

Article

Determinants of non-performing loans in conventional and Islamic banks: Emerging market evidence

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Abstract: This study examines the determinants of non-performing loans (NPLs) among macroeconomic and bank-specific factors for the Islamic and conventional banking sectors in Bangladesh. We implement a dynamic panel data model with a two-stage system GMM for the period 2010-2021. Among the bank-specific factors, this study finds that return on assets, return on equity, bank size, and inefficiency help to reduce NPLs. In contrast, gross loan growth, leverage, and capital adequacy ratios contribute to increasing NPLs. Among macroeconomic determinants, inflation, and GDP growth have a significant negative impact on NPLs. Moreover, unemployment and exchange rates are also found to be significant determinants of NPLs. At the bank level, growth in gross loans reduces NPLs in Islamic banks, while the opposite is true for conventional banks. Our findings have significant implications for depositors and regulators in making appropriate decisions.

Keywords: NPL; Macroeconomic; Bank-specific factors; GMM; Bangladesh.

JEL Classification: C58; G21; E60

1. Introduction

For a bank supervisory authority concerned with financial stability, identifying the drivers of non-performing loans (NPLs) is critical. NPLs are usually recorded due to ex-post credit risk, which is considered to be the genesis of the banking crisis (Reinhart & Rogoff, 2010). As a result, NPLs are likely to be among the first signs of financial disruption and bank insolvency, which pose a risk to the health of the economy. As the banking sector carries out the most important financial activities, the health of the economy depends mainly on a sound banking system.

Given the adverse impact of NPLs on economic and financial systems, our research aims to examine the macroeconomic and bank-specific drivers of NPLs in the Bangladeshi banking sector. In recent years, the NPLs of Bangladeshi banks have been increasing steadily, which is extremely difficult to control. As a result, it has become one of the biggest problems in the banking sector, which may hinder Bangladesh's economic progress. According to international standards, NPLs should be less than 2%, but they are much higher in Bangladesh. It's almost 4 to 5 times the standard set by international financial experts. Figure 1 shows the total NPLs and the ratio of NPLs to total gross loans of banks in Bangladesh from 2011 to 2022. Both NPLs and NPLs to total gross loans ratios show an increasing trend from 22644 crore in 2011 to 120656 crore in 2022 and from 1.9% in 2011 to 8.21% in 2022, respectively.

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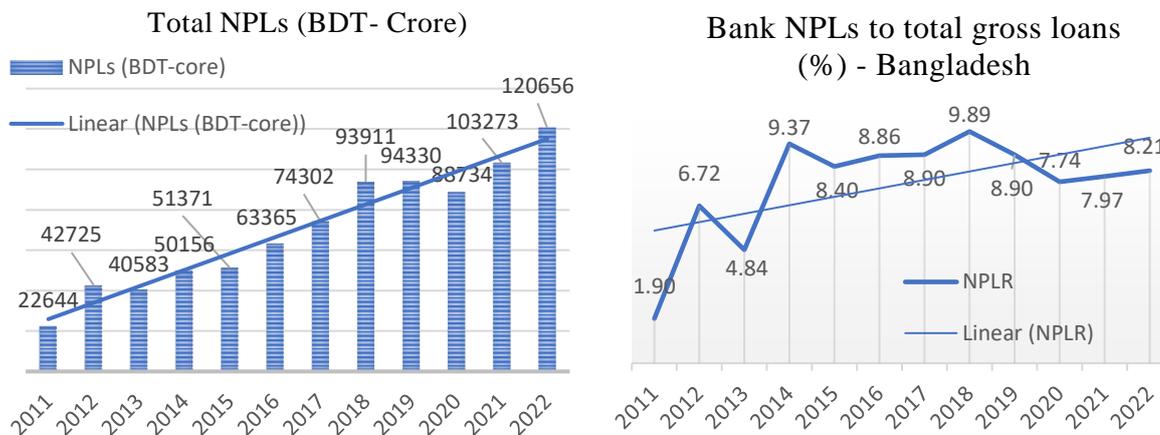
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Figure 1. Total NPLs and the NPLs ratio of Bangladesh from 2011 to 2022.



Source: Bangladesh Bank.

According to Bangladesh Bank, the NPLs at the end of 2019 stood at Tk94,313 crore, an increase of 0.42 percent from the previous year, although it declined by 5.93 percent in 2020 due to massive loan restructuring (Tk12,140 crore). However, in 2021 and 2022, NPLs skyrocketed to 1,03,273 and 1,20,656, respectively, the highest NPLs in the history of Bangladesh. Moreover, it is evident from these statistics that the NPL ratio is continuously increasing. The higher the NPL ratio, the more difficult it is for the banks to provide loans and basic operational functions, and their profitability suffers as a result. On the other hand, the interest payment for the deposit money has to be counted regularly. This increases the probability of bankruptcy. This problem is now almost equally visible in both developed and developing countries. According to Makri et al. (2014), an excessive increase in non-performing loans is expected in the coming years, posing a threat to global macroeconomic stability. However, it is important to examine the factors that contribute to the high level of NPLs in the banking industry and how a country can address these concerns.

