Factors affecting bank credit risk: An empirical insight

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Abstract

Credit risk impedes the growth of bank's performance and position which is largely influenced by a number of factors that should be taken consideration and minimized. The objective of the study is to illustrate the inclusion of valid causes of selecting best model with regard to statistical significance. The study conducted on panel data consisting of 322 observations with 22 commercial banks and 15 consecutive years. The study finds that profitability, capital and bank size are inversely associated with bank credit risk whereas net interest margin and inefficiency have positive effect. Moreover consecutive addition of each variable is in charge of constructing the accurate model considering the variation and goodness of fit value in the respective model. However, no evidence is found in support of macroeconomic variables used in the model. Last not the least, the sensitivity of the model test argued in favor of baseline model which established the cause and effect relationship in a logical manner.

1 Introduction

The banking business is tremendously affected by the observed and unobserved factors in a stiff competitive environment. In every respect of its operation, banks

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should take effective measures to reduce risk by identifying the probable causes based on practical scenarios. The profitability of banks and capital regulation has an important impact on credit risk. Most of the research focus on capital regulation and bank risk is the way of diminishing financial viability and striking the bottom line figures of bank. Altunbas et al. (2007) argued that capital levels are inextricably related to bank performance. Operating income is considered as an important source of capital (Zhang et al., 2008). The internal fund is one of the sources to increase capital, and the level of earnings may influence banks" capital level (Berger, 1995). Scholtens (2000) found a strong positive relationship between profitability and tier one capital which is also supported by an early study of Berger (1995).

The present scenario of the banking system of Bangladesh has its long history of socio-economical as well as political transformation. The ownership reform allows privatization in a tiny part of the financial sector in 1982. During the period, two out of six National Commercial Banks (NCBs) were denationalized due to diminishing profitability, growing non-performing assets, capital shortfall, low recovery rate, excessive government interference and lack of supervision (Hasan, 1994). The severe findings extracted from Raquib (1999) revealed that accounting and audit qualities are insufficient and internal control system are malfunctioning. These evidences were sufficient to prove the current scenario of banking system in Bangladesh.

The contemporary banking scandal deals with large financial frauds and high rate of default loan which influence the socio-economic performance of the country as a whole. The remarkable banking scandal was committed by several commercial banks during the period 2010-2012 and was debated as a burning issue in the economy. The top most scam related to "Hallmark group" and "Bismillah group". The lessons from these scam was not enough for the decision maker to protect banking industry from the culprits. Due to limited transparency and defective governance policy, banking industry working under threats.

The objective of the study is to examine the determinants of bank credit risk considering bank level and macroeconomic variables in the developing country context. The study found that bank level variables profitability, capital and total assets has a significant negative effect on bank credit risk same as macroeconomic variables GDP growth rate and inflation whereas net interest and inefficiency has positive effect. Several researcher (Salas and Saurina, 2002; Espinoza and Prasad, 2010; Louzis et al., 2011; Nkusu, 2011) found that some specific bank level variables are responsible for the increase of bank credit risk or the deterioration of credit quality.

The motivation of the research is the rational choice of undermine economy in the South Asian region which suffers from the improper guidance of academic research. There are very few research scopes in this area due to the social, cultural, political and economical vulnerability of the country. Moreover, many researchers avoid this country as a sample due to limited availability of information in the worldwide database system. This study critically examines the published annual

reports of the commercial banks and shows the effect of bank level and macroeconomic variables in the risk-taking behavior. Furthermore, it also investigates the probable relation between the bank credit risk and different explanatory variables to select the best model based on certain criteria. This work will add value in the further research for taking evidences and formulating new models in this arena.

2   Literature Review

The recent financial scams and growing trends of fraudulent activities devaluate the banking image and surveillance under criticism. The urgency of scrutinizing banking behavior is emergence for the instable financial performance and gradual reduction of public confidence over time. Empirical research based on single country and multiple country evidences proclaimed heterogeneous issues with respect to bank credit risk. Kwan and Eisenbies (1997) in their study showed the interrelationship among bank risk, capitalization and operating efficiency.   They used secondary data of United States from second quarter of 1986 to the fourth quarter of 1995 of 352 bank holding companies. The simultaneous equation system is operated using two-stage least-squares method for four linear equations such as BADLOAN, GAP, CAPITAL and INEFFICIENCY. The study found that inefficiency has positive effect on bank risk taking and also on the level of capital. The study supports the Moral Hazard Hypothesis (MHH) which confirms that risk taking behavior is vulnerable for poor performer rather than high performer banks. They also found that bank with higher capital level can perform better than with lower capital level. The most focus point of the findings is the detection of U-shaped relationship between inefficiency and loan growth.
The study conducted by Lin et al. (2005) on Taiwan's banking industry from the year 1993 to 2000 of 40 banks including 24 state-owned banks and 16 new private banks showed the relationship between capital adequacy and financial performance of banks. They also show the effect of the capital adequacy regulation before and after implementation. They used ordinary least square (OLS) method to analyze and interpreted results. The study used capital adequacy and insolvency rate as an independent variable with four dependent variables that measures the performance of banks like return on assets (ROA), return on equity (ROE), net profit margin (NIS) and earnings before income tax (PIS). Along with main variables, they used two control variable size and time to explore the reciprocation of the effect and results. The study found that capital adequacy ratio (CA) is positively associated with insolvency-risk (IR) index and also with financial performances. On the contrary, insolvency-risk (IR) index is negatively associated with financial performance and are statistically significant.

