Indicators of Market Discipline in Nigerian Commercial Banks

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Abstract
The introduction of bank deposit insurance schemes provides a financial safety net for depositors and the financial system. This may, however, induce bank management to take on an excessive risk appetite, thus creating a moral hazard problem that may lead to reduced market discipline following deposit insurance implementation. This study investigates indicators of market discipline in Nigerian commercial banks with a set of bank-specific and macroeconomic variables, using the generalised least squares regression technique to analyse data obtained from 15 selected banks over the period 2009 to 2020. Results from the study show that bank-specific variables (credit quality, liquidity, size and earnings) and macroeconomic variable (gross domestic product) are ways through which market discipline is exerted in Nigerian commercial banks. This study is one of first that investigates the indicators of market discipline in Nigerian commercial banks. The findings provide support for the economic theory of deposit insurance and show that interest expense plays a more dominant role in market discipline in Nigerian commercial banks than deposit growth.

Introduction

Banks, especially in developing economies, are the main source of finance for firms and other economic units in addition to the role they play in economic growth (Smith, 2002). Accordingly, bank failures/crisis may lead to loss of confidence in the system and affect the economy negatively (Anginer & Demirgüç-Kunt, 2018; Smith, 2002). Anginer and Demirgüç-Kunt (2018) identified some of the costs of bank failures as increased unemployment, lost productions and investments and the use of taxpayer funds to bail out distressed banks. To reduce the incidence and severity of these challenges, several countries introduced Deposit Insurance Schemes (DIS) to safeguard the banking sector, thereby creating a financial safety net for both depositors, banks and the economy. The scheme has the objective of protecting depositors against losses arising from bank failures irrespective of the cause of failure.

Literature shows that deposit insurance reduces the incidence of bank runs without having any adverse effects on the assets/maturity transformation function of banks, thereby improving financial stability (Diamond & Dybvig, 1983; Hasan, Fang, Liu, & Zhang, 2017; Nikolaj, Draženović, & Buterin, 2022). Nonetheless, deposit insurance also comes along with associated risks due to depositors (with increased confidence in the sector) seeking higher rates and paying less attention to risks undertaken by banks. Resultantly, banks, in order to meet up with depositors' demand for higher rates, may engage in taking up more risky projects that would generate more returns and cause bank failures (Quintero, 2019). This behaviour can best be explained in the context of

moral hazard in two folds[1]. On one hand, deposit insurance provides depositors with the assurance of the safety of their deposits, but they now have a reduced incentive to monitor bank activities (Anginer & Demirgüç-Kunt, 2018). On the other hand, banks embarking on riskier activities would enjoy the benefits of increased returns in their books and, in the event of any problem, deposit insurance bail out would be available (Acharya, Anginer, & Warburton, 2016; Karas, Pyle, & Schoors, 2019). The destabilising effect of a moral hazard issue is even more magnified in financial systems where the deposit insurance was not well designed at the inception of the scheme, as observed by Anginer and Demirgüç-Kunt (2018), and Nikolaj et al. (2022).

To counter destabilisation, the International Association of Deposit Insurers (IADI) in its 2014 document highlights important elements necessary for mitigating problems arising from moral hazard. These principles serve as a framework to support deposit insurance schemes and countries add additional measures as needed for effective schemes to operate. A key important feature of deposit insurance scheme, according to the document, is the coverage level which should be limited, credible, as well as provide protection to majority of depositors. A limited and credible coverage limit would ensure that uninsured depositors have the incentive to monitor the financial performance of their banks. At the same time, they can equally call to order banks taking up excessive risks by withdrawal of deposits and a demand for higher risk premiums (Nys, Tarazi, & Trinugroho, 2015). These actions consequently introduce market
discipline into the system. Market discipline, introduced as one of the three pillars of the Basel