The existing research on identifying the drivers of NPLs has expanded significantly, with evidence suggesting that both macroeconomic and bank-specific factors are responsible for rising NPLs. For example, Louzis et al. (2012), Kjosevski and Petkovski (2020), and Vithessonthi (2016) examine macroeconomic and bank-specific factors in Greece, the Baltic States, and Japan. They find that both macroeconomic and bank-specific factors affect NPLs. On the other hand, scholars in Bangladesh have paid less attention to the factors that influence NPLs. Most studies in Bangladesh have focused on the impact of either macroeconomic or bank-specific factors on NPLs, especially in the conventional banking sector, with ambiguous and equivocal results (Akter & Roy, 2017; Zheng et al., 2020; Hosen et al., 2020). There is no consensus among the previous researchers on the factors that most contribute to NPLs, which need to be explored for better policy decisions.

The motivation to focus on Bangladesh's banking industry is driven by the fact that the country has greatly accelerated its economic development in recent years, with an average annual growth rate of more than 6% (Hasan et al., 2022 & 2023). The country's banking sector, which accounts for more than 60% of domestic loans to the financial sector, is primarily responsible for the country's phenomenal economic growth (World Bank, 2019). Therefore, the banking industry is becoming increasingly important as the country's economy grows (Siddiquee et al., 2013). However, for the past few years, the banking sector has been struggling due to high non-performing loans (Amin et al., 2019). Therefore, there is a need to ensure fairness, transparency, and accountability in this sector for its recovery.

Another motivation for our study is to highlight the Islamic banking sector and compare it with the conventional banking sector, which is still lacking in the existing literature. The operations of Islamic and conventional banks differ in several dimensions. According

to Sharia principles, the interest rate (Riba) on a loan is strictly prohibited, while conventional banks make profit from the interest charged on the loan amount. In addition, gambling and extremely risky transactions such as speculation, short selling, and arbitrage are severely restricted under Islamic law (Parmankulova et al., 2022). Therefore, we hypothesize that the critical drivers of NPLs of Islamic banks may be different from those of conventional banks.

In light of the above, it is critical for bank management and policymakers in Bangladesh to identify the appropriate drivers of NPLs. Therefore, we intend to address the following two research questions in this study. First, which variables (both macroeconomic and bank-specific) are driving the rising NPL ratio in both Islamic and conventional banks? Second, which type of bank (conventional vs. Islamic) is most affected by NPLs?

The current study contributes to the NPL literature mainly in the following ways. First, we identify the key determinants of NPLs that are actually behind the increase in NPLs in emerging markets like Bangladesh. Therefore, our findings will provide crystal clear evidence of the factors causing non-performing loans in Bangladeshi banks, which will enable policymakers to take justifiable measures to eliminate them. Secondly, this study examines the determinants of NPLs considering different banks based on regulations and ethics, i.e. Islamic and conventional banks. These categorizations allow us to find out which banking sectors are highly affected by the NPLs. Thirdly, our study would help policymakers and corporate governance bodies to make sector specific regulations. In addition, bank depositors may find it useful to predict the default risk of sector-specific banks. Finally, this study suggests some realistic ways to reduce non-performing loans in the context of Bangladesh.

The remainder of this paper is organized as follows: Section 2 reviews the previous relevant studies; Section 3 discusses the data and methodology; Section 4 provides a brief overview of the results obtained; and finally, Section 5 concludes the study.

2. Literature Review

In view of the performance of the banking sector, many researchers have conducted their studies on banking activities. Among the previous studies, the case of proper movements, the survival issue of banks, and the issue of non-performing loans (NPLs) have attracted much attention from different perspectives in recent years. Researchers have been studying the factors of NPLs in recent years, mainly in response to the growing need to grasp the elements that significantly lead to the vulnerability of the financial sector. Previously, two types of factors-bank-specific and macroeconomic-have mainly been shown to influence the NPL ratio (e.g., Louzis et al., 2012; Dimitrios et al., 2016; Zheng et al., 2020; Kjosevski & Petkovski, 2020, among others). Therefore, in this section, we aim to provide an overview of the factors that have already been considered to identify the determinants of NPLs.

For example, Festic and Repina (2009) examine the impact of macroeconomic and bank-specific determinants on NPLs in the Baltic States for the period 1998Q1 to 2008Q3. The results of the study show that a slowdown in economic activity accelerates the growth of NPLs. The results also suggest that rapid credit growth is detrimental to loan performance. Accordingly, Louzis et al. (2012) examine the determinants of NPLs in the Greek banking system separately for each loan category (consumer loans, business loans, and mortgages). In the end, they suggest that both macroeconomic variables - real GDP growth, unemployment, and lending rate - and bank-specific factors - performance and quality of management and risk management practices - are responsible for the variation in NPLs.

