



Credit risk management and deposit money banks' profitability in Nigeria: A panel data regression approach

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Abstract

This study investigates the impact of credit risk management on DMBs' profitability in Nigeria using panel data covering a time period of 11 years, from 2009 to 2019. The longitudinal research design was adopted since the data spanned a specific timeframe. Three different models were estimated with ROA, ROE and ROI serving as the dependent variables, while NPL, LLP, BL and BS constituted the independent variables across the three models. The findings of the study showed that both the NPL and BL variables exerted negative impacts on ROA, ROE and ROI across the three models. The LP variable exerted a positive impact on ROA in model one, but showed negative impacts on ROA, ROE and ROI in models two and three. The adjusted R-squared values of 0.17, 0.59 and 0.67 suggest that the explanatory powers of the independent variables are somewhat low. The values of the DW statistics stood at 2.01, 2.23, and 2.11, indicating that the respective estimated models were free from the presence of autocorrelations. Based on these empirical findings, the study concluded that effective CRM strategies are a panacea for enhancing DMBs' profitability. It is, therefore, strongly recommended that both the regulatory authorities and the top management of the DMBs in Nigeria should, as a matter of urgency and deliberate efforts, introduce appropriate CRM policies that are designed to reduce the already high profiles of NPL and LLP to increase profitability among the DMBs.

Keywords:

Credit risk management
Deposit money banks' profitability
Panel data regression methodology.

JEL Classification:

C32; F43; L11; N17; O14.

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1. Introduction

In Nigeria, the 89 commercial and merchant banks that constituted the nation's banking system in 2003 underwent a consolidation exercise that involved mergers and acquisitions. At the conclusion of that exercise, 25 mega banks emerged and commenced operations from January 1, 2005; each of them was legally required to hold a minimum capital base of N25 billion. Today, these mega banks are known as Deposit Money Banks (DMBs) and they provide both retail and wholesale banking services as they accept deposits from the general public and grant commercial and consumer loans to their credit-worthy customers. They have become key

players in the country's payments system, and they finance international trade transactions. They also provide skeletal insurance and mortgage services within the economy. In this sense, the DMBs can be seen as resident depositories. Liabilities are deposits that are payable on demand or transferable by payment instruments such as checks and electronic payment cards, or otherwise usable for effecting payments. DMBs, like other businesses in the organized private sector, are established to make profit to maximize their owners' wealth.

In pursuance of this motive, DMBs generate their income through interest-bearing activities (such as the extension of credit) and non-interest-bearing activities (such as the use of e-payment instruments, bank checks and other related activities to earn commission). DMBs' profits come from their overall annual income after deducting operational expenses and tax liabilities, and their profitability (π) serves as a powerful indicator of liquidity and soundness and enables the banks to introduce more products and services to broaden their size. Therefore, DMBs' profitability is crucial for financial sector stability.

It can be said with reasonable justification that the DMBs move funds among savers and investors and, in the process, facilitate financial system stability. This idea might have prompted [Das and Ghosh \(2007\)](#) to state that financial system stability stimulates economic growth, while a lack of it leads to the collapse of the system, which leads to serious consequences for the entire economy.

The financial intermediation function of the DMBs serves to increase the overall activities within the economy, which, in turn, enhances the payments system efficiency as well as bank liquidity ([Cohen, 1986](#)). Thus, the granting of loans and advances represents a viable channel through which the DMBs create wealth, as the greatest proportion of banks' total income comes from the source. Despite this, loan extension exposes the DMBs to credit risk, liquidity risk, market risk, legal risk, foreign exchange risk, and operation risk when they discharge their intermediation services.

Therefore, credit risk seems to be the greatest risk in the banking business, as its occurrence can easily send a bank into distress or even liquidation, especially where its liabilities have become greater than its assets. This is why credit officers are required to evaluate borrowers' credit history as well as forecast harsh macroeconomic conditions that are likely to impede their ability to repay. Such unfavorable conditions could be encapsulated as limited institutional capacity, lax credit standards, interest rate fluctuations, weak management, low liquidity levels, and others ([Kithinji, 2010](#)).

Perhaps, it is in this realization that [Giesecke \(2002\)](#) stated that credit risk demands careful handling because the survival of banks depends largely on efficient credit risk management. Risk refers to the uncertainty associated with business operations, and [Coyle \(2000\)](#) defined credit risk as the inability of borrowers to repay their loans and advances in accordance with the initial agreement. In a similar vein, [Kolapo, Ayeni, and Oke \(2012\)](#) defined credit risk as the extent of volatility in market instruments and derivatives owing to variations in the credit worthiness of borrowers. Similarly, the [Basel Committee on Banking Supervision \(2001\)](#) opined that credit risk is the possibility of losing outstanding loans and advances, either in full or in part, as a result of loan repayment defaults. The studies by [Kanchu and Kumar \(2013\)](#) and [Kolapo et al. \(2012\)](#) see credit risk as the risk taken by banks when borrowers default on debt obligations at maturity. In the words of [Gil-Diaz \(2008\)](#), the increase in defaulted loans and advances in the banking system arise from lax credit standards for borrowers, a poor loan portfolio, and the inability to adapt to changes in the economy, which can lead to changes in the credit ratings of the borrower.

It should be noted that the global financial crisis of 2008 was caused mainly by the poor credit risk management styles in the banking system ([Ogboi & Unuafe, 2013](#); [Onoalapo, 2012](#)). Therefore, the importance of Credit Risk Management (CRM) cannot be over-emphasized as it tends to exert a direct and proportionate effect on the banking system and, invariably, the overall economy. Premised on the foregoing, it becomes justifiable to investigate the impact of CRM on DMBs' profitability in Nigeria.

