Print ISSN: 2288-4637 / Online ISSN 2288-4645
doi:10.13106/jafeb.2021.vol8.no12.0095

Macroeconomic and Firm-specific Factors Influencing Non-Performing Loans in Bangladesh: A Panel Data Regression Approach

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Received: August 15, 2021 Revised: October 23, 2021 Accepted: November 01, 2021

Abstract

A prerequisite of a sound financial system is effective channeling of financial resources to efficient users; hence maximizing economic and societal welfare. To that end, the prevalence of bad loans in banks in emerging economies is a major policy concern. In an attempt to add to the growing body of literature explaining the interrelationship between macroeconomic and firm-specific factors, and non-performing loans (NPL), this paper examines data from 24 scheduled commercial banks in Bangladesh from 2008 to 2019. Macroeconomic factors as well as firm-specific factors related to profitability, capital strength, and efficiency are considered. Panel data regression analysis is performed to estimate pooled OLS, fixed effects, and random effects models. Following the necessary testing, it was found that the fixed effects model with robust standard error is appropriate. Results show that return on assets and inflation have a negative influence on NPL, but GDP growth has a favorable impact. The paper concludes by asserting that the evidence supports similar findings from studies both in Bangladesh and elsewhere and it is noted that a combination of these macroeconomic and firm-specific factors explains only a small portion of the total variation in NPL.

Keywords: Classified Bank Assets, Firm-Specific Variables, Fixed Effects Model, Macroeconomic Variables, NPL determinants

JEL Classification Code: C01, C23, G21

1. Introduction

One of the fundamental roles of a healthy and well-functioning financial system is to effectively channel limited financial resources to the most efficient and competent players in the economy. A sound financial system allocates resources to productive and profitable uses, mostly through banks and capital markets, ensuring healthy returns on investment. Such investments have the potential to determine the quality of social and economic infrastructure in a country.

The problem of escalating non-performing loans must be addressed, and a large number of studies have been conducted to better understand the underlying causes and factors of non-performing loans in Bangladesh's banking sector. Some of these studies aimed to look at the possible relationship between macroeconomic variables e.g., GDP growth, inflation, exchange rates, etc., and the level of non-performing loans in banks operating in Bangladesh (Mondal, 2016; Rifat, 2016; Roy et al., 2014). For example, strong evidence was found in support of a relationship between lending rates and non-performing loans in the long run (Ara & Islam, 2019).

Some studies also looked into firm-specific factors such as profitability, liquidity, and capital adequacy and their possible relationship with non-performing loans. Still, other studies investigated one of the important factors behind the

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problem of NPL at hand: the quality of corporate governance in banking institutions and its implication on NPL trends. To this end, findings were mixed. Some studies found no significant relationship between corporate governance indicators and non-performing loans while others have found strong evidence of a link between the two. In essence, different determinants have been attributed to NPL. Macro variables identified include GDP growth, domestic credit to the private sector, unemployment, exchange rate, etc., whereas capital adequacy ratio, bank loan growth, deposit rate, profitability, return on equity, etc. were some noteworthy firm-specific factors related to NPL.

However, different authors used their own combinations of variables and time-span as per convenience, respective hypotheses, and their research interests. As a result, a research gap has been identified for a study that examines all important macroeconomic and firm-specific factors and their combined impact on the banking system's non-performing loan scenario. The objective of this paper was to extensively investigate the relationship between macroeconomic and firm-specific factors in relation to non-performing loans to better understand the underlying factors and add further evidence to a growing body of literature on this issue. The study aimed to look into the relevant macroeconomic and firm-specific factors contributing to non-performing loans in the formal banking sector in Bangladesh.