Saba et al. (2012) find two macro factors, i.e., interest rate and real GDP per capita, that significantly affect NPLs in the US banking sector for the period 1985-2000. Similarly, Beck et al. (2013) conducted a study using dynamic panel data for 75 countries and found that macroeconomic variables such as real GDP growth, stock prices, exchange rate and

lending rate significantly affect NPLs ratio. Specifically, they explain that NPL is very sensitive to GDP growth, and the NPL ratio is inversely related to stock returns, especially for countries with large stock markets relative to GDP. Consistently, Messai and Jouini (2013), using a sample of 85 banks in Italy, Greece, and Spain, show that NPL varies inversely with GDP growth rate and bank asset profitability, while it is positively affected by the unemployment rate, the ratio of loan losses to total loans, and the real interest rate. Moreover, in the context of CESEE (Bosnia and Herzegovina, Bulgaria, Hungary, Croatia, Czech Republic, Estonia, Latvia, and Lithuania), Klein (2013) suggests that NPLs are positively related to macroeconomic conditions such as GDP growth, unemployment, and inflation.

Moreover, using a dynamic panel dataset of 25 Ghanaian banks, Alhassan et al. (2014) find that both macroeconomic and bank-specific variables such as credit growth, bank market structure, bank size, inflation, real exchange rate, and GDP growth rate are critical factors in determining bank asset quality. Similarly, Ekanayake and Azeez (2015) focus on the Sri Lankan banking sector and find that both macroeconomic conditions and bank specific factors significantly affect NPLs. In the Jordanian banking sector, Rajha (2016) reports that the ratio of loans to total assets is the most significant factor among the bank-specific components that significantly increase NPLs. On the contrary, in terms of macroeconomic factors, the study finds that economic growth and inflation rates have a negative and significant effect on NPLs.

To determine the long-run and short-run dynamics between NPLs and macroeconomic variables considering commercial banks in Pakistan, Badar et al. (2013) analyze the impact of macroeconomic variables - inflation, exchange rate, interest rate, GDP, and money supply - on NPLs. A long-run relationship is documented between NPLs and money supply and interest rates. However, there is a weak short-run dynamic relationship between NPLs and inflation and exchange rate. Consistently, Kjosevski and Petkovski (2016) investigate the link between macroeconomic and bank-specific determinants of NPLs in the Baltic countries. The evidence shows that the bank-specific variables, such as the ratio of equity to total assets, return on assets, return on equity, and the growth of gross loans, are essential indicators in the case of NPLs. Furthermore, Koju et al. (2018) evaluate the impact of bank management and economic indicators on NPLs for 30 commercial banks in Nepal. The results of this study show that export-import ratio, inefficiency, and asset size have a positive impact on NPLs, while GDP growth, capital adequacy, and inflation rate have a negative impact on NPLs.

In the case of Bangladesh, very few studies have considered the issue of NPLs in the banking and non-bank financial institutions (NBFI) sectors. In Bangladesh, Rifat (2016) aimed to detect the determinants of NPLs in the Non-Bank Financial Institution (NBFI) sector using a panel data set considering seven NBFIs from 2003 to 2014. The results show that firm-specific factors, including loan growth, loan to asset ratio, return on assets, and the relative size of the firm, were more significant for NBFIs' NPLs. Moreover, among macroeconomic variables, money supply had a significant impact. Similarly, Zheng et al. (2020) found that industry-specific factors, such as bank loan growth, net operating profit, and deposit rates, have a negative impact on NPLs, while bank liquidity and lending rates have a positive impact on NPLs. Furthermore, in terms of macroeconomic factors, GDP growth and unemployment rate reduce NPLs, while domestic credit and exchange rates increase NPLs. Ghosh et al. (2020) examine the behavioral factors of NPLs and find that moral hazard problems, inadequate collateral and nepotism, interest rate, and lack of proper monitoring are the significantly positive determinants of NPLs. However, they did not find poor credit assessment, repayment flexibility and business risk as determinants of NPLs in Bangladesh. According to Akhter (2023), the main causes of NPLs in Bangladesh are both firm-specific and macroeconomic factors. The firm-specific indicators are, for example, the NPL lag, the ratio of equity to total assets, the ratio of loan loss provisions

to total equity, the capital adequacy ratio, the ratio of net loans to total deposits and borrowings, the return on equity, and macroeconomic factors such as inflation and the GDP ratio.

From the above literature, it can be concluded that the literature on NPLs is well established. However, the evidence on the determinants of NPLs is mixed and inconclusive. In addition, the majority of previous studies only consider macroeconomic and bank-specific determinants, while overlooking the sectoral impact of these determinants. Moreover, to the best of the authors' knowledge, no study has considered Islamic and conventional banks separately in the Bangladeshi banking sector. Therefore, the aforementioned gaps in the literature have prompted us to structure the analysis of the impact of bank-specific and macroeconomic determinants on Islamic and conventional banks along with the overall sample in the context of the Bangladeshi banking sector.