2. Literature Review

In banking, CRM is the financial cushion put in place by banks to reduce the harmful or severe effects that loan losses exert on a bank's capital and loan loss reserves. In this context, it has become a tradition for banks to maintain adequate capital and sufficient loan loss reserves. Doing so has oftentimes posed a huge problem for financial institutions since what actually constitutes 'adequate capital' or 'sufficient loan loss reserves' is difficult to determine. CRM is a mechanism to identify the sources of risks and evaluate and monitor risks with the intent of keeping loan repayment defaults at tolerable levels. This singular action is particularly important given that rising default loans and advances have great potential for increasing loan loss provisions which, in turn, deplete banks' profits.

2.1. Conceptual Issues

The conceptual issues relevant to the study are briefly discussed in the following subsections.

2.1.1. Credit Risk Management (CRM)

Credit risk management involves identifying, evaluating and monitoring the risks that arise from the default in loan repayment which, in turn, reduces a bank's profitability as a result of increasing loan loss provisions. Therefore, CRM is an important issue when a bank extends credit to businesses, individuals or

governments (Abiola & Olausi, 2014). This idea may have led Bessis (2002) to assert that, since banks act as 'risk machines' by taking up risks and turning those risks into banking products and services, it becomes important for banks to implement effective and efficient CRM policies to regulate their credit operations.

The main aim of this study is to empirically verify the extent to which CRM has impacted DMBs' financial performance in Nigeria.

2.1.2. Bank Profitability

Bank profitability refers to the differentials between asset return and liabilities. In finance literature, bank profitability is dependent upon both micro and macro factors. The micro factors are bank-specific and include bank size, liquidity level, and operational efficiency. On the other hand, the macroeconomic factors are exogenous and include interest rate, inflation, and exchange rate. Examining the concept of profitability allows policy makers to determine financial performance. Recent finance literature (e.g., Beck, Cull, and Jerome (2013)) stated that bank profitability is often represented by return on assets (ROA), return on equity (ROE), profit after tax (PAT), the cost-to-income ratio (CIR), and net interest income (NII). In practice, ROA is commonly seen as the best technique for measuring operational efficiency and profitability (Tulsian, 2014).

2.1.3. Non-Performing Loans (NPLs)

A non-performing loan refers to a credit facility on which both interest and the principal amount have remained unpaid for 90 days or more. Stuti and Bansal (2016) stated that bank profitability depends largely on the magnitude of non-performing loans. According to them, a reduction in the level of NPLs signifies an improvement in the quality of a bank's assets, while an increase in NPLs leads to poor asset quality that is harmful to financial system stability. This is because a situation of this type erodes banks' profits as a result of interest income losses and an eventual write-off of the principal loan amount itself.

In Nigeria, the banking system experienced instability between the late 1980s and the early 1990s and this led to the distress of many banks. Much of that instability was attributable to the increasing level of NPLs held by banks (Omoruyi & Igbinsosa, 2014). Hence, Aminu (2013) stated that rising levels of NPLs can lead to a reduction in banks' profits, erosion of capital, and poor asset quality.

One of the tasks of this study is to empirically examine the effects of non-performing loans on DMBs' profitability for a period of 21 years, from 2001 to 2021.

2.1.4. Loan Loss Provision (LLP)

Loan loss provision is a mechanism employed by banks to reduce the level of anticipated losses arising from loan repayment defaults. It is a cushion against loan losses and has become popular among banks in their credit extension operations (Laeven & Majnoni, 2003). In this regard, banks often make adequate provisions for loan losses, although there seems to be no unanimity about what is 'adequate'. In the works of Beatty and Liao (2009), LLP is useful for assessing financial system stability as it is an important element of the volatility in banks' profitability and capital positions that take a strong hold on bank credit to the economy. One benefit of LLP is that it helps banks to predict the expected losses that may arise from a particular portfolio. In other words, when these expected losses eventually manifest, banks can quickly fall back on these reserves to absorb such losses without diminishing their highly valued capital.

The extent to which LLP has affected DMBs' profitability remains an issue for empirical examination in this study.

2.1.5. Bank Liquidity (BL)

Bank liquidity refers to the ability of banks to raise funds within a short period of time to meet matured obligations at little or no cost. Bencharles and Abubakar (2020) opined that liquidity helps a financial institution to discharge its maturing short-term obligations by liquidating its current assets, borrowing, or by means of external reserves. Thus, bank liquidity can be conceptualized as the ability of financial institutions to discharge their short-term liabilities at maturity.

Verifying the relationship between bank liquidity and DMBs' financial performance is one of the tasks in this study.

2.2. Empirical Review

Many studies exist in relation to the nexus between credit risk management and DMBs' profitability. However, the findings of these studies are mixed. While some of them found negative relationships between the variables, others found positive relationships. For instance, Gadzo, Oduro, and Asiedu (2019) examined the influence of credit risk management on the performance of banks listed on the Ghana Stock Exchange. The outcome of that study showed that an inverse relationship existed between bank size, financing gap and credit risk management. Hamza (2017) investigated the impact of CRM on the financial performance of commercial banks in Pakistan. In doing this, he dissected financial performance into return on assets and return on equity and used a panel data regression framework to analyze the data. The results of the study showed that there is a negative relationship between the variables. Similarly, Annor and Obeng (2017) investigated the influence of

CRM on the profitability of DMBs listed on the Ghana Stock Exchange. By employing a panel regression framework, the study found that NPLs, LLP and the loan-to-asset ratio exerted negative and significant effects on banks' profitability. Furthermore, the study by [Ajayi and Ajayi \(2017\)](#) showed that CRM impacted DMBs' financial performance negatively. The outcome of the study by [Tan, Floros, and Anchor \(2017\)](#) on China showed that variations in profitability were greatly explained by CRM and that the relationships between CRM and profitability were negative. According to the authors, this inverse relationship could be ascribed to the enormous volume of NPLs which increased bank cost and hence reduced profitability. The study by [Mendoza and Rivera \(2017\)](#) regarding the relationship between credit risk management and the profitability of rural banks in the Philippines showed an inverse relationship between CRM and banks' profitability. In that study, profitability was represented by ROA, and credit risk was denoted by NPLs.