2. Literature Review

Broadly speaking, both systematic or macroeconomic variables and unsystematic or bank-specific variables have been theorized and tested for their influence on credit risk for banks (Cebenoyan & Strahan, 2004; Khemraj & Pasha, 2009; Waqas et al., 2017; Warue, 2013). However, actual evidence from various parts of the world has not always corroborated commonly held assertions. For example, multi-country studies have found leverage to be not significantly related to credit risk determination (Ahmad & Ariff, 2008). Ahmad and Ariff (2008) found that management quality was a more important factor for emerging economy banks which is in compliance with the established understanding of the importance of governance in determining asset quality in financial institutions (Anastasiou et al., 2019; Lee et al., 2018; Rehman et al., 2016; Tarchouna et al., 2017). Factors relating to both firm-specific governance and general political governance have been found to play a significant impact in this case. The bank's credit management policies must comply with capital the adequacy requirements (Luong & Nguyen, 2021). The impact of business cycles that borrowing entities go through can be hypothesized to have an impact. Tran and Nguyen (2020), however, found that business cycle impact has no significant effect on credit risks in the banks.

It is, however, difficult to translate governance practices into a comparable and universally recognised index that can be used in an empirical model. This can especially prove cumbersome for emerging economies where data related to governance indicators at the firm level may not be reliable or worse, may not be available at all. Hence, many studies primarily focus on bank-specific performance factors as well as systematic macro factors for which data is more reliably and easily available. Warue (2013) looked into several bank-specific and macroeconomic factors and found bank-specific factors to be more strongly related to NPL. The study incorporated 44 commercial banks in Kenya from the period 1995–2009 and found return on assets (ROA), bank size, and per capita income to be significantly related to NPL for the study period observed. This was the case for banks of all sizes and ownership structures (Warue, 2013).

Similar studies have also been conducted in Greece, Ireland, Portugal, Spain, Italy, Jordan, countries of sub-Saharan Africa, countries from the European Union, India, Pakistan, and Bangladesh (Anastasiou et al., 2016; Louzis et al., 2012; Waqas et al., 2017). Interestingly, these variables influence each other as well and are likely to be interdependent. For example, NPL and capital adequacy also in turn affect bank performance variables (Hersugondo et al., 2021). The findings imply that both macroeconomic and bank-specific factors influence the prevalence and trend of nonperforming loans in the formal banking system. This is the case for even small banks in East Java in Indonesia (Puspitasari et al., 2021).

Several studies have looked into NPL determinants for Bangladesh in particular. Table 1 summarizes previous studies on the relationship between NPL and various determining factors. The table lists variables used by authors and the quantitative model estimated to investigate the interrelationship.

Ara and Islam (2019) attempted to review the impact of lending interest rates as part of macroeconomic factors on NPLs in banks of Bangladesh. According to the study, there was a long-run relationship between lending interest rate and NPL. In NPL, the lending interest rate imbalance converged to long-term parity. Mondal (2016) attempted to evaluate the sensitivity of NPL to macroeconomic variables (GDP growth rate, inflation rate, interest rate spread, and unemployment rate). The author stated that inflation rate and interest rate spread had a significant negative relationship with NPL, whereas GDP and unemployment rate have a positive but insignificant relationship with NPL. According to Roy et al. (2014), there was a negative relationship between NPL and GDP growth and inflation. GDP was also significantly and negatively correlated with credit risk in Vietnam whereas the effects of inflation were minimal (Pham & Pham, 2021).