3. Data and Methods

3.1. Data

This study uses cross-sectional panel data to investigate the determinants of non-performing loans (NPLs) in the Bangladeshi banking sector. To identify the determinants of NPLs more comprehensively, we consider both bank-specific and macroeconomic factors in our study. Our sample includes 34 different types of banks, covering a total of 408 (34 banks × 12 years) annual panel data for each variable with the period from 2010 to 2021. The data period chosen for this study is based on the availability of bank-specific and macroeconomic data, and to maintain the consistency of the sample data set. However, we separate our entire sample into Islamic and conventional banks. The macroeconomic data are obtained from the World Bank Development Indicator (WDI) website, while the bank-specific variables are obtained from the annual reports of the respective banks and the Bangladesh Bank website. The variables analyzed are summarized in Table 1.

Table 1. Description of variables used in the study.

Variables	Abbr.	Measurement	Unit	Sources
Non-performing loans	NPLs	Bank's loan defaulted or is about to default or bad debts.		
Bank-specific factors:				
Return on Asset	ROA	Net Profit after tax /Total assets.	Percentage	Annual reports of respective banks and Bangladesh Bank
Return on Equity	ROE	Net Profit after tax /Total equities.		
Bank inefficiency	INEF	Total operating income /total operating expenditure.		
Growth of gross loans	GGL	Growth of total loans.		
Financial Leverage	LEVE	Debt to equity ratio.		
Capital adequacy ratio	CAR	Bank's ability to pay liabilities and respond to credit risks and operational risks.		
Firm Size	SIZE	The natural logarithm of total sales is used to measure size.		
Macroeconomic factors:				
Inflation rate	INR	An increase in the general price level of goods and services.	Percentage	World Development Indicators (WDI)
GDP growth rate	GDPGR	The annual growth rate (%) of gross domestic product (GDP) at market prices is based on constant local currency.		
Unemployment rate	UNE	The proportion of the labor force those are unemployed but looking for jobs.		
Exchange rate	EXR	Annual percentage based on BDT to US dollar.		

3.2. Methodology

3.2.1. Two-step system GMM estimation

Considering the nature of our data, we have employed the system generalized method of moment (GMM) model in order to verify the determinants of the NPLs in banks. The system GMM estimator introduced by Arellano and Bover (1995), and Blundell and Bond (1998) overcome the bias associated with traditional panel models, such as fixed-effect and pooled OLS models. Finally, the system-GMM estimator is more efficient when a small number of time-series observations and the persistence in the dependent variable are highly correlated with the autoregressive term, which is close to unity (Blundell & Bond, 1998). Moreover, system GMM estimation provides more consistent and efficient estimates, even though independent variables are not strictly exogenous and autocorrelation and heteroskedasticity exist in the sample study. This model can tackle endogeneity issues that may arise from explanatory variables (Harris & Mátyás, 2004). We estimate the system GMM model using the following equation:

$$y_{i,t} = \sum_{j=1}^p a_j y_{i,t-j} + x_{i,t} \beta_1 + w_{i,t} \beta_2 + v_i + \varepsilon_{i,t}, i = 1 \dots, N; t = 1, \dots, T \tag{1}$$

where, $y_{i,t}$ represent non-performing loan loss for bank i at the year t , a_j are the p parameters to be estimated, x_{it} are the exogenous variables and β_1 are the coefficient for the exogenous variable, w_{it} are the endogenous variables and β_2 are their coefficients., v_i represent panel-level effects and ε_{it} represent the identically independently distributed for the whole sample. There is an assumption that v_i and the ε_{it} are independent for each bank i and overall t .

3.2.2. Panel causality test

Our study also uses non-causality tests based on the individual Wald measurements proposed by Dumitrescu and Hurlin (2012) following Hasan and Hossain (2022). Dumitrescu and Hurlin’s (2012) causality test distinguishes between regression model heterogeneity and causal relationship heterogeneity in cross-sectional Granger causality specifications. The model considers the association of one variable to another for all the variables, whether there is a causal relationship from X to Y or Y to X . According to the non-homogenous causality, the first one (X to Y) is designed, implying no causality. Nevertheless, the second one (Y to X) goes with homogenous causality, indicating the presence of n number of causality. In the case of homogenous causality, Y is assumed with the previous information of Y and X , where the factors of Y are heterogeneous in the sample. The causality equation can be written as:

$$X_{i,t} = \mu_i^x + \sum_{j=1}^{ki+d \max} \theta_{11,ij} X_{i,t-j} + \sum_{j=1}^{ki+d \max} \theta_{12,ij} Y_{i,t-j} + \mu_{i,t}^x, \tag{2}$$

$$Y_{i,t} = \mu_i^y + \sum_{j=1}^{ki+d \max} \theta_{21,ij} X_{i,t-j} + \sum_{j=1}^{ki+d \max} \theta_{22,ij} Y_{i,t-j} + \mu_{i,t}^y, \tag{3}$$

where for each i , the maximum order of integration is considered by $d \max$. $X_{i,t}$ and $Y_{i,t}$ represent the pairwise causal relationship for all the series. We examine the causality from X to Y in Equation (2) and Y to X in Equation (3).