On the contrary, the study by [Okere, Isiaka, and Ogunlowore \(2018\)](#) in terms of the relationship between credit risk management and the financial performance of DMBs in Nigeria showed a positive and significant relationship between credit risk management and the financial performance of DMBs. Similarly, [Saeed and Zahid \(2016\)](#) found a positive relationship between credit risk management and banks' profitability in the United Kingdom, and the study by [Gizaw and Kebede \(2015\)](#) revealed a positive and significant relationship between credit risk management and banks' profitability in Ethiopia. [Aishatti \(2015\)](#) investigated the impact of CRM on the profitability of Jordanian banks, with bank profitability serving as the dependent variable, and non-performing loans (NPLs) to total loans and advances (TLA) to the economy, loan loss provision (LLP) and leverage ratio (LR) representing the independent variables. The outcome showed a positive relationship between CRM and the financial performance of commercial banks in Jordan. Investigating the relationship between credit risk management and commercial banks' performance in Nigeria, [Abiola and Olausi \(2014\)](#) employed return on assets and return on equity to measure financial performance. They found that CRM positively and significantly impacted the performance of DMBs. Finally, [Ejoh, Okpa, and Egbe \(2014\)](#) investigated the influence of credit and liquidity risk on DMBs' profitability in Nigeria, and their findings revealed a positive relationship between CRM, liquidity and banks' profitability.

3. Theoretical Framework and Model Specification

This section is divided into two subsections – theoretical framework and model specification – that are briefly discussed below.

3.1. Theoretical Framework

The study is anchored on the anticipated income theory and the liquidity management theory, as the two theories tend to be the foundation of credit extension practices in modern banking.

3.1.1. Anticipated Income Theory (AIT)

Anticipated income theory was propounded by [Prochnow \(1949\)](#), and it postulates that banks should abandon the erstwhile self-liquidating commercial loan doctrine and term length (i.e., short-, medium- and long-term) loans as well as non-business loans because the 'real bill' is repaid from the future earnings of the borrower (anticipated income). If this is considered as the true source of bank loan repayment, it stands to reason that bank lending should not be restricted to the traditional commercial loan theory; the important issue in bank lending is the borrower's ability to repay the loan, and their future income constitutes the source for that.

3.1.2. The Liquidity Management Theory (LMT)

Conceptually, liability management in banking refers to the process of ensuring that a bank maintains adequate cash on hand as well as hold some liquid assets that can be easily converted to cash with little or no loss of value in order to meet its short-term obligations when they are due. Thus, effective liquidity management is a necessary and sufficient condition for lending operations that constitute the cornerstone of banks' healthy balance sheets. Depositors' money and funds borrowed from other financial institutions constitute bank liabilities ([Kenton, 2022](#)). It is no wonder, therefore, that the liquidity management theory holds that a bank can use its liability in a manner that such liability could be transformed into a good source of liquidity. Banks normally do this by buying money when required ([Anyanwu, 1993](#)). Thus, the key point of the theory is that a bank should borrow the funds it needs through bank-related money market instruments.

In Nigeria, for example, many DMBs currently access funds from the Central Bank at 2% for on-lending to creditworthy micro, small and medium-scale enterprises (MSMEs) at 9%. Through this process, the participating banks are able to increase their liquidity through the purchased money and, at the same time, earn higher profits and ultimately facilitate banking system soundness.

3.2. Model Specification

To achieve the objectives of the study, the functional forms of the models to be estimated in the study are presented as follows:

$$ROA = f(NPL, LLP, BL, BS) \quad (1)$$

$$ROE = f(NPL, LLP, BL, BS) \quad (2)$$

$$ROI = f(NPL, LLP, BL, BS) \quad (3)$$

Where:

ROA = Return on assets.

ROE = Return on equity.

ROI = Return on investment.

NPL = Non-performing loan.

LLP = Loan loss provision.

BS = Bank size.

BL = Bank liquidity.

Rewriting Equations 1 – 3 in econometric forms yield:

$$ROA_{it} = \beta_0 + \beta_1 NPL_{it} + \beta_2 LLP_{it} + \beta_3 BL_{it} + \beta_4 BS_{it} + \varepsilon_{it} \quad (4)$$

$$ROE_{it} = \beta_0 + \beta_1 NPL_{it} + \beta_2 LLP_{it} + \beta_3 BL_{it} + \beta_4 BS_{it} + \varepsilon_{it} \quad (5)$$

$$ROI_{it} = \beta_0 + \beta_1 NPL_{it} + \beta_2 LLP_{it} + \beta_3 BL_{it} + \beta_4 BS_{it} + \varepsilon_{it} \quad (6)$$

Where:

β_0 = Intercept or constant term.

$\beta_1 - \beta_4$ = Coefficients.

ε_{it} = Stochastic (or error) term.

i = Cross sections.

t = Time.