Table 1: Previous Bangladeshi Studies on NPL, Factors Included and Models Used

#	Author(s)	Journal	Factors Chosen	Model Used
1.	Ahmad and Ariff (2008)	International Journal of Banking and Finance	Management quality, moral hazard, cyclicality of credit, the board size, and board independence	Correlational analysis; found no problem of multi-collinearity
2.	Bhattarai (2018)	IJAFR	Board size, board independence, audit committee, CEO remuneration, ownership pattern	Multiple regression analysis
3.	Ara and Islam (2019)	International Conference on Data Science Series	Lending interest rate	Autoregressive Distributed Lag (ARDL)
4.	Badar et al. (2013)	wseas Transactions on Business and Economics	Inflation, exchange rate, interest rate, GDP, money supply	Johansen and Juselius multivariate cointegration, pairwise bivariate cointegration, Granger causality test, vector error correction model
9.	Kumar et al. (2020)	International Journal of Applied Economics	Customer selection, Loan monitoring	Descriptive statistics
10.	Lata (2015)	World Review of Business Research	Profitability, Net interest income	Coefficient, ANOVA, and Linear Regression Model
11.	Mondal (2016)	Global Journal of Management and Business Research	GDP growth rate, inflation rate, interest rate, the unemployment rate	Descriptive statistics, Augmented Dickey-Fuller (ADF) Unit Root Test, Pearson Correlation Analysis, Granger Causality Test, Regression Analysis
12.	Rifat (2016)	Journal of Business and Technology (Dhaka)	macroeconomic variables: GDP growth rate, inflation rate, and broad money firm-specific variables: loan growth, loan to asset ratio, return on asset, and relative size of the firm	Correlation analysis, Fixed Effect Regression Analysis
13.	Roy (2015)	Social Science Research Network	Profitability	correlation, regression & ANOVA
14.	Roy et al. (2014)	Social Science Research Network	GDP growth, inflation, and interest spread	The Correlogram and the Unit root test (ADF test), Pearson correlation test, The Multicollinearity test, Granger Causality test
15.	Shamsudheen and Masih (2015)	Research Gate	Interest rate	Autoregressive Distributive Lag (ARDL) model
16.	Sheefeni (2015)	International Review of Research in Emerging Markets and the Global Economy	gross domestic product, interest rate and inflation rate	Unit root, co-integration, Granger causality, impulse response function, and forecast error variance decompositions within the vector autoregression (VAR) framework

3. Methodology

The study assumed a positivist research philosophy and was focused primarily on quantitative methods for investigating the relation between the two sets of variables.

3.1. Sample for the Study

This study was conducted on scheduled commercial banks in Bangladesh and non-bank financial institutions were excluded since they held a significantly different portfolio of assets and till this point, constituted a relatively small portion of total loan disbursement. Hence, sampling elements for this study were individual scheduled banking institutions. As of June 2021, there were a total of 61 scheduled banks in Bangladesh. This constituted the total population for the study. Keeping in mind the volume of data collection needed and time constraints under which the current work was conducted, the sample size was determined to be 24 banks in total, based on convenience sampling. There were 19 conventional commercial banks and 5 Islamic Shariah-based banks in the sample of the study. The scope included both publicly listed as well as private commercial banks.

3.2. Panel Data, Variables, and Analysis

For this study, panel data consisting of 12 time periods and 24 cross-sections were used. The time period variable was 'year' and cross-sections were based on 'individual banks'. Since time period variable $T = 12$ was smaller than the cross-section variable $N = 24$, and data on each variable was available for all cross-sections in all time periods, the panel data was considered a strongly balanced and wide panel data. Macroeconomic variables for the 12 years were repeated for all cross-sections. The total number of observations, therefore, for each variable was 288. STATA Version 13 was used for all analysis and modeling purposes.

Data related to macroeconomic variables and firm-specific inputs was collected from secondary sources. A detailed description of these variables, relevant mathematical transformations have been provided in Table 2. For the purpose of this study data on these variables will be collected for a period of 12 years from 2008 to 2019.

Table 2: Summary Description of Study Variables

Variable Name	Variable Label	Description	Source
Return on Assets (ROA)	logroa	Return on assets (ROA) is a measure of profitability for the bank and is calculated by taking net income as a percentage of total assets. Log transformation on the original variable was used. (Bank Specific)	Bank Specific Financial Statements for the period 2008–2019
Operating Expenditure as % of Total Expenditure	logopx	This is a proxy variable for operating cost structure as well as bank size. The authors took total operating expenditure as a percentage of total expenditure reported in the income statement. Log transformation on the original variable was used. (Bank Specific)	Bank Specific Financial Statements for the period 2008–2019
Capital Adequacy Ratio	logcapad	The capital adequacy ratio measures long-term bank solvency. Log transformation on the original variable was used.	Bank Specific Financial Statements for the period 2008–2019
Credit Deposit Ratio	logcredep	The credit deposit ratio expresses total loans and advances as a percentage of total deposits collected by the bank. Log transformation on the original variable was used. (Bank Specific)	Bank Specific Financial Statements for the period 2008–2019
Loans to Assets Ration	logla	Loans to assets ratio expressed as total loans and advances as a percentage of total assets measure the extent to which the bank is invested in lending activities relative to its total assets. Log transformation on the original variable was used. (Bank Specific)	Bank Specific Financial Statements for the period 2008–2019
Operating Income per Executive Employee	logopincex	This is a proxy variable used to measure bank operating efficiency. Data on the total number of executive employees working in a bank in a given year was collected. Log transformation on the original variable was used. (Bank Specific)	Bank Specific Financial Statements for the period 2008–2019 and annual reports for the same period

