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Does Bank size Contribute to Bank Earnings Volatility? Empirical Evidence from Nigeria

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ABSTRACT

The study empirically investigated the impact of bank size on bank earnings volatility in 14 Nigerian banks with a panel data set spanning the years 2010 to 2020. The fixed effect model of Driscoll and Kraay was used, which accounted for serial correlation, heteroskedasticity, and cross-sectional dependency. Empirical results reveal that bank size and loan to asset ratio significantly influence bank earnings volatility in the sample Nigerian commercial banks. The market population variable was seen to have a negative but insignificant impact on bank earnings volatility. Also, the insignificance of the bank size squared reveals that this effect is linear. Additionally, this demonstrates that bank size does not always imply earnings stability. Policy implications of the findings are discussed.

Keywords: *Bank Earnings Volatility, Bank Size, Fixed Effect, Nigerian Commercial Banks*

1. Introduction

The significance of the banking industry in a country's growth and development cannot be overstated, particularly in developing countries such as Nigeria, where capital markets are mainly inefficient and financial literacy is poor and the real sector's progress is reliant on the financial sector's stability (Ojeyinka and Akinlo, 2021). Commercial Banks deal with a lot of money and a lot of transactions, so their management can utilize those large transactions to cover misstatements, and earnings manipulation, all of which hurt their financial performance (Augustine et al, 2014). Commercial banks, according to Iannotta (2010), are high-leverage financial intermediaries that employ customer deposits to provide loans to businesses and people. Individual banks maintain a trade-off between efficiency and profitability since increased efficiency comes at the expense of some opportunity cost, which has a negative impact on bank earnings (Udom, et al 2016). The volatility of bank earnings is a key predictive factor of financial crises. Increased volatility in earnings can lead to uncertainty regarding the level of equity capital and a deterioration in the stability of banks can emerge (Couto, 2002). Extreme volatility in bank earnings might lead to capital structure instability (Albertazzi and Gambacorta, 2009). This demonstrates that there is a connection between earnings volatility and bank failure. In the banking industry, bank size is commonly employed to capture potential economies or diseconomies of scale. This variable accounts for product pricing disparities and risk diversification based on the financial institution's size.

The 2004–2005 bank capital reform in Nigeria, which was implemented to strengthen the banking system's financial capability, resulted in a massive restructuring of the banking sector. Within 18 months, banks were obliged to boost their equity capital from two billion to twenty-five billion naira. Due to compliance issues, only twenty-five of the previously existing eighty-nine banks were founded as a result of the reform. More than 75% of the banks were formed as a result of mergers and acquisitions. Many banks were obliged to merge as a result of the recapitalization process. Only 25 commercial banks operated in the country after 2005. Furthermore, the recapitalization process resulted in the creation of major banks in terms of asset base and coverage. The sector is expected to create large banks that can compete favorably with their counterparts in other countries and have a better cost structure as a result of the consolidation process (Karray and Chichti, 2013). In the banking industry, bank size is commonly employed to capture potential economies or diseconomies of scale.

However, it appears that this topic of research in Nigeria has gotten insufficient attention. As a result, the focus of this research is on the Nigerian banking system. The volatility of bank earnings, which is proxied by the variation in banks' return on average assets, is the dependent variable in our study (ROAA). We investigate whether bank size, as measured by logged total assets, affects earnings volatility while controlling for bank size-squared, loan to total asset, and Market Population. To reflect variations in the relationship between size and earnings as bank size varies, the square of the logarithm of total assets was incorporated in the model. We use data for commercial banks from the financial statements of the selected banks in this paper to examine how bank size affects earnings volatility in selected Nigerian banks from 2010 to 2020 while taking into account the fact that other reasons may also affect banks' earnings volatility.

2. Review of Related Literature

Theoretical Literature

This study is built on two main theories; the relative market power theory and the efficiency structure theory. Shepherd (1983) proposed the relative market power theory, which states that banking success is based on market shares. Large banks with differentiated products can influence prices and profit margins. Large banks achieve non-competitive profits (monopolistic competition) by selling a wide range of products. Individual market shares, according to this concept, accurately determine market power and its defects. According to the efficiency structure theory, the variations in bank profits are explained by the efficiency of the fact that the most profitable banks are the most effective (Leibensteinen, 1966). The efficiency of a bank determines the relationship between its market structure and its performance.