A priori expectations:

$$\beta_1 - \beta_3 < 0; \beta_4 > 0.$$

4. Data Analysis and Interpretation of Results

The data analysis and the interpretation of the estimated results are presented and discussed in this subsection as follows:

4.1. Data of the Study

The data set of the study is contained in Appendix 1.

4.2. Data Analysis and Results

The data estimation exercises and interpretation of the results are carried out in the following subsections.

4.2.1. Descriptive Statistics

The results of the descriptive statistics obtained in the estimation exercise of the study are reported in Table 1.

Table 1. Descriptive statistics.

Variable	Mean	Std. dev.	Skewness	Kurtosis	P-value (Jarque–Bera)
ROA	0.027	0.04	3.15	18.24	0.00
ROE	0.028	0.01	0.52	2.88	0.04
ROI	0.03	0.01	0.69	2.99	0.00
BL	0.09	0.08	1.78	7.87	0.09
NPL	0.09	0.08	1.78	7.85	0.00
LLP	0.04	0.04	1.09	3.32	0.09
BS	7.95	1.57	-0.71	1.84	0.00

A close look at the results in Table 1 reveals that the average performance of the DMBs within the period of study was fair. For example, the mean value for ROA stood at 0.027, that of ROE stood at 0.028, and that of ROI stood 0.03. The results also show that the mean value of non-performing loans and advances averaged 0.09 at the traditional 1% level of significance, and bank liquidity had a mean value of 0.09 and was significant at the 9% level. The loan loss provision stood at a value of 0.04 and was not significant at the 1% or 5% levels. The mean value for bank size stood at 7.95 and was significant at the traditional 1% level. The standard deviation values for all variables showed little deviation from the mean, implying that the series oscillates around their mean. The results show that the variables of the study were positively skewed, with the exception of bank size that recorded a negative skewness implying a long left tail. The results further show that all the variables were leptokurtic, indicating that they have values larger than their observed means. Finally, the

results show that the dataset of the study did not form a normal distribution as indicated by the ρ -value from the Jarque–Bera test result. Generally, all values were found to be less than the 5% level of significance with the exception of those for BL and LLP, which recorded values higher than the 5% level of significance.

4.2.2. Econometric Regression Results

In this subsection, the econometric results of our estimation exercise are presented and interpreted concerning the impact of credit risk management on DMBs’ profitability in Nigeria. The results of the pooled effects model, the fixed effects model, and the random effects model are presented in **Tables 2a, 2b**, and **2c**, respectively.

Table 2a contains the regression results which show the relationship between credit risk management and DMBs’ profitability (ROA) given various variables in the models of **Equation 4**. A cursory look at the results reveals that the estimation was free from the presence of autocorrelation, as indicated by the Durbin–Watson (DW) statistic values obtained for the pooled effects model (PEM), the fixed effects model (FEM), and the random effects model (REM), which stood at 2.01, 2.23, and 2.11, respectively. Furthermore, the results also showed that the F-statistic values for the PEM, FEM, REM stood at 6.80[0.000], 3.27[0.000], and 4.6[0.000], respectively, indicating that the three models passed the test of overall significance at the traditional 1% level. The values of the coefficients of determination, R^2 , stood at 0.21, 0.35, and 0.15, while those of their adjusted counterparts, R^2 , stood at 0.17, 0.24 and 0.12, respectively, after allowing for degrees of freedom. These results indicate that the explanatory power of the model is quite low. It should be noted that this is expected in panel estimation, as a high number of observations normally leads to a decline in the coefficients of determination.

Looking at the relationships among the variables, it can be observed that non-performing loans showed the expected negative values of -0.26, -0.25, and -0.25, respectively, and are equally significant at the traditional 1% level. This implies that a shock in NPLs causes an inverse response from DMBs’ profitability, as represented by the ROA. Therefore, a unit increase in the level of non-performing loans leads to a corresponding decrease in DMBs’ profitability.

Table 2a. Regression summary.

Dependent variable: ROA			
Variable	Pooled effects model	Fixed effects model	Random effects model
NPL	-0.26 (0.00)**	-0.25 (0.02)*	-0.25 (0.00)**
LLP	0.60 (0.00)**	0.34 (0.13)	0.54 (0.00)**
BL	-0.06 (0.29)	-0.10 (0.17)	-0.07 (0.27)
BS	-0.008 (0.00)**	-0.04 (0.00)**	-0.008 (0.01)*
C	0.093 (0.00)	0.40 (0.00)**	(0.10) (0.00)**
R^2	0.21	0.35	0.15
Adj. R^2	0.17	0.24	0.12
Durbin–Watson	2.01	2.23	2.11
F-stat.	6.80 (0.000)	3.27 (0.000)	4.6 (0.00)

Note: Figures in parentheses are probability values. * and ** denote significance at the 1% and 5% levels, respectively.

The results in **Table 2b** show that the outcomes of our diagnostic tests appeared with the correct signs and can thus be said to be a good fit. Specifically, the adjusted R-squared values stood at 0.59, 0.57, and 0.41, respectively. The implications for these empirical results are that the independent variables of our models possessed a fairly high explanatory power for the three models estimated (i.e., PEM, FEM, and REM). Thus, it can be inferred that a sizeable number of variations in the response variable is accounted for in the models. The values of the Durbin–Watson statistics stood at 1.55, 1.55, and 1.56, respectively, indicating the presence of serial correlation among the variables in the three models. The F-statistic values stood at 4.41[0.000], 12.4[0.000], and 12.8[0.000], indicating that the three models passed the test of overall significance at the traditional 1% level.