Table 2: Continued

Variable Name	Variable Label	Description	Source
Inflation	loginfl	12-month-average inflation rates were used for the current study. Log transformation on the original variable was used. (Macroeconomic)	Bangladesh Bank Archive; Reports of Bangladesh Bureau of Statistics
Exchange Rate	logexr	The annual average exchange rate between Bangladeshi Taka and United States (US) Dollar was used. Since the US is a major trading partner and also a major currency, other rates were not taken into consideration and the USD/BDT exchange rates were used as a proxy for the exchange rate scenario in general. Log transformation on the original variable was used. (Macroeconomic)	Bangladesh Bank Archive; Reports of Bangladesh Bureau of Statistics
Broad Money Supply (M2)	logm2	For the current study, broad money M2 (cash, cash equivalents, and short-term deposits) was used to measure the money supply. Log transformation on the original variable was used. (Macroeconomic)	Bangladesh Bank Archive; Reports of Bangladesh Bureau of Statistics
Lending rate	loglendr	The average lending rate aggregated by Bangladesh Bank was considered. Log transformation on the original variable was used. (Macroeconomic)	Bangladesh Bank Archive; Reports of Bangladesh Bureau of Statistics
GDP Growth	loggdp	The growth rate in Gross Domestic Product at constant prices was considered. Log transformation on the original variable was used. (Macroeconomic)	Bangladesh Bank Archive; Reports of Bangladesh Bureau of Statistics

4. Results

In this section, a brief discussion of the study variables is presented along with relevant calculations preceding the analysis and model estimation process. This is followed by a detailed estimation of three-panel data regression models i.e., pooled OLS, fixed effects, and random effects models and along with their corresponding model parameters and relevant test results. In the final part, model summaries are provided and the final model used for estimation of the panel data regression is given.

4.1. Study Variables

There were five bank-specific and five macroeconomic variables as possible explanatory variables for the panel data regression model. Macroeconomic data was collected from the Bangladesh Bank (the country's central banking authority) and the Bangladesh Bureau of Statistics (BBS). Bank-specific data on the other hand was collected from individual bank financial statements and annual reports published during the study period. Log transformation was done for all the independent variables as well as the dependent variable for this study. Among the bank-specific variables, Log of Operational Income Per Executive Employee (logopincex) was an author-calculated proxy variable for operational efficiency. For the current wide panel, a formal unit root test for stationarity assumption for the variables selected was not required.

4.2. Descriptive Statistics on Study Variables

Table 3 provides summary statistics on study variables. Variable logroa had a mean of 0.035 and a standard deviation of 0.3. It ranged from −2 to 0.782. Skewness and kurtosis for this were −2.382 and 17.401 respectively. Variable logopx as a % of Total Expenditure ranged from 1.062 to 1.856 and had a mean value of 1.439. The standard deviation for this was 0.143. Skewness and kurtosis values were 0.23 and 3.08 respectively. The mean value for logcapad was 1.082. This had a standard deviation of 0.058 and ranged between 0.08 and 0.8. The standard deviation for logla and logopincex was 0.073 and 0.62 respectively.

Means values for the five macroeconomic variables – loginlf, logexr, logm2, loglendr, and loggdo were 6.973, 0.847, 1.882, 0.762, 1.062, and −1.186 (in that order). Standard deviation values for these variables were 0.093, 0.03, 0.017, 0.055, 0.058 respectively. Among the macroeconomic variables, only inflation had a positive Skewness value. The rest were negative. Inflation,