Another study conducted on MENA countries taken sample of 173 banks over the 1988 to 2005 period by Naceur and Omran (2011) with the objective of showing

the effects of bank regulation, competition, and financial reforms on banks' performance. They used the dependent variable like bank performance indicator (net interest margin, return on assets, and cost efficiency) and independent variables, such as bank concentration (assets of three largest banks as a share of assets of all commercial banks), bank-specific characteristics (Size, Equity and credit risk), regulatory policies (non interest earning assets to total assets), macroeconomic indicator (inflation, GDP growth rate), financial development indicators (stock market capitalization divided by GDP, private credit by deposit money banks divided by GDP) and institutional development indicators (GDP per capita, law and order index, and corruption index). The study found that bank capitalization and credit risk has a positive effect on net interest margin, cost efficiency and profitability. They also found that regulatory and institutional variable have an impact on bank performance but macroeconomic and financial indicator don't have influence on net interest margin. Bank concentration is negatively associated with bank performance and statistically significant. For institutional variable, corruption increases the cost of-efficiency and net interest margin but law and order index decreases cost-efficiency without affecting bank performance.

One more study by Guidora et al. (2013) focused on bank's capital buffer, risk and performance in the Canadian banking system and showed the impact of business cycles and regulatory changes. The study used quarterly financial statement and stock market data from 1982 to 2010. The study used two-step generalized method of moments (2SGMM) estimation technique in estimating simultaneous equations. The study used three dependent variables capital buffer(variation of the capital buffer), risk (variation of bank risk) and performance (variation of performance), along explanatory variables size, business cycle indicator, GDP growth rate, concentration ratio, charter value, volatility of market index, total loan over total asset ratio, and dummy variables to control for the stages of Basel regulations. The study found that well-capitalized banks have larger capital buffer and can protect the financial crises even in economic recession. They also found that there is no strong evidence in changing banks risk impact to ROA.

The study by Zhang et al. (2013) investigates the relationship between market concentration, risk taking and bank performance for the period 2003 to 2010 of BRIC countries. The study found that market concentration is negatively associated with performance which supports "quiet life" hypothesis. They also found that banks that have lower level of risk perform better.

Mamatzakis and Bermpei (2014) in their study examine factors that affect the performance of banks in G7 and Switzerland.   They found that risk, liquidity and investment banking fees significantly impact upon performance. The study also found that Z-Score is positively associated with bank performance but liquidity exerts a negative effect. Finally they conclude that capital adequacy and liquidity can enhance bank performance.

There are lots of empirical evidences that both the bank level and macroeconomic variable are crucially responsible for increasing bank risk. **Table 1** below presents

the empirical findings of different authors based on single country and multiple country exposure.

Table 1: Related Studies on bank risk

Authors	Empirical evidences	
Kanishi and Yasuda (2004)	Country	Japan
	Periods	1990 to 1999
	Methods	OLS
	Findings	✓ They found that capital adequacy, stable shareholder's ownership, and franchise value affect the bank risk taking.
		✓ There is nonlinear relationship between stable shareholder's ownership and bank risk taking.
		✓ They also revealed that capital adequacy requirement reduce commercial bank risk taking but decline franchise value react oppositely.
Amidu and Hinson (2006)	Country	Ghana
	Periods	1998-2003
	Methods	OLS
	Findings	✓ They examined how credit risk affects a bank's capital structure, profitability, and lending decisions.
		✓ They used cash and cash equivalent to total assets, total liabilities and advances to total assets, the ratio of pretax profit to total assets, and bank's size as determinants of bank risk.
		✓ Their results reveal that equity to total assets ratio is positively associated with credit risk, profitability and risk whereas negatively associated with bank's size, liquid assets and lending.
Hussain and Hassan (2005)	Country	11 developing nations
	Periods	2000-2004
	Methods	GMM, 3SLS
	Findings	✓ Their findings reveal that current LLPs to potential bad loans, GOVS, year dummy, domestic credit have a significant impact on changes in risk.
		✓ The study found that implementation of Basel capital requirements is not allure banks to increase capital ratio in the developing countries but lessen the portfolio risk of banks.
		✓ They also found that level of financial development opens up the alternative sources and reduce risk.
Altunbas et al. (2007)	Country	15 European countries
	Periods	1992-2000

	Methods	SUR
	Findings	✓ Empirical results show that net loans to total assets, liquid assets to the customer and short-term deposits, interest rate spreads over 3-year government bonds, current assets to current liabilities, banking system liquid assets to total assets, banking system loan loss provisions to total loans have a significant impact on bank risk.
Iannotta et al. (2007)	Country Periods Methods Findings	15 European countries 1999 to 2004 OLS ✓ They evaluated the impact alternative ownership models, together with the degree of ownership concentration, on their profitability, cost efficiency, and risk. ✓ They included ownership structure (OWNS), the ownership percentage held by the largest shareholder, national GGDP, SIZE, the ratio of liquid assets to total earning assets, the ratio of retail deposits to total funding in the equation of risk. ✓ Their results showed that OWNS, CONC, liquidity have a significant impact on bank risk.
Lee and Hsieh (2013)	Country Periods Methods Findings	42 Asian countries 1994-2008 GMM ✓ They examine the impacts of bank capital on risk and profitability. ✓ Their results reveal that LR, LLRs to gross loans, net loans to TA, liquid assets to customers and short-term deposits, INFR, GGDP, domestic credit to private sector, real IR have a significant influence on bank risk.
Chaibi and Ftiti (2015)	Country Periods Methods Findings	France and Germany 2005-2011 GMM ✓ They investigate the factors of NPLs of commercial banks from. ✓ They found that all macroeconomic variables except INFR have a significant influence on risk. LLPs, inefficiency, SIZE and ROE are found as significant factors of bank risk.

