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FINANCIAL SOUNDNESS INDICATORS AND EFFICIENCY OF LISTED DEPOSIT MONEY BANKS IN NIGERIA.

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Abstract

The efficiency of a country's banking industry is key to the stability of its financial system. However, there has been an increasing scholarly debate on the factors that affect bank efficiency. Some scholars argue that efficiency is enhanced by mainly improvements in the strategic internal resources of a bank such as firm specific attributes like capital, assets, and liquidity while other scholars posit that industry wide factors and macroeconomic variables such as market structure and interest rate respectively are also integral to bank efficiency. Notwithstanding the divergent opinion, measuring bank efficiency using International Monetary Fund's core set of financial soundness indicators, which are firm specific attributes that stand for capital adequacy, asset quality, earnings, liquidity and sensitivity to market risk, has become widely accepted in finance literature. Using bank-level analysis approach, this paper assesses the effect of financial soundness indicators on efficiency of listed deposit money banks in Nigeria for the period 2010-2018. The paper, which applies correlational research design, uses firm-level secondary data extracted from the annual reports and accounts of 14 out of the 22 licensed banks as at 31st December, 2018. The robust fixed effect regression result used for analysis shows that overall; the core set of financial soundness indicators has significant effect on efficiency of deposit money banks in Nigeria for the period under review. At the level of individual components, all the variables except asset quality have significant effect on efficiency though the direction of the relationship between efficiency and both capital adequacy and profitability is not in line with theoretical expectation. The paper recommends amongst other things that bank management should continue to use financial soundness indicators in benchmarking the efficiency of their operations.

Keywords: deposit money banks; efficiency; finance; financial crisis; financial intermediation; financial soundness indicators; Nigeria

JEL: G01 & G28

1. Introduction

Since the 2007 financial crisis that drastically affected the global economy, banking regulators across the globe have been focusing attention on monitoring the entire financial system to ensure its stability and soundness as well as how to recognise and arrest early warning signals of potential bank financial unsoundness. At the onset of the crisis therefore, banking supervisors in many countries have promoted financial soundness by requiring banks to boost capital, enhance quality of assets and increase liquidity (Che & Shinagawa, 2014; Parrado-Martínez et al., 2014). The decision was predicated upon the belief that a strong relationship exists between financial soundness and safety of banks.

In line with the Financial Sector Assessment Program that International Monetary Fund (IMF) and World Bank jointly launched in 1999, the IMF developed and compiled a set of financial soundness indicators (FSIs) in 2000 to serve as a tool, which financial regulators could employ to monitor the soundness of financial systems. Sundararajan et al. (2002:2) defined FSIs as indicators compiled to monitor the health and soundness of financial institutions and markets,

and of their corporate and household counterparts. The indicators include both aggregated information on financial institutions and indicators that are representative of markets in which financial institutions operate. At macroeconomic level, the indicators include both FSIs and other indicators that support the assessment and monitoring of the strengths and vulnerabilities of financial systems, notably macroeconomic indicators.

According to IMF (2006), FSIs are classified into core and encouraged sets of financial indicators. The core set of the indicators comprises capital adequacy, asset quality, earnings and profitability, liquidity, and sensitivity to market risk, which are based on CAMELS financial indicators (Sundararajan et al., 2002; Restoy, 2017) except for the exclusion of management efficiency in FSIs. The encouraged FSIs are financial ratios that include geographical distribution of loans to total loans, gross asset position in financial derivatives to capital, gross liability position in financial derivatives to capital, trading income to total income, personnel expenses to non-interest expenses, spread between highest and lowest interbank rate, and customer deposits to total (non-interbank) loans (IMF, 2006).

Capital adequacy is one of the prominent indicators of the financial soundness of a bank. It is the percentage ratio of a financial institution's primary capital to its assets that measures its financial strength and stability (Wapmuk, 2016). It is a measure of a bank's available capital expressed as a percentage of its risk-weighted credit exposures (Federal Deposit Insurance Corporation - FDIC, 2019). It is used to protect depositors and promote the stability of financial systems.

Asset quality is critically considered in determining the overall condition of a bank. It is described as the evaluation of a bank's assets to determine the risk associated with its lending activities and measure the price at which a bank or other financial institution can sell a loan (FDIC, 2019). It is an important parameter and a gauge that is used to ascertain the component of non-performing assets as a percentage of the total assets (Habib et al., 2014).

Earnings represent the prime source of increasing capital of a bank. It constitutes the profit a bank is able to generate from its operations (Rai, 2012) and serves as the initial safeguard against the risks of its engagement in business as well as the first line of its defence against capital depletion resulting from shrinkage in asset value (Habib et al., 2014). Strong earnings and profitability profile of a bank reflect its ability to support present and future operations, and increased earning ensures adequate capital and adequate capital can absorb all losses and give shareholder adequate dividends.

