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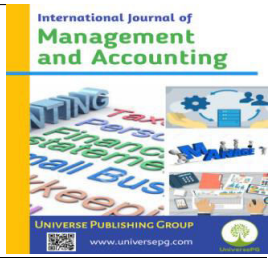

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Factors Affecting Non-Performing Loan: A Comparative Study between State-Owned Commercial Banks and Private Commercial Banks in Bangladesh

Rukshana Begum[1], Sumi Saha[1], Mst. Hasna Banu[1], Md. Mahofuzur Rahman[2], and Md. Sumon Hossain[1]*

[1]Department of Accounting & Information Systems, Faculty of Business Studies, University of Rajshahi, Bangladesh
[2]Department of Business Administration, Port City International University, Chattogram, Bangladesh

*Correspondence: sumon7027@ru.ac.bd (Dr. Md. Sumon Hossain, Associate Professor, Department of Accounting & Information Systems, Faculty of Business Studies, University of Rajshahi, Bangladesh).

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Abstract

Financial sustainability is a crucial factor facilitating consistent economic growth in the economy, but the rising trend of non-performing loans (NPL) has recently been identified as the most challenging factor within the banking sector of Bangladesh. This study aims to investigate the bank specific and macroeconomic factors that affect the non-performing loans of state-owned commercial banks (SCBs) and private commercial banks (PCBs) in Bangladesh. Data were collected from twelve banks covering ten years using stratified random sampling technique, analysed employing descriptive statistics such as mean, standard deviation, minimum, maximum and inferential statistics correlation matrix, regression statistics etc. Descriptive statistics shows that the average non-performing loan of SCBs is 2.44 times higher than the average NPL of PCBs. The regression results show that operational efficiency (OTA), lending interest rate (INT) and unemployment rate (UNP) impact positively the NPL of SCBs and return on assets (ROA), but capital adequacy ratio (CAR) and assets GDP growth influence negatively the NPL of SCBs. Moreover, the NPL of PCBs is statistically significantly and negatively impacted by ROA and CAR. OTA, GDP, INT, exchange rate, UNP and asset GDP growth are positively related but not statistically significant. The findings imply that strengthening operational efficiency, profitability, capital adequacy, and macroeconomic stability-particularly within SCBs-is essential for reducing non-performing loans and improving overall banking sector resilience. The results of the study will provide empirical support to the policymakers of the concerned sector to devise an effective credit management approach for the banking sector of the developing economy of Bangladesh

Keywords: Non-performing loan, Liquidity, Operational efficiency, GDP, and Unemployment rate.

1. Introduction

This non-performing loan situation has been a constant threat to the strength and soundness of the banking system in the country. Even though the banking sector has experienced growth in terms of its volume and coverage of the economy through the years, the stock of defaulted loans has resulted in the weakening of the quality of its assets and the profitability of this sector. This situation has been the result of poor management practices of the sector, politicization of loan programs, ineffectiveness of loan evaluation practices, and lenient loan

rescheduling practices. The situation has been reflected in recent statistical data. The classified loans had been Tk 1.46 trillion in December 2023, which jumped to Tk 1.82 trillion in March 2024. The NPL ratio also increased from 9.0 percent to 11.11 percent in only one quarter. This percentage has been considerably higher than the regional and global average. The outstanding loans from state-owned banks were Tk 3.13 trillion as of June 2024. Of this amount, Tk 1.02 trillion, which was 32.77 percent of the loan, had been classified as non-performing. In contrast, the state-owned banks' NPL ratios were considerably lower at 7.94 percent. However, this situation has been alarming in the context of the overall financial position of the financial system of the country of Bangladesh (Mahmud and Rahman, 2020; Bangladesh Bank, 2024).

NPL Statistical data

Year	NPL Ratio	Year	NPL Ratio	Year	NPL Ratio
2018	10.30%	2020	8.06%	2022	8.16%
2019	9.30%	2021	10.70%	2023	9.00%
2024	20.20%				

Source: Bangladesh Bank website.

An increase in non-performing loans also provides information about vulnerabilities in credit risk management and affects overall banking performance. As a result, there will be an effect on the components of profitability and capital adequacy ratios of banks. The situation also creates pressure in the macroeconomic environment due to the scarcity of credit alongside the decreased confidence levels of investors and depositors. The rescheduling of loans due to the pandemic, disruptions in global supply chains, and the increasing import costs of banks create a poor credit environment. Structural disparities stemming from differences in banking models, especially between Islamic and conventional banks, might also exert pressure due to their vulnerability to credit risks. In this regard, the current study assumes significance from a comparative point of view in identifying the factors of NPLs in SOBs and PCBs because the context of this study relates to Bangladesh.