3   Methodology

The study is based on the systematic process to ensure the trustworthiness[3] of the research. To justify the research findings, secondary data are used in empirical quantitative fashion in the study. The main source of data are the annual reports published by the banks because in most of the developing and developed countries widely used annual report as a major source of reliable information among other sources (Akhtaruddin, 2005; Alattar & Al-Khater, 2007; Catasús, 2008; Chau & Gray, 2010). Empirical studies (Naser & Nuseibeh, 2003; Al-Razeen & Karbhari, 2004) show that the annual report is the formal means of information in the developing countries. But it is not the only means because shareholders can retrieve information from the direct sources or other media publications.   In this regard, the study relies on the annual reports as a major source of its data collection. This study also chooses single country experiment in its research. The reason is that the socio-political or economic environment of Bangladesh is not in the same track of the Asian region. Moreover, there is a lack of adequate research in the field of risk disclosures in the financial sector of Bangladesh.

3.1 Data
The data set are constructed based on panel data consists of 15 years (2001-2015) time series data and 22 commercial banks longitudinal data. The total number of observation is 322. In 2006, there are 48 banks operated in Bangladesh consists of 4 categories of scheduled banks: i.e. National Commercial Banks (SCBs), Development finance institutions (DFIs), Private commercial banks (PCBs) and Foreign Commercial Banks (FCBs). The structure of the banking sector with a breakdown by type of banks is shown in below:

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[3] Guba (1981) explained the trustworthiness of research which is the combination of credibility (internal validity), transferability (External validity), dependability (reliability) and conformability (objectivity).

Table 2: Total number of banks, branches, % of Industry assets and % of Deposits

	Number of Banks	Number of Branches	% of Industry Assets	% of Deposits	Number of Banks	Number of Branches	% of Industry Assets	% of Deposits
NCBs	4	3393	37.4	40	6	3669	28.4	28.4
DFIs	5	1340	9.7	5.8	2	1405	2.9	3.1
PCBs	30	1638	45.6	47	39	3982	63.3	64.1
FCBs	9	41	7.3	7.2	9	75	5.4	4.4
Total	48	6412	100	100	56	9131	100	100

Source: Bangladesh Bank (https://www.bb.org.bd)

The study focuses on both SCBs and PCBs because both maximum capture percentages of industry assets which are 83% in 2006 and 92.5% in 2015. Moreover, deposits also show the highest and significant amount contrast with others. That is why; we have selected 4 SCBs and 28 PCBs (excluded 2 for outliers and unavailability of reports) as an experimental group.

3.2 Measurement of variables
The study identified several independent variables, based on prior research, to perform a statistical analysis to draw a conclusion whether the effect of the independent variable changes the dependent variable to some extent. The variables are shown in the table below:

Table 3: Definition of Variables

Dependent Variables:		
Credit Risk	NPLR	Bank non-performing loan to total loans
Independent Variables:		
Profitability	ROA	Percentage of net profit after tax to total assets
	ROE	Percentage of net profit after tax to total equity
Capital Ratio	CAP	Tier 1 plus tier 2 capital divided by risk weighted assets
Bank Size	SIZE	The natural logarithm of book value of total assets
Net interset margin	NIITA	The ratio between net interest income and total assets
Inefficiency	INEFFIC	Cost to Income Ratio
GDP growth rate	GDPG	Annual real GDP growth rate
Inflation rate	INFLA	Annual inflation rate

3.3 Model specification
In developing the model, quantitative techniques are followed to examine and interpret the scenario. In quantitative analysis, descriptive statistics and regression analysis are conducted to show the statistical significance and dependencies. The statistical methods will be used to test the association between profitability and bank risk with and without control variables. The reason is the appropriate choice of model based on the response of coefficient and goodness of fit. For the simplicity of the analysis, we will run OLS model for the entire equation. To conduct OLS model, several assumptions of Least Squares should be satisfied:

i. The error term u_i has conditional mean zero given $X_{1i}, X_{2i}, \ldots, X_{ki}$; that is $E((u_i \mid X_{1i}, X_{2i}, \ldots \ldots \ldots \ldots X_{ki}) = 0$;

ii. $(X_{1i}, X_{2i}, \ldots \ldots \ldots X_{ki}, Y_i)$, i=1,\ldots \ldots,n, are independent and identically distributed (i.i.d.);

iii. $X_{1i}, X_{2i}, \ldots \ldots, X_{ki}$ and Y_i have nonzero finite fourth moments, i.e. $0 < E(X_{ki}^4) < \infty$ and $0 < E(Y_i^4) < \infty$.

iv. There is no perfect multicollinearity.