Liquidity represents a bank's ability to fund assets and meet its financial obligations as they come due (FDIC, 2019). An adequate liquidity position refers to a situation, where an institution can obtain sufficient funds, either by increasing liabilities or by converting its assets quickly at a reasonable cost. It is considered as an important criterion for financial soundness in banking business as it shows the degree to which a bank is capable of fulfilling its obligations as they fall due. It is assessed in terms of assets and liability management (Demyanyk & Iftekhhar, 2009; Idris, 2010).

Sensitivity to market risk is directly related to unpredicted fluctuations in market prices and closely associated with asset and liability management (Abdallah, 2013). FDIC (2019) defined it as the extent to which changes in interest rates, foreign exchange rates, commodity prices, or equity prices could negatively affect the earnings or capital of a financial institution. It focuses

mainly on the ability of a bank to recognise, monitor, manage and control the market risk and give indication to management for the supervision in the problematic area.

One of the expectations regarding FSIs is that once properly managed by banks and monitored by regulators, the banking system will be sound, safe and more efficient (Wapmuk, 2016). Efficiency is described as a performance level that explains a process that uses the lowest amount of inputs to create the greatest amount of outputs. In banking, it reflects a sound intermediation process that makes banks contribute to economic growth (Shaddady, 2017). The degree of efficiency of banks is key to the stability of the financial system of any economy.

There has been an increasing scholarly debate on the factors that affect bank efficiency. Some scholars have argued that efficiency is enhanced by mainly improvements in the strategic internal resources of a bank such as firm specific attributes. Other scholars argued that industry wide factors and macroeconomic variables are integral to bank efficiency. Notwithstanding the divergent opinion, a number of strategic firm internal resources and key financial indicators have been widely acknowledged as factors that affect the efficiency of banks (Ehimare, 2013).

Extant literature has documented different methods of and approaches to measuring the efficiency of banks. One of such approaches is the frontier analysis method, which involves separating banks that perform better, in relation to a specific benchmark, from those that perform poorly by applying either a parametric or non-parametric frontier analysis to the banks. Apart from frontier analysis method, use of accounting ratios and financial indicators such as risk rating, banking productivity per employee hour and interest margins has also been widely documented (Ehimare, 2013).

Of the accounting measures that have been popularly used to represent efficiency in previous determinants studies, efficiency ratio (ER) stands unique. As a financial ratio, ER measures the level of a bank's non-interest expenses also called overhead expenses that is needed to support both interest income and non-interest or fee income. It is generally viewed as a popular ratio for evaluating the performance of banks partly because it reflects both on and off balance sheet activities (Shaddady, 2017). As a general rule, a lower ER for a bank is better and therefore preferred to a high ratio.

With increasing emphasis on reform of the Nigerian banking industry since the global financial crisis of 2007, it is important to examine the influence of FSIs on efficiency of banks in the country. This paper therefore assesses the effect of FSIs on efficiency of DMBs in Nigeria for the period 2010-2018. It hypothesises that FSIs do not have significant effect on the efficiency of DMBs in the country.

The paper organises its contents in five (5) sections. Section 2 reviews empirical literature on FSIs and bank efficiency. Section 3 explains the dataset and techniques of data analysis. Section 4 analyses the regression results. Section 5 concludes the paper and offers some suggestions.

2. Review of Empirical Studies

Babihuga (2007) examined the relationship between some selected macroeconomic variables and FSIs using panel dataset of FSIs for 96 countries for the period 1998-2005. The study used capital adequacy, asset quality and profitability to represent FSIs and a number of key macroeconomic indicators. The result showed that FSIs fluctuate strongly with both the business

cycle and the inflation rate. The result also revealed that short term interest rates and the real exchange rate significantly affect the relationship between macroeconomic variables and FSIs.

Shajari and Shajari (2012) examined the relationship between three FSIs of asset quality, capital adequacy and profitability, and selected key macroeconomic, bank-specific, and structural variables in Iran's banking system. The results showed that business cycle significantly influenced asset quality and capital adequacy while interest rate negatively affected asset quality. The result also showed that short term deposit interest rate and changes in the exchange rate significantly affect capital adequacy while inflation rate and NPLs ratio affect profitability of Iranian banks. Also, Oyuntsatsral and Mukhzaya (2012) examined the relationship between some FSIs and corporate governance index of Mongolian financial system from the first quarter of 2000 to fourth quarter of 2011. The findings showed that Mongolian financial sector during the study period had been unsustainable. Both studies did not cover all the five FSIs. Their findings would not have been the same if they had used all the indicators as used in this study.