The Nigerian Banking system

In recent years, the banking industry of the country has seen several substantial developments. In 2004, the Central Bank of Nigeria (CBN) ordered the existing 89 banks to increase their capital base from $2 billion to $25 billion. This

resulted in a severe fall in the number of institutions from 89 to 25 by the end of 2005 (Okafor, 2011). The Central Bank of Nigeria revoked the operating licenses of 14 banks that failed to meet the recapitalization standards. The CBN implemented the second wave of reforms in 2009, which were aimed at tackling the problem of excessive non-performing loans in banks' credit portfolios. Because of the banking industry's persistent volatility in 2009, the CBN decided to undertake a special examination of all existing banks to determine their financial soundness. The audit revealed that many of the banks had significant capital and liquidity adequacy issues (CBN, 2009). In 2009, this resulted in the injection of N620 billion in bailout funds into eight banks. Afribank Plc, Finbank Plc, Oceanic Bank Plc, Union Bank Plc, Intercontinental Bank Plc, Platinum Habib Bank Plc (Bank PHB), Equatorial Trust Bank Ltd, and Spring Bank Plc were among the financial institutions involved.

Three of these eight banks (Afribank Plc, Bank PHB, and Spring Bank) had their boards of directors replaced, and three of them (Afribank Plc, Bank PHB, and Spring Bank) were nationalized and eventually auctioned off by the CBN (CBN, 2009). Following mergers and acquisitions, the number of banks was reduced to 19 in 2015. (CBN, 2015). In addition to monetary policy, the CBN has implemented some other regulatory tools known as macro-prudential policies in order to properly supervise the banking system. However, the CBN's actions did not eliminate the problem of financial instability, as many banks' capital adequacy and asset quality issues persisted (CBN, 2015). As a result, the Asset Management Corporation of Nigeria (AMCON) was founded in 2010 to address banks' poor risk management practices. These two changes were intended at restructuring the banking sector to make it more stable and responsive to the country's developmental needs.

Empirical Review

Has There Been a Shift in the Relationship Between Bank Size and Profitability? Banks do not need to become larger to be successful, according to Regehr and Sengupta (2016), business strategy and local economic growth are just as essential in determining bank profitability as size. Minor changes in bank-specific and market-specific characteristics are equivalent to huge changes in size when it comes to increasing earnings. Controlling for bank-specific factors such as age, risk, loan-to-asset ratio, and total securities split by total assets, as well as market-specific characteristics such as market size and economic conditions, greater returns are related with larger banks (Regehr and Sengupta, 2016), however, size does not always imply higher returns. Indeed, higher-returning banks may simply be better positioned to expand. Similar findings for Nigeria are reported by Ojeyinka and Akinlo (2021). The influence of bank size on cost efficiency in Nigeria during the post-consolidation period, from 2006 to 2018, was investigated using the dynamic generalised method of moments (GMM) for a sample of 14 commercial banks. According to Ojeyinka and Akinlo (2021), bank size has no impact on cost efficiency; larger banks do not have a cost advantage over smaller banks. Banks should cut their operating costs and improve their cost-efficiency. Banya and Biekpe (2018) came to similar conclusions. According to Banya and Biekpe (2018), bank size has a negative and significant impact on cost efficiency. They say that larger banks are more costly and difficult to run, resulting in higher operating costs.

Moutsianas and Kosmidou (2016) on the other hand, claim that there is a nonlinear link between bank size and earnings volatility of commercial and investment banks. They used data from 89 commercial and 52 investment banks in the UK from 2000 to 2012. According to Moutsianas and Kosmidou (2016), the size of a bank has a negative impact on earnings volatility for both commercial and investment banks, implying that a larger bank has less earnings volatility. Similarly, according to Stever (2007), small banks have fewer options to diversify, which can lead to increased earnings volatility.