Problem Statement

The banking sector of Bangladesh has been suffering from persistently high levels of NPLs. This has been the impact of poor credit management practices, borrower screening, collaterals' evaluation, and regulatory requirements. The political factor that affected the loan decisions has resulted in rescheduling of loans and ineffective recovery practices. This has contributed to the high number of defaulted loans. The rising levels of the non-performing loans impact the interest income negatively, along with the additional provisioning costs due to the reduced capital adequacy. Recent studies provide additional insights. Rahman *et al.* (2023) used a dynamic panel estimator to show that fiscal consolidation tends to elevate NPL levels, as contractionary policies reduce the repayment capacity of households and firms. Barra and Ruggiero (2023), examining Italian banks from 1994–2015, identified regulatory credit conditions, capital strength, loan volumes, and intermediation costs as key determinants of NPLs. Using quarterly data from 2005–2019, Kartal *et al.* (2023) reported that NPLs and economic growth in Turkey move together, with long-term growth exerting substantial influence on NPL fluctuations. Hassan *et al.* (2023) emphasized the need for deeper investigation into Islamic banking in Bangladesh, particularly in areas such as governance quality, Islamic microfinance integration, and risk management mechanisms. Internationally, the instability of the macroeconomic environment, the imposition of fiscal policy constraints, as well as the poor state of governance, have been found to contribute to aggravations of the levels of non-performing loans. In the case of Bangladesh, despite various reforms introduced by the regulatory framework of the country's banking system, the level of non-performing loans remains high in Asia. The situation at the state banks of the country becomes particularly alarming because the innate problem of structure and institution aggravates the credit risks. Although there has been research work done concerning the nature of NPLs in the context of the Bangladeshi banking sector, only little work has been done which aims to provide a comparative study of the differences in the factors that contribute to the default of state banks

and private banks. This is because the internal factors along with the external factors that affect the trend of non-performing loans of state and private banks are of utmost importance because of vast differences between the two. In this backdrop, the research study has tried to fill the existing gap in the research work.

Objectives of the Study

The main aims of the study are:

- To compare the trends of NPLs of SCBs and PCBs in Bangladesh.
- To examine the main bank-specific and macroeconomic factors influencing the level of non-performing loans
- To examine the impact of macroeconomic factors on NPLs of SCBs and PCBs in Bangladesh.
- To provide empirical evidence-based suggestions for policy makers.

2. Review of Literature

Empirical findings clearly display the negative correlation of NPLs and profitability ratios ROA and ROE (Felix & Claudine, 2008; Talata, 2011; Akter & Roy, 2017). Academic research from Kenya, Nigeria, Nepal, and the GCC regions determines the poor credit evaluation, poor credit monitoring, liquidity problems, and credit risks as the prime factors of loan default (Muasya, 2009; Kithinji, 2010; Al-Khouri, 2011; Mwangi, 2012; Adebisi & Matthew, 2015; Bhattarai, 2016). Studies from the Bangladeshi context display political influences, customer data unavailability, and imperfect credit management practices as the prime factors triggering the emergence of NPLs (Khanam *et al.,* 2013; Karim & Anjom). Several studies - Espinoza & (Prasad, 2010; Louzis *et al.* 2012; Koju *et al.* 2018; Partovi & Matousek, 2019; Ozili, 2019; Khan *et al.* 2020)-affirm that banks are less likely to be non-performing when they are more efficient. The impact of solvency and the quality of capital has been identified to affect non-performing loans in Macedonia (Kjosevski *et al.,* 2019; Turkey Ersoy, 2022).

Contrary to many research findings that revealed improved solvency can lead to reduced non-performing loans (Salas & Saurina, 2002; Klein, 2013; Makri *et al.*). In emerging markets, the sources of NPLs are additionally fuelled by macroeconomic instability, inflation levels, and unemployment trends (Beck *et al.,* 2013). Rezina *et al.* (2020) noted the significance of operational activities and governance in banks being the moderating factors of NPLs and suggested that the dynamics of credit risks may be unique to Islamic banks compared to conventional banks because of structural disparities in their financing models. The role of diversification remains mixed because, while Khan *et al.* (2020) and others contend that the higher the level of diversification, the lower the non-performing loans, there also appear to be instances whereby banks consequently become prone to risks because of their reduced focus on the lending sector (Ismail *et al.,* 2017; Ahmed *et al.,* 2021). Macro-economic factors such as GDP growth, Inflation rate, Interest rate, and Indebtedness affect NPLs in various global researches (Ali & Dali, 2010; Staehr & Uusküla, 2017; Ozili, 2019; Syed & Aidyngul, 2022).

The empirical results from the Bangladeshi context also support that leverage, credit growth, and interest margin are significant factors downwardly influencing the value of NPLs. However, the results indicate that Inflation and GDP growth exert significant macro-level factors (Chowdhury *et al.,* 2023). Other research findings from the Chinese context's Nepal, Macedonia, Poland, Sri Lanka, Ethiopia, Indonesian context's banks, and European Union banks support the importance of macro-economic factors in influencing the behavior of the value of NPLs. Some recent research findings differentiate between SOBs and PCBs. SOBs face system-level problems concerning their performance to witness poor levels of NPLs. However, PCBs continue to exercise proper risk management practices because of which their default levels are substantially low compared to the others (Mahyoub & Said, 2021). Recently, the quality of governance and the strength of institutions are regarded as crucial forces shaping loan performance, particularly in emerging nations like Bangladesh. The structural disparity between Islamic banks and conventional banks has also been found to be a factor that contributes to the level of NPLs (Chowdhury *et al.* 2022; Sarker *et al*. 2025).