Navajas and Thegeya (2013) assessed FSIs effectiveness in predicting banking crises by testing whether FSIs, broad macroeconomic indicators and institutional indicators can predict banking crisis. The study used an IMF based dataset of homogeneous indicators comparable across many countries over the period 2005 to 2012 and applied multivariate logit models for the analysis. The results showed a significant correlation between some FSIs and the occurrence of systemic banking crises. On their part, Kasselaki and Tagkalakis (2013) examined the relationship between FSIs and financial crisis using IMF's dataset on aggregate capital adequacy, asset quality and bank profitability indicators for 20 OECD countries. The paper found that in times of severe financial crisis, capital adequacy increases; asset quality represented by the ratio of non-performing loans (NPLs) to total loans also increases. In contrast, loan loss provisions lag behind NPLs while profitability deteriorates dramatically. The focus of the two aforementioned studies was on financial stability. In many jurisdictions, it was found that efficiency of banking industry or lack it serves as the precursor to financial stability. Therefore, while the studies used some FSIs, they did not consider efficiency as one of their variables.

Using the dataset of 94 banks operating in Arab Gulf Cooperation Council (GCC) countries, Al-Muharrami (2015) investigated the effect of FSIs on financial stability of Arab GCC deposit takers for the period 1999-2013. The results indicated that asset quality, capital adequacy and liquidity significantly influence the health of the Arab GCC financial sector. Albulescu (2015) examined the influence of financial soundness indicators on the profitability of banks in a set of emerging countries using IMF monthly data for the period 2005-2013. The result of the panel data analysis showed that NPLs have negative effect on banks' profitability. It also showed that liquidity has a mixed influence while capitalisation and interest rate margins have positive effect on the profitability of the banks. The result further revealed that non-interest expenses negatively affect profitability. The studies were carried out in different countries that have different regulations. Their findings may not therefore apply to Nigeria.

Asian Development Bank (2015) carried out a trend analysis of financial soundness indicators in Bangladesh. The review, which considered all the core set and encouraged set of FSIs, concluded that FSIs need to be improved in the country. It also showed that while some of the core set of indicators are doing well, a lot of work need to be done regarding the encouraged set. On their part, Ini et al. (2015) used quarterly data to evaluate the effect of FSIs on financial stability in Nigerian financial system for the period 2007-2015. The study, which applied correlation

analysis technique, found a downward trend for all the indicators during the period covered. The exclusion of liquidity and sensitivity to market risk from the core set of FSIs covered by the study has made the findings not generalisable to the entire gamut of IMF's core set of FSIs.

Chang (2016) assessed the relationship between FSIs, financial cycle, credit cycle and business cycle in Taiwan financial system using cyclical behaviour based quarterly data on indicators of real economic activity, lending and prices of assets. The study also calculated concordance index to examine the degree of synchronization among the cycles. The probit estimation result shows that expansion and contraction phase of financial, credit and business cycle is enhanced during the period of the study. Also, Yaaba (2016) examined the dynamic linkages between FSIs and selected macroeconomic variables in Nigeria using quarterly data for the period 2007-2015. The result of the autoregressive distributed lag approach indicated that overall, macroeconomic events significantly affect the state of health of the Nigeria financial system. With regard to specific FSIs variables, the study found that changes in the level of economic activities negatively affect capital adequacy and positively affect asset quality and profitability. On their part, Masud and Haq (2016) analysed the financial soundness trend of selected Bangladesh banks using different statistical tools and financial indicators for the period 2006-2014. The study showed that different financial indicators exhibited upward trends during the period covered. In terms of ranking of the financial indicators used, the study found that higher deposits, loans and advances, investments, branches, employees do not necessarily translate into higher profit of banks in Bangladesh.

Rahman (2017) assessed the financial soundness of twenty-four private commercial banks in Bangladesh for the period 2010-2015 using Bankometer model that was developed according to the IMF's guidelines for measuring bank financial soundness. The study found that all the banks have ensured sound financial status individually and the industry as a whole has been in a favourable position throughout the period of the study. Though the study was on financial soundness, the variables covered were not the same with FSIs.

Fapohunda and Eragbhe (2017) examined the impact of regulation, financial development and financial soundness on performance of banks in Nigeria for the period 1985-2015. The study employed multivariate OLS, co-integration analysis and associated error correction model. The results of the various analyses revealed that cash reserve ratio, monetary policy rate, financial developments and financial soundness significantly affect bank performance both in the short run and long-run. The study is comprehensive except that a lot of changes and reforms had occurred in Nigeria's financial system between 2016 and 2018 due to economic recession and other global happenings, which were not captured by the study.