Table 3: Descriptive Statistics on Study Variables

	N	Mean	Std. Dev.	Range	Min	Max	Variance	Skewness	Kurtosis
logroa	288	0.035	0.3	2.782	−2	0.782	0.09	−2.382	17.401
logopx	288	1.439	0.143	0.794	1.062	1.856	0.02	0.23	3.08
logcapad	288	1.082	0.058	0.454	0.8	1.254	0.003	−0.193	4.683
logla	288	−0.157	0.073	1.195	−0.31	0.885	0.005	9.803	142.225
logopincex	288	6.973	0.62	2.75	5.137	7.887	0.385	−0.425	2.766
loginfl	288	0.847	0.093	0.291	0.736	1.026	0.009	0.64	2.209
logexr	288	1.882	0.03	0.088	1.836	1.924	0.001	−0.431	1.709
logm2	288	0.762	0.017	0.052	0.732	0.784	0	−0.352	1.878
loglendr	288	1.062	0.055	0.158	0.98	1.138	0.003	−0.192	1.719
loggdp	288	−1.186	0.058	0.208	−1.297	−1.089	0.003	−0.047	2.432

exchange rate, broad money supply, lending rate, and GDP growth rate had kurtosis of 2.766, 2.209, 1.709, 1.878, and 1.719 respectively.

4.3. Model Estimation

In the fixed effects model, the intercepts are assumed to vary across groups whereas in a random effects model the error variation component differs for different groups as well as across time (Park, 2011). The summaries of the estimates and model parameters were presented and the final selection of the model best fit for the current research context was described.

4.3.1. Pooled OLS

In cases where the individual or group-specific effects are zero, a pooled OLS can be estimated. Pooled OLS model makes a number of important assumptions. Among these, linearity assumption demands that the dependent variable be related with the explanatory variables in a linear way; exogeneity assumes the mean value of zero for the disturbances term and disturbances are homoscedastic or they have equal variance.

For the current research context, the authors initially estimated the following pooled OLS panel regression equation:

$$\begin{aligned} \text{lognpl} = {} & \alpha + \beta_1 \text{logroa}_{it} + \beta_2 \text{logopx}_{it} + \beta_3 \text{logcapad}_{it} \\ & + \beta_4 \text{logcredep}_{it} + \beta_5 \text{logla}_{it} + \beta_6 \text{logopincex}_{it} \\ & + \beta_7 \text{loginfl}_{it} + \beta_8 \text{logexr}_{it} + \beta_9 \text{logm2}_{it} \\ & + \beta_{10} \text{loglendr}_{it} + \beta_{11} \text{loggdp}_{it} + \varepsilon_{it} \end{aligned} \quad (1)$$

The *F*-statistic for the model was 14.727 and the corresponding *p*-value (0.000) was small enough to reject the null hypothesis that all regressor coefficient was zero at the 1% level of significance. Hence, the model was significant. Adjusted *R*-squared for the estimated model was 0.370 meaning that 37% of the variation in the dependent variable was explained by the set of independent variables included in the model. The dependent variable was negatively related with return on assets, credit deposit ratio, loans to assets ratio, operating income per executive employee, broad money supply and positively related with operating expenditure as a % of total expenditure, capital adequacy ratio, inflation, exchange rate and GDP growth rate. The impact of return on assets, operating expenditure as a % of total expenditure and credit deposit ratio was significant at the 1% level and the impact of the exchange rate was significant at the 10% level.

To investigate the possible presence of multicollinearity in the panel data, the authors calculated Variance Inflation Factor for the regressors. Initially, the mean VIF of 8.459 was significantly higher than the conventional threshold of 4. It was seen that most of the macroeconomic variables have significant inflation variance factors. For further details, we looked into the correlation matrix for the independent variables.

A few variables have significantly high correlation values with other independent variables included in the list of regressors. For example, the correlation between broad money supply (logm2) and inflation (loginfl) was −0.717, and the correlation between broad money supply (logm2) and exchange rate (logexr) was 0.915. Broad money supply (logm2) and exchange rate (logexr) were also significantly correlated with GDP growth (loggdp) (0.771 and 0.824 respectively). Among the bank-specific independent variables, the credit deposit ratio (logcredep) showed high correlation values with operating expenditure as a % of total expenditure (logopx) and loans to assets ratio (logla).