In general, the available literature verifies the contribution of both macroeconomic and bank-level factors toward the behaviour of non-performing

loans and the fact that the quality of institutions and governance practices are of utmost significance in influencing banks' ability to avoid the deterioration of their loans. In various global and Bangladeshi-level research studies available until today, there remains a consensus about the impact of non-performing loans being driven by various levels of financial and macroeconomic factors.

Hypotheses Development

Bank Specific Factors

Lending to Deposit Ratio (LDR) and Non-performing Loan

The loans to total deposit ratio measure a bank's liquidity by calculating the percentage of collected deposits that have been used for loans. Makri et al. (2014) found a clear and substantial correlation between the loans to total deposit ratio and the extent of non-performing loans in the banking industry. The ratio indicates the extent to which a bank is financing its loans using deposits. The term "LTD ratio" is an alternative name for the ratio of loans to deposits. Several other empirical studies have also employed ADR (or LTD ratio) as an explanatory variable for NPLs. (Louzis *et al.* 2012; Messai and Jouini, 2013**)** likewise incorporated the ratio in their cross-country analysis and found it to be positively correlated with NPL levels. Similarly, (Ekanayake and Azeez 2015; Boudriga *et al.* 2010) used the variable to evaluate banks' lending behavior and its impact on asset quality. According to the information given, the study formulates the following hypothesis.

H_1: There is significant impact of lending on non-performing loans (NPLs)

Return on Assets and Non-performing Loan

Return on assets is a financial metric that measures a company's profitability by dividing its net income by its total assets. Return on assets is a quantitative measure that assesses the effectiveness of asset utilization and indicates the level of net income generated from those assets. It signifies the bank management's capacity to generate profits through the effective utilization of the bank's assets. Therefore, a high return on assets (ROA) ratio signifies outstanding performance in profit generation. Ahmed and Bashir (2013) and Makri *et al.* (2014) have demonstrated a strong and statistically significant correlation between Return on Assets (ROA) and non-performing loans. Nevertheless, (Boudriga *et al.* 2009; Vatansever and Hepsen, 2013) present empirical support for the notion that an increase in the return on assets has a positive impact on the level of non-performing loans. Return on Assets (ROA) measures the efficiency of bank management in generating profits through the utilization of the bank's available assets. The figure provides investors with an indication of the company's efficiency in converting its invested capital into net income. Based on this information, the study develops the following hypothesis.

H_2: There is a significant negative impact of ROA on non-performing loans (NPLs)

Operating Efficiency and Non-performing Loan

Operating efficiency (OTA) is a financial metric that measures the proportion of operating expenses to total assets. The OTA ratio is used to determine the efficiency of banks' operations with regard to operating expenses (excluding interest expense) and total assets. A small ratio is more efficient and implies that the assets generated are sufficient to meet the operational expenditures. Incompetent banks with highly inefficient operations tend to incur higher non-performing loans (Louzis, Vouldis, & Metaxas, 2012; Sufian and Chong, 2008).

H_3: There is a significant positive impact of operating efficiency (OTA) on NPLs

Capital Adequacy Ratio (CAR) and Non-performing Loan

The Capital Adequacy Ratio (CAR) is a metric employed to evaluate the financial robustness of a bank and its capacity to withstand potential losses. The capital adequacy ratio is a metric that assesses the amount of capital a bank possesses relative to its risk-weighted assets and existing liabilities. The study conducted by Makri *et al.* (2014) revealed a negative correlation between non-performing loans and non-performing loans. However (Djiogap and Ngomsi, 2012) found a clear link between non-performing loans and capital adequacy ratio.

Similarly, the study on capital adequacy ratio has a minimal effect on non-performing loans (Louzis *et al.,* 2012). CAR is a measure of banks solvency and ability to absorb risk. It is used to protect depositors and promote the stability and efficiency of financial systems. It is calculated by dividing a bank's capital by its risk-weighted assets. However, this study predicts a negative correlation with non-performing

loans. Based on it, the study posits the following hypothesis.

H_4: There is significant negative relationship between capital adequacy and NPLs

Liquidity and Non-performing Loan

The liquid assets to deposits ratio (LQD) is the ratio that determines the relative amount of liquid assets to the total amount of deposits and is used as a measure for the liquidity position held by banks. Liquidity held by banks is important for them to be able to pay back their deposits and is a factor that decreases the chance for NPLs (Boudriga *et al.,* 2009; Said & Tumin, 2011).

H5: There is a significant link between liquidity (LQD) and NPLs

Macroeconomic Factors

GDP Growth Rate (GDP) and Non-performing Loan

GDP growth is a representation of the overall economic environment and is a factor that influences the ability to repay loans by debtors. A higher GDP growth rate is assumed to decline the NPLs. A negative link between GDP growth and NPLs was identified by previous studies (Salas and Saurina, 2002; Gunsel, 2008; Thiagarajan, Paul, and Kumar, 2011); however, a positive link was observed under particular conditions by other studies (Beck, Jakubik, and Piloiu, 2013; Pandey, 2016).

H6: There is a significant correlation between the growth rate of GDP and NPLs.

Lending Interest Rate (INT) and Non-performing Loan

Higher rates mean higher costs for loans. This may lead to higher NPLs. Research has found a significant and positive correlation between interest rates and NPLs (Athanasoglou, Brissimis, and Delis, 2008; Nkusu, 2011).