With respect to the relationship between credit risk management and return on investment (ROI), non-performing loans exerted a negative effect on ROI across the three models estimated in the study. In fact, the NPL coefficients stood at -0.01[0.02] for the PEM, 0.005[0.78] for the FEM, and -0.002[0.87] for the REM.

The empirical finding is that non-performing loans impacted credit risk management negatively across all three models.

Table 2b. Regression summary (ROI equation).

Variable	Pooled effects model	Fixed effects model	Random effects model
BS	0.002 (0.01)	-0.0006 (0.85)	0.001 (0.00)
NPL	-0.01 (0.02)	-0.005 (0.78)	-0.002 (0.87)
BL	-0.002 (0.00)	-0.00006 (0.41)	-0.0009 (0.03)
LLP	-0.05 (0.04)	-0.018 (0.65)	-0.01 (0.73)
C	0.01 (0.00)	0.04 (0.17)	0.02 (0.00)
R ²	0.62	0.62	0.51
Adj. R ²	0.59	0.57	0.41
Durbin-Watson	1.55	1.55	1.56
F-stat.	4.41	12.4	12.8

The regression results with respect to the interrelationships between credit risk management and return on equity are shown in Table 2b. The values of the coefficients for bank liquidity (BL) are 0.002[0.00] for the PEM, -0.00006[0.41] for the FEM, and -0.0009[0.03] for the REM, respectively. These findings imply that DMBs in Nigeria do not seem to hold adequate liquidity that would assist them in meeting short-term obligations as and when they are due, and this type of scenario has serious consequences for profitability.

The coefficient values for loan loss provision (LLP) are -0.05[0.04] for the PEM, -0.018 [0.65] for the FEM, and -0.01[0.73] for REM, respectively. These results imply that loan loss provisions by the DMBs in Nigeria are grossly insufficient and might not be able to provide the necessary financial cushion for LLP.

The results in Table 2c reveal that the coefficients for bank size are 0.001[0.02], 1.001[0.00], and 1.006[0.04] for the PEM, REM, and FEM, respectively. What these empirical findings signify is that bank size exerted a positive and significant effect on ROE at the 2%, 1%, and 1% levels, respectively. The non-performing loans variable had coefficients of -0.03[0.02], -0.02[0.16], and -0.007[0.04] for the PEM, REM, and FEM, respectively. These empirical findings imply that nonperforming loans exerted negative impacts on ROE at the 3%, 16% and 1%, respectively with regard to the PEM, REM, and FEM. The bank liquidity variable recorded the coefficients of -0.002[0.00], -0.001[0.02], and -0.001[0.080] for PEM, REM, and FEM, respectively. The implications for these empirical outcomes are that bank liquidity impacted ROE negatively and significantly in the three panel regression models. The coefficients of the loan loss provision variable stood at -0.05[0.08], -0.01[0.00], and -0.01[0.79] for the PEM, REM, and FEM, respectively. These empirical findings portend that loan loss provisions impacted ROE negatively during the period covered by the study.

Table 2c. Regression summary (ROE equation).

Variable	Pooled effects model	Fixed effects model	Random effects Model
BS	0.001 (0.02)	1.006 (0.04)	1.001 (0.00)
NPL	-0.03 (0.02)	-0.007 (0.04)	-0.02 (0.16)
BL	-0.002 (0.00)	-0.001 (.08)	-0.001 (0.02)
LLP	-0.05 (0.08)	-0.01 (0.79)	-0.01 (0.00)
C	0.01 (0.00)	0.02 (0.48)	0.01 (0.25)
R ²	0.70	0.50	0.55
Adj. R ²	0.67	0.43	0.42
Durbin-Watson	1.50	1.74	1.94
F-stat.	3.50[0.000]	1.71[0.000]	7.11[0.000]

The summary statistics in Table 2c show that the coefficient of the adjusted R² recorded values of 0.67, 0.42, and 0.43 for the PEM, REM, and FEM, respectively. These results show that all the independent variables contained in Table 2c were able to explain approximately 67%, 42%, and 43% of the systematic

variations in ROE after allowing for degrees of freedom. The Durbin–Watson statistics stood at 1.50, 1.94, and 1.74 for the PEM, FEM, and REM respectively. Each of these values is less than 2; hence, it can be inferred that there is the presence of serial correlation among the variables in the models. Finally, the F-statistic values with respect to the PEM, REM and FEM are 3.50[.000], 7.11[.000], and 1.71[0.000], respectively. The implications for these statistical results are that each of the models passed the test of overall significance at the traditional 1% level.

5. Concluding Remarks

5.1. Summary of Findings

This study investigated the impact of credit risk management on DMBs' profitability in Nigeria using panel data covering a timeframe of 11 years, from 2009 to 2019. In doing this, three different models were estimated as DMBs' profitability was split into ROA, ROE, and ROI to represent the dependent variables in each of the models. Non-performing loans, loan loss provision, bank liquidity, and bank size constituted the independent variables. The findings of the study revealed that:

1. Non-performing loans exerted a significant negative impact on DMBs' profitability across the three models specified in the study, and these aligned with the a priori expectations of the study.
2. Loan loss provision exerted a positive and significant impact on DMBs' profitability in Equation 1 but exhibited a negative impact on DMBs' profitability with respect to Equations 2 and 3.
3. Bank liquidity recorded a negative and insignificant relationship with DMBs' profitability across the three models of the study. The implication of this finding is that the DMBs in Nigeria did not seem to hold adequate liquidity to guarantee their ability to meet short-term obligations when they are due.
4. Bank size exerted positive and significant impact on DMBs' profitability in Nigeria in models 1 and 3 but exhibited a significant negative impact on DMBs' profitability in model 2.

