growth averaging 6.22% and inflation 10.48%. Bank inefficiency shows extreme outliers, while capital adequacy averages 0.276. Bank size is heterogeneous (mean 15.65), and coverage averages 0.369. Diversification is highly dispersed, ranging from 2.44 to 8.35. Profitability is close to zero on average, with some banks recording negative ROA. The loan-to-deposit ratio is highly variable (mean 2.10, max 33.34), reflecting aggressive lending in certain cases.

Overall, the statistics reveal substantial heterogeneity across banks, particularly in NPLs, inefficiency, diversification, and LDR – key features for econometric analysis.

Table 1. Descriptive statistics of all variables

Variables	Mean	SD	Min	Max	N
NPL ratio	0.067	0.142	0.000	0.966	540
Real GDP growth	6.217	1.580	1.600	8.800	540
Inflation	10.478	1.183	7.980	12.250	540
Inefficiency	0.378	1.418	-26.142	10.251	540
CAR	0.276	0.308	0.110	3.187	540
Bank size	15.648	1.791	10.435	18.735	540
Coverage	0.369	0.214	0.000	1.000	540
Diversification	0.451	0.465	-2.442	8.349	540
ROA	0.010	0.151	-1.966	0.217	540
LDR	2.103	2.961	0.014	33.338	540

Source: Computed by the author based on confidential data from the CBU

Table 2 presents the pairwise correlations among the study variables. The relationship between Ownership and Bank size (0.42), CAR and ROA (−0.32), and Inflation and GDP growth (−0.30) is moderate. These results suggest that state-owned banks generally hold larger asset bases, stronger capitalization may come at the expense of profitability, and higher inflation is typically associated with slower economic growth.

Other variable pairs, such as the NPL ratio with GDP growth and inflation, show weak positive correlations that are not statistically significant. Overall, most correlations are relatively low, indicating limited evidence of multicollinearity beyond the few moderate associations noted above.

Table 2. The pairwise correlation matrix of all continuous variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) NPL ratio	1.000										
(2) GDPgrowth	0.031 (0.471)	1.000									
(3) Inflation	0.037 (0.385)	-0.300*	1.000								
(4) Inefficiency	0.053 (0.219)	-0.106*	0.015 (0.732)	1.000							
(5) CAR	0.168* (0.000)	-0.095* (0.027)	0.026 (0.544)	0.034 (0.429)	1.000						
(6) Bank_size	-0.394* (0.000)	0.057 (0.185)	-0.086* (0.046)	0.015 (0.734)	-0.572* (0.000)	1.000					
(7) Coverage	-0.114* (0.008)	0.011 (0.803)	0.046 (0.291)	-0.028 (0.510)	-0.011 (0.797)	0.085* (0.048)	1.000				
(8) Diversification	0.089* (0.039)	0.115* (0.007)	-0.033 (0.446)	-0.893* (0.000)	-0.110* (0.010)	0.035 (0.423)	-0.022 (0.603)	1.000			
(9) ROA	-0.521* (0.000)	-0.004 (0.931)	-0.020 (0.645)	0.111* (0.010)	-0.318* (0.000)	0.327* (0.000)	-0.012 (0.783)	-0.187* (0.000)	1.000		
(10) LDR	0.432* (0.000)	0.004 (0.921)	0.015 (0.733)	0.026 (0.550)	0.166* (0.000)	-0.170* (0.000)	0.093* (0.030)	-0.028 (0.521)	-0.394* (0.000)	1.000	
(11) Ownership	0.039 (0.367)	-0.035 (0.423)	0.052 (0.224)	0.008 (0.857)	-0.112* (0.009)	0.422* (0.000)	0.101* (0.019)	0.055 (0.206)	-0.105* (0.015)	0.254* (0.000)	1.000

Significance: * $p < 0.05$

Source: Computed by the author based on confidential data from the CBU

Table 3. Regression results from Fixed and Random Effects models

Regressors	FE Model	RE Model	FE (Clustered SE)	RE (Clustered SE)
L.GDPgrowth	0.000 (0.002)	0.000 (0.002)	0.000 (0.002)	0.000 (0.002)
L.Inflation	0.006 (0.004)	0.006 (0.004)	0.006 (0.005)	0.006 (0.005)
L.Inefficiency	0.065*** (0.010)	0.059*** (0.010)	0.065** (0.031)	0.059** (0.029)
L.CAR	-0.189*** (0.019)	-0.173*** (0.019)	-0.189** (0.070)	-0.173*** (0.063)
L.Bank_size	-0.063*** (0.013)	-0.059*** (0.007)	-0.063 (0.037)	-0.059** (0.027)
L.Coverage	-0.101*** (0.026)	-0.088*** (0.024)	-0.101 (0.091)	-0.088 (0.084)
L.Diversification	0.193*** (0.034)	0.173*** (0.031)	0.193** (0.092)	0.173** (0.087)
L.ROA	-0.027 (0.043)	-0.069* (0.040)	-0.027 (0.075)	-0.069 (0.068)
L.LDR	0.007*** (0.002)	0.008*** (0.002)	0.007*** (0.002)	0.008*** (0.002)
Ownership	0.116*** (0.027)	0.095*** (0.021)	0.116 (0.089)	0.095 (0.066)

Regressors	FE Model	RE Model	FE (Clustered SE)	RE (Clustered SE)
2022.year	0.016 (0.012)	0.018 (0.011)	0.016 (0.013)	0.018* (0.011)
2023.year	0.025* (0.014)	0.027** (0.012)	0.025 (0.019)	0.027 (0.017)
2024.year	0.030* (0.017)	0.031** (0.014)	0.030 (0.032)	0.031 (0.025)
2025.year	0.035 (0.022)	0.034* (0.020)	0.035 (0.033)	0.034 (0.024)
Cons	0.890*** (0.197)	0.835*** (0.122)	0.890* (0.495)	0.835** (0.343)
R ² (within)	0.3577	0.3541	0.3577	0.3541
R ² (Between)	0.3707	0.4412	0.3707	0.4412
R ² (Overall)	0.3567	0.3967	0.3567	0.3967
Prob>F	0.0000	0.0000	0.0000	0.0000
Hausman test p		0.5057	RE preferred	