4. Results and Discussion

Table 2 presents the descriptive statistics of the variables analyzed. The table shows that conventional banks have higher average NPLs than Islamic banks, indicating that conventional banks are highly affected by NPLs and have less controllability than Islamic banks. Furthermore, we find that the performance of Islamic banks (ROA and ROE) is higher than that of conventional banks. Similarly, average gross loan growth and bank

size are more significant in Islamic banks, while inefficiency, leverage and capital adequacy ratios are higher in conventional banks.

The correlation matrix between the variables is shown in Table 3. The results of the correlation matrix indicate low to moderate levels of correlations among the variables studied. In addition, NPLs appear to be negatively correlated with return on assets and equity, gross loan growth, capital adequacy ratio, leverage, inflation, and exchange rate. However, NPLs are positively correlated with bank size, inefficiency, GDP growth, and unemployment. Moreover, the positive correlations between GGL and profitability (ROA and ROE) are consistent with Becker and Ivashina (2014), who argue that bank profitability affects the supply of bank loans.

The results of the unit root test are presented in Table 4. Based on ADF and PP tests, the unit root analysis indicates that the null hypothesis of non-stationarity cannot be rejected for all variables (except GDPGR and UNE) at the level. However, after the first difference, the null hypothesis of non-stationarity can be rejected for all factors in our selected set at the 1% significance level. Therefore, our data set suffers from unit root problems.

Next, in Table 5, we present the empirical estimates from the two-stage system GMM in three separate models for the bank-specific, macroeconomic, and full samples of factors. The results confirm that both bank-level and macroeconomic factors play a significant role in explaining bank asset quality. The models seem to fit the panel data reasonably well, as the Wald test indicates methodological fitness. The Sargan test indicates that the chosen instruments are valid (the p-value in Model 1 is 0.164, 0.241 for Model 2, and 0.193 for Model 3). The estimator ensures efficiency and consistency, provided that the residuals do not exhibit second-order serial correlation. Even if the equations indicate the presence of first-order autocorrelation, this does not imply that the estimates are inconsistent. Inconsistency would be implied if second-order autocorrelation is present (Arellano & Bond, 1991), but this case is rejected by the test for AR (2) errors.

Table 5 highlights some critical results for our three models. In particular, the coefficient on the lagged dependent variable has the expected sign in all three models, indicating the dynamic nature of the estimated models. This variable has values ranging from 0.847 to 0.933, indicating that a change in NPLs is likely to affect the banking sector.

Among the bank-specific determinants, we find that return on assets and return on equity have a negative and significant impact on NPLs at the 1% level, which supports Berger and DeYoung's (1997) bad management hypothesis. A bank characterized by high profitability is less likely to engage in risky activities such as making risky loans. These results indicate that there is effective management of funds invested by shareholders through good agency relationships in the banking system in Bangladesh. These results are consistent with the findings of Erdinc and Abazi (2014), Makri et al. (2014), Dimitrios et al. (2016), and Kjosevski and Petkovski (2020).

Moreover, we find that growth in gross loans significantly leads to faster growth in NPLs in Model 1. Namely, this result is supported by Dash and Kabra (2010) and Kjosevski and Petkovski (2017), who condemn unsustainable credit booms as a factor leading to increased financial fragility. This result may also suggest that central bank actions to curb excessive lending growth are necessary to ensure financial stability. Moreover, this negative effect of credit growth on NPLs suggests that more lending tends to put more emphasis on credit operations, making them more adept at using credit scoring, evaluation, and monitoring systems. As a result, banks can mitigate the level of NPLs in the current year by focusing on lending activities.

Table 2. Descriptive statistics.

Variables	All banks sample				Islamic banks sample				Conventional bank sample			
	Mean	Max	Min	Std. Dev.	Mean	Max	Min	Std. Dev.	Mean	Max	Min	Std. Dev.
NPLs	10.377	84.000	0.950	14.862	3.926	84.000	0.950	24.703	9.485	57.150	1.180	10.945
ROA	1.306	103.0	-10.07	5.626	1.611	3.540	-9.970	2.193	1.576	103.000	-7.490	6.150
ROE	9.603	81.300	-274.1	17.679	10.670	36.220	0.630	5.778	9.363	81.300	-274.080	19.714
GGL	11.848	13.990	9.040	0.868	12.098	13.990	10.360	0.784	11.866	13.458	9.201	0.730
SIZE	12.282	14.350	9.327	0.863	12.407	14.308	10.918	0.748	12.337	14.350	10.223	0.722
INEF	0.895	167.658	-20.394	8.430	0.454	0.712	0.239	0.094	1.122	167.658	-2.714	9.351
CAR	0.115	10.100	-1.374	0.533	0.124	0.167	0.091	0.017	0.154	10.100	-0.156	0.557
LEVE	0.912	1.072	0.432	0.060	0.751	0.936	0.357	0.149	0.911	1.072	0.432	0.063
GDPGR	6.373	7.882	3.448	1.065	-	-	-	-	-	-	-	-
INF	6.660	11.395	5.423	1.659	-	-	-	-	-	-	-	-
UNE	10.795	14.383	6.373	2.314	-	-	-	-	-	-	-	-
EXR	79.678	85.084	69.649	4.487	-	-	-	-	-	-	-	-