H7: ***The lending interest rate is positively and significantly related to NPLs.***

Exchange Rate (EXG) and Non-performing Loan

Changes in the exchange rate influence debt repayment for the borrower, particularly for foreign denominated loans. A fall in the exchange rate decreases the wealth held by the borrower and thereby raises the risk of default (Ekanayake and Azeez, 2015; Beck *et al.,* 2013)

H8: Exchange rate and non-performing loans (NPLs) have a significant relationship

Unemployment Rate (UEMP) and Non-performing Loan

Unemployment rate is simply defined as the percentage of entire labor force that is unemployed but keenly looking for a job and willing to contribute (Bernstein, 2014). Higher unemployment is regarded as one of the factors contributing to the increase in problem loans. As business is not doing well, firm might sack their employees to reduce their operating costs, hence causing unemployment rate to be increased (Louzis *et al.,* 2011).

H9: Exchange rate and non-performing loans (NPLs) have a significant relationship

Asset Size of Banks (AST_GDP) and Non-performing Loan

Bank size relative to GDP represents the credit-extending ability for banks. The more significant the banks, the greater the volume of credit may be, which may affect NPLs based on risk management (Athanasoglou *et al.,* 2008; Beck *et al.,* 2013).

H10: The size of the assets held by banks (AST_GDP) is significantly correlated with NPLs

Research Gap

Although the impact of NPLs has been widely explored in the existing body of knowledge, the majority of research has been concentrated in developing nations. This leads to the scarcity of existing evidence available within the emerging markets regarding the extent of institutional weaknesses and governance issues. Few researches can be found which provide a systematically structured comparison of SCBs and PCBs regarding the differences that exist in terms of their respective characteristics of ownership, organizational form, and their regulatory treatment. The previous research also presented limited data.

3. Methodology

Research Design

In this research work, secondary data has been used to identify the factors affecting the NPLs in the commercial banking sector of Bangladesh. The data at the banking level has been collected from the audited financial statements of the selected banks, and the macroeconomic information has been gathered from the reports of the Bangladesh Bank. The study encompasses data from the years 2014

through 2023 and involves two SCBs and ten PCBs. This constitutes about 30% of the banks in each group. A quantitative research methodology was used to gauge the contribution of both bank-specific and macro factors to the levels of non-performing loans and to compare their relative significance in SCBs and PCBs.

Population and Sample Selection

The population comprises all scheduled SCBs and conventional PCBs operating in Bangladesh. Banks were selected using purposive sampling based on the availability and completeness of their financial statements. The chosen sample includes Janata Bank PLC, Agrani Bank PLC, One Bank PLC, National Bank PLC, BRAC Bank PLC, City Bank PLC, Dhaka Bank PLC, Dutch-Bangla Bank PLC, Eastern Bank PLC, IFIC Bank PLC, Mercantile Bank PLC, Mutual Trust Bank PLC

Framework and Measurement of Variables

Ten independent variables - five bank-specific and five macroeconomic - were selected based on prior studies. The dependent variable is the NPL ratio, defined as non-performing loans relative to total loans.

Table 1: Variables, Indicators, and Measurement.

Type	Variable	Indicator / Formula
Dependent	Non-Performing Loans (NPL)	NPL / Total Loans
Bank-Specific	Lending (LDR)	Total Loans / Total Deposits
	Profitability (ROA)	Net Income / Total Assets
	Operating Efficiency (OTA)	Total Operating Expense / Total Assets
	Capital Adequacy (CAR)	Total Capital / Risk-Weighted Assets
	Liquidity (LQD)	Liquid Assets / Total Deposits
Macroeconomic	GDP Growth Rate (GDP)	Annual % change in GDP
	Lending Interest Rate (INT)	Average lending rate (%)
	Exchange Rate (EXG)	Average BDT/USD rate
	Unemployment Rate (UEMP)	% of unemployed labor force
	Bank Asset Size / GDP (AST_GDP)	Total bank assets / GDP

Data analysis tools

The data were analysed using STATA software. The data was first described using descriptive statistics to provide information about the distribution of each variable through mean, standard deviation, and the minimum and maximum points. A correlation matrix was estimated to identify possible multi-collinearity problems of the independent variables. Tests were also run to confirm the assumptions of the regression models concerning the residuals and their distribution. Panel's regression techniques, involving fixed effect models, random effect models, and GLS models, were employed to model the relationships of the selected variables with the NPLs. The technique facilitated the assessment of the time series and cross-sectional aspects of the variations to identify the underlying factors of the NPLs.

Model Specification

The study employs two regression models:

Model 1: $Y\ (NPL) = \beta_0 + \beta_1 LDR + \beta_2 ROA + \beta_3 OTA + \beta_4 CAR + \beta_5 LQD + s_t$

Model 2: $Y\ (NPL) = \beta_0 + \beta_1 GDP + \beta_2 INT + \beta_3 EXG + \beta_4 UEMP + \beta_5 AST_GDP + s_t$

Where, Y represents NPLs; β_0 is an intercept, $\beta_1 \ldots \beta_{10}$ = Coefficients of independent variables; LDR, ROA, OTA, CAR, LQD, GDP, INT, EXG, UEMP, AST respectively represent the independent variables; and s_t represents error term.