II accord on capital regulation, involves a comprehensive reporting of banks' assets, risk exposure, among other indices, to enable stakeholders monitor banks' risk profile and evaluate their financial soundness. According to World Bank's Global Development Report of 2019/2020, the introduction is to curb incentives that would lead to excessive risk taking by banks as well as to complement supervisory and regulatory functions. Market discipline exists when depositors take actions to curb excessive risk-taking by banks.[2] These actions may come in the form of either higher interest rates or deposit withdrawal/deposit switch to another bank. Consequently, banks' appetite for increased risks is restrained because they would not want to incur additional expenses that would come in the form of demand for higher rates by depositors (Berger, 1991). Nonetheless, for market discipline to work well, relevant stakeholders should have ways of monitoring banks (Bliss & Flannery, 2002; Skvarciany & Jurevičienė, 2017), have incentives to enforce market discipline (Sironi, 2003) and have access to related and on-time information (Anginer, Demirguc-Kunt, & Zhu, 2014; Arnold, Größl, & Koziol, 2016).

Following the liberalisation of the Nigerian financial system in 1986, The Nigerian Deposit Insurance Cooperation (NDIC) was established in 1988 to primarily provide a financial safety net for the banking system to protect depositors from loss of insured deposits due to bank failures and boost confidence in the system. The NDIC's current coverage scheme for participating institutions is one that provides full coverage for most small and non-complex depositors and ensures a large proportion of deposits are subject to market discipline. Two main features of the DIS in Nigeria are the ex-ante funding method where funds are generated before bank failures via payment of periodic premiums by participating institutions and the rules-based explicit guarantee on deposit[3]. However, studies show that these features have the disadvantage of increasing the moral hazard problem by distorting incentives for monitoring via market discipline to prevent banks from taking up excessive risks that may lead to bank failures (Hadad, Agusman, Monroe, Gasbarro, & Zumwalt, 2011; Karas, Pyle, & Schoors, 2013). From the perspective of depositors, monitoring is reduced because their deposits are insured and guaranteed and, from that of banks, they (i.e., banks) profit from increased risk-taking activities, but losses from failures are borne through DIS. Statistics from the NDIC's annual report of 2020 shows that total insured deposits had a 57% growth from ₦2,686.35 billion in 2016 to ₦4,232.35 in 2020. In view of this increase and the structure of DIS in Nigeria, this paper is one of the first studies that contributes to extant literature by investigating the indicators of market discipline in Nigerian commercial banks, a research area that is underexplored. Additionally, literature on market discipline is extended by determining the more dominant way through which depositors discipline banks (i.e., increased funding costs or deposit switch) in Nigeria. Market discipline exists when banks take up additional risks and depositors discipline them by either withdrawal of deposits and/or demand for higher risk premiums (Nys et al., 2015). To attain the objective of this study, annual bank-specific and macroeconomic variables are to serve as proxy for microeconomic and macroeconomic risks, respectively. Microeconomic risks,

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[1] Moral hazard would occur in the form of excessive risk taking by banks.

[2] Market discipline of banks may either be by depositors or regulatory authorities. This study focuses on discipline by depositors.

[3] It is however important to note that ex-ante funding and rules-based explicit guarantee do not suggest that they are invariant of risks taken by banks. Not all ex-ante funded DIS charge a flat rate as some use differential premium assessment (DPAS) with the rules-based guarantee and does not suggest compliance-based supervision. Many DIS use risk-based approach in their supervision, a non-focal point of this study.

which are specific to banks in this study, originate from daily banking operations and may take the form of credit, liquidity, or insolvency risks. Macroeconomic risks, as argued by Levy-Yeyati, Martinez Peria, and Schmukler (2010), may lead to deterioration of the overall condition of an economy and have adverse effect on bank assets including deposits.

Literature Review

The economic theory of deposit insurance shows that reduction in bank liquidity risk, via management efficiency, helps in reducing the probability of systemic risk occurrence in the banking sector in the interest of the public (Calomiris & Jaremski, 2016; Diamond & Dybvig, 1983; Nikolaj et al., 2022). Nevertheless, benefits accrued from deposit insurance also come with associated costs such as moral hazard and the reduction in market discipline resulting from increased risk-taking activities of banks that may destabilise the sector. This occurs when the incentives to monitor banks by depositors are reduced because of the existence of insurance. Consequently, signs of distress/failures that would have been evident if market discipline had been in place are concealed (Acharya & Thakor, 2016). Additionally, bank managers are emboldened to engage in excessive risk-taking because they are sure that losses arising from such activities would be borne by government (Berger & Turk-Ariss, 2015; Hett & Schmidt, 2017).