Notes: NPLs, ROA, ROE, GGL, SIZE, INEF, CAR, LEVE, GDPGR, INF, UNE, and EXR stand for non-performing loans, return on assets, returns on equity, growth of gross loans, bank size, banks' inefficiency, capital adequacy ratio, leverage ratio, GDP growth rate, inflation rate, unemployment rate, and exchange rate, respectively. Max., Min., and Std. Dev. refer to maximum, minimum, and standard deviation, respectively.

Table 3. Correlation matrix

Probability	NPLs	ROA	ROE	GGL	SIZE	INEF	CAR	LEVE	GDPGR	INF	UNE	EXR
ROA	-0.230*	1										
ROE	-0.461*	0.053	1									
GGL	-0.262*	0.093*	0.081	1								
SIZE	0.072	-0.242*	-0.234***	-0.181*	1							
INEF	0.184*	0.041	-0.192***	-0.093***	0.082*	1						
CAR	-0.011	0.200*	0.061	-0.070	-0.221*	-0.001	1					
LEVE	-0.332*	-0.140*	0.066	0.102**	0.401*	0.064	-0.504*	1				
GDPGR	0.130*	-0.173*	-0.301***	-0.043	0.433*	0.162*	0.093***	0.131	1			
INF	-0.131**	0.142*	0.240***	0.180*	-0.393*	-0.142*	0.012	-0.130	-0.311*	1		
UNE	0.150*	-0.224*	-0.390***	-0.121**	0.412*	0.173*	0.052	0.131	0.492*	-0.511*	1	
EXR	-0.021	0.025	-0.019	0.224*	-0.090*	-0.031	-0.011	-0.044	0.211*	0.160*	-0.303*	1

Notes: NPLs, ROA, ROE, GGL, SIZE, INEF, CAR, LEVE, GDPGR, INF, UNE, and EXR stand for non-performing loans, return on assets, returns on equity, growth of gross loans, bank size, banks' inefficiency, capital adequacy ratio, leverage ratio, GDP growth rate, inflation rate, unemployment rate, and exchange rate, respectively. The symbols '*', '**', and '***' represent the significance levels at 1%, 5%, and 10%, respectively.

Table 4. Panel unit root tests

Variables	ADF-fisher chi-square		PP-fisher chi-square	
	Level	First difference	Level	First difference
NPLs	87.294***	131.160*	95.613***	273.095*
ROA	168.439*	161.891*	201.726*	401.230*
ROE	131.850*	151.199*	158.203*	381.871*
GGL	93.130*	101.227*	152.639*	286.854*
SIZE	280.466*	343.239*	508.653*	583.772*
LEVE	203.139*	228.170*	272.922*	401.408*
INEF	187.258*	187.287*	205.701*	350.081*
CAR	169.661*	224.271*	291.562*	424.762*
INF	385.401*	626.303*	455.281*	385.274*
GDPGR	32.507	211.819*	25.998	150.406*
UNE	40.802	331.840*	14.921	393.008*
EXR	93.025*	142.557*	171.390*	324.133*

Notes: NPLs, ROA, ROE, GGL, SIZE, INEF, CAR, LEVE, GDPGR, INF, UNE, and EXR stand for non-performing loans, return on asset, return on equity, growth of gross loans, bank size, banks' inefficiency, capital adequacy ratio, leverage ratio, GDP growth rate, inflation rate, unemployment rate, and exchange rate, respectively. The symbols '*', '**', and '***' represent the significance level at 1%, 5%, and 10%, respectively.

Table 5. The results of two-step system GMM estimations

Variables	Model-1: Bank-specific factors		Model-2: Macroeconomic factors		Model-3: Whole sample	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
NPLs(-1)	0.847*	0.011	0.933*	0.003	0.851*	0.021
ROA	-0.431*	0.025	-	-	-0.342*	0.041
ROE	-0.125*	0.007	-	-	-0.113*	0.011
GGL	1.274*	0.378	-	-	0.166	1.087
SIZE	-1.226*	0.469	-	-	-1.123*	0.116
LEVE	7.019*	0.484	-	-	5.805*	1.318
INEF	-1.717*	0.371	-	-	-1.103*	0.388
CAR	2.759*	0.666	-	-	5.847*	1.011
INF	-	-	-0.332*	0.025	-0.366*	0.033
GDPGR	-	-	-0.886*	0.096	-0.750*	0.147
UNE	-	-	2.472*	0.069	0.669*	0.235
EXR	-	-	0.243*	0.006	0.161**	0.013
Constant	329.800*	44.510	147.00***	76.710	271.900*	100.100
Year		Yes		Yes		Yes
Observations		374		374		374
Cross-section		34		34		34
Hansen J test (P value)		0.164		0.241		0.193
AR(1)		0.005		0.008		0.009
AR(2)		0.332		0.407		0.252

Note: '*', '**', and '***' represent the significance level at 1%, 5%, and 10%, respectively.