5.2. Conclusion

The outcomes of the three models are robust and revealing. Accordingly, the study concluded that the empirical analysis conducted was suitable for fine-tuning the existing credit risk management policies of the DMBs. Additionally, it concluded that effective credit risk management enhances DMBs' profitability and should be treated with the utmost diligence for the array of products and services provided by the banks to be worthwhile and beneficial for all stakeholders, including regulatory authorities, owners, and customers.

5.3. Recommendations

Based on the empirical findings and the conclusion of the study, it is strongly recommended that:

- (a) The regulatory authorities in Nigeria [i.e., the Central Bank of Nigeria (CBN) and the Nigeria Deposit Insurance Corporation (NDIC)] should introduce stringent policies aimed at curbing the increasing non-performing loans in the DMBs as a matter of urgency. Furthermore, the DMBs must also introduce adequate policies aimed at retrieving default loans and their accompanying interest to reduce the number of non-performing loans. These actions are imperative, given that the high or excessive profiles of non-performing loans are inimical to bank profitability.
- (b) DMBs should follow standard practice with respect to the extension of credit facilities to their customers. Prospective borrowers need to be correctly rated to identify those with low credit ratings. This recommendation, if implemented, is likely to enhance bank liquidity.
- (c) DMBs must ensure that they increase the array of their products and services to enhance their size. This is important because both evidence and theory have shown that the more products and services banks provide, the larger their size will be.
- (d) DMBs should ensure that borrowers service their loans in accordance with the terms and conditions governing those loans to scale down the current high profile of loan loss provision. This is crucial given that the high level of the provision of loan losses can significantly deplete the level of profitability of the DMBs.

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Appendix 1. Data (2009–2019).

Year	Bank	ROA	NPL	LLP	LR	SIZE	ROI	ROE
2009	Access Bank Plc	0.016	0.081	0.017	0.587	8.850	0.048	0.021
2010	Access Bank Plc	0.019	0.167	0.021	0.562	8.900	0.024	0.026
2011	Access Bank Plc	0.009	0.030	0.024	0.354	9.210	0.032	0.017
2012	Access Bank Plc	0.022	0.039	0.030	0.346	9.240	0.031	0.019
2013	Access Bank Plc	0.015	0.024	0.031	0.432	9.230	0.04	0.024
2014	Access Bank Plc	0.020	0.028	0.017	0.515	9.300	0.042	0.032
2015	Access Bank Plc	0.027	0.024	0.022	0.515	9.380	0.039	0.028