To examine the cause and effect relationship on banks' risk-taking behavior in of Bangladesh, we have generated the following regression model:

$$NPLTL_{it} = \beta_0 + \beta_1 ROA_{it} + \varepsilon_{it} \quad \text{----------------- (1)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROA_{it} + \beta_{02} CAP_{it} + \varepsilon_{it} \quad \text{----------------- (2)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROA_{it} + \beta_{02} CAP_{it} + \beta_3 SIZE_{it} + \varepsilon_{it} \quad \text{----------------- (3)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROA_{it} + \beta_{02} CAP_{it} + \beta_3 SIZE_{it} + \beta_4 NIITA_{it} + \varepsilon_{it} \quad \text{----------------- (4)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROA_{it} + \beta_{02} CAP_{it} + \beta_3 SIZE_{it} + \beta_4 NIITA_{it} + \beta_5 INEFFIC_{it} + \varepsilon_{it} \quad \text{----------------- (5)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROA_{it} + \beta_{02} CAP_{it} + \beta_3 SIZE_{it} + \beta_4 NIITA_{it} + \beta_5 INEFFIC_{it} + \beta_6 GDPG_{it} + \varepsilon_{it} \quad \text{----- (6)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROA_{it} + \beta_{02} CAP_{it} + \beta_3 SIZE_{it} + \beta_4 NIITA_{it} + \beta_5 INEFFIC_{it} + \beta_6 GDPG_{it} + \beta_7 INFLA_{it} + \varepsilon_{it} \quad \text{- (7)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROE_{it} + \varepsilon_{it} \quad \text{----------------- (8)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROE_{it} + \beta_{02} CAP_{it} + \varepsilon_{it} \quad \text{----------------- (9)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROE_{it} + \beta_{02} CAP_{it} + \beta_3 SIZE_{it} + \varepsilon_{it} \quad \text{----------------- (10)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROE_{it} + \beta_{02} CAP_{it} + \beta_3 SIZE_{it} + \beta_4 NIITA_{it} + \varepsilon_{it} \quad \text{----------------- (11)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROE_{it} + \beta_{02} CAP_{it} + \beta_3 SIZE_{it} + \beta_4 NIITA_{it} + \beta_5 INEFFIC_{it} + \varepsilon_{it} \quad \text{----------------- (12)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROE_{it} + \beta_{02} CAP_{it} + \beta_3 SIZE_{it} + \beta_4 NIITA_{it} + \beta_5 INEFFIC_{it} + \beta_6 GDPG_{it} + \varepsilon_{it} \quad \text{---- (13)}$$

$$NPLTL_{it} = \beta_0 + \beta_1 ROE_{it} + \beta_{02} CAP_{it} + \beta_3 SIZE_{it} + \beta_4 NIITA_{it} + \beta_5 INEFFIC_{it} + \beta_6 GDPG_{it} + \beta_7 INFLA_{it} + \varepsilon_{it} \quad \text{-- (14)}$$

$$\varepsilon_{it} = v_{it} + u_{it}$$

Where the cross-sectional dimension across banks is represented by i subscript, and time dimension is represented by t. ε_it is the random error term, with v_it capturing the unobserved bank specific effect, and u_it is the idiosyncratic error and is independently identically distributed (i.i.d), eit N(0,σ2). Equation (1) investigates whether the capital and profitability levels reflect the changes in bank risk.

3.4 Jarque-Barre (JB) test for normality

Jarque-Barre (JB) test shows that the variables are independently identically distributed (i.i.d.) or normally distributed. The statistical formula used for the JB test is:
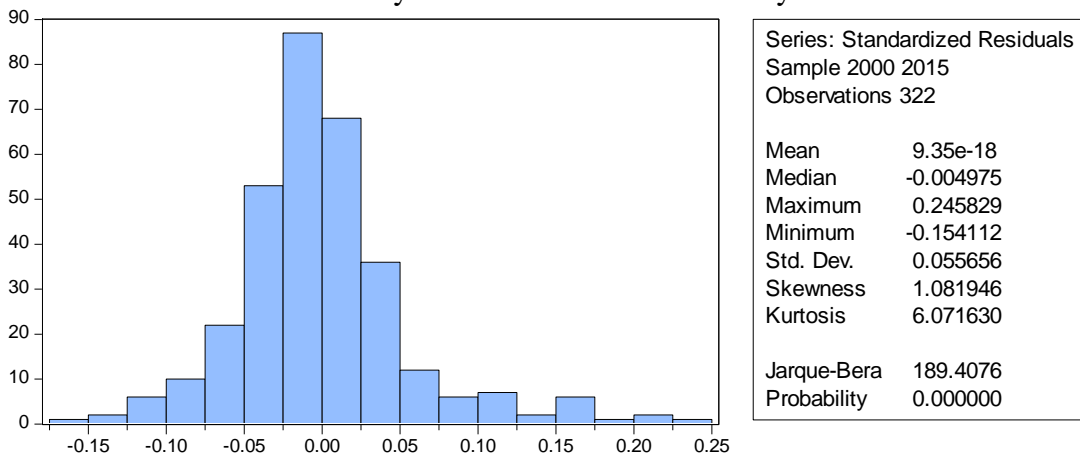
$$JB = n \left(\frac{skew^2}{6} + \frac{kurt^2}{24} \right) \sim x^2(2)$$

H_0: Data are not normally distributed.