The empirical results in Table 5 also show that bank size has a negative effect on NPLs, i.e., a 1% increase in bank assets reduces the level of NPLs by about 1.123% to 1.226%, all else being equal. This result is consistent with Kjosevski and Petkovski (2020)

and Muhammad et al. (2020). Bank size is generally significant in a firm because bank size is represented by total assets, average total assets, total sales, and average sales. Thus, it can be argued that as the assets of the bank increase, the NPLs may decrease. In addition, banks with larger total assets are more likely to keep track of their financing risks with greater flexibility and may be better able to regulate their NPL levels. To reduce the likelihood of NPLs, banks with large assets can more freely allocate funding that has the potential to generate substantial returns.

Moreover, our results show that the leverage ratio is a significant positive deterrent to NPLs in the Bangladeshi banking sector, which favors the "too big to fail" effect on risk-taking. This result suggests that the higher the debt to total bank assets ratio, the higher the risk of loan default.

On the other hand, inefficiency is found to have a negative and statistically significant impact on NPLs at the 1% level, indicating that the higher the inefficiency ratio, the lower the size of NPLs and vice versa. In contrast, the capital adequacy ratio has a positive and significant impact on NPLs in Models 1 and 3. As Demirgüç-Kunt and Huizinga (1999) have pointed out, a large capital stock makes banks more ambitious in their pursuit of opportunities, which implies that risks are increased, resulting in increasing NPLs. Moreover, with a higher CAR, the bank is better prepared to withstand future losses, especially those from NPLs. Our results are consistent with previous studies (see, for example, Boudrigha et al., 2010; Lafuente et al., 2019).

From the macroeconomic results, we observe that GDP growth has a significant negative impact on NPLs in Models 2 and 3. This result shows that an improvement in the real economy improves the strength of the borrower's debt service capacity, leading to a reduction in NPLs. This result is consistent with those documented by Chaibi and Ftiti (2015), Dimitrios et al. (2016), Woosd and Skinner (2018), and Kjosevski and Petkovski (2020).

However, the negative results could be explained by the fact that higher inflation reduced the actual value of the debt and consequently made it easier for the debtor to repay the debt. In this context, inflation affected actual interest rates and, in a broader sense, economic activity. Similarly, Castro (2013) and Chaibi and Ftiti (2015) come to the same conclusions for the five European countries and the French banking system, respectively.

In contrast, the significant and positive effect of unemployment on NPLs proves that bank loans react when a person loses his source of income. As a result, he cannot repay his loan, which contributes to higher NPLs. This result is consistent with Chaibi and Ftiti (2015) and Kjosevski and Petkovski (2020). Finally, our result establishes the exchange rate as a macroeconomic determinant of NPLs, as it positively affects NPLs at the 1% significance level. This result implies that the depreciation of the exchange rate leads to an intensification of NPLs in any country with a high degree of foreign currency lending to unhedged borrowers, estimated by international claims denominated in foreign currencies (Beck et al., 2013).

We have used the random effect OLS approach for bank-wise estimation since the Islamic bank sample has lower cross-sectional data than the number of years, i.e., $N < T$. To select the model that fits the analysis and estimate, we employ the Hausman (1978) test (Chi-square (χ^2) test); the results are reported in Table 6. The Hausman test indicates that probability (p-value) is insignificant, indicating that the random effect model is the best-fitted model.

Table 6. The results of Hausman tests

Hausman tests	Model-Islamic banks	Model-Conventional banks
Chi-square statistic	11.048	8.461
p-value	0.440	0.748

Table 7 reports the results of the random effect OLS estimation for each of the Islamic and conventional banks. The results show that return on assets and equity help to reduce NPLs for both Islamic and conventional banks. However, gross loan growth has a negative effect on NPLs only for the Islamic bank sample, while gross loan growth increases NPLs for the conventional bank sample. This result can be attributed to the fact that Islamic banks grant loans based on the principles of profit and loss sharing, where both parties are equally responsible for the loss of the loan. In addition, bank size and inefficiency help to reduce NPLs, while the leverage ratio contributes to more NPLs for both banks.