Extant studies on DIS indicate that market discipline and bank risk cut across single country and cross-country studies with each study revealing relevant information that guides research in the field of deposit insurance. Some of the studies investigated market discipline and the type of DIS in place and concluded that in countries where unlimited coverage largely exists, there is less market discipline i.e., there is less incentive for monitoring by depositors. One of such studies is Imai's (2006), which found that when coverage level was unlimited in Japan, depositors did not monitor nor punish risky banks. Contrarily, there was evidence of market discipline when coverage was limited, suggesting that discipling measures of depositors may be reduced in countries with substantial deposit insurance. Similarly, Nys et al. (2015) found that after the implementation of limited coverage DIS in Indonesia, political connection was a key factor in attracting bank deposits unlike when there was unlimited coverage.

The categorisation of deposits and bank size has also been shown to cause a change in the level of market discipline. Quintero (2019) investigated market discipline and deposit insurance coverage levels in Colombian banks and found no evidence of market discipline in two categories of banks. These were big banks ('too-big-to-fail') and banks with insured deposits. Contrarily, market discipline existed in banks who depended mainly on uninsured deposits which reduced when coverage was increased. The existence was ascribed to the presence of incentives necessary to monitor banks and prevent excessive risk-taking behaviour. Acharya et al. (2016) also observed the absence of market discipline (by depositors) in big banks in the United States of America because they were viewed as too big to fail and were less concerned with the inherent risk.

In terms of market discipline and bank risk, Thiagarajan, Ayyappan, and Ramachandran (2011) concluded that market discipline made privately owned banks in India to increase capital ratios to reduce interest expenses paid on deposits. Conversely, Lé (2013) found that apart from big banks, bank risk was increased through a reduction in bank capital in 117 countries with the introduction of deposit insurance. Karas et al. (2019) found an increase in moral hazard and reduced market discipline in the Russian banking sector. This result is indicative of Russian banks being incentivised to take on additional risks while depositors relax in the monitoring of banks' financial conditions knowing that their deposits are safe with the presence of the DIS. Ioannidou and De Dreu (2019) similarly showed evidence of Bolivian banks granting risky loans with high interests and high possibility of default, especially in banks with insured deposits. On one hand, depositors ensured firm market discipline in uninsured banks, and on the other hand, they overlooked insured banks' financial soundness even as their risk appetite increased. A similar conclusion was reached earlier by Calomiris and Jaremski (2016) in their microeconomic analysis of the implementation of deposit insurance schemes across the world, with the addition that removing market discipline led to an increase in the moral hazard problem.

There are a few attempts at investigating deposit insurance, market discipline and bank risk in Nigeria. One of such is Ebiaghan and Jeroh (2020) who examined the relationship between deposit insurance fund and risk assets in Nigerian banks, using aggregate macrolevel data and the auto-regressive distributed lag and the vector error correction approach. The study found that loans and total deposits had inverse relationship with deposit insurance fund and no relationship between asset quality and target reserve ratio. However, the use of aggregate data, as argued by Holderness (2016), does not control for bank-specific characteristics and may lead to false inferences about individual banks. The present study improves on the methodology by making use of bank-level data to provide more robust results to make meaningful inferences. A more related work is that of Yaaba, Shaba, and Ibrahim (2017) who investigated whether depositors disciplined banks in Nigeria during the

period of 2007 to 2016. They found that size and deposit categorisation indicated the existence of market discipline. This study extends the work of Yaaba et al. (2017) by using more recent data to determine the more dominant form of market discipline in Nigerian commercial banks (i.e., cost of funds or deposit growth). Furthermore, the potential effect of the 2007/2008 global financial crisis is removed by using post crisis data. Market discipline, as shown by literature, tends to appear during crisis periods but disappear during stable periods (Hett & Schmidt, 2017; Nikolaj et al., 2022). Another macro-level study is that by Igwe and Toby (2021) who investigated DIS and credit risks of banks in Nigeria between 1986 and 2019 with time series data. They found evidence that while variations in insured deposits may be due to variations in non-performing loans, an inverse relationship existed between insured deposits and bank distress. Nonetheless, the argument of Holderness (2016) on the use of macro-level data in making accurate inferences about individual economic units is applied to Igwe and Toby's (2021) conclusion.