H_1: Data are normally distributed.

The acceptance of null hypothesis confer that data are not normally distributed but the alternative hypothesis confirms the normality of the dataset. In the **Chart 1** shows that data are normally distributed at 1% level of significance. For this reason, we conclude that the variables consider in the model are i.i.d. that meets the assumption (ii).

Chart 1: Normality test for the dataset from the year 2000 to 2015

Series: Standardized Residuals	
Sample 2000 2015	
Observations 322	
Mean	9.35e-18
Median	-0.004975
Maximum	0.245829
Minimum	-0.154112
Std. Dev.	0.055656
Skewness	1.081946
Kurtosis	6.071630
Jarque-Bera	189.4076
Probability	0.000000

4   Analysis and findings

4.1 Univariate Analysis

The study is conducted in the developing country's scenario to detect the cause and effect relationship which can replicate in the similar context. The analysis of this study segregated into two parts; descriptive statistics and multivariate analysis. The descriptive statistics contains a minimum value, maximum value, mean and standard deviation of each variable with some observations. Mean is the average value obtained by dividing the sum of the data by the number of data in the set. Given a set of data, $\{x_1, x_2, x_3, ..., x_n\}$, you can find the mean, $\bar{x}$, using the following formula:

$$\bar{X} = \frac{1}{n} \sum_{i=1}^{n} X_i$$

Mean is the best measure by which the user can visualize the dataset and can take their decisions. However, standard deviation shows the spread of the dataset or the extent to which data differs from the mean. The mathematical value of standard deviation is always positive and indicates distance. The formula for the standard deviation, σ_X, of this set is as follows:

$$\sigma_X = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (X_i - \mu_X)^2}$$

In this study, **Table 4** shows that NPLTL has a minimum value of 0.0000 and maximum 0.3957 that means within the total loan and advances only (1-0.3957) or 60.43% is recoverable. So, it is a panic for the banking industry as well as depositors for the safe custody of deposits. The reason is that banks are the intermediary between depositors and lenders and making a profit by time maturation. The mean value is 6.33% with standard deviation 7.31% indicates that only a few banks have high NPLTL rate but their deviation from average value is no so high. In the profitability, variable ROA represents much better than ROE with average value 1.2970 and standard deviation 0.6521. Conversely, ROE has mean value 17.8625 with standard deviation 8.1643 which shows a tremendous volatility with the longest range of minimum and maximum values like, 1.5067 and 43.9210.   However, CAP has a small deviation which is 0.0250 with expected value 0.0818 because banks are bound to follow the regulatory capital requirement from the implementation of BASEL in 2007. Among bank-level variables SIZE, NIITA, and INEFFIC, banks suffer from lower operating performance at an average value of 0.4453 with deviation 0.3109. The approximate reason is the stiff competition in the market place where new banks arrive and capture the markets aggressively and secondly diverting focus on non-operating activities. In the macroeconomic variable, both GDPG and INFLA have an average value of 5.8674 and 6.0862 with deviation 0.8244 and 1.4523 respectively.

Table 4: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
NPLTL	322	0.0000	0.3957	0.0633	0.0731
ROA	322	0.0519	5.0996	1.2970	0.6521
ROE	322	1.5067	43.9210	17.8625	8.1643
CAP	322	0.0149	0.1478	0.0818	0.0250
SIZE	322	8.5707	12.5904	10.9784	0.9038
NIITA	322	0.0156	0.1011	0.0322	0.0094
INEFFIC	322	0.1785	5.6141	0.4453	0.3109
GDPG	322	3.8331	7.0586	5.8674	0.8244
INFLA	322	3.2612	8.1646	6.0862	1.4523

The bivariate correlation shows in the **Table 5**. Correlation shows the relationship between the pair of variables with their magnitudes. It shows the directional relationships based on randomly assigned variables and merely relies on logical proposition, but it helps in predicting the maneuvering status of variables. The correlation (ρ_{XY}) between the variables X and Y can be determined by dividing the covariance of XY (σ_{XY}) by the product of the standard deviation of X and Y (σ_X, σ_Y):

$$\rho_{XY} = \frac{\sigma_{XY}}{\sigma_X \sigma_Y}$$

The relationship between the variables can range from perfectly positive (+1) to perfectly negative (-1) values. The ρ_{XY} value closes to "+1" or "-1" meaning that the more closely the variables are related but ρ_{XY} value "0" indicates no relation with the variables.

$$-1 \leq \rho_{XY} \geq 1$$

In the **Table 5** shows the bivariate correlation among variables. The dependent variable NPLR is negatively associated with ROA, ROE, CAP, SIZE, NIITA, GDPG and INFLA but positive correlation with INEFFIC. The independent variables ROA and ROE are correlated with NPLTL at -0.456 and -0.322 and are significant (P<0.01). It also found that ROA and ROE have a strong positive correlation which is 0.710 and statistically significant (P<0.01). For this reason, ROA and ROE use simultaneously in the model will create multicollinearity problem (OLS assumption IV). That is why; we use ROA and ROE separately as an alternative measure of profitability in the same model.