According to Hughes and Mester (2013), banks benefit from scale economies as they grow in size because they can strengthen diversification, which decreases credit and liquidity risks. Larger banks also benefit from the spreading of administration costs. De Haan and Poghosyan (2012) investigated if bank earnings volatility is affected by bank size and banking sector concentration. We find that bank size reduces return volatility when using quarterly data for non-investment banks in the United States from 2004Q1 to 2009Q4 and controlling for quality of management, leverage, and diversification. They show that during the recent financial crisis, larger banks in concentrated markets had more volatility.

Hypothesis Development

The Central Bank of Nigeria's recapitalization program led several banks into a series of mergers and acquisitions, resulting in the development of large banks in terms of asset base and coverage. We propose the null hypothesis below to examine the relationship between bank earnings volatility and bank size in Nigerian banks.

H_0: There is no significant relationship between bank earnings volatility and bank size.

3. Methodology

Model Specification and Data Description

Consistent with Moutsianas and Kosmidou (2016), earnings volatility is measured by the change in banks' return on average assets (ROAA). The standard deviation of bank i's return on average assets (ROAA) determined over the previous three years is used to represent variations over time. The earnings volatility for bank i in year t can be stated as follows:

$$\text{Volatility}_{\text{i,t}} = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}(\text{ROAA}_{\text{i,t}} - \frac{1}{T}\sum_{t=1}^{T}\text{ROAA}_{\text{i,t}})}$$

T = {3}

$\Delta\text{Volatility}_{\text{i,t}} = \text{Volatility}_{\text{i,t}} - \sum_{i=1}^{n}\text{Volatility}_{\text{i,t}}$

While accounting for changes in bank-specific and market-specific factors, the regression assesses how bank size influences bank earnings volatility. Bank size, bank size-squared, and loan to total asset ratio are among the bank-specific characteristics, whereas the market population is among the market-specific elements. Our primary focus is on the bank size variables. The squared term reflects the pace of acceleration or deceleration in earnings associated with a percent change in bank size; it indicates whether the rate of change is increasing or decreasing. In this study, 14 commercial banks in Nigeria were used as the sample. Financial statements from the selected institutions from 2010 to 2020 were used to compile the data for the analysis. Citi Bank, Unity Bank, Wema Bank, Fidelity Banks, Stanbic IBTC Bank, Sterling Bank, and Union Bank, as well as United Bank for Africa Bank, Access Bank, Eco Bank, First City Monumental Bank, Guarantee Trust Bank, First Bank, and Zenith Bank, were among the banks sampled.

The model is based on the assumption that bank earnings fluctuate depending on bank size, market population, and other bank-specific characteristics. The model can be expressed as follows:

$$\text{Volatility}_{\text{i,t}} = \alpha_{0\,\text{i,t}} + \alpha_1\text{Bank size}_{\text{i,t}} + \alpha_2\text{Bank size}^2_{\text{i,t}} + \alpha_3\ \text{loan to total asset}_{\text{i,t}} + \alpha_4\text{Market population}_{\text{i,t}} + \varepsilon_{\text{i,t}}$$

Where:

Bank size:	a proxy for the size of bank i at time t is measured by the logged total assets
Bank size-squared:	the square of Bank Size
Loan to total asset:	a measure of credit risk
Market Population:	annual market population in every market area in which the bank i has a branch.
ε:	error term

To empirically analyze the previous functional form, the Levin, Lin, and Chu (2002) and Im-Pesaran-Shin (2003) unit root tests were employed to establish the order of integration of the variables in the model. The Pedroni panel cointegration test is used to confirm that the variables in the model have a long-run relationship.

To empirically investigate the aforementioned functional form, the data were analyzed using the Panel ordinary least square of estimate method. The panel regression model differs from normal time-series or cross-section regression in that it can allow a double subscript. The fixed-effect approach posits that the variables being studied are time-

invariant and unique to the individual and that they should not be associated with other factors. According to Torres-Reyna (2007), the fixed effect is used when a character inside an individual variable may influence the result and there is a need to control for it. Random effect assumes that variations in variables are uncorrelated with the predictor or independent variables and are therefore random. According to Torres-Reyna (2007), the assumption that differences between entities have an impact on the dependent variable entails utilizing the random effect approach.