Methods
Data
Financial institutions in Nigeria that participate in the deposit insurance scheme include commercial banks, merchant banks, microfinance banks and payment services banks. However, due to data availability, this study selected 15 commercial banks whose data were available during the study period. Panel data of the 15 selected banks for the study were collected from their published annual reports while macroeconomic data were obtained from World Bank Development Indicator (WDI) data base.[4] The period of study, which commenced in 2009 and ended in 2020, was chosen for two reasons. One was to avoid the 'disappearing and appearing' effect that might have occurred during the 2007/2008 global financial crisis and the second reason was data availability. The final data comprised of an unbalanced panel of 152 observations due to the inability to get data for some banks in some years. The use of panel data helps to control data heterogeneity related problems and omitted variable bias in the analysis (Brooks, 2008).
Variable Description and Measurement

Market Discipline (Dependent variable)
Extant literature shows that market discipline occurs when depositors ask for higher rates to compensate for additional risks undertaken by banks, i.e., level of risk should be commensurate with cost of fund. Consequently, banks that grant this request would incur extra costs in the form of increased interest expenses on deposits, thus serving as a form of disincentive to take on further risks (Afzal, Mirza, & Arshad, 2021; Anginer & Demirgüç-Kunt, 2018). Nevertheless, a third-party guarantee in the form of deposit insurance would make depositors worry less about the financial condition as well as the level of risk taken by the bank (Fernández-Aguado, Martínez, Ruíz, & Urena, 2022; Imai, 2006). Resultantly, a reduction in market discipline (which would dissuade banks from taking up additional risks) may pave way for moral hazard. Literature also shows that, in the presence of market discipline, depositors would move funds from one bank to another to take advantage of higher interest rates to match their risk appetite, i.e., deposit switch (Karas et al., 2019). Accordingly in this study, two proxies in extant literature are used to capture market discipline in order to investigate its existence and determine which of the two proxies is a better explainer of market discipline in the Nigerian banking sector. These are total interest expenses, which is measured as the natural logarithm of total interest expense (IE) paid to depositors (Demirgüç-Kunt & Huizinga, 2004; Fernández-Aguado et al., 2022; Imai, 2006) and growth rate of deposits, calculated as the annual rate of change in total deposits (DG) (Quintero, 2019; Trinugroho, Pamungkas, Ariefianto, & Tarazi, 2020). Market discipline would be determined from the statistical significance, sign and magnitude of the coefficient of risk variables.
Bank-specific and macroeconomic variables (Independent variables)

When market discipline exists, depositors are expected to be able to assess various risks inherent in the bank. Consequently, this study makes use of five indicators used in determining the financial soundness of banks as core independent variables for analysing banks' risk-taking behaviour. These are capital adequacy, asset quality, management quality, earnings and liquidity risk[5]. Capital adequacy (CAP) captures sufficiency of capital ratio of banks and may also be used as a solvency variable. It is expected that banks with higher capital ratios would bargain and offer lower interest rates on deposits because depositors are more concerned about the safety of their funds (Berger & Turk-Ariss, 2015). This implies that a negative coefficient is expected for interest expense

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[4] The beginning period of this study (2009) had 15 banks which reduced to 14 as at 2020 due to the merger of two of the banks in 2019.
[5] This is also known as the CAMEL rating system used by supervisory bodies to determine the overall condition of a bank.