These two independent variables had a correlation of −0.291 and 0.411, respectively. Considering these values in connection with the relevant economic justifications, these variables were dropped Credit deposit ratio (logcredep) was removed from the bank-specific list, and broad money supply (logm2) and exchange rate (logexr) were removed from the macroeconomic list. After this pooled OLS panel regression equation was as follows:

$$\begin{aligned}\text{lognpl} = {} & \alpha + \beta_1 \text{logroa}_{it} + \beta_2 \text{logopx}_{it} + \beta_3 \text{logcapad}_{it} \\ & + \beta_4 \text{logla}_{it} + \beta_5 \text{logopincex}_{it} + \beta_6 \text{loginfl}_{it} \\ & + \beta_7 \text{loglendr}_{it} + \beta_8 \text{loggdp}_{it} + \varepsilon_{it}\end{aligned} \quad (2)$$

The *F*-statistic for the new estimated model was 17.937 and significant at the 1% level. It was noted that even though the Adjusted-*R* square reduced to 0.340 from the previous 0.370, the number of independent variables with a statistically significant impact on the dependent variable in this pooled OLS is higher. Return on assets (logroa), operating expenditure as a % of total expenditure (logopx), lending rate (loglendr), and GDP growth rate (loggdp) had a significant impact on the dependent variable at the 1% level while loans to assets ratio (logla) and inflation rate (loginfl) had a significant impact on the dependent variable at the 5% level.

Variance Inflation Factors (VIFs) for the new pooled OLS model looked unproblematic as seen in Table 4 with a mean VIF of 1.946. This was well below the ideal threshold of 4.00. For the successive fixed effects model and random effects model estimations for our panel data, the new list of regressors was maintained.

4.3.2. Fixed Effects Model

In the fixed effects model, individual-specific effects are considered part of the intercept, and correlation with other regressors is permitted (Park, 2011). For the current research context, the estimated the fixed effects model using the following regression equation:

$$\begin{aligned}\text{lognpl} = {} & (\alpha + u_i) + \beta_1 \text{logroa}_{it} + \beta_2 \text{logopx}_{it} \\ & + \beta_3 \text{logcapad}_{it} + \beta_4 \text{logla}_{it} \\ & + \beta_5 \text{logopincex}_{it} + \beta_6 \text{loginfl}_{it} \\ & + \beta_7 \text{loglendr}_{it} + \beta_8 \text{loggdp}_{it} + v_{it}\end{aligned} \quad (3)$$

F-test statistic for the null hypothesis that all regression coefficients are zero was 26.53 with a *p*-value small enough to reject the null hypothesis at the 1% level of significance indicating that the regression model was significant. The *F*-statistic for the null hypothesis that all group-specific dummy variable parameters are zero was 7.09 and the *p*-value (0.000) for this was small enough to reject the null hypothesis at a 1% level of significance indicating strong evidence of the presence of fixed effects in the regression.

Among the independent variables with statistically significant coefficients, return on assets (logroa) and inflation (loginfl) had a negative impact on the dependent variable whereas lending rate (loglendr) and GDP growth rate (loggdp) had a positive impact. Return on assets (logroa) and GDP growth rate (loggdp) were significant at the 1% level and inflation (loginfl) and lending rate loglendr) were significant at the 5% level. To examine heteroscedasticity, the authors conducted a Modified Wald test. The Chi-square value for the Modified Wald test for group-wise heteroskedasticity was 836.19 and the *p*-value (0.0000) was small enough to reject H_0. This indicated that the fixed effects model had a heteroskedasticity problem. To address this, the fixed effects model with heteroskedasticity-robust standard errors was estimated.

For the newly estimated fixed effects model with heteroskedasticity-robust standard errors, *F*-test for the null hypothesis that all coefficients are zero went up slightly to 38.56 compared to the earlier fixed effects model and the corresponding *p*-value (0.0000) was small enough to reject the null hypothesis at the 1% significance level. Return on assets (logroa) was significant at the 1% level, GDP growth rate (loggdp) was significant at the 5% level and lending rate (loglendr) was significant at the 10% level.