Table 5: Pearson's Correlation

	NPLTL	ROA	ROE	CAP	SIZE	NIITA	INEFFIC	GDPG	INFLA
NPLTL	1	-.456**	-.322**	-.422**	-.179**	-.042	.140*	-.340**	-.407**
ROA		1	.710**	.436**	-.019	.365**	-.222**	-.008	.169**
ROE			1	-.185**	-.391**	.139*	-.142*	-.191**	-.229**
CAP				1	.532**	.201**	-.097	.301**	.555**
SIZE					1	.230**	.092	.450**	.622**
NIITA						1	-.037	.098	.280**
INEFFIC							1	.011	.013
GDPG								1	.459**
INFLA									1

** Significant at 1% level, * Significant at 5% level

4.2 Multivariate analysis

In the preliminary analysis and results, the model is supported by the OLS method. However, we run the multiple regressions by OLS method with robust standard error to remove the heteroskedasticity problem.

In regression analysis, coefficient shows the rate of change of the dependent variable due to change of independent variables.

The OLS estimators of the slope $\widehat{\bar{\beta}_1}$ and the intercept $\widehat{\bar{\beta}_0}$ are:

$$\widehat{\beta_1} = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sum_{i=1}^{n}(X_i - \bar{X})^2}$$

$$\widehat{\beta_0} = \bar{Y} - \widehat{\beta_1}\bar{X}$$

The OLS predicted values $\widehat{Y}_i$ and residuals $\widehat{u}_i$ are:

$$\widehat{Y}_i = \widehat{\beta_0} + \widehat{\beta_1}X_i$$

$$\widehat{u}_i = Y_i - \widehat{Y}_i$$

The estimated intercept $(\widehat{\beta_0})$, slope $(\widehat{\beta_1})$, and residual $(\widehat{u}_i)$ are computed from a sample of n observations of X_i and Y_i, i=1… n. These are estimates of unknown true population intercept (β_0), slope (β_1), and error term (u_i).

Standard Error:

The standard error of the regression (SER) is an estimator of the standard deviation of the regression error u_i.

$$SER = \sqrt{\frac{1}{n-k-1}\sum_{i=1}^{n}\widehat{u_i^2}} = \frac{SSR}{n-k-1}$$

The R^2:

In the regression equation, the model goodness-of-fit is based on explained sum of squares (ESS) and total sum of squares (TSS) as given below:

$$R^2 = \frac{ESS}{TSS}$$

$$ESS = \sum_{i=1}^{n}(\widehat{Y_i} - \bar{Y})^2$$

$$TSS = \sum_{i=1}^{n}(Y_i - \bar{Y})^2$$

The general norm of the R-squared is that its value never decreases rather increases when additional variables are included in the model. The sum of squared residuals (SSR) never increases when additional regressors are added to the model (Wooldridge, 2009, p 81).

General form of the t-Statistics:

The t-statistic is the example of a test statistic. It is also called standardized sample average or t-ratio. It performs a central role in testing statistical hypothesis. The general form of the t-statistic is given below:

$$t = \frac{estimator - hypothesized\ value}{standard\ error\ of\ the\ estimator}$$

$$t = \frac{(\widehat{\beta_1} - \beta_{1,0})}{SE(\widehat{\beta_1})}$$

The p-value:

The p-value is also called the significance probability. It is the probability of drawing a statistic at least as adverse to the null hypothesis assuming that the null hypothesis is correct.

$$P\ value = Pr_{H_o}(|t| > |t^{act}|)$$

The F Statistics:

The "overall" regression F statistics tests the joint hypothesis that all the slope coefficients are zero. The null and alternative hypotheses are:

$$H_0: \beta_1 = 0, \beta_2 = 0, \dots \dots \dots \dots, \beta_k = 0,$$

$$H_1: \ \beta_j \neq 0, at \ least \ one \ j, \ j = 1, \dots \dots, k$$

The null hypothesis states that none of the regressors explains any of the variation in Y_i, although the intercept can be nonzero.

Table 6 showed seven (7) models containing incremental inclusion of different variables. The purpose variable return on assets (ROA) has the significant negative relationship with non-performing loan rate (NPLR) in all the models from **Model I** to **Model VII**. The studies chronologically setup the models with two (2) stages of variable and their effect on dependent variable. These independent variables are:

i) Bank level Variable
ii) Macro level Variable

Model I shows that ROA is negatively influence NPLR and significant at 1% level with 20.79% explained variations. This explained variation is remarkable as only one variable affect NPLR more than 20%. On the other hand, Model II to Model VII considers moderating variable to strengthen the sensitivity of the model.