variable while a positive coefficient is expected for deposit growth rate. Following previous studies such as Karas et al. (2019) and Hett and Schmidt (2017), a leverage ratio, expressed as the proportion of total capital to total assets, is used to measure capital adequacy. Asset quality (LLP) captures the performance of a bank's loan portfolio and its ability to recover loans from debtors. Banks with high proportions of non-performing loans indicate riskier banks with poor quality assets. Thus, in order to grow deposits, such banks would pay higher rates on deposits thereby incurring higher costs. In this study, the ratio of non-performing loans to total loans is used to measure asset quality (Afzal et al., 2021; Karas et al., 2019). A negative coefficient is expected for deposit while a positive coefficient is expected for interest expense. Management quality refers to the efficiency in operational activities that minimises cost and maximises returns. Management quality (EXP) in this study is measured as the ratio of total overhead costs to total income. High ratios are indicative of inefficiency in management and depositors would want to discipline banks by asking for higher rates which would translate to increased interest expenses (Trinugroho et al., 2020). A negative coefficient is expected for deposit growth rate and vice-versa for interest expense. Earnings (ROA) is proxied with the return on assets and shows managements' efficiency in utilising bank assets to earn profit. The presence of market discipline here, in the case of interest expense, would be indicated with lower earnings (negative coefficient) and would imply less risky and stable banks which use this advantage to offer lower interest rate, while for deposit growth rate, it would be a positive coefficient. ROA is calculated as the ratio of net income to average assets (Karas et al., 2019; Quintero, 2019). Liquidity (LIQ) is the extent to which banks can meet daily demand for deposits without running into problems such as bank runs. The ability of banks to meet liquidity demand as and when due, instils confidence in depositors. Thus, banks with high LIQ have lower funding costs (Afzal et al., 2021; Trinugroho et. al., 2020). A positive coefficient is expected for deposit growth rate and negative one for interest expense. The ratio of liquid assets to total assets is used to calculate LIQ. Bank size (SZ) is introduced to capture the 'too-big-to-fail' factor in this study and is measured as the natural logarithm of total assets (Imai, 2006; Quintero, 2019). Two macroeconomic variables, inflation (INF) and gross domestic product (GDP), are added into the equation because of their effect on overall economic activities including bank operations. During periods of economic boom, a rise in bank deposits is expected with consequential lower interest expenses due to competitive lower rates. Inflation is measured as the change in consumer price index, while gross domestic product is calculated as annual growth rate of real GDP (Afzal et al., 2021). Table 1 gives a summary description and measurement of variables.

Model Specification and Estimation Technique

This study adapts the model of Afzal et al. (2021) and specifies market discipline as a function of bank-specific and macroeconomic variables as given in Eq. (1)

$$MD_{i,t} = \alpha + \beta X_{i,t} + \varphi Y_{i,t} + \varepsilon_{i,t} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (1)$$

Where *MD* is market discipline, explanatory variables, *X*, are a set of bank specific variables and *Y* represents a set of macroeconomic variables, *i* is bank, *t* is time, ε is the error term.

Eq. (1) is further broken down into the two proxies used to capture market discipline as:

$$IE_{i,t} = \alpha_0 + \beta_1 CAP_{i,t} + \beta_2 LLP_{i,t} + \beta_3 EXP_{i,t} + \beta_4 ROA_{i,t} + \beta_5 LIQ_{i.t} + \beta_6 SZ_{i.t} + \beta_7 INF_{i.t} + \beta_8 GDP_{i,t} + \epsilon_{i,t} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

$$DG_{i,t} = \alpha_0 + \beta_1 CAP_{i,t} + \beta_2 LLP_{i,t} + \beta_3 EXP_{i,t} + \beta_4 ROA_{i,t} + \beta_5 LIQ_{i.t} + \beta_6 SZ_{i.t} + \beta_7 INF_{i.t} + \beta_8 GDP_{i,t} + \epsilon_{i,t} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(3)$$

Eq. (2) represents the model for interest expense while Eq. (3) is the deposit growth model. All variables are as described in Section 3.2 (Variable description and measurement).

Due to the panel nature of the data and to choose the most suitable method to estimate Eq. (2) and (3), a Breusch-Pagan – Lagrange Multiplier (BP-LM) test for heteroscedasticity with the null hypothesis of homoskedasticity of errors in regression is done. This helps in determining either the use pooled ordinary least squares (POLS) or generalised least square (GLS) regression technique. If the test result indicates that the GLS should be used, the Hausman test is done to select either of random effects (RE) or fixed effects (FE) methods. Furthermore, to validate the results before interpretation and discussion, the F-Statistics is used to check the overall significance of the regression model while the adjusted R^2 is used to determine how much variation in the dependent variable (market discipline) are due to bank-specific and macroeconomic variables in the

regression equation. In addition, to control for the likelihood of cross-section heteroskedasticity in the data if GLS method is used, White heteroskedasticity consistent standard errors are reported.