4. Results and Discussion

Descriptive statistics of SCBs

Descriptive statistics for the two datasets - State-Owned Commercial Banks (SCBs) and Private Commercial Banks (PCBs)-are summarized in **Table 2**. Key indicators are analyzed and compared to highlight differences in performance and financial characteristics. NPLs among SCBs exhibit large variation, which suggests certain persistent asset-quality weaknesses in a number of banks. There is large dispersion in independent variables, too, reflecting heteropreneity in the underlying financial conditions in the sample. While there are deviations

in some measures of skewness and kurtosis from the normality assumption, these remain within acceptable levels for OLS.

Table 2: Showing descriptive statistics of SCBs and PCBs.

Bank Type	Variables	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
SCBs	NPL Net	20	2.56	28.37	14.5700	7.21105	-.163	.512	-.479	.992
	LDR	20	53.81	89.17	68.1570	10.18102	.491	.512	-.800	.992
	ROA	20	-1.12	1.00	.1770	.41885	-.931	.512	4.921	.992
	OTA	20	1.21	2.44	1.6683	.33572	.834	.512	.268	.992
	CAR	20	4.57	10.69	9.1720	1.67131	-1.608	.512	1.823	.992
	LQD	20	13.76	44.41	26.5313	8.47503	.629	.512	-.345	.992
	GDP	20	3.45	7.88	6.4780	1.19308	-1.669	.512	2.811	.992
	INT	20	7.10	12.90	9.4070	1.86204	.480	.512	-.674	.992
	EXG	20	77.64	106.31	85.0430	8.39570	1.734	.512	2.697	.992
	UENP	20	4.35	5.83	4.8690	.57351	.798	.512	-.944	.992
	AST_GDP	20	2.65	4.69	3.3330	.54072	1.209	.512	1.341	.992
PCBs	NPL	100	2.08	33.07	5.9758	4.83023	3.704	.241	15.896	.478
	LDR	100	47.18	111.17	87.8370	12.35721	-1.115	.241	1.543	.478
	ROA	100	.01	2.07	.9537	.48859	.302	.241	-.216	.478
	OTA	100	1.39	4.63	2.3784	.73440	1.146	.241	.917	.478
	CAR	100	10.03	17.20	13.2486	1.67588	-.182	.241	-.667	.478
	LQD	100	8.64	32.45	19.3115	6.27868	.235	.241	-.799	.478
	GDP	100	3.45	7.88	6.4780	1.16873	-1.564	.241	2.029	.478
	INT	100	7.10	12.90	9.4070	1.82404	.450	.241	-.782	.478
	EXG	100	77.64	106.31	85.0430	8.22434	1.625	.241	1.937	.478
	UEMP	100	4.35	5.83	4.8690	.56181	.748	.241	-.999	.478
	AST_GDP	100	.68	1.90	1.1253	.22385	.835	.241	1.434	.478

Source: Authors calculation based on annual reports of sample banks

From **Table 2**, the summary statistics indicate that NPLs have an average value of 14.57% and range between 2.56% and 28.37%, with high variability as captured by an SD of 7.21. The independent variables do show moderate to high variation across banks, with wide ranges and standard deviations indicating remarkable differences in liquidity position, profitability level, capital strength, and macroeconomic exposure. **Table 2** shows that the average NPLs of private commercial banks are 5.98% but vary widely (2.08–33.07; SD 4.83), indicating asset quality unevenness. The independent variables also show broad ranges with sizable standard deviations, reflecting substantial variations in liquidity, profitability, capital strength, operational structure, and macroeconomic condition variations across banks. In contrast to the SCBs, relatively higher ROAs and OTA values of the PCBs indicate effective cost management and financial performance. The liquidity ratios (LQD) in the case of the PCBs are relatively less volatile, which indicates improved short-term solvency. The LDRs also show variation, where the PCBs have shown relatively moderate loan-to-deposit ratios compared to the SCBs.

Correlation Matrix

Table 3: Showing correlation matrix of SOBs.

	NPL	LDR	ROA	ota	car	lqd	gdp	lending	exhch.	Unem	ast
NPL	1.0000										
LDR	0.0983	1.0000									
roa	-0.5451	-0.0474	1.0000								
ota	0.2721	-0.6510	-0.1472	1.0000							

car | -0.4590 -0.5163 0.1723 0.4965 1.0000

lqd | -0.0053 -0.8177 -0.0699 0.8305 0.5579 1.0000

gdp | 0.0521 0.0973 -0.0132 0.2585 0.0477 0.0308 1.0000

lend| -0.2655 -0.5430 0.2634 0.4916 0.6728 0.4853 0.0988 1.000

exh| 0.4152 0.7215 -0.1882 -0.5371 -0.8776 -0.6299 -0.1510 -.7008 1,000

une| 0.0798 0.2325 -0.1895 -0.6329 -0.4497 -0.4375 -0.4816 -0.7607 0.4307 1,000

ast | -0.7091 -0.4324 0.4393 -0.1174 0.4751 0.1883 -0.1659 0.6660 -0.5710 -0.2272 1.000

