CAPITAL ADEQUACY AND OPERATING EFFICIENCY OF NIGERIAN DEPOSIT BANKS: EVIDENCE FROM PANEL DATA

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Abstract
Capital adequacy in commercial banks is vital for meeting liquidity needs, ensuring profitability, protecting depositors' funds, and maintaining public confidence. This study examines the impact of capital adequacy on the operational efficiency of banks in Nigeriafrom 2014-2024. There is scarcity of empirical studies that decomposed capital adequacy into equity capital, capital adequacy ratio, leverage ratio as well as total assets and rigorously investigate their distinct impacts on return on assets. A historical research design was used, drawing on annual bank reports and the Central Bank of Nigeria (CBN) Statistical Bulletin. Fifteen DMBs were used as sample. The Panel EGLS (Estimated Generalized Least Squares) with fixed effects and cross-sectional effects was used to examine the relationship between capital adequacy and bank efficiency. The results showed that capital adequacyhad asignificant negative impact on operating efficiency: a 1% increase in capital adequacy resulted 1.14%increase in operating efficiency (p-value = 0.00). The study also found a negative significant relationship between equity capital and return on equity. However, a positive significant relationship was found between total assets and return on equity. Finally, the results indicated a positive significant relationship between the capital adequacy ratio and return on assets, but a negative significant relationship between the leverage ratio and return on equity. The study recommended, among

others, that the minimum capital requirement should continue to be reviewed and monitored to ensure banks remain liquid and profitable. The study confirmed that the total assets, equity capital, capital adequacy ratio, and leverage ratio are key drivers of capital adequacy of deposit money banks.

Key words: Capital adequacy ratio, equity capital, leverage ratio, operating efficiency, return on assets, total assets.

1.0 Introduction

Across the global financial architecture, banks function as critical financial intermediaries, mobilizing capital primarily from shareholders' contributions to facilitate economic intermediation and sustainable development. Their profit-earning capacity, within both developed and emerging economies, is fundamentally shaped by their ability to efficiently absorb operational and risk-related costs, sustain public confidence, attract diversified sources of financing in increasingly integrated capital markets, strategically reinvest earnings, and demonstrate prudent management of assets and liabilities in line with evolving global regulatory and competitive dynamics.Proper management of a bank is crucial to ensure the growth and development of any growing economy. A sound and reliable bank would ensure the availability of cash at all times to meet customers' demands. (Longe, 2015; Nnanna, 2015).

In Nigeria, capital adequacy is the minimum level of capital that banks are required to maintain, as prescribed by regulatory and supervisory authorities, to ensure financial soundness and stability. It serves as a key indicator of a bank's solvency and reflects the extent to which the institution has sufficient capital to absorb risks associated with its financial position. According to Onoh (2012), a bank's capital is considered adequate when it is sufficient to cover operational costs, meet customers' demands, and safeguard depositors against partial or total losses in the event of liquidation. Furthermore, capital should constitute a permanent and unrestricted source of funds, be readily available to absorb losses, and enable deposit money banks to sustain operations during periods of financial distress. It should not impose compulsory charges on earnings and, in the event of liquidation, must be subordinate to the claims of depositors and other creditors.

Despite steady growth in Nigerian banks' total assets over the years, driven by expansion in deposits, investments, and technological adoption, many banks continue to experience high operating costs, declining profit margins, and inefficiencies in resource utilization. Given the competitive pressures, regulatory challenges, and volatile macroeconomic environment in Nigeria, understanding the relationship between total assets and the operating efficiency of deposit money banks is imperative. Moreover, the influence of equity capital on operating efficiency remains ambiguous and often inconsistent. Despite regulatory efforts by the Central Bank of Nigeria (CBN) to strengthen banks' equity bases through recapitalization and the implementation of prudential guidelines, many banks continue to struggle with high operating expenses, declining cost-to-income ratios, and inefficient asset utilization. This raises a fundamental concern: whether increased equity capital truly enhances operating efficiency or merely expands the financial base without improving operational effectiveness or resource productivity. Several banks that meet or exceed the minimum capital adequacy requirements still experience high operating costs, weak profitability, and declining efficiency levels. This paradox raises serious concerns about whether compliance with capital adequacy standards truly translates into improved operational performance or merely satisfies regulatory conditions without enhancing operational efficiency. Some highly leveraged banks have reported strong short-term profitability but poor long-term efficiency, while others with conservative leverage structures struggle to generate optimal returns. This inconsistency raises critical questions about whether higher leverage enhances operating efficiency through increased financial capacity or undermines it by heightening financial risk and

management pressure. The absence of clear empirical evidence on how total assets, equity capital, capital adequacy ratio, and leverage ratio influence the capital adequacy of deposit money banks in Nigeria creates a significant knowledge gap, necessitating a comprehensive investigation to guide capital adequacy structure and operational efficiency of deposit money banks in Nigeria.