Table 1: Variable Definition and Measurement

Variable	Description / Measurement	Supporting Literature
Deposit growth (DG)	This serves as a proxy for market discipline and is measured as the annual rate of change in total deposits	Trinugroho et al. (2020); Quintero (2019)
Interest expense (IE)	This is another proxy used in measuring market discipline. It is calculated as the natural logarithm of interest expense paid to depositors.	Fernández-Aguado et al. (2022); Demirgüç-Kunt & Huizinga (2004)
Capital adequacy (CAP)	Capital adequacy is measured as debt-to-equity ratio	Karas et al. (2019); Hett & Schmidt (2017)
Asset management (LLP)	Asset management serves as the proxy for credit risk and is measured as the natural logarithm of loan-loss provisions	Karas et al. (2019); Afzal et al. (2021)
Management quality (EXP)	Management quality measures the extent to which the operations of the banks are being run efficiently in a way that minimises cost. It is calculated as the cost to income ratio	Trinugroho et al. (2020)
Earnings (ROA)	Earnings is proxied by the returns on assets and serves as a profitability variable (%)	Karas et al. (2019); Quintero (2019)
Liquidity (LIQ)	Liquidity refers to the risk inherent in maintaining liquid assets and it measured as the ratio of liquid assets to total assets	Afzal et al., 2021; Trinugroho et al. (2020)
Size (SZ)	Size is calculated as the natural logarithm of total assets	Calomiris and Jaremski (2016); Imai (2006); Quintero (2019)
Inflation (INF)	Inflation is measured as the annual price consumer index (%)	Afzal et al., 2021
Gross domestic product (GDP)	This is measured as the year-on-year growth rate of real GDP (%)	Afzal et al. (2021)

Results and Discussion

Table 2 reports the summary statistics of the variables. The means of ROA and DG are observed to be higher than their standard deviations, implying a high variation from the mean. This may be due to the negative values recorded in the data set and suggests the non-normality of the data, a common feature in corporate finance studies (Flannery & Hankins, 2013). Nonetheless, the use of the generalised least squares estimation technique addresses the issue.

Table 2: Summary Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
DG	4.9778	30.4861	-28.6189	268.7445
IE	13.8122	3.2371	6.9985	18.7793
CAP	15.8578	10.5149	2.5	97
LLP	12.8885	3.3512	5.5094	18.5463
EXP	62.3326	15.2409	14.1	92
ROA	1.2049	3.8291	-1.6169	26.78
LIQ	24.6616	25.0056	1.6344	96.4475
SZ	17.0537	3.1014	11.2319	21.9759
INF	11.1449	3.1859	5.3822	17.8634
GDP	4.8454	2.7899	-1.8	8.2109

The rest of the variables have means that are higher than the standard deviation and implies lesser variation around the mean. The negative minimum value of -1.8 recorded for GDP occurred in 2020 and may be attributed to the effect of the COVID-19 pandemic that affected most economies negatively world over. CAP has a mean of 15.86 implying that most of the banks are adequately capitalised with no negative values. Average INF value is observed to be in double digits and above the ideal rate of 2%. This implies that monetary policy regulators need to put in more efforts at lowering the inflation rate and bring it within the single digit bracket.

To detect the presence of multicollinearity in the dataset, the variance inflation factor (VIF) test is conducted. Appendix 1 shows the individual VIF value for each explanatory variable and the mean VIF as 1.2. The VIF values are less than 5 while tolerance values are greater than 0.25 suggesting that multicollinearity is not a problem (Salmerón, García, & García, 2018).

Having established that multicollinearity is not a problem, a Breusch-Pagan–Lagrange Multiplier (BP-LM) test was done to determine whether to use the POLS or the GLS regression technique. The results reported in Table 3 for IE and DG show that the null hypothesis of homoskedasticity of errors is rejected at 1% level of significance. This implies that GLS is the suitable method.