Source: Authors calculation based on annual reports of sample banks

Table 3 suggests that NPLs have weak direct linkages with most bank indicators. The low value of the NPL–LDR correlation (+9.83%) is indicative of only a marginal association between lending intensity and credit risk. On the other hand, the strongest positive correlations-OTA–LQD(+83.05%) and exchange rate–LDR (+72.15%) - underline structural patterns where operational costs, liquid-dity, and exchange-rate movements go in tandem. Similarly, the strongest negative correlations-LQD–LDR (–81.77%) and exchange rate–CAR (–87.76%)-are indicative of the fact that higher liquidity often reflects lending constraints, while adverse currency movements sharply weaken capital adequacy. Other moderate negative associations such as ROA–NPL (–54.51%) and CAR–NPL (–45.90%) underline that profitability and capital strength worsen with declining asset quality. Overall, this shows that SCBs' risks are driven more by structural inefficiencies and macro pressures than by operational choices.

Table 4: Showing correlation matrix of PCBs.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) NPL	1.000										
(2) LDR	0.257	1.000									
(3) ROA	-0.538	-0.289	1.000								
(4) OTA	-0.317	-0.341	0.439	1.000							
(5) CAR	-0.474	-0.090	0.467	0.377	1.000						
(6) LQD	-0.270	-0.200	0.283	0.445	0.179	1.000					
(7) GDP	0.050	0.042	0.056	0.050	-0.088	0.062	1.000				
(8) INT	-0.177	-0.114	0.123	0.275	-0.348	0.250	0.099	1.000			
(9) EXG	0.219	0.034	-0.100	-0.183	0.299	-0.254	-0.151	-0.701	1.000		
(10) UMP	0.087	0.047	-0.124	-0.252	0.315	-0.219	-0.482	-0.761	0.431	1.000	
(11) AST_GDP	-0.145	-0.302	0.160	0.449	0.003	0.376	-0.045	0.356	-0.263	-0.173	1.000

Source: Authors calculation based on annual reports of sample banks.

Table 4 shows clearer and more market-driven relationships. NPLs are weakly positively correlated with LDR (+25.74%), which indicates that more aggressive lending moderately raises credit risk, while the strong negative NPL–ROA correlation (–53.78%) confirms that asset deterioration directly reduces profitability. Other moderate positive relationships include ROA–CAR (+46.72%), LQD–OTA (+44.44%), and AST–LQD (+45.01%), indicative of better-capitalized, more liquid, larger banks with stronger operational efficiency. Most macroeconomic variables are weakly linked to NPLs, such as GDP–NPL +4.97%, underscoring that private banks' credit risk is shaped basically by their internal management. The strongest negative correlations, exchange rate–lending rate (–70.08%) and unemployment–lending rate (–76.07%), reflect the sensitivity of lending conditions under macro-economic pressure. Moderate negative correlations, such as OTA–NPLs (–31.70%) and CAR–NPLs (–48.16%), indicate that higher operating intensity and weaker capital buffers are matched by increasing credit risk. Overall, it reveals a more disciplined risk structure that is driven by bank-level performance and efficiency. Generally, SCBs have stronger and more volatile relationships among variables, hence their in-efficiency in structure as opposed to PCBs.

VIF test for Multicollinearity

Table 5: Showing comparison of bank-specific variables and Macro variables between SOBs and PCBs.

	VIF test of SOBs			VIF test of PCBs		
		Collinearity Statistics			Collinearity Statistics	
		Tolerance	VIF		Tolerance	VIF
Bank-specific variables	LDR	.318	3.146	LDR	.847	1.180
	ROA	.887	1.128	ROA	.668	1.498
	OTA	.296	3.377	OTA	.627	1.595
	CAR	.632	1.581	CAR	.735	1.360
	LQD	.171	5.843	LQD	.791	1.265
Macro variables	GDP	.847	1.180	GDP	.530	1.885
	INT	.668	1.498	INT	.163	6.149
	EXG	.627	1.595	EXG	.429	2.330
	UEMP	.735	1.360	UEMP	.214	4.680
	AST_GDP	.791	1.265	AST_GDP	.850	1.177

Source: Authors calculation based on annual reports of sample banks

To find multicollinearity amongst the study's variables, VIF tests are employed. **Table 8** indicates that all variables of LDR, ROA, OTA, CAR, and LQD have shown no multicollinearity, as all of the matrix's correlation coefficients between SOBs and PCBs remain within 10 VIF. VIF tests are employed to find multicollinearity amongst the study's variables. In both the case of SOBs and PCBs, Table 5 indicates that all variables of GDP, Lending Interest rate, exchange rate, Unemployment Rate, and AST have shown no multicollinearity, as all of the matrix's correlation coefficients remain within 10 VIF.