Talibong and Simiyu (2018) examined the effect of FSIs on the financial performance of deposit taking microfinance banks in Kenya. The study assessed the influence of capital adequacy, asset quality, sustainability financial cover, liquidity and investment growth on financial performance of 13 banks using causal research design for the period 2012-2017. The result obtained from the multiple regression run showed that capital adequacy, asset quality, liquidity, sustainability financial cover and investment growth explained 68.43% of the variation in financial performance of the banks while the combined effect of the explanatory variables used in the study is statistically significant. In terms of individual variables, the study found that capital adequacy, liquidity and investment growth have significant positive effect on financial

performance of the banks while asset quality and sustainability financial cover have significant negative effect.

Jesuwunmi et al. (2019) examined the effect of capital adequacy, liquid asset and leverage ratios on financial performance of 16 deposit money banks in Nigeria for the period 2010-2017. The study, which adopted ex post factor design, used return on asset, asset quality, expense-revenue and return on equity to represent financial performance. The findings showed that capital adequacy, leverage and liquid asset ratios have significant effect on DMBs in Nigeria. It also showed that there is no significant difference in the financial soundness proxy's prediction of international and national deposit money banks' financial performance surrogates used in the study except in the case of asset quality which shows significant difference. The study used some of the firm-specific variables, which formed the basis of FSIs. However, because its focus was not on FSIs, sensitivity to market risk was excluded from the study.

Yakubu et al. (2020) examined the relationship between financial soundness of Nigeria's banking sector and macroeconomic performance using balanced quarterly data for the period 2007-2018 extracted from various sources domiciled in the Central Bank of Nigeria. The study applied autoregressive distributed lag approach to examine the dynamic linkages between FSIs and key macroeconomic variables. The result indicated a strong relationship between financial soundness indicators and macroeconomic variables. Though the study covered all the essentials of FSIs, its focus was not on efficiency.

There are also empirical studies on determinants of bank efficiency. However, the studies mostly focused on firm-specific variables and few other studies included some macroeconomic variables. This means, their studies are different from the present study, which focused on IMF's FSIs and efficiency of banks in Nigeria. For example, Muazaroh et al. (2012) assessed the factors that determine Indonesian banks' profit efficiency from 2005 to 2009 using Stochastic Frontier Analysis (SFA) and scores-based regression technique. The findings indicated that the score-efficiency of Indonesian banks is inefficient. The result further showed that size, capital, ownership structure and market share significantly affect bank profit efficiency.

Řepková (2015) assessed the determinants of efficiency in the Czech banking sector for the period 2001-2012 using Data Envelopment Analysis. The analysis revealed that on one hand, level of capitalisation, liquidity risk and riskiness of portfolio have significant positive effect on the efficiency of banks in Czech. On other hand, return on assets (ROA), interest rate and GDP are found to have significant negative effect on efficiency of the banks. The result showed that the effect of other determinants used in the study on bank efficiency were not statistical significant.

Kamarudina et al. (2017) examined the efficiency of 29 domestic and foreign Islamic banks from Malaysia, Indonesia and Brunei for the period of 2006-2014. The study employed Data Envelopment Analysis (DEA) method to measure efficiency, and applied t-test, Mann-Whitney Wilcoxon and Kruskal-Wallis tests to test for difference in the efficiency of the two types of banks. The analysis revealed that domestic Islamic banks have higher efficiency levels compared to their foreign peers.

Batir et al. (2017) applied Tobit regression to examine the determinants of efficiency among Islamic and conventional banks in Turkey for the period 2005-2013. The sample of the study consists of 4 Islamic banks and 27 conventional banks. The analysis showed that expenses and

loan quality have significant negative relationship with efficiency of conventional banks, and significant positive relationship with the efficiency of Islamic banks. The analysis also revealed that total loans have a significant positive relationship and external variables have significant negative relationship with the efficiency of both types of the banks.

Zeb and Sattar (2017) assessed the effect of profit efficiency on financial stability of commercial banks in Pakistan for the period 2008-2014 using Data Envelopment Analysis (DEA) to gauge the dependent variable and panel regression to estimate the effect of financial regulations on both efficiency and financial soundness. The study found that the ratio of NPLs to assets and reserve ratio have positive effect on profit efficiency of the banks whereas; liquidity ratio and the ratio of loans to deposits have significant negative affect.