Table 3: BP-LM Test

Variable	χ^2	p-value	Hypothesis Decision
IE	126.58	0.000	Reject Ho (Pooled OLS is not an appropriate method to use for the analysis due to the presence of a significant difference across units i.e., the existence of a panel effect data heterogeneity.
DG	113.86	0.000	Reject Ho (Pooled OLS is not an appropriate method to use for the analysis due to the presence of a significant difference across units i.e., the existence of a panel effect data heterogeneity.

Subsequently, the Hausman test to choose between fixed effects or random effects is conducted. Table 4 reports the results and shows that fixed effect is the appropriate GLS method to use for both models. At 5% level of significance, the null hypothesis of difference in coefficients not systematic is rejected, indicating the presence of fixed effects. Econometric literature shows that the use of fixed effects estimation technique allows for control of time-invariant unobservable bank-specific effects (e.g., managerial ability, managerial motivation, etc.), thus removing any bias that may be due to omitted time-invariant features (Brooks, 2008). It also controls for heteroskedasticity and serial correlation in panel data (Wooldridge, 2002).

Table 4: Hausman Test

Variable	χ^2	p-value	Hypothesis Decision
IE	24.37	0.0020	Reject Ho (Fixed effects regression is appropriate i.e., difference in coefficients is systematic
DG	19.28	0.0038	Reject Ho (Fixed effects regression is appropriate i.e., difference in coefficients is systematic

Test: Ho: difference in coefficients not systematic

The fixed effect regression results are presented in Table 5 for both IE and DG in Panels A and B, respectively. In Panel A, the overall significance of the model shown by the F-statistics in Eq. (2) is at 1% level of significance, while that of Panel B (Eq. (3)) is at 10%, implying that the data fits the models. In addition, variations in market discipline are explained by 79.24% of the independent variables in Panel A when compared to that of Panel B's 32.95%. Furthermore, there are more statistically significant explanatory variables in Panel A than Panel B, as shown by individual t-statistics of the risk variables These three observations suggest that bank-specific and macroeconomic risk variables have more influence on market discipline when total interest expense is used as the proxy for market discipline. Consequent on this, the discussion of results is based on values reported in Panel A.

Table 5: Fixed Effects Regression

Variable	Panel A (IE)				Panel B (DG)			
	Coefficient	Std. Error	t-Statistics	p-value	Coefficient	Std. Error	t-Statistics	p-value
Cons	0.0469	0.0083	5.64	0.000	-13.2127	53.1151	-0.25	0.804
CAP	-0.0016	0.0074	0.21	0.831	0.3931	0.2593	1.52	0.134
LLP	0.5548	0.0502	11.05	0.000	-9.2685	1.7649	-5.25	0.000
EXP	0.0113	0.0098	1.15	0.255	-0.0241	0.3306	-0.07	0.942
ROA	-0.0731	0.02541	-2.88	0.006	0.6483	0.8898	0.73	0.469
LIQ	-0.0088	0.00497	-1.78	0.080	0.06516	0.1761	0.37	0.713
SZ	0.2653	0.0686	3.87	0.000	6.2446	2.4029	2.60	0.012
INF	0.0099	0.0334	0.30	0.768	1.4852	1.1316	1.31	0.194
GDP	-0.0742	0.0417	-1.78	0.080	0.8112	1.4365	0.56	0.574
F-statistics	29.10			0.000	1.74			0.073
R^2		0.7924			0.3295			
No of Observations		152			152			
N		15			15			

Panel A in Table 5 shows that asset quality (LLP), earnings (ROA), liquidity risk (LIQ), size (SZ) and gross domestic product (GDP) are the variables observed to have statistically significant effect on market discipline proxied by interest expense.   At 1% level of significance ($p<0.01$), Asset quality proxied by LLP, which captures banks' loan portfolio performance, has a positive effect on IE implying that when LLP increase by one unit, IE would increase by 0.5548 units. This indicates the presence of market discipline suggesting that increase in non-performing loans may send a signal to relevant stakeholders about the quality of the loan portfolio and as such, depositors may be wary of bringing in their funds. Thus, to attract deposits, the banks would offer higher interest rates on deposits, which would lead to increase in total interest expense. The result here is consistent with studies such as Calomiris and Jaremski's (2016) and Quintero's (2019).