4.3.3. Random Effects Model

In the random effects model, the intercept and the slope are assumed to be equal and the variation lies in the group-specific error term (Park, 2011). Hence, group-specific variation is part of the "composite error term" in a random effect model. For the current research context,

Table 4: Variance Inflation Factors (VIFs) for the Regressors (After Dropping Correlated Regressors)

	VIF	1/VIF
loglendr	3.967	0.252
loginfl	2.861	0.35
loggdp	2.458	0.407
logroa	1.448	0.69
logopx	1.276	0.784
logcapad	1.269	0.788
logla	1.203	0.831
logopincex	1.084	0.922
Mean VIF	**1.946**	

the study estimated the fixed effects model using the following regression equation:

$$\begin{aligned} \text{lognpl} = \alpha + \beta_1 \text{logroa}_{it} + \beta_2 \text{logopx}_{it} + \beta_3 \text{logcapad}_{it} \\ + \beta_4 \text{logla}_{it} + \beta_5 \text{logopincex}_{it} + \beta_6 \text{loginfl}_{it} + \\ \beta_7 \text{loglendr}_{it} + \beta_8 \text{loggdp}_{it} + (v_{it} + u_i) \end{aligned} \quad (4)$$

The null hypothesis that all the estimated coefficients are zero was rejected at the 1% level of significance. R^2 was 0.4506 and overall R^2 was 0.3225. The Breusch-Pagan Lagrange Multiplier test for random effects yielded a Chi-square statistic of 140.47, and the corresponding *p*-value (0.000) was small enough to reject the null hypothesis at a 1% level of significance, showing strong evidence of random effects. Five independent variables were found with a significant impact on the dependent variable. The impact of return on assets (logroa) and inflation (loginlf) was negative and these were significant at the 1% and 5% levels respectively. Operating expenditure as a % of total expenditure (logopx), lending rate (loglendr), and GDP growth rate (loggdp) positively impacted the dependent variable with significance at the 5%, 1%, and 1% levels respectively.

4.3.4. Summaries of Model Estimates and Model Selection Criteria

For estimation purposes, the study looked into pooled OLS, fixed effects, and random effects models on the panel data. Table 5 provides model summaries. Estimated coefficients and standard errors are provided for all three models. The study also presented model parameters such as *R*-squared, adjusted *R*-squared, and *F*-statistic. All three models were found to be significant. Adjusted *R*-squared values for pooled OLS and fixed effects model were 0.321 and 0.438 respectively. In the pooled OLS model, six independent variables were found to have a significant impact on the dependent variable. For fixed effects (robust) and random effects models, the number of significant regressors was 3 and 5 respectively.

Since null hypotheses for *F*-test for both the fixed effects model and Breusch-Pagan Lagrange Multiplier (LM) test were rejected, the authors conducted a Hausman test to determine model selection. The null hypothesis for Hausman test posits no correlation between the individual effects and the regressors used in the model. The Chi-square test value was 19.279 with a *p*-value of 0.013. At the 5% level, the null hypothesis was rejected. Thus, the appropriate model to select for the panel data estimation was fixed effects model with robust standard errors.

In the robust fixed effects model, the study found the return on assets (logroa) negatively impacts NPL and this impact is significant at the 1% level. This indicates that as profitability goes up, downward pressure is put onto NPL. This is the only bank-specific variable found to be significant in the final model. Among macroeconomic variables, the study found that inflation (loginfl) has a negative impact on NPL at the 10% level and GDP growth rate (loggdp) has

Table 5: Summary of Estimated Panel Data Models

	Pooled OLS	Fixed Effects Model	Random Effects Model
logroa	−0.2*** (0.04)	−0.312*** (0.04)	−0.285*** (0.038)
logopx	0.323*** (0.08)	0.15 (0.201)	0.244** (0.101)
logcapad	0.12 (0.195)	0.276 (0.207)	0.251 (0.175)
logla	−0.318** (0.15)	−0.103 (0.082)	−0.157 (0.136)
logopincex	0.015 (0.017)	0.022 (0.02)	0.022 (0.017)
loginfl	−0.443** (0.182)	−0.358* (0.187)	−0.36** (0.155)
loglendr	0.961*** (0.367)	0.773 (0.52)	0.828*** (0.309)
loggdp	1.038*** (0.274)	0.704** (0.289)	0.768*** (0.235)
_cons	0.461 (0.436)	0.266 (0.641)	0.168 (0.416)
Observations	288	288	288
R-squared	0.34	0.453	–
Adj R^2	0.321	0.438	–
F-stat	17.937	38.563	–
RMSE	0.171	0.133	0.142
Standard errors are in parentheses			