The main objectives of this research is to examine the effect of firm attributes, specifically total assets, equity capital, capital adequacy ratio and leverage ratio on the operating efficiency of deposit money banks in Nigeria.

The study's research hypotheses were formulated as follows:

H_{01}: Total assets of banks positivelyaffectthe of deposit money banks.

H_{02}: Equity capital has a significant effect on the operating efficiency of deposit money banks,

H_{03}**:** The capital adequacy ratio has a significant effect on the operating efficiency of deposit money banks.

H_{04}: The leverage ratio positively influences operating efficiency of deposit money banks.

Capital adequacy is fundamental to the efficiency and stability of banks, as it provides a protective buffer that safeguards depositors and ensures resilience in the face of unexpected losses. It is also a key regulatory requirement under the Banks and Other Financial Institutions Act (1991), reinforcing its importance in maintaining financial discipline. Adequate capitalization enhances banks' solvency, strengthens public confidence, and improves their ability to attract funds from the market. Additionally, it positions banks to take advantage of profitable investment opportunities, thereby supporting sustained growth and operational efficiency.

2.0 Literature Review

Below is the conceptual framework (Fig.1) of Capital Adequacy as a latent construct that is operationalized through four observable financial indicators: Equity Capital Ratio (X1), Total Asset Ratio (X2), Capital Adequacy Ratio (X3), and Leverage Ratio (X4). These variables collectively represent the multidimensional structure of banks' capital strength and financial stability.The framework implies that capital adequacy, as captured by these four proxies, exerts a direct influence on Return on Equity (ROE) and Operating Efficiency, which serve as the outcome variables. The directional arrows indicate that improvements in capital structure and regulatory capital positions are expected to impact operationalefficiency.

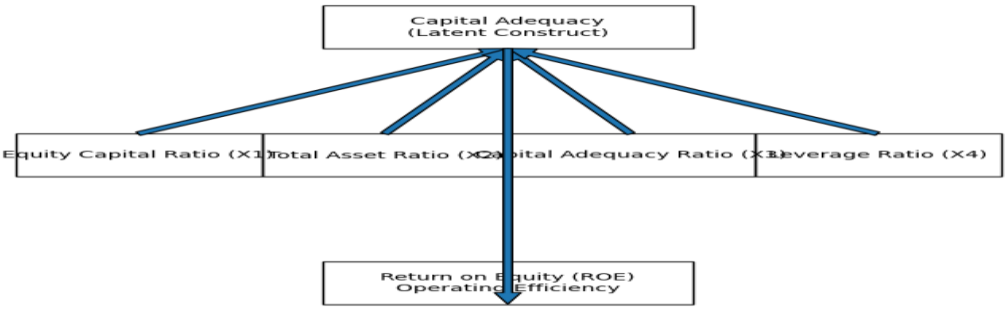


Figure 1: Conceptual framework

Operational efficiency is fundamental to the survival and competitiveness of banks, particularly given their service-oriented nature, in which overhead costs account for a substantial share of total operating expenses. Banks derive a significant share of their income from interest earned on loan portfolios, which are largely funded through customers' deposits. Consequently, adequate capitalization is essential to support lending activities, enhance operational sustainability, and strengthen banks' capacity to absorb financial risks. (Okoi, Ikoh, Agunbiade, and Okoi, 2025; and Odiong, Okoi, Okon, and Nwanne, 2025).

Theoretical Foundation

The study is anchored on Economic efficiency theory theorized by Koopmans (1981). The theory explained that whenever an increase in one of the coordinates (the net output of a particular good) can be achieved only at the cost of a decrease in some other coordinate (the net output of another good. That is, efficiency point is realized where output is optimal with a given input. In another way, it is a firm's efficiency proposing an estimation of efficiency frontier from a production observed. It is output growth to input growth and technical change by differencing movements along a production frontier from shifts in the frontier. The theory is relevant because a firm that wants to reduce wastages will focus on producing maximum output relative to input.