Miah and Uddin (2017) examined the business orientation, stability, and efficiency of 48 conventional banks and 28 Islamic banks in the Gulf Cooperative Council (GCC) countries for the period 2005-2014. The paper applied both Stochastic Frontier Analysis (SFA) and regression methods to analyse the data collected for the study. The analyses showed that while conventional banks are more efficient in managing cost than their Islamic banks, the latter is more solid in terms of short-term solvency than its conventional counterparts. The analyses also revealed that highly capitalised banks are more stable but cost inefficient.

Banya and Biekpe (2018) investigated the determinants of banking efficiency in ten frontier African countries using bank-level panel data set for the period 2008-2012. The study employed DEA technique to estimate technical, pure technical and scale bank efficiency, and Simar and Wilson (2000)'s truncated bootstrapping approach to analyse the determinants of banking efficiency in the sample countries. The analysis showed that the banking sectors of the sampled countries are to a greater extent efficient. The results of the truncated bootstrapping regression revealed that while size has negative effect on efficiency of the banks, the degree of risk affects it positively.

Sulaeman et al. (2019) examined the factors that affect efficiency of banks in Indonesia using quarterly data extracted from financial statements for the period 2013-2017. The study employed Tobit regression technique to examine the effect of FSIs related ratios on operational efficiency of the sampled conventional and Islamic commercial banks in the country. The analysis revealed that asset quality, earnings, capital adequacy ratio and economic growth have significant positive effect on the banks' efficiency.

Lotto and Papavassiliou (2019) assessed that factors affecting operating efficiency of 36 commercial banks in Tanzania for the period 2000-2017. The study used bank-specific variables of capital adequacy, asset quality, earnings, liquidity and size to represent the independent variables. The robust random-effect regression results showed that bank liquidity, capital adequacy and profitability have a positive relationship with bank operating efficiency.

3. Methodology

This paper applies correlational research design to assess the effect of financial soundness indicators on efficiency of DMBs in Nigeria. The population consists of all the 22 DMBs operating in the country as at 31st December, 2018 (CBN, 2018). A filter was introduced to exclude banks that do not have audited financial reports for the entire period of the study (2010-2018). Based on the filter, Diamond Bank, Heritage Bank, Jaiz Bank, Keystone Bank, Pollaris Bank, Providus Bank, Standard Chartered Bank and Suntrust Bank were excluded due to

unavailability of the complete data needed for the study. Some of the excluded banks such as Providus and Suntrust started operation less than five years ago. Jaiz Bank has only seven years financial statements because it started operation in 2012 while Pollaris, Keystone and Heritage do not have the minimum required financial statements because they are part of mergers and acquisition that led to change of name from their original names. Standard Chartered Bank does not have a separate financial statement for its operations in Nigeria. The remaining 14 banks; Access Bank, Citibank Nigeria, Ecobank Nigeria, Fidelity Bank, First Bank of Nigeria, First City Monument Bank, Guaranty Trust Bank, Stanbic IBTC Bank, Sterling Bank, Union Bank of Nigeria, United Bank for Africa, Unity Bank, Wema Bank and Zenith Bank constituted the adjusted population of the study, which were studied based on census approach.

The study extracts bank-level secondary data from the annual reports and accounts of the banks for the nine-year study period (2010-2018), which translated into 126 balanced panel observations for each of the study variables. The data were analysed using relevant descriptive and inferential statistical techniques. The study has one dependent variable, efficiency ratio (EFCY) and five independent variables: capital adequacy (CAAD), asset quality (ASTQ), earnings (ROAS), liquidity (LQDT) and sensitivity to market risk (SMKR) representing FSIs. The study also controlled for size (SIZE) to capture the effect of different sizes and scope of operation of the banks.

In line with Jesuwunmi et al. (2019), Lotto and Papavassiliou (2019) and Sulaeman et al. (2019), the mathematical relationship between the dependent and explanatory variables based on multiple regression technique is given as:

$$EFCY_{it} = \beta_0 + \beta_1 CAAD_{it} + \beta_2 ASTQ_{it} + \beta_3 ROAS_{it} + \beta_4 LQDT_{it} + \beta_5 SMKR_{it} + \beta_6 SIZE_{it} + \varepsilon_t$$

Where: β_0 - β_6 represent the parameters of the model to be estimated, ε is the disturbance error term while subscripts i and t represent bank and year respectively.

There are several measures of efficiency documented in the literature. In this study, efficiency is measured using efficiency ratio (ER). The ratio is calculated as a bank's non-interest expense divided by its total income.

The literature has documented several ratios for measuring capital adequacy. The risk weighted capital to total risk weighted assets ratio is preferred in this paper in view its superiority to other measures because it focuses on the core capital of a bank as a ratio of its assets that are risk based (Aspal & Dhawan, 2016). The risk weighted capital includes both Tier 1 and Tier 2 capitals. Tier 1 capital is a bank's core capital that consists of shareholders' equity and retained earnings while Tier 2 is a bank's supplementary capital that includes un-disclosed reserves, subordinated term debts, hybrid financial products, and other items.