A fixed effects (FE) or random effects (RE) model is selected using the Hausman test, which shows that a fixed-effects model is better for analyzing commercial banks. Diagnostic tests are carried out to test for heteroskedasticity and serial correlation in the panel data. Bank size, bank size squared and market population variables are converted into their natural log.

4. Data Presentation and Discussion of Empirical Results

This section begins with a simple descriptive statistic of the variables in the model. Table 1 below provides summary statistics of our dependent and main explanatory variables.

Table 4.1: Descriptive Statistics of the Variables

	Volatility	Bank Size	Bank Size Sqr	Loan to Asset	Market Population
Mean	19.08427	47863144	1.35E+16	2.354272	1.92E+10
Median	10.96010	14633453	2.14E+14	2.394256	1.14E+10
Maximum	76.75887	5.55E+08	3.08E+17	4.340669	9.88E+10
Minimum	0.084600	240.3937	57789.13	2.469821	7.76E+08
Std. Dev.	19.80264	1.06E+08	4.78E+16	1.278429	2.05E+10
Observations	154	154	154	154	154

Source: Author's computation

Table 4.1 shows that the standard deviation of bank earnings volatility is 19.8. The difference between the mean and the standard deviation is 0.72. This is an indication of wide variations in the bank earnings volatility around the mean. It means that there is a significant variation in the bank earnings volatility of the sampled banks. The minimum and maximum are 0.084600 and 76.75887 respectively. The minimum value implies that some banks experience less bank earning fluctuation in some accounting years.

The average bank size as indicated on the table as mean value is 14633453. The mean of the loan to asset ratio of the sampled banks is about 2.354272, which indicates the average loan to asset of the sampled banks from 2010 with a minimum of 2.469821 and a maximum of 4.340669. The standard deviation of 1.278429 indicates that there is a significant difference between the loan to asset ratio of the banks. The Levin, Lin, and Chu (2002) and Im-Pesaran-Shin (2003) unit root tests were used to determine the order of integration of the variables in the model. In panel data analysis, if the unit root is found in the data, the problem of spurious regression will arise. The results are shown in Table 4.2.

Table 4.2: Panel Unit Root Test Result

Variables	Levin et al		Order of Integration	Variables	Im et al		Order of Integration
	Levels	First Diff.			Levels	First Diff.	
Volatility	-7.56818**	-	I(0)	Volatility	-4.67470**		I(0)
Bank size	-6.13344**	-	I(0)	Bank size	-2.96365**		I(0)
Size-sqr	-6.11023**	-	I(0)	Size-sqr	-2.86837**		I(0)
LTA	-7.56818**	-	I(0)	LTA	-4.67470**		I(0)
Mrktpop	-5.46400**	-	I(0)	Mrktpop	-1.59779**	-	I(0)

Source: Authors' computation, 2021

Notes: Values reported are t-statistics value.
***** denote significance 5 percent.***

The test was conducted with the assumption of intercept and no trend in both Levin et al (2002) and Im et al (2003) specification
The Levin, Lin, and Chu (2002) and Im-Pesaran-Shin (2003) unit root tests generated the same findings, Table 2 shows that all of the variables in the model are integrated at levels (I(0)).

The data sample is then subjected to a panel cointegration test to see if the model demonstrates a long-term relationship. Cointegration analysis is performed after the unit-roots of the series have been examined. The Pedroni panel cointegration technique is used to analyze the long-term relationship between the variables in the panel cointegration test. The results show that the variables in the model have a long-term association, as shown in Table 3.