The study is supported by buffer theory proposed by Calem and Rob (2016), banks approaching the regulatory minimum capital ratio are likely to have incentives to increase their capital levels and reduce risk exposure to avoid the regulatory costs associated with breaching capital requirements. In other words, a deposit money bank may intentionally hold extra capital above regulatory minimums to avoid the high costs of failing to meet capital requirements and to absorb unexpected losses that could endanger its stability. Banks hold extra capital because violating capital requirements is costly; holding a buffer reduces the probability of breaching capital rules, and raising capital is costly and difficult. However, inadequately capitalized banks may be incentivized to take on greater risk in the expectation that higher returns will enable them to strengthen their capital base. This represents one channel through which low capital adequacy can adversely affect banking operations. In the event of bank failure, losses are borne by the bank, its customers, and the Nigeria Deposit Insurance Corporation (NDIC). At present, the NDIC provides a maximum deposit insurance coverage of ₦200,000 per depositor in the event of a bank failure. Consequently, depositors remain highly concerned about the capital position and financial soundness of banks. As a result, banks may prefer to maintain a capital "buffer" above the regulatory minimum to reduce the likelihood of breaching statutory capital requirements, particularly when their capital adequacy ratios are highly volatile.

Capital requirements constitute the principal supervisory instrument in the Nigerian banking system. A breach of these requirements is regarded as a serious violation of banking regulations and is not tolerated by the Central Bank of Nigeria (CBN). Banks that remain undercapitalized for prolonged periods are subject to regulatory closure. The withdrawal of certain banking licenses following the 2005 banking sector recapitalization exercise in Nigeria provides clear evidence of this regulatory stance.

The apex bank has a statutory obligation to regulate banks' capitalization to mitigate their solvency problems, which may destabilize the domestic and international financial systems (Bernauer&Koubi, 2012; Brash, 2011). Compliance with this statutory requirement has led the banking industry to adopt various strategies, including mergers and acquisitions, capital market sourcing, and consolidation, as viable options for maintaining continuity. The new recapitalization

of banks is targeted to commence March, 2026 in which commercial banks- international license: ₦500 billion; national license: ₦200 billion; regional license: ₦50 billion; other banks- Merchant banks: ₦50 billion; non-interest banks (national): ₦20 billion; non-interest banks (regional): ₦10 billion. Other banks are: Merchant banks (₦50 billion); non-interest banks (national) (₦20 billion); and non-interest banks (regional) ₦10 billion. The exercise, according to CBN, will protect depositors, make banks stronger against economic shocks, and support big-ticket financing. The new recapitalization is designed to reset, strengthen, and reposition the banking sector to support Nigeria's current economic realities and long-term development goals (Okoi, Ogar, Hogan, &Nkiri, 2025).

The imperative for banking sector reform stems from the critical role that banks play in promoting economic growth and development. As noted by Soludo (2015), the banking sector functions as a key catalyst for economic expansion and structural development in any economy. These objectives are achieved primarily through the core function of financial intermediation, in which banks mobilize savings from surplus economic units and allocate them to deficit economic units to facilitate productive investment and economic development. For banks to perform these functions effectively, they must maintain adequate short-term liquidity to ensure operational continuity while simultaneously generating sufficient profitability to sustain long-term viability.

Bank capital refers to funds attributable to the owners of the bank as reported in the statement of financial position (Okoi, Ogar, Hogan, and Nkiri (2025). These funds serve multiple purposes; however, there is a broad consensus that their primary and overriding function is to provide a buffer against losses not covered by current earnings and to protect depositors and other creditors in the event of liquidation. Although opinions differ among banking and finance experts regarding what constitutes adequate capital, they agree that this is a long-standing issue for which no clear consensus has yet emerged. As noted by Okoi et al., (2025), the question of capital adequacy has a long historical foundation, dating back almost as far as the banking system itself.Adequate capital refers to the level of funds that a bank should possess or plan to maintain in order to conduct its operations in a prudent and sound manner. Functionally, adequate capital is the amount sufficient to perform its primary role of preventing bank failure by absorbing losses. Given that these losses are associated with the risks inherent in banks' efforts to meet the legitimate credit needs of the economy, adequate capital provides the ultimate safeguard against insolvency and liquidation arising from banking risks. Any bank or firm with inadequate capital is subject to latent constraints, as management attention is often diverted toward defensive strategies, such as raising additional capital or guarding against potential takeovers, rather than focusing on core operational and strategic objectives. Capital adequacy is therefore critical in enabling banks to absorb risks until sustainable profitability is achieved. Notably, banks whose capital levels exceed regulatory minimum requirements are more likely to attract customers and enhance public confidence in the financial system.