The Earnings (ROA) coefficient also confirms the presence of market discipline through the statistically significant and negative sign (-0.0731; $p<0.01$). This implies that one unit change in ROA leads to 0.0731 decrease in interest expense. This, according to Quintero (2019), implies that banks with higher earnings are viewed as less risky, efficiently managed and more stable, an advantage used in offering lower interest rates to depositors. Thus, they are predisposed to accumulating lesser interest expenses. LIQ, which is the risk involved in meeting depositors demand, has the expected sign of a negative and statistically significant coefficient (-0.0088; $p<0.1$). This implies that IE would decrease by 0.0088 units with a unit increase in LIQ and suggests the presence of market discipline in line with previous studies such as Trinugroho et al.'s (2020) and Afzal et al.'s (2021). The "too-big-to-fail" fail syndrome is indicated by SZ with a positive and statistically significant

coefficient (0.2653; p<0.01). Larger banks can utilise economies of scale in risk diversification and attract more deposits, resulting in more interest being paid on deposits, which is consistent with the conclusions of Acharya et al. (2016); Afzal et al. (2021) and Imai (2006). Macroeconomic variable GDP has the expected coefficient sign and is statistically significant at 10% level of significance (-0.0742; p<0.1). As observed from literature, on one hand, a booming economy may increase bank deposits. On the other hand, it discourages payment of higher interest rates by banks because banks would not want to incur additional interest expense as argued by Afzal et al. (2021).

Overall, the results demonstrate the presence of market discipline, which is indicative of the economic theory of deposit insurance in the Nigerian banking sector with bank-specific characteristics (asset quality, earnings, liquidity, size) and macroeconomic variable (GDP) playing significant roles. More importantly, interest expenses (which reflects cost of funds to banks) is better at explaining the disciplining role of depositors in curbing banks' appetite for excessive risk taking through demand for higher interest rates.

Conclusion

This study examined the indicators of market discipline in Nigerian commercial banks. The fixed effects method of the generalised least squares technique was used to analyse an unbalanced panel data sourced from 15 banks for the period 2009 to 2020. The results suggest that bank size, asset quality, liquidity, earnings and gross domestic product are the indicators of market discipline in Nigerian commercial banks. Furthermore, the findings revealed that interest expense is a better proxy for market discipline than deposit growth and that depositors exert market discipline in Nigeria by demanding for higher interest rates on deposits, i.e., premium on deposits from commercial banks with risky profiles.

The results have some policy implications. The presence of market discipline implies that commercial banks need to moderate their risk-taking activities (especially for the variables found to be important; size, asset quality, liquidity, earnings and macroeconomic conditions), which may, in the long run, lead to increased management efficiency. This, as argued by economic theory of deposit insurance, would ensure that problems due to asset quality, liquidity and earnings are easily identified on time and corrective measures taken by bank management before the issues deteriorate and supervisory/regulatory authorities step in. This action would further lead to stability and increased confidence in the system. Secondly, having established that cost of funds (intertest expense) is a better proxy for market discipline, it is expedient for bank management to engage in regular cost/benefit analysis in order to offer competitive rates that would not overshadow its earnings to depositors.

The results of this study show that, for commercial banks in Nigeria, interest expense plays a more dominant role in market discipline than deposit growth. Thus, future studies may extend this work by investigating market discipline in other categories of deposit money banks that are covered under the deposit insurance scheme in Nigeria, such as microfinance banks, payment services banks, merchant banks etc. This would determine the applicability of the present study's conclusion to such category of banks. Further investigations may also be extended to explore if there are differences in bank-risk taking behaviour of Nigerian banks before and after the introduction of the deposit insurance scheme.

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Declaration of Interest

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Appendix 1: Multicollinearity Tests Results

Variable	VIF	Tolerance (1/VIF)
CAP	1.08	0.9301
LLP	1.26	0.7958
EXP	1.08	0.9233
ROA	1.08	0.9240
LIQ	1.03	0.9745
SZ	1.10	0.9067
INF	1.37	0.7302
GDP	1.56	0.6390
Mean VIF	**1.20**	