There are many measures of asset quality of banks. Notwithstanding the different measures however, in this paper, the ratio of NPLs/TA is preferred because the core business of banks is lending and banks' lending activities. Since a bank's asset quality measures how well credits are created, managed and recovered, benchmarking non-performing loans with total assets is preferred.

Different financial and non-financial measures are used to represent earnings. Of the numerous financial measures that are commonly found in the literature, return on assets (ROA) and return on equity (ROE) are the most popular ratios utilised. In this paper, ROA, which is defined as the

ratio of a bank's profit before tax (PAT) to its total assets is used because unlike ROE, the ratio of ROA captures financial leverage and the risks associated with it.

Liquidity is measured using a number of financial ratios. Of the different ratios used, the ratio of total loans and advances to total deposits (TLA/TD) that measures the liquidity available to the total deposits of a bank is preferred. This is because as a deposit run-off ratio, the ratio shows a bank's ability to continuously use its deposits and short term liquidity position to meet its customer needs and short-term liabilities (Wapmuk, 2016).

In this paper, sensitivity to market risk is measured in line with the suggestion of Wapmuk (2016). According to him, the ratio of net interest income to average total assets is a good proxy for sensitivity to market risk. The ratio shows the relationship between the total loans portfolio of a bank and its assets. It also provides the percentage change of the portfolio in changes related to interest rates or other issues related to financial intermediation activities of the bank.

4. Analysis and Interpretation

The summary of the descriptive statistics of the variables used is presented in Table 1. The statistics provide information on the dataset in terms of its distribution and features.

Table 1: Summary of Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
EFCY	126	0.058	0.039	0.010	0.198
CAAD	126	0.314	0.095	0.014	0.654
ASTQ	126	0.142	0.055	0.036	0.302
ROAS	126	0.848	0.256	0.207	2.464
LQDT	126	0.810	0.148	0.194	1.000
SMKR	126	0.249	0.095	0.105	0.786
SIZE	126	5.890	0.446	4.860	6.597

Source: Authors' extraction from output generated by Stata

Table 1 shows the summary of the descriptive statistics for the variables of the study. The mean value for efficiency (EFCY) is 0.058 while the standard deviation is 0.039. The mean lies between the minimum and maximum values of 0.010 and 0.198 respectively. The standard deviation of 0.039 indicates absence of wide dispersion of the dataset from the mean. Capital adequacy (CAAD) reported a mean value of 0.314. The minimum and maximum values are 0.014 and 0.654 respectively. The standard deviation of 0.095 suggests a wide dispersion of the value from the average.

Asset quality (ASTQ) reported minimum and maximum values of 0.036 and 0.302 respectively. A cursory look at the values indicates a very wide gap between the two values. This may be as a result of different asset sizes of the banks in relation to their non-performing loans (NPLs) or perhaps a sharp rise (decrease) in NPLs of banks. The average value is 0.142 while the standard deviation is 0.055. The standard deviation also corroborates the wide gap observed between the lower and upper values.

Earnings (ROAS) has a mean value of 0.848 and standard deviation of 0.256 while the minimum and maximum values are 0.207 and 0.464 respectively. The minimum value for liquidity (LQDT) is 0.194 while the maximum value is 1.000. This indicates a very wide gap between the two values. The mean value of the dataset is 0.810 while the standard deviation is 0.148. The

value of the standard deviation indicates a wide dispersion between the standard deviation and average value of the dataset.

Sensitivity to market risk (SMKR) has an average value of 0.249. The standard deviation of the variable is 0.095 while the minimum and maximum values are 0.105 and 0.786 respectively. On one hand, the mean and standard deviation values indicate narrow dispersion between the two statistical measures. On other hand, the values suggest that all the observations, except very few, fell within the average value. The control variable, size (SIZE) has a mean value of 0.5.890 and standard deviation of 0.446. Its minimum and maximum values are 4.860 and 6.597 respectively.

Table 2 reports the Pearson correlation coefficient among the variables of the study.