The number of distressed banks in Nigeria increased significantly from 1991, regardless of individual banks' capital bases. Reports from the Nigeria Deposit Insurance Corporation (NDIC) and the Central Bank of Nigeria (CBN) indicate that eight (8) banks were classified as distressed in 1991; this number doubled to sixteen (16) in 1992 and continued to rise until 2005, when the need for comprehensive banking sector reform became evident (Uremandu, 2010). Soludo (2015) further affirmed that strengthening and consolidating the banking system was intended to promote a diversified, strong, and reliable banking sector capable of safeguarding depositors' funds,

supporting economic development, and enhancing competitiveness in both regional and global financial markets.

Naceur (2016) examined the effects of capital regulation on the cost of intermediation and bank profitability and found that the capital adequacy ratio positively affects bank profitability. Similarly, White and Morrison (2011) argued that capital requirements ensure that banks maintain sufficient capital at risk, thereby strengthening financial discipline. Bichsel and Blom (2015) supported this view, contending that capital regulations help to reduce negative externalities, such as systemic loss of confidence in the banking system while also contributing to GDP growth. Cotter (2016) observed that, where shareholders' interests are dominant, capital is a key managerial decision variable; consequently, a wealth-maximizing bank's capital position influences its capital structure and loan policy.Hassan (2011) analyzed the performance of Islamic banks over the period 1994–2001 using a range of internal and external banking characteristics to predict profitability. The findings indicated that higher levels of capital are associated with increased profitability. Consistent with this, Abreu (2012) reported that well-capitalized banks face lower expected bankruptcy costs and, consequently, lower funding costs, thereby improving profitability.

Given that bank credit constitutes the primary source of banks' income, any contraction in lending is likely to adversely affect bank performance. Haron (2014) asserted that the proposition of a negative relationship between a bank's capital-to-assets ratio and its return on equity appears intuitive and may not require extensive empirical validation. Using a mean–variance framework, Kim and Santamero (2013) compared bank portfolio choices under regimes with and without solvency regulation and demonstrated that capital requirements alter the composition of banks' risky portfolios, potentially increasing risk and the profitability of failure. Gordard (2014), in a study of European banks, found a positive relationship between bank profitability and the capital–asset ratio.Furthermore, Mwega (2015) found that capital requirements reduce the likelihood of bank insolvency in the event of sudden shocks. The study demonstrated that higher risk-weighted capital adequacy ratios are associated with a lower probability of insolvency among commercial banks, suggesting a negative relationship between risk-weighted capital adequacy ratios and bank insolvency.

Rather than allowing capital to deteriorate to levels that could jeopardize depositors' funds, many banks periodically review their capital adequacy positions. In addition, monetary authorities, in response to prevailing economic conditions, periodically specify minimum capital requirements for licensed banks. Past experiences with bank failures have reinforced the necessity for regulatory authorities to establish and enforce minimum capital standards for insured banks. Prior to the adoption of the international capital convergence framework by the Central Bank of Nigeria (CBN) in 1990, both the CBN and the Nigeria Deposit Insurance Corporation (NDIC) relied on subjective measures to assess banks' capital adequacy. These assessments were typically conducted as part of routine bank examinations.

In determining bank capital adequacy, the Central Bank of Nigeria (CBN) and the Nigeria Deposit Insurance Corporation (NDIC) consider a range of regulatory and risk-based factors. Section 13 of the Bank and Other Financial Institutions Act (BOFIA) of 1991 requires banks to maintain, at all times, a capital fund that is unimpaired by losses and maintained in such ratios to assets, liabilities, or both, for all offices within and outside Nigeria, as may be prescribed by the CBN. Additional measures used in assessing capital adequacy include the minimum paid-up capital as

stipulated by the CBN, the capital adequacy figure derived by deducting the risk content of classified assets from adjusted capital, and the ratio of adjusted capital to total loans and advances.