Comparison of the impact of Bank-specific factors on NPL between SOBs and PCBs

Table 6 demonstrates that a unit increase in LDR would result in .004 increase in State Commercial Banks' non-performing loans (NPL), a unit increase in ROA would result in -5.870 decrease in State Commercial Banks' non-performing loans (NPL), a unit increase in OTA would result in a 18.615 increase in State Commercial Banks' non-performing loans (NPL) of listed companies in Bangladesh, and a unit increase in CAR would result in a -2.590 decrease in State Commercial Banks' NPL, a unit increase in LQD would result in -.349 decrease in State Commercial Banks' non-performing loans (NPL). The regression results show that ROA and CAR are negatively associated with non-performing loan indicate statistically significance at the 5% interval level which means that the larger the NPL reduces the return on assets (ROA), and capital adequacy ratio (CAR) of state-owned commercial banks in Bangladesh. In contrast, the study also shows that the operating efficiency (OTA) positively associated with the non-performing loan indicate statistically significance at 5% interval level which dictates that the larger the NPL enhances the operating cost on assets of states owned commercial banks in Bangladesh.

Table 6: Showing the comparative regression results between PCBs and SCBs using bank specific variables.

Variables	Private Commercial Banks				State-owned Commercial Banks			
	Coef.	St.Err.	t-value	p-value	Coef.	St.Err.	t-value	p-value
LDR	.047	.035	1.36	.177	.004	.187	.023	.982
ROA	-3.473	.985	-3.53	.001	-5.870	2.701	-2.173	.047
OTA	.251	.676	0.37	.712	18.615	5.874	3.169	.007
CAR	-.845	.274	-3.09	.003	-2.590	.808	-3.207	.006
LQD	-.084	.069	-1.22	.227	-.349	.306	-1.141	.273
Constant	.174	.047	3.74	.000	17.222	19.296	.893	.387
Dep: NPL	R-squared: 0.377; Observation: 100; F-test: 11.260				R-squared: 0.6974; Observation: 20; F-test: 6.45			

Source: Authors calculation based on annual reports of sample banks

Whereas **Table 6** represent that a unit increase in LDR would result in .047 increases in PCBs' non-performing loans (NPL), a unit increases in ROA would result in a -3.473 in PCBs NPL; a unit increase in OTA would result in .251. OTA increase in its NPL; a unit increase in CAR would result in a -.845 decrease in Private Commercial Banks' NPL; a unit increase in LQD would result in a -.084 decrease in Private Commercial Banks' NPL. The regression results also manifest that ROA, CAR and LQD is negatively associated with non-performing loan (NPL) indicate statistically significance at 5 % interval level which means that the higher the NPL indicates the lower the ROA, CAR and LQD of private commercial banks in Bangladesh. ROA and CAR are significant predictors of NPLs in both bank groups. However, OTA is significant only for SOBs, while LQD is significant only for PCBs, indicating structural differences in operational efficiency and liquidity management.

Comparison regression results of Macro-variables between SOBs and PCBs

Table 7: Showing the comparative regression results between PCBs and SCBs using macroeconomic variables.

Variables	Private Commercial Banks				State-owned Commercial Banks			
	Coef.	St.Err.	t-value	p-value	Coef.	St.Err.	t-value	p-value
GDP	.424	.567	.748	.456	.723	1.189	.608	.553
INT	.104	.656	.158	.875	5.054	1.690	2.991	.010
EXG	.125	.090	1.400	.165	.315	.188	1.674	.116
UEMP	.509	1.857	.274	.784	8.846	4.366	2.026	.062
AST_GDP	-1.901	2.337	-.813	.418	-15.86	3.139	-5.055	.000
Constant	-8.743	21.814	-.401	.689	-54.58	46.526	-1.173	.260
Dep: NPL	R-squared: 11.36; Observation: 100; F-test: 0.3767				R-squared: .611.; Observation: 20; F-test: : 6.97			

Source: Authors calculation based on annual reports of sample banks

Table 7 displayed that Lending Interest Rate is positive and significant in SOBs which higher borrowing costs increase the likelihood of loan default. Unemployment Rate also positive and significant because Job losses weaken repayment capacity. But AST shows negative and significant. Larger banking system assets relative to GDP reduce NPLs. GDP and exchange rate is positive but statistically insignificant. On the other- hand the table 7 displayed that none of the macroeconomic variables are statistically significant, suggesting that PCBs are less sensitive to broad economic fluctuations due to superior risk management and diversified portfolios. The regression result shows that all the macro-variables are not statistically significant of private commercial banks in Bangladesh.

Summary of Results of Hypothesis Testing

In both the cases of SOBs and PCBs, in this regression model, all independent variables - including LDR ROA, OTA, CAR, LQD, GDP, Lending Interest Rate, Exchange Rate, Unemployment Rate, and AST making them all insignificant, as p-values are greater than 0.05 and the variables proven to be hypothesis testing.