Year	Bank	ROA	NPL	LLP	LR	SIZE	ROI	ROE
2016	Access Bank Plc	0.023	0.020	0.021	0.515	9.490	0.037	0.030
2017	Access Bank Plc	0.008	0.029	0.029	0.500	9.510	0.046	0.038
2018	Access Bank Plc	0.010	0.069	0.022	0.562	8.900	0.041	0.043
2019	Access Bank Plc	0.041	0.038	0.021	0.240	8.530	0.039	0.041
2009	Citibank Nigeria Limited	0.026	0.104	0.088	0.115	8.560	0.046	0.031
2010	Citibank Nigeria Limited	0.030	0.080	0.047	0.138	8.563	0.052	0.037
2011	Citibank Nigeria Limited	0.0256	0.065	0.034	0.157	8.565	0.048	0.041
2012	Citibank Nigeria Limited	0.041	0.055	0.049	0.181	8.519	0.047	0.024
2013	Citibank Nigeria Limited	0.041	0.038	0.021	0.240	8.532	0.059	0.028
2014	Citibank Nigeria Limited	0.039	0.000	0.006	0.234	8.602	0.054	0.012
2015	Citibank Nigeria Limited	0.025	0.080	0.045	0.219	8.634	0.046	0.025
2016	Citibank Nigeria Limited	0.042	0.008	0.034	0.196	8.781	0.031	0.034
2017	Citibank Nigeria Limited	0.0542	0.015	-0.002	0.165	8.775	0.036	0.020
2018	Citibank Nigeria Limited	0.047	0.055	0.049	0.189	8.510	0.041	0.028
2019	Citibank Nigeria Limited	0.041	0.038	0.021	0.240	8.530	0.023	0.032
2009	Diamond Bank Plc	-0.012	0.211	0.050	0.498	8.812	0.022	0.042
2010	Diamond Bank Plc	0.002	0.166	0.049	0.518	8.773	0.027	0.041
2011	Diamond Bank Plc	-0.017	0.101	0.106	0.487	8.901	0.032	0.039
2012	Diamond Bank Plc	0.019	0.049	0.054	0.497	9.071	0.042	0.047
2013	Diamond Bank Plc	0.019	0.037	0.024	0.454	9.181	0.040	0.038
2014	Diamond Bank Plc	0.013	0.053	0.049	0.406	9.243	0.035	0.031
2015	Diamond Bank Plc	0.002	0.077	0.082	0.417	9.192	0.049	0.028
2016	Diamond Bank Plc	0.001	0.112	0.074	0.488	9.221	0.024	0.031
2017	Diamond Bank Plc	0.000	0.160	0.088	0.446	9.229	0.036	0.023
2018	Diamond Bank Plc	0.004	0.129	0.091	0.427	8.700	0.037	0.026
2019	Diamond Bank Plc	0.017	0.014	0.006	0.504	9.249	0.039	0.024
2009	Eco Bank Nigeria Ltd	0.0254	0.141	0.062	0.274	8.273	0.0035	0.001
2010	Eco Bank Nigeria Ltd	0.025	0.139	0.062	0.273	8.338	0.0043	0.0021
2011	Eco Bank Nigeria Ltd	0.025	0.138	0.062	0.273	8.394	0.019	0.003
2012	Eco Bank Nigeria Ltd	0.026	0.137	0.061	0.272	8.444	0.021	0.009
2013	Eco Bank Nigeria Ltd	0.008	0.018	0.008	0.428	9.165	0.009	0.018
2014	Eco Bank Nigeria Ltd	0.017	0.014	0.006	0.504	9.249	0.02	0.025
2015	Eco Bank Nigeria Ltd	0.006	0.016	0.007	0.456	9.254	0.007	0.029
2016	Eco Bank Nigeria Ltd	0.003	0.017	0.008	0.481	9.257	0.003	0.005
2017	Eco Bank Nigeria Ltd	0.011	0.019	0.009	0.454	9.262	0.004	0.002
2018	Eco Bank Nigeria Ltd	0.026	0.137	0.061	0.272	8.444	0.02	0.008
2019	Eco Bank Nigeria Ltd	0.025	0.139	0.062	0.273	8.338	0.04	0.015
2009	Fidelity Bank Plc	0.005	0.128	0.091	0.427	8.700	0.042	0.037
2010	Fidelity Bank Plc	0.012	0.147	0.160	0.331	8.680	0.041	0.029
2011	Fidelity Bank Plc	0.008	0.099	0.029	0.345	8.8700	0.051	0.033
2012	Fidelity Bank Plc	0.006	0.087	0.043	0.310	9.000	0.057	0.032
2013	Fidelity Bank Plc	0.007	0.067	0.038	0.394	9.030	0.054	0.043
2014	Fidelity Bank Plc	0.012	0.032	0.008	0.456	9.070	0.049	0.041
2015	Fidelity Bank Plc	0.011	0.036	0.010	0.469	9.090	0.047	0.039
2016	Fidelity Bank Plc	0.007	0.036	0.012	0.553	9.11	0.046	0.023
2017	Fidelity Bank Plc	0.013	0.036	0.013	0.557	9.14	0.039	0.032
2018	Fidelity Bank Plc	0.012	0.032	0.009	0.456	9.050	0.035	0.034
2019	Fidelity Bank Plc	0.008	0.099	0.029	0.345	8.870	0.034	0.044
2009	First Bank of Nigeria Plc	0.006	0.008	0.015	0.368	6.300	0.046	0.032
2010	First Bank of Nigeria Plc	0.01	0.077	0.043	0.493	6.370	0.049	0.028
2011	First Bank of Nigeria Plc	0.007	0.022	0.021	0.438	6.460	0.047	0.037
2012	First Bank of Nigeria Plc	0.024	0.024	0.019	0.500	6.500	0.032	0.028
2013	First Bank of Nigeria Plc	0.227	0.023	0.018	5.831	5.490	0.047	0.036
2014	First Bank of Nigeria Plc	0.190	0.022	0.017	7.211	5.460	0.047	0.029
2015	First Bank of Nigeria Plc	0.008	0.022	0.016	8.242	5.450	0.052	0.039
2016	First Bank of Nigeria Plc	0.028	0.021	0.016	9.693	5.430	0.047	0.048
2017	First Bank of Nigeria Plc	0.034	0.021	0.015	10.545	5.430	0.054	0.042
2018	First Bank of Nigeria Plc	0.227	0.022	0.018	5.834	5.490	0.043	0.035

Year	Bank	ROA	NPL	LLP	LR	SIZE	ROI	ROE
2019	First Bank of Nigeria Plc	0.008	0.022	0.021	0.438	6.460	0.042	0.034
2009	Guarantee Trust Bank Plc	0.030	0.130	0.058	0.528	9.010	0.048	0.043
2010	Guarantee Trust Bank Plc	0.044	0.042	0.016	0.558	9.030	0.038	0.048
2011	Guarantee Trust Bank Plc	0.040	0.007	0.026	0.464	9.180	0.031	0.037
2012	Guarantee Trust Bank Plc	0.064	0.004	0.000	0.481	9.210	0.043	0.044
2013	Guarantee Trust Bank Plc	0.045	0.007	0.003	0.487	9.280	0.054	0.046
2014	Guarantee Trust Bank Plc	0.042	0.016	0.005	0.556	9.330	0.050	0.041
2015	Guarantee Trust Bank Plc	0.041	0.044	0.009	0.556	9.360	0.045	0.043
2016	Guarantee Trust Bank Plc	0.049	0.090	0.045	0.542	9.420	0.044	0.031
2017	Guarantee Trust Bank Plc	0.057	0.156	0.091	0.448	9.450	0.052	0.033
2018	Guarantee Trust Bank Plc	0.064	0.004	0.001	0.481	9.210	0.046	0.014
2019	Guarantee Trust Bank Plc	0.045	0.007	0.003	0.486	9.280	0.031	0.019
2009	Stanbic IBTC Bank Plc	0.019	0.1641	0.075	0.335	5.519	0.027	0.014
2010	Stanbic IBTC Bank Plc	0.021	0.174	0.094	0.330	5.571	0.023	0.018
2011	Stanbic IBTC Bank Plc	0.017	0.139	0.109	0.259	5.734	0.020	0.009
2012	Stanbic IBTC Bank Plc	0.015	0.169	0.122	2.025	4.8603	0.037	0.016
2013	Stanbic IBTC Bank Plc	0.111	0.1584	0.132	2.106	4.877	0.026	0.008
2014	Stanbic IBTC Bank Plc	0.174	0.184	0.141	2.257	4.879	0.019	0.017
2015	Stanbic IBTC Bank Plc	0.130	0.198	0.150	2.407	4.880	0.021	0.028
2016	Stanbic IBTC Bank Plc	0.008	0.148	0.157	2.557	4.880	0.026	0.023
2017	Stanbic IBTC Bank Plc	0.323	0.199	0.169	2.706	4.882	0.024	0.037
2018	Stanbic IBTC Bank Plc	0.130	0.198	0.145	2.407	4.880	0.025	0.031
2019	Stanbic IBTC Bank Plc	0.017	0.139	0.109	0.249	5.734	0.027	0.029
2009	Sterling Bank Plc	0.032	0.285	0.101	0.380	8.310	0.039	0.034
2010	Sterling Bank Plc	0.016	0.376	0.118	0.360	8.410	0.042	0.037
2011	Sterling Bank Plc	0.014	0.296	0.131	0.322	8.700	0.048	0.038
2012	Sterling Bank Plc	0.012	0.265	0.102	0.395	8.760	0.044	0.041
2013	Sterling Bank Plc	0.012	0.229	0.085	0.455	8.850	0.053	0.036
2014	Sterling Bank Plc	0.010	0.233	0.064	0.450	8.920	0.048	0.028
2015	Sterling Bank Plc	0.013	0.293	0.129	0.424	8.900	0.041	0.021
2016	Sterling Bank Plc	0.006	0.240	0.096	0.564	8.920	0.033	0.034
2017	Sterling Bank Plc	0.008	0.209	0.084	0.560	9.030	0.029	0.035
2018	Sterling Bank Plc	0.016	0.377	0.118	0.360	8.410	0.031	0.032
2019	Sterling Bank Plc	0.011	0.229	0.085	0.455	8.850	0.045	0.034
2009	Union Bank of Nigeria Plc	-0.064	0.094	0.030	0.363	6.040	0.053	0.025
2010	Union Bank of Nigeria Plc	0.142	0.170	0.061	0.205	5.920	0.033	0.034
2011	Union Bank of Nigeria Plc	-0.092	0.542	0.173	0.175	5.920	0.023	0.042
2012	Union Bank of Nigeria Plc	0.004	0.191	0.089	0.156	5.950	0.016	0.026
2013	Union Bank of Nigeria Plc	0.006	0.118	0.042	0.238	5.950	0.019	0.023