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

a positive impact on NPL at the 5% level. The robust fixed effects model equation with estimated coefficients for the panel data is as given below:

$$\begin{aligned} \text{lognpl} = (0.266 + u_i) &- 0.312 \times \text{logroa}_{it} + 0.150 \\ &\times \text{logopx}_{it} + 0.276 \times \text{logcapad}_{it} - 0.103 \\ &\times \text{logla}_{it} + 0.022 \times \text{logopincex}_{it} - 0.358 \\ &\times \text{loginfl}_{it} + 0.773 \times \text{loglendr}_{it} + 0.704 \\ &\times \text{loggdp}_{it} + v_{it} \end{aligned} \quad (5)$$

5. Summary of Findings and Discussion

The panel data for this paper consisted of 12 years of annual data on selected macroeconomic and firm-specific variables for 24 Private Commercial Banks in Bangladesh. After logarithmic transformation, the independent variable (NPL) did not show any particular non-stationarity problem. After estimating three-panel data regression models, the study found that the fixed effects model with the robust standard error was appropriate. Return on assets and inflation were found to have a negative impact on NPL. GDP growth on the other hand was found to have a positive impact. The findings are similar to the findings by Bhattarai (2018), Towhid et al. (2019), and Mondal (2016). Similar findings were found by Rifat (2016), Roy et al. (2014), and Sheefeni (2015) for banks in Bangladesh.

Rachman et al. (2018) also deployed a fixed-effects model and found ROA to have a similar negative impact on NPL. Banks with higher ROA are likely to afford and institute better credit management policies which help to reduce loan classification (Rachman et al., 2018). According to our findings, profitability is negatively related to NPL. This can be explained in two ways: Regardless of macroeconomic conditions, more profitable (and thus arguably more efficient) banks were better at managing loan portfolios and controlling credit risk, whereas firms with higher classified assets in their balance sheets found it difficult to turn around and make their processes more efficient and profitable within the study timeframe. Inflationary pressure would put further interest burden on the borrower thereby making already troubled assets more likely to be classified.

The model shows that GDP growth (aggregate macro-economic growth) has a positive impact on NPL. This finding is similar to findings from previous studies. The banking sector is an important driver of private sector growth; hence, higher levels of economic growth are likely to result in more loan classifications. During periods of economic expansion and private sector credit expansion, a portion of loans disbursed may inevitably be given to borrowers who are overestimated. Future research should examine whether this is due to an unavoidable baseline increase in bank classified assets during times of aggregate economic expansion, or whether it is due to a gap in managerial efficiency and credit risk management at an industry level.

Before concluding the paper, it can be noted that even after including major relevant macroeconomic and firm-specific variables to explain NPL, Adjusted-*R* squared for the model was 43.8%. This indicates more than half of the variation in NPL is left unexplained by these variables. Understanding the factors that influence NPL has significant policy consequences. Future research should aim to improve the explanatory power of these models by incorporating qualitative variables that can influence NPL. For example, qualitative variables like managerial overconfidence and corporate governance have already been found to have a significant impact on investment decisions made by banks in Indonesia (Zaludin et al., 2021).

6. Conclusion

This paper looked into the factors that have an impact on NPL in the banking sector of Bangladesh. By adopting a mixed-method research approach, the study incorporated both qualitative insights from industry participants and quantitative data on the variables selected. After modeling a panel data of 24 banks across 12 years from 2008 to 2019 with selected bank-specific and macroeconomic variables, the study found that the robust fixed effects regression model can be used to model the relationship between these factors and the dependent variable. The findings suggest that return on assets (ROA) as a measure of profitability has a significant negative impact on NPL. Among macroeconomic variables, inflation had a significant negative impact on NPL, and GDP growth rate had a significant positive impact on NPL. These findings are consistent with those of similar studies on NPL in Bangladesh, and they add to the growing body of literature on the subject.

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