Summary of hypotheses testing of SCBs and PCBs

Hypotheses	Relationships Direction	SCBs		PCBs	
		P-Values	Decision	P-Values	Decision
H_1	LDR → NPL	.982	Rejected	.177	Rejected
H2	ROA → NPL	.047	Accepted	.001	Accepted
H3	OTA → NPL	.007	Accepted	.712	Rejected
H4	CAR → NPL	.006	Accepted	.003	Accepted
H5	LQD → NPL	.273	Rejected	.227	Rejected
H6	GDP → NPL	.553	Rejected	.456	Rejected
H7	INT → NPL	.010	Accepted	.875	Rejected
H8	EXG → NPL	.116	Rejected	.165	Rejected
H9	UEMP → NPL	.062	Rejected	.784	Rejected
H10	AST_GDP → NPL	.000	Accepted	.418	Rejected

5. Conclusion

The findings from the comparative study bring out the differences in the factors that trigger the NPLs in the Bangladeshi context. SOBs continue to be vulnerable due to the ineffectiveness of their operational and governance structures, while the PCBs display relatively higher levels of resilience. This points to the need for policy initiatives to improve the internal control and governance arrangements, especially in the case of state-owned banks. The study's results have a lot of important effects on policymakers, regulators, and bank managers in Bangladesh. To begin with, the descriptive statistics show that the average NPL ratio of state-owned commercial banks (SCBs) is 2.44 times higher than that of private commercial banks (PCBs). This clearly shows that SCBs have problems with their structure, governance, and operations that won't go away. For SCBs, it is important to strengthen credit risk management, improve monitoring systems, and make sure that loan approval and recovery processes are held accountable. The regression analysis offers significant insights into the factors influencing NPLs. For SCBs, return on assets, operational efficiency (OTA), capital adequacy , lending interest rates (INT), and asset growth have statical significant effect on NPLs. This means that bad operational efficiency makes credit quality worse, which could be because of weak internal controls, slow loan processing, or bad recovery practices. The fact that lending interest rates have a positive effect shows that higher borrowing costs make it more likely that borrowers will default. Increasing unemployment indicates that macroeconomic instability leads to loan delinquency, highlighting the vulnerability of SCBs' asset quality to economic fluctuations. But return on assets (ROA), capital adequacy ratio (CAR), and asset GDP growth all have a negative effect on SCBs' NPLs. These findings suggest that banks with strong finances and a lot of capital are better at handling credit risks. Better bank profits and capital buffers make banks more resilient and less likely to default on loans. Also, higher asset GDP growth means that the economy is doing well, which helps borrowers pay back their loans. The statistically significant negative effect of ROA and CAR on PCBs shows how important it is to have good financial performance, enough capital, and enough liquidity buffers to keep loan portfolios healthy. These findings suggest that PCBs possessing substantial internal financial strength are more effective in managing credit risk. Even though factors like OTA, GDP, INT, the exchange rate, unemployment, and asset GDP growth are all positively related to NPLs, they aren't statistically significant. This means that PCBs are less likely to be affected by operational or macroeconomic shocks than SCBs. This is probably because they have better governance and risk management practices. The findings show that SCBs need specific changes, such as making operations more efficient, improving loan recovery systems, and making governance and oversight stronger. To stop the buildup of NPLs in the banking sector as a whole, it is important to keep enough capital buffers, make profits, and make sure there is enough liquidity. Policymakers should also think about ways to keep the economy stable, such as keeping unemployment and interest rates from going up and down too much, to help the health of the whole financial sector. These implications are essential for formulating effective strategies to mitigate NPLs and bolster the sustainability of the banking system in Bangladesh. Future research should adopt a more comprehensive and forward-looking approach to the analysis of non-performing loans (NPLs). First, extending the data series beyond 2023 would enable scholars to capture post-crisis recovery dynamics and assess the persistence or reversal of stress in bank asset quality. Second, examining sectoral and regional variations in NPL behavior can reveal structural differences in credit risk exposure across industries and geographic locations, offering more nuanced policy implications. Third, integrating behavioral borrower attributes through mixed-methods research-combining quantitative loan-level data with qualitative insights from borrowers and credit officers-can deepen understanding of repayment behavior and default motivations. Fourth, a comparative analysis of the determinants of NPLs in conventional and Islamic banks is essential, given their distinct contractual structures, risk-sharing mechanisms, and governance frameworks. Fifth, future studies should rigorously assess the quality and effectiveness of governance indices as moderating variables in the relationship between bank-specific, macroeconomic factors, and NPLs. Finally, the development of predictive models using machine learning algorithms can enhance the accuracy of NPL forecasting

by capturing non-linear relationships and complex interactions among variables, thereby supporting early warning systems and more effective risk management strategies.

6. Author Contributions

Conceptualization: R.B.; M.M.R.; and M.S.H.; Methodology: S.S.; and M.H. B.; Software: M.S.H.; and R.B.; Validation, M.M.R.; Formal Analysis: M.S.H.; Investigation: R.B.; Resources: M.H. B.; Data Curation: S.S.; Writing-Original Draft Preparation: R.B.; Writing-Review & Editing: M.S.H.; and M.M.R.; Visualization: M.H.B.; Supervision: R.B.; and M.S.H. Authors have read and agreed to the published version of the manuscript.

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9. Conflicts of interest

The authors declare no conflicts of interest.

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Appendix A: Sampling frame of the study.

No.	State-Owned Banks (SCBs)	No.	Private Banks (PCBs)
1	Janata Bank PLC	1	One Bank PLC
2	Agrani Bank PLC	2	National Bank PLC
		3	BRAC Bank PLC
		4	City Bank PLC
		5	Dhaka Bank PLC
		6	Dutch-Bangla Bank PLC
		7	Eastern Bank PLC
		8	IFIC Bank PLC
		9	Mercantile Bank PLC
		10	Mutual Trust Bank PLC

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