Table 2: Correlation Matrix

	EFCY	CAAD	ASTQ	ROAS	LQDT	SMKR	SIZE
EFCY	1.0000						
CAAD	0.1048	1.0000					
ASTQ	0.1028	-0.0066	1.0000				
ROAS	-0.0938	0.1032	-0.2479	1.0000			
LQDT	-0.1674	-0.3153	-0.0694	-0.0471	1.0000		
SMKR	-0.0685	-0.1142	-0.0278	-0.3311	0.0690	1.0000	
SIZE	0.6387	0.4135	-0.0531	0.1743	0.1394	-0.3542	1.0000

Source: Authors' extraction from output generated by Stata

From the correlation coefficients contained in table 2, the correlation between EFCY on one hand and each of CAAD, ASTQ and SIZE is positive based on the correlation values of 0.1048, 0.1028 and 0.6387 respectively. This implies that the variables are positively correlated with efficiency of DMBs in Nigeria within the period of this study and that an increase in CAAD, ASTQ and SIZE will potentially lead to a corresponding increase in EFCY. On other hand, ROAS, LQDT and SMKR have negative relationship with EFCY. The coefficient values stand respectively at -0.0938, -0.1674 and -0.0685, which imply that an increase in ROAS, LQDT and SMKR will potentially lead to a corresponding decrease in EFCY. The table also reports a weak form of correlations amongst all the explanatory variables.

Generally, correlation coefficient of less than 0.7 amongst explanatory variables is considered as moderate correlation, which is of harmless effect (Greene, 2012) though for the purpose of estimation, weak relationship amongst explanatory variables is preferred to strong relationship because it points to possible absence of collinearity. On the contrary, strong correlation is expected between the outcome variable and each of the explanatory variables because it serves as a pointer to the explanatory power of the variables.

The dataset was subjected to several relevant diagnostic and robustness tests such as the Breush-pagan/Cook-weigberg test for heteroskedasticity, variance inflation factor (VIF) test and its corresponding tolerance values (1/VIF) test for checking multicollinearity, and Hausman specification test. The full results of all the tests are attached as appendix. The result of the Hausman specification test for choosing between fixed (FE) effect and random effect (RE) models reveals a probability of the Chi² value that is statistically significant, thus favouring the FE model. The Modified Wald test for groupwise heteroskedasticity in FE regression model was then carried out. The result shows a Chi² probability value that is statistically significant. In view

of that, the FE regression model was re-run using robust option. The robust FE result is used for analysis and test of hypotheses.

Table 3 contains the summary of the FE, RE and robust FE regression results obtained from the Stata output. The aspects of the robust FE result are used for analysis and hypotheses testing.

Table 3: Summary of Fixed Effect, Random Effect and Robust Fixed Effect Results

Fixed Effect Model				Random Effect Model			Robust Fixed Effect Model		
Variable	Coef.	T	P> t	Coef.	Z	P> z	Coef.	T	P> t
CAAD	-0.116	-4.480	0.000	-0.163	-6.120	0.000	-0.116	-3.530	0.004
ASTQ	0.049	1.130	0.260	0.063	1.610	0.107	0.049	1.200	0.252
ROAS	-0.035	-4.220	0.000	-0.023	-2.550	0.011	-0.035	-3.700	0.003
LQDT	-0.113	-7.620	0.000	-0.117	-7.380	0.000	-0.113	-5.580	0.000
SMKR	0.077	3.220	0.002	0.087	3.510	0.000	0.077	2.890	0.013
SIZE	0.078	11.22	0.000	0.085	14.60	0.000	0.078	6.730	0.000
_CONS	-0.272	-6.710	0.000	-0.307	-8.750	0.000	-0.272	-3.800	0.002
		F. Stat.	34.13		Wald	232.3		F. Stat.	29.8
		Prob> F	0.000		Prob.	0.000		Prob> F	0.000
	R ²	Within	0.65	R ²	Within	0.64	R ²	Within	0.65
		Between	0.62		Between	0.69		Between	0.62
		Overall	0.64		Overall	0.66		Overall	0.64
	Hetttest Chi ²	7.34			Hausman Chi ²	39.76		Modified Wald Chi ²	10436
	Prob.	0.000			Prob.	0.000		Prob.	0.000

Source: Authors' extraction from STATA Output

From Table 3, the F-statistics, which indicates whether the model is fitted or not, is 29.8 while the p-value is 0.000, which is statistically significant at 1% level of significance. This shows that overall; the robust FE model is fitted. The predicting power of the model is 65% based on the R² value within and R² values of 0.62 and 0.64 for between and overall respectively. This means that the combined effect of the explanatory variables explained changes in the dependent variable by 65% while the remaining 35% is explained by variables not included in the model.

The table further reveals the coefficients, t-values and p-values of each of the explanatory variables. From the result, capital adequacy (CAAD) has a coefficient value of -0.116 and t-value of -3.530. The p-value (0.004) shows that the negative relationship between CAAD and EFCY is statistically significant at 1% level of significance. The result is neither in line with theory nor in line with a priori expectation because regulators used the ratio of total capital, which comprises both Tier 1 and Tier 2 capital, to risk-weighted assets to grade banks' capital adequacy as either capitalised or under-capitalised. In view of that, a higher positive CAAD ratio is better for a bank since it indicates that a bank can absorb shocks, sustains its operations and even expand its activities for higher efficiency. Where the coefficient turns out to be negative, it means the relationship is inverse and that the higher the CAAD is, the lower a bank's efficiency is.