Year	Bank	ROA	NPL	LLP	LR	SIZE	ROI	ROE
2014	Union Bank of Nigeria Plc	0.022	0.077	0.016	0.328	5.970	0.014	0.027
2015	Union Bank of Nigeria Plc	0.018	0.063	0.052	0.349	6.000	0.028	0.021
2016	Union Bank of Nigeria Plc	0.014	0.076	0.043	0.436	6.050	0.019	0.011
2017	Union Bank of Nigeria Plc	0.010	0.227	0.067	0.366	6.130	0.017	0.009
2018	Union Bank of Nigeria Plc	0.006	0.118	0.042	0.238	5.920	0.013	0.021
2019	Union Bank of Nigeria Plc	-0.092	0.542	0.174	0.175	5.970	0.027	0.026
2009	United Bank for Africa Plc	0.002	0.089	0.006	0.392	6.190	0.034	0.019
2010	United Bank for Africa Plc	0.000	0.082	0.005	0.389	6.210	0.043	0.037
2011	United Bank for Africa Plc	-0.004	0.090	0.004	0.355	6.290	0.039	0.033
2012	United Bank for Africa Plc	0.019	0.010	0.003	0.320	6.350	0.047	0.035
2013	United Bank for Africa Plc	0.021	0.104	0.002	0.359	6.350	0.041	0.030
2014	United Bank for Africa Plc	0.017	0.105	0.015	0.378	6.370	0.046	0.032
2015	United Bank for Africa Plc	0.021	0.126	0.014	0.371	6.350	0.044	0.037
2016	United Bank for Africa Plc	0.019	0.104	0.014	0.429	6.400	0.031	0.033
2017	United Bank for Africa Plc	0.014	0.106	0.013	0.400	6.470	0.039	0.027
2018	United Bank for Africa Plc	0.021	0.104	0.002	0.359	6.350	0.035	0.031
2019	United Bank for Africa Plc	0.012	0.104	0.014	0.429	6.600	0.043	0.031
2009	Zenith Bank of Nigeria Plc	0.012	0.070	0.064	0.421	9.220	0.03.	0.038
2010	Zenith Bank of Nigeria Plc	0.012	0.044	0.034	0.523	9.250	0.035	0.024
2011	Zenith Bank of Nigeria Plc	0.019	0.028	0.012	0.546	9.340	0.039	0.028
2012	Zenith Bank of Nigeria Plc	0.039	0.018	0.009	0.586	9.390	0.032	0.019
2013	Zenith Bank of Nigeria Plc	0.023	0.014	0.013	0.435	9.4600	0.037	0.024
2014	Zenith Bank of Nigeria Plc	0.032	0.015	0.010	0.461	9.570	0.036	0.023
2015	Zenith Bank of Nigeria Plc	0.031	0.016	0.100	0.497	9.600	0.041	0.019
2016	Zenith Bank of Nigeria Plc	0.033	0.025	0.016	0.483	9.680	0.04	0.021
2017	Zenith Bank of Nigeria Plc	0.032	0.015	0.010	0.461	9.520	0.039	0.022
2018	Zenith Bank of Nigeria Plc	0.012	0.069	0.064	0.421	9.220	0.034	0.016
2019	Zenith Bank of Nigeria Plc	0.032	0.044	0.033	0.375	9.750	0.038	0.020

Source: Annual reports and statements of accounts of sampled DMBs.