Table 6: Panel data regression of the credit risk (Non-Performing Loans Rate) on the extent of profitability (ROA) of the commercial banks in Bangladesh over the period 2000-2014

	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
ROA	-0.0511**	-0.0377**	-0.0397**	-0.0490**	-0.0480**	-0.0501**	-0.0495**
	(0.0081)	(0.0072)	(0.0082)	(0.0081)	(0.0082)	(0.0073)	(0.0070)**
CAP		-0.8072**	-0.6904**	-0.5997**	-0.5881**	-0.4831*	-0.2462
		(0.2021)	(0.2471)	(0.2458)	(0.2456)	(0.2203)	(0.1927)
SIZE			-0.0048*	-0.0098**	-0.0102**	-0.0005	0.0080
			(0.0047)	(0.0047)	(0.0047)	(0.0042)	(0.0046)
NIITA				1.4438**	1.4375**	1.4509**	1.7185**
				(0.4764)	(0.4702)	(0.4539)	(0.4640)
INEFFIC					0.0104	0.0085	0.0094
					(0.0158)	(0.0143)	(0.0133)
GDPG						-0.0275**	-0.0221**
						(0.0051)	(0.0048)
INFLA							-0.0149**
							(0.0030)
C	0.1296**	0.1781**	0.2244**	0.2364**	0.2350**	0.2839**	0.2203**
	(0.0125)	(0.0207)	(0.0506)	(0.0487)	(0.0487)	(0.0509)	(0.0474)
Observation	322	322	322	322	322	322	322
F	40.13	23.17	15.26	15.41	12.54	14.97	15.02
P>F	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-Squared	20.79	26.96	27.19	29.94	30.12	37.7	42.03

** Significant at 1% level, * Significant at 5% level

In accordance to our expectation, there is a significant negative relation between risk (proxied by NPLR) and profitability which supports the findings of Kwan and Eisenbies (1997), Lin et al. (2005), Zhang et al. (2013) but does not support the findings of Naceur and Omran (2011). The significant relation indicates that banks with low profitability take more risk. Risk is persistent for all the models. The coefficients for risk are -0.0511 for model I, -0.0377 for Model II, -0.0480 for Model III, -0.0490 for Model IV, -0.0480 for Model V, -0.0501 Model VI and -0.0495 for Model VII. The weakness of this model is the high F value (40.13) which is significant at 1% level, i.e. $F \notin I$[4].

In Model II, Capital ratio is included along with ROA to show the sensitivity of the bank credit risk. It is showed that capital has negative significant impact on

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[4] Accept the null hypothesis if $F \in I$; reject it if $F \notin I$.

credit risk measure (Model II to Model VII) which supports the results of Jacques and Nigro (1997), Zhang et al. (2008), Agoraki et al. (2011), Lee and Hsieh (2013), Lee and Chih (2013) but opposite to the results of Shrieves and Dahl (1992), Blum (1999), Rime (2001), Lin et al. (2005), Altunbas et al. (2007). The result suggests that a 1% increase in CAR would decrease risk by 0.8072% for model II, 0.6904 for Model III, 0.5997 for Model IV, 0.5881 for Model V, 0.4831 Model VI and 0.2462 for Model VII. These findings also advocate the MHH and option model. Model II has R squared value of 26.96% which showed more explained variation of data rather than Model I with lower F value which is 23.17 and also statistically significant (p<.01).

In **Model III**, Bank size is incorporated with ROA and CAP. Chaibi and Ftiti (2015); Tan and Floros (2013); Fiordelisi et al.(2011); Amiduand Hinson (2006); Kanishi and Yasuda (2004); Jacques and Nigro (1997)found that bank size is a significant determinant of risk. Bank size is negatively associated with credit risk and significant in Model III, Model IV and Model V which is supported by Haq and Heaney(2012)and Deelchand and Padgett(2009) but showed insignificant in Model VI and Model VII. Model VII validates "Too-Big-To-Fail (TBTF)" concept in accordance with De Nicolo(2000); the study found that banks with higher assets or in larger volume are positively associated with risk due to lower control. The model has R squared of 27.19% and F statistics value 15.26 with significant at 1% level.

In **Model IV**, one more variable (NIITA) included in the model and showed the impact that it is positively associated with the credit risk. The higher interest margin causes higher credit risk and makes a burden for the borrower in their trading. The borrower is struggling with the over burden of interest and market competition. If the borrower can take loan with lower interest rate than they can easily perform their operating activities and will be return back from defaulter. The study of Mujeri and Younus (2009) showed that the ratio of non-interest income to total assets of a bank and its spread has a negative effect on profitability. The remarkable point in this model is the F value which is 15.41 and also significant (p<.01) but higher than previous models. That is why; Model IV is not competent among other models due to higher F value.

Model V include INEFFIC variable and found a positive relationship with bank credit risk (NPLR). According to "Bad Management" hypothesis, inefficiency is positively associated with the credit risk of the bank. The possible cause is the increase of nonperforming loan which silently deteriorates the future earnings. Again Kwan and Eisenbeis (1997), Altunbas et al. (2007), and Agusman et al. (2008) found that inefficiency is positively related with risk-taking behavior of bank which is also supported by the "Moral Hazard Hypothesis (MHH)". The study also found the similar result of the positive coefficient of 0.0104 in Model V, 0.0085 in Model VI and 0.0094 in Model VII but statistically insignificant. The F value of this model is 12.54 and statistically significant at 1% level. The explained variation in this model is 30.12%.