Asset quality (ASTQ) has a positive coefficient of 0.049 and t-value of 1.200. The coefficient and t-value showed that the relationship between ASTQ and efficiency is not statistically significant based on the p-value of 0.252. Theoretically, the ratio of non-performing loans to total assets negatively affects a bank's efficiency. This is because high NPL leads to loan loss provisions that in turn increases total operating expenses and consequently results in a decline in a bank's net income. Based on the result obtained herein, ASTQ relates with EFCY in the same direction, which suggests that the higher the ASTQ, the higher the operating expenses and consequently the lower the level of efficiency.

Earnings (ROAS) variable reports a coefficient value and t-value of -0.035 and -3.700 respectively. The negative relationship is statistically significant at 1% level of significance based on the p-value of 0.003. The result implies that the relationship between ROAS and EFCY is inverse in the sense that higher ROAS will potentially lead to lower efficiency. This is not in line with the theoretical expectation or a priori expectation. Theoretically, the ratio of profit after tax to total assets should positively affects efficiency because it is believed to depict the ability of a bank to generate earnings from its assets in such a way that an increase in ROAS will eventually lead to an increase in efficiency (Wapmuk, 2016).

Liquidity (LQDT) also reports a negative relationship with efficiency of DMBs in Nigeria that is statistically significant at 1% level of significance. This is based on the coefficient value of -0.113 and t-value of -5.580. The direction of association between LQDT and EFCY is consistent with theory. This is because liquidity ratio as measured in this paper indicates what percentage of a bank's assets is tied up in loans. Accordingly, the higher the ratio, the less liquid a bank is.

Sensitivity to market risk (SMKR) reports a positive relationship with efficiency of DMBs in Nigeria that is statistically significant at 5% level of significance. The coefficient value of 0.077 and t-value of 2.890 implied that the direction of association between SMKR and EFCY is consistent with theory and a priori expectation. The ratio of net interest income to average total assets used for sensitivity to market risk positively affects bank.

The control variable, SIZE has a positive coefficient value of 0.078 and t-value of 6.730. The relationship, which is in line with both theory and a priori expectation, is statistically significant based on the p-value of 0.000. This means the higher the size of a bank the higher its level of efficiency.

Based on the robust fixed effect regression result contained in Table 3, the hypotheses of the study are tested as shown in Table 4.

Table 4: Summary of Hypotheses Testing

Variable	Expected sign	Reported sign	Level of significance	Remark
CAAD	+	–	1%	Rejected
ASTQ	–	+	Not significant	Not rejected
ROAS	+	–	1%	Rejected
LQDT	–	–	1%	Rejected
SMKR	+	+	5%	Rejected

Source: Authors' extraction from the Robust Fixed Effect Results

From Table 4, it can be seen that four out of the five hypotheses formulated for the study were rejected based on the evidence provided by the results. One hypothesis could not be rejected due to lack of sufficient evidence to support its rejection. The rejection is based on the fact that the hypotheses were formulated in two-tail form. However, on the basis of direction of association,

only LQDT and SMKR are in line with a priori expectations. Though the hypotheses regarding CAAD and ROAS are rejected, in terms of the direction of association with EFCY, both are not in line with a priori expectations. The reason for the inconsistency between the a priori expectations and some of the results may not be far from the structure of the banking industry in Nigeria. While eight banks are designated as international banks based on the license granted to them with scope of operation extending to some countries outside Nigeria, the remaining banks used in the study are categorised as national banks. The activities and scope of operations of the banks are not on the same level thus the outcome of analysis of data on their operations is likely to be mixed.

5. Conclusion and Recommendations

The analysis carried out in this paper shows that overall, the core set of IMF' (2006) financial soundness indicators (FSIs) have significant effect on efficiency of deposit money banks in Nigeria during the period 2010-2018. This is supported by the *F-statistic*. At the level of individual components of the FSIs, four variables namely; CAAD, ROAS, LQDT and SMKR are statistically significant while ASTQ is not statistically significant. However, two of the statistically significant variables, CAAD, ROAS are not consistent with the expected theoretical postulation. Therefore, little can be said about their significance, particularly in the area of effective policy recommendation. In light of these findings, the paper recommends, amongst other things, that bank management should continue to use FSIs in benchmarking the efficiency of their operations.

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