Table 4.3: Pedroni Panel Cointegration Test Results

	Panel statistics			**Group statistics**	
Panel	**Statistics**	**Probability**	**Group**	**Statistics**	**Probability**
v-statistics	**80.53536**	**0.001****	**rho-statistics**	5.024604	1.0000
rho-statistics	**3.118414**	**0.774**	**PP-statistics**	-4.044521	0.0000**
PP-statistics	**-2.958871**	**0.000****	**ADF statistics**	2.748744	0.0015**
ADF-statistics	1.474261	0.929			

Source: Authors' computation, 2021
*****Denote significance at 5%. Notes: Trend assumption: No deterministic intercept or trend Automatic lag length selection based on AIC***

The Pedroni cointegration test results are shown in the table above. Two out of four panel statistics and two out of three group statistics of the examined variables appear to be cointegrated, according to the findings. The study must choose an appropriate baseline model after establishing a cointegration relationship between the analyzed variables. The F-test was used to choose between the pooled OLS and the FE model in the study. The FE model is more appropriate than the pooled OLS model if the F-test probability value is significant. The choice between the RE model and the pooled OLS using the BP LM test likewise implies that the RE model is better, however, the Hausman test suggests that the FE model is better than the RE model.

The FE model then becomes the standard model. The study then goes on to test for heteroskedasticity, finding that the model has non-constant variance in the error term. The model suffers from serial correlation, according to the results of Wooldridge's serial correlation test, however the Pesaran CD and Pesaran Scaled LM tests for cross-sectional dependence yield contradictory results at the 5% level of statistical significance. The Pesaran CD test suggests the absence of cross-sectional dependence, the Pesaran Scaled LM test indicates its presence.

However, the study corrects for these biases in the fixed effect model using Driscoll and Kraay (1998) standard errors, which use a nonparametric covariance matrix estimator to correct for heteroskedasticity, serial correlation, and cross-sectional dependency (Hoechle, 2007).

Table 4.4: Panel Regression Results

	Bank Earnings Volatility			
	Pooled OLS	**Fixed Effects**	**Random Effects**	**Driscoll Kraay**
constant	2.282887** (0.0000)	2.297203** (0.0000)	14.41781** (0.0000)	2.297203** (0.0000)
Bank Size	4.50E-09 (0.1214)	3.00E-09** (0.027)	4.02E-09** (0.009)	3.00E-09** (0.027)
Bank Size squared	-9.30E-18 (0.1438)	-6.61E-18 (0.1844)	8.48E-18 (0.1188)	-6.61E-18 (0.3464)

Loan to total asset	0.039241** (0.00000)	0.034628** (0.00000)	0.036149** (0.00000)	0.034628** (0.00000)
Market population	-8.81E-12 (0.3215)	-1.48E-11 (0.0912)	-1.48E-11 (0.0562)	-1.48E-11 (0.0910)
R2 Overall	0.270681	0.668202	0.299401	
R2 Between				
R2 Within				
F-Stat	0.000000	0.000000	0.000000	0.000000
F-Test				
Wald			0.0000	
Hausman			0.0930	
B-P LM	0.0000		0.0000	
M.Wald		0.0000		
Wooldridge		0.0000	0.0000	
Pesaran CD		0.0378	0.0000	
Pesaran Scaled LM		0.0000	0.0000	
Observations	140	140	140	140

Source: Author's computation. Note: Dependent Variable: Domestic Investment. B-P LM is Breusch Pagan Langragian Multiplier test, M. Wald is the Modified Wald test for heteroskedasticity. Probability values of coefficients are in parenthesis. Diagnosis and post-estimation test results presented are probability values. ** denote statistical significance at 5%.

The panel regression analysis' findings are stated in Table 3. The adjusted R squared value is 0.668202, indicating that independent variables varied by 66.82 % due to changes in bank earnings volatility. This means that the independent factors can only account for 66.82 percent of fluctuations in bank earnings volatility. At the 5% level, bank size has a positive (3.00E-09) and significant (p=0.027) effect on bank earnings volatility. At the 5 percent level, bank size-squared has a negative (-6.61E-18) but non-significant (p=0.1844) effect on bank earnings volatility. At a 5% level, the loan-to-asset ratio has a positive (0.034628) and statistically significant (p=0.00000) influence on bank earnings volatility. At a 5% level, the market population has a significant (p=0.0912) negative (-1.48E-11) effect on bank earnings volatility.