Table 7. The results of random OLS estimations (bank-wise)

Variables	Islamic banks		Conventional banks	
	Coeff.	Std. error	Coeff.	Std. error
ROA	-0.421*	0.145	-0.312**	0.132
ROE	-0.180*	0.042	-0.149*	0.038
GGL	-0.153*	0.038	0.151*	0.034
SIZE	-1.538***	0.745	-3.539*	0.826
LEVE	2.305*	0.821	1.803*	0.876
INEF	-2.305**	0.953	-2.252*	0.873
CAR	-2.099	8.194	-1.729	7.429
INF	-1.134**	0.455	-1.609*	0.405
GDPGR	-0.359***	0.202	-0.546*	0.181
UNE	0.825	1.216	1.635**	0.628
EXR	-0.033	0.087	-0.052	0.080
Constant	46.800*	12.750	56.420*	10.210
R-squared		0.711		0.857
Adjusted R-squared		0.603		0.834
F-statistic		6.611*		38.051*
Durbin-Watson stat		1.736		2.139

Note: ‘*’, ‘**’, and ‘***’ represent the significance level at 1%, 5%, and 10%, respectively.

Among the results of macroeconomic determinants, we observe that inflation and GDP growth have a significant negative impact on NPLs in both Islamic and conventional banks. However, the unemployment rate has an insignificant effect on NPLs in Islamic banks, while NPLs in conventional banks have increased significantly.

In order to obtain the causal direction among the studied variables, we apply the pairwise Dumitrescu and Hurlin (2012) panel causality test, which is reported in Table 8. A bi-directional relationship is documented between NPLs and ROA, NPLs and ROE, and NPLs and bank size, indicating that changes in return on assets, return on equity, and bank size directly affect NPLs, and changes in NPLs also affect return on assets, return on equity, and bank size. Similarly, among the macroeconomic factors, only a bidirectional relationship is found between NPLs and the unemployment rate. Moreover, unidirectional causality is found running from inflation to NPLs and from NPLs to GGL, GDPGR, and EXR.

5. Conclusions

This study determines the factors influencing the non-performing loans in Bangladeshi banking sectors from the period 2010-2021. By employing a two-step system GMM approach, we find that return on assets, return on equity, bank size, inefficiency, inflation, and GDP growth rate helps to reduce NPLs, while growth of gross loans, leverage ratio, capital adequacy ratio, unemployment, and exchange rate contribute to influence NPLs. Moreover, based on Islamic and conventional banks, the growth of gross loans helps to

reduce NPLs in the Islamic banking sample, while the growth of gross loans increases NPLs in conventional banks. Conversely, the causality results show a bidirectional relationship between NPLs and return on assets, NPLs and equity, NPLs and bank size, and NPLs and unemployment. There is also a unidirectional causality from inflation to NPLs.

Table 8. The results of Pairwise Dumitrescu-Hurlin (2012) panel causality tests

Variable pair			X to Y	Y to X	Causality direction
X	and	Y	F-Statistic	F-Statistic	
NPLs	and	ROA	2.507*	3.461**	↔
NPLs	and	ROE	14.066***	5.789***	↔
NPLs	and	GGL	12.569*	1.128	←
NPLs	and	SIZE	16.452*	2.485***	↔
NPLs	and	LEVE	1.616	0.877	-
NPLs	and	INEF	1.092	554	-
NPLs	and	CAR	1.908	1.171	-
NPLs	and	INF	0.952	4.663**	←
NPLs	and	GDPGR	4.318**	0.497	←
NPLs	and	UNE	5.745*	4.925*	↔
NPLs	and	EXR	6.044*	0.109	←

Notes: ‘*’, ‘**’, and ‘***’ represent the significance level at 1%, 5%, and 10%, respectively. The casualty direction ‘↔’, ‘←’, and ‘-’ denote the ‘bidirectional’, ‘unidirectional’, and ‘no’ causal relationships, respectively.

Our study will contribute significantly to policy-making and depositor decision-making in several ways. First, by reviewing our findings, the banking authority and the corporate governance body will be aware of both the macroeconomic and bank-specific determinants behind the NPLs in Bangladesh banking sector. Second, our findings suggest that the regulators or policymakers should provide more incentives and confirm the accountability to control the NPLs because the selected banks may not be relatively inefficient. In addition, the regulators should focus on and monitor the management performance by identifying the banks with the potential increase of NPLs. Thirdly, depositors may make a better choice to deposit their funds in the Shariah-based banking sectors, as these types of banks are less affected by the NPLs. Overall, by being aware of the individual determinants of NPLs, the banking sector can help strengthen the financial sectors in Bangladesh.

The main shortcomings of this study are as follows: Due to the unavailability and maintaining conformity, this study utilizes the data period from 2010-2021. This study utilizes only 34 among the 61 scheduled banks in Bangladesh based on the data availability is another limitation. Further studies could extend this study by incorporating more probable factors with robust approaches. Moreover, future research can be conducted with the NPL ratio against several uncertainties. The determinants of NPLs can be analyzed by categorizing the firms with political connections and board diversifications. Also, future research can be conducted by developing the loan categories to find out the determinants of NPLs more sharply.

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