In M**odel VI and VII**, we add in GDPG and INFLA consecutively. Both the variables used as a macro economic indicator in the model. It showed that GDPG and INFLA are negatively associated with bank credit risk and are significant (p<.01). Chaibi and Ftiti (2015) suggest that the relationship between inflation and risk can be positive or negative. Hussain and Hassan (2005) have shown there is a positive impact of inflation on risk. Lee and Hsieh (2013) argued that when the inflation is high, customers may be charged more by banks. Due to changes in the structure or in the volume of loan demand, banks" capital and credit risk choices may be affected by GDPG (Hussain and Hassan, 2005). GDPG is assumed to be significant because Ayuso et al. (2004) and Jiménez and Saurina (2006) shown that due to cyclical factors the credit risk and capital have a tendency to be determined. The explained variations of the models are 37.70% and 42.03% but the F value increased to 14.97 and 15.02 respectively with compared to Model V. Among six models, Model V is more competent and reliable based of F statistics, goodness of fit (R squared) and standard errors. So, our predicted model will be:

$$NPLTL_{it} = 0.2350 - 0.048\, ROA_{it} - 0.5881\, CAP_{it} - 0.0102\, SIZE_{it} + 1.4375\, NIITA_{it}$$

4.3 Robustness Check

Model I to VI is replicated in the **Model VIII to XIV** using the proxy of profitability as ROE. Both ROA and ROE are the common measures of profitability in performance measurement scale. It is assumed that banks with high profitability take lower risk. That is why; profitability is also included in the risk equation as an explanatory variable. ROE is used as a measure of profitability in the study for checking the robustness. By following the studies of Lee and Hsieh (2013), Chaibi and Ftiti (2015), Sufian and Habibullah (2009), Dietrich and Wanzenried (2011), Athanasoglou et al. (2008), Sufian (2012), we use ROE as an alternative measure of profitability. ROE is calculated by net income divided by shareholders" equity and is expressed as a percentage. According to Sufian (2009), ROE reflects how effectively bank management is in utilizing its shareholders funds.

Table 7: Panel data regression of the credit risk (Non-Performing Loans Rate) on the extent of profitability (ROE) of the commercial banks in Bangladesh over the period 2000-2014

	Model VIII	Model IX	Model X	Model XI	Model XII	Model XIII	Model XIV
ROE	-0.0029**	-0.0037**	-0.0040**	-0.0044**	-0.0044**	-0.0044**	-0.0045**
	(0.0005)	(0.0004)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
CAP		-1.4588**	-1.2918**	-1.3375**	-1.3089**	-1.2364**	-0.9689**
		(0.2093)	(0.2278)	(0.2267)	(0.2286)	(0.2046)	(0.1706)
SIZE			-0.0097*	-0.0132**	-0.0139**	-0.0041	0.0048
			(0.0047)	(0.0047)	(0.0048)	(0.0043)	(0.0045)
NIITA				1.2078**	1.2145**	1.1927**	1.5117**
				(0.4032)	(0.3973)	(0.3789)	(0.3882)
INEFFIC					0.0116	0.0101	0.0108
					(0.0124)	(0.0112)	(0.0098)
GDPG						-0.0266**	-0.0208**
						(0.0047)	(0.0043)
INFLA							-0.0162
							(0.0029)
C	0.1148**	0.2488**	0.3474**	0.3577**	0.3559**	0.4011**	0.3369**
	(0.0101)	(0.0235)	(0.0548)	(0.0536)	(0.0534)	(0.0532)	(0.0485)
Observation	322	322	322	322	322	322	322
F	39.92	42.87	28.95	26.87	21.72	24	23.45
P>F	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-Squared	10.36	34.37	35.27	37.39	37.62	44.73	49.86

** Significant at 1% level, * Significant at 5% level

Table 7 contains regression results of the seven (7) different models to justify baseline model. In the above Table, Model XII is the best fitted because of lower F value which is 21.72 and also significant at 1% level. Model VIII to XI and Model XIII and XIV has higher F value compared to Model XII. In Model XII the coefficient of ROE, CAP and SIZE are negatively associated with NPLR which are -.0044, -1.3089 and -0.0139 and are also statistically significant ($p<0.01$). NIITA is positively associated with NPLR with the coefficient 1.2145 and also significant at 1% level but INEFFIC is insignificant in the model. The explained variation, i.e. goodness of fit is 37.32% which is also persistent with the Model V.

5 Conclusion

The persistent increase of non-performing loan makes a pessimistic effect in the banking business of Bangladesh. The economic growth tremendously obstructs by the narrow down of credit expansion and higher defaults. The cause certainly be the moral persuasion and lack of ethical behavior as a norm of social culture in the country. The study tried to show the backward effect of credit defaults in bank

profitability though other factors are considered with equal importance. In accordance to our expectation, there is a significant negative relation between risk (proxied by NPLR) and profitability (proxied by ROA and ROE) which supports the findings of Kwan and Eisenbies (1997), Lin et al. (2005), Zhang et al. (2013) but does not support the findings of Naceur and Omran (2011). The study chronologically showed the uni-variate to multivariate regression to determine the best performed model. The study addressed the credit risk which is the burning question in the contemporary time horizon. The intense market completion in the banking sector is shrinken the opportunity to invest in unproductive projects rather forgo the profitable returns. The influence of the political agendas make bound to the state owned banks to disburse their deposits in lower competitive projects. The consequences are the higher defaults with lower returns and in turn of insolvent. The regulatory authority and the policy maker should revise the rules and regulations and also emphasis on strong governance policy so that the commercial banks can perform well and contribute in the national economy at their best.

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