First, for the banks in the sample, bank size (measured as the log of total assets) is positively related to bank earnings volatility. The calculated bank size variable coefficients describe the change in bank earnings associated with a 1% increase in real assets while holding all other variables constant. The bank size squared represents the rate of profitability acceleration or deceleration linked with a percentage change in bank size (real asset). The negative coefficient suggests that earnings diminish with size, indicating a slowing pace of change. The findings indicate that larger banks are riskier; nevertheless, the insignificance of the bank size squared suggests that this effect is linear.

That is, large banks' earnings are more volatile, contrary to the findings of Haan and Poghosyan (2012) for the UK. Haan and Poghosyan (2012) discovered that large banks experience less volatility; yet, they identified a threshold beyond which volatility increases. At the 5% level of significance, the association between size and bank earnings volatility is significant. The findings also differ from that of Stiroh (2004). Stiroh (2004) argued that the standard deviation of the return on equity is unrelated to the size of the bank. The loan-to-total-asset ratio, which pertains to credit risk, is statistically significant for the earnings volatility of the Nigerian banks in the sample. As expected, the loan to total asset ratio coefficient is positive, indicating that increasing (decreasing) the ratio produces more (less) volatility in earnings.

In the case of Nigerian banks, the market population is negatively associated with earnings volatility. The market population, on the other hand, is not statistically significant. Finally, the model's explanatory power, as measured by the value of r^2, is 0.67 percent, indicating that the model was able to explain around 67 percent of the fluctuations

in bank earnings volatility. The findings in Table 4 provide significant evidence to reject the null hypothesis of no cross-sectional dependence among the sampled banks. The outcomes are consistent across the three CD tests used. The F-statistics probability values of less than 5% show that all of the variables in the model have a substantial influence on the volatility of bank earnings in Nigerian banks.

Conclusion

The Central Bank of Nigeria's recapitalization program prompted numerous commercial banks to merge, leading to the formation of large banks with a larger asset base and more coverage. In this context, a thorough examination of the relationship between bank size and earnings volatility is crucial for impending banking restructuring. The effect of bank size on bank earnings volatility in Nigeria between 2010 and 2020 is examined in this study, which focuses on 14 commercial banks that accounted for more than 95 percent of the sector's total assets as of 2020. The goal of this research is to examine the relationship between bank size and earnings volatility while controlling for bank-specific and market structure variables. To account for cross-sectional dependence among units, the Driscoll and Kraay (1998) fixed effects estimator with robust standard errors is utilized. This estimate accounts for most biases in panel econometric modeling.

For the sampled commercial banks, our findings reveal that bank size has a positive effect on bank earnings volatility; the coefficient is positive, meaning that a larger (smaller) bank has more (less) earnings volatility. The insignificance of Bank size squared shows that the effect is linear. Smaller banks, in other words, have less erratic earnings. For the earnings volatility of the sample Nigerian banks, the loan to total asset ratio for commercial banks, which provides information on loans relative to assets, is positive and statistically significant. The market population is negatively related to the volatility of bank earnings, but the link is statistically insignificant. The findings of the study reject the null hypothesis that there is no relationship between bank earnings volatility and bank size. Despite the potential benefits of diversification, larger banks have more earnings volatility than smaller banks, according to the study. This indicates that a bank's size does not automatically imply earnings stability. The findings of this study have significant policy implications for Nigeria's structural reforms relating to commercial bank size. Because there is a positive relationship between size and earnings volatility, merging banks to produce larger banks may increase volatility. The findings also include information on loan-to-asset ratio and market population, which are just as relevant as size in driving bank earnings volatility and are crucial for bank top management. Other elements, such as credit risk, account for swings in bank earnings to achieve steady earnings. As a precautionary step against high risk, this conclusion emphasizes the importance of monitoring and regulating bank capital. To ensure earnings stability, the study recommends that the Central Bank of Nigeria continue to embrace policies that promote bank efficiency.

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