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Computed by the author based on confidential data from the CBU

Table 3 reports the outcomes of the static panel estimations. Macroeconomic variables – real GDP growth and inflation – do not exhibit statistically significant effects on NPLs. In contrast, cost inefficiency, diversification, and the loan-to-deposit ratio (LDR) show positive and significant associations with NPLs. These findings suggest that inefficient banks devote fewer resources to monitoring and risk control, diversified banks may misallocate attention away from credit oversight, and institutions with high LDRs weaken their liquidity buffers through aggressive lending, all of which contribute to higher default rates.

Capital adequacy (CAR) is negatively significant, confirming that well-capitalized banks are more resilient to credit risk. Bank size also demonstrates a negative and significant relationship with NPLs, consistent with the view that larger institutions benefit from stronger monitoring capacity and economies of scale.

The effects of NPL coverage and ownership are unstable: while initially significant (negative for coverage, positive for ownership), they lose significance once clustered standard errors are applied. Profitability (ROA) remains insignificant across all specifications.

4. Discussion

The positive association between cost inefficiency and NPLs suggests that higher operating expenses, when used ineffectively, contribute to greater loan defaults. This outcome points to weaknesses in bank management practices in Uzbekistan, such as inadequate staff skills, poor loan monitoring, and inaccurate borrower assessment, which ultimately increase NPLs despite rising expenditures.

The negative relationship between capitalization and NPLs indicates that well-capitalized banks are more effective in managing credit risk. With stronger capital buffers, they can diversify away from risky sectors and attract skilled staff, which enhances loan monitoring. In contrast, undercapitalized banks often relax lending standards to boost profits and market share, extending credit to weaker borrowers and thereby increasing default risk. This pattern reflects the moral hazard problem in the Uzbek banking sector.

The inverse relationship between bank size and NPLs shows that institutions with larger asset bases tend to experience fewer loan defaults. This outcome reflects the advantages of scale: bigger banks generally have stronger governance structures, more effective risk controls, and greater experience in credit management. The finding supports the economies of scale perspective, where size enhances efficiency and reduces credit risk exposure.

Contrary to the expectation of a negative link, the analysis reveals a positive relationship between diversification and NPLs in Uzbekistan's banking sector. This suggests that expanding into non-interest activities has not improved risk management; instead, it has weakened loan oversight. As banks allocate more focus to non-interest income, complexity rises and credit monitoring becomes less effective, ultimately leading to higher default rates. This outcome reflects the risk diversification paradox, where broader activity fails to reduce risk and instead amplifies it.

The static models confirm a positive relationship between LDR and NPLs. Banks with high LDRs tend to pursue aggressive lending strategies, which weaken liquidity buffers and increase credit risk. Smaller banks may raise deposit rates to attract funds and then quickly channel these resources into loans under less stringent conditions. This behavior fosters adverse selection, as weaker borrowers gain access to credit, ultimately raising default levels.

5. Conclusion

This study examined the determinants of NPLs in the Uzbek banking sector using static panel estimation models. The findings reveal that macroeconomic indicators such as GDP growth and inflation do not exert a statistically significant influence on NPLs, suggesting that loan quality in Uzbekistan is shaped more by bank-specific characteristics than by broader economic conditions.

Among internal factors, cost inefficiency, diversification, and high loan-to-deposit ratios (LDR) consistently increase NPLs. Inefficient banks allocate resources poorly, weakening monitoring and risk control, which leads to higher default rates. Similarly, diversification into non-interest activities, rather than reducing risk, appears to dilute credit oversight and complicate risk management, resulting in the paradoxical rise of NPLs. Aggressive lending reflected in high LDR ratios further undermines liquidity buffers and exposes banks to adverse selection, amplifying credit risk.

Conversely, stronger capitalization and larger bank size are associated with lower NPLs. Well-capitalized banks are more resilient, able to absorb shocks, and maintain stricter lending standards. Larger institutions benefit from economies of scale, stronger governance, and more effective monitoring capacity, all of which contribute to improved credit risk management. Other variables, such as coverage ratio, ownership, and profitability, show unstable or insignificant effects once robust estimation techniques are applied, underscoring the importance of focusing on structural and managerial aspects rather than short-term performance indicators.

Taken together, these results highlight that the quality of bank management, capitalization, and lending practices are the primary drivers of credit risk in Uzbekistan. The evidence points to systemic weaknesses in governance and risk oversight, particularly in smaller and less capitalized banks, where aggressive lending and inefficient diversification strategies contribute to rising NPLs.

From a policy perspective, the findings suggest several implications. First, regulators should strengthen prudential requirements, particularly capital adequacy standards, to ensure banks maintain sufficient buffers against credit risk. Second, supervisory frameworks need to emphasize the quality of loan monitoring and borrower assessment, with targeted training programs to improve staff skills and risk management practices. Third, diversification strategies should be carefully evaluated to ensure that expansion into non-interest activities does not compromise credit oversight. Finally, stricter oversight of liquidity management is necessary to prevent excessive risk-taking through aggressive lending.

In conclusion, the study demonstrates that NPLs in Uzbekistan are primarily driven by internal bank characteristics rather than macroeconomic fluctuations. Addressing inefficiency, improving capitalization, and enhancing governance are essential steps toward building a more resilient banking sector capable of supporting sustainable economic growth.

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