Since the inception of banking regulation in Nigeria, regulatory standards have emphasized minimum required paid-up capital, which has increased progressively over time. For instance, the 1952 Banking Ordinance prescribed minimum capital requirements of ₦25,000 for indigenous banks and ₦200,000 for expatriate banks. These thresholds were subsequently increased to ₦600,000 and ₦1.5 million for indigenous and expatriate banks, respectively. The 1976 amendment to the Banking Act of 1968 set the minimum start-up capital for merchant banks at ₦2 million. This was later revised upward to ₦20 million for commercial banks and ₦12 million for merchant banks. Furthermore, Section 9(2) of BOFIA (1991) specified minimum start-up capital requirements of ₦50 million for commercial banks and ₦40 million for merchant banks. In 2005, the CBN further increased the minimum capital requirement to ₦25 billion as part of the banking sector consolidation exercise.

One of the commonly used measures of bank capital adequacy is the equity-to-total-assets ratio (EQTA). Equity capital represents the primary source of loss-absorbing funds for banks, as emphasized under the Basel capital framework. Equity capital comprises common stock, perpetual preferred stock, surplus funds, bonus issues, reserves, capital reserves, contingency reserves, and minority equity interests in subsidiary companies. Bank assets, in turn, include investments, bills discounted, short-term funds, loans and advances, cash holdings, leased equipment, fixed assets, and other assets. The ratio of equity capital to total assets, therefore, provides a useful indicator of capital adequacy. A higher EQTA ratio implies a stronger capacity for banks to absorb losses beyond loan loss provisions, thereby enhancing financial resilience.

Since operating efficiency reflects how effectively inputs (such as assets and expenses) are transformed into outputs (profits or income), return on equity (ROE) serves as a precise indicator of this relationship. A higher ROE indicates that a bank is efficiently managing its resources to generate profits, whereas a lower ROE suggests inefficiencies in resource utilization. Accordingly, a higher ROE reflects effective cost management, strategic deployment of shareholders' capital, and strong internal control systems, all of which are hallmarks of operational efficiency. Return on equity is therefore a robust, reliable, and widely accepted measure of the operating efficiency of deposit money banks in Nigeria, as it captures how effectively banks convert their capital base into net earnings by integrating both profitability and operational performance. The Central Bank of Nigeria (CBN) and the Nigeria Deposit Insurance Corporation (NDIC) regularly use profitability ratios, such as ROE, to assess banks' operational soundness.

Given that banks' capital accounts for a substantial share of total assets and deposits, assessing capital adequacy in isolation, without considering performance, may be misleading. In this regard, Eyo and Offiong (2012) argued that evaluating bank performance in relation to capital adequacy should also incorporate factors such as managerial quality and productive efficiency, which are significantly influenced by the degree of competition within the industry. The effectiveness with which bank management deploys and manages capital ultimately determines how adequate that capital is in practice. Moreover, maintaining capital adequacy ratios at or above the minimum levels recommended under the Basel framework does not, in itself, guarantee bank safety, as such ratios are primarily focused on credit risk and may not fully capture other sources of financial vulnerability.

In the banking industry, capital is typically regulated by the apex regulatory authority in order to mitigate the risk of bank insolvency (Bernaver&Koubi, 2012). In Nigeria, this regulatory responsibility is exercised by the Central Bank of Nigeria (CBN). Capital adequacy theory emphasizes regulatory measures and supervisory frameworks established by the apex bank to ensure that banks maintain sufficient capital to meet their financial obligations. Under this framework, it is assumed that adequately capitalized banks are better positioned to absorb losses and sustain their business operations.

A bank's capital position is influenced by several factors, including its size, risk profile, prevailing market conditions, lending policies, managerial capacity, asset and liquidity structure, statutory reserve requirements imposed by the CBN, and growth rate (Bernaver&Koubi, 2012; Barrios & Blanco, 2010). These factors jointly determine the appropriate level of capital required by a bank. For example, as a bank expands through increased deposits and growth in earning assets it must correspondingly strengthen its capital base while maintaining effective risk management (Uremadu, 2010).

Notwithstanding the specific determinants of a bank's capital level, capital must remain adequate and compliant with the statutory requirements of the apex regulator. The interaction between capital adequacy and other operational and strategic factors ultimately shapes a bank's overall performance. Given that profit maximization remains the primary objective of commercial banks, institutional strategies and operational activities are designed to align capital management, risk-taking, and operational efficiency to support sustainable profitability (Alexandru, 2016; Murthy & Sree, 2013).

Okoi, Ogar, Hogan, and Nkiri (2025) conducted a related study on leverage decisions and bank profitability in the Nigerian banking sector and reported similar findings, indicating that leverage decisions significantly affect returns on assets. Specifically, their results showed that the long-term debt-to-total-assets ratio and the equity-to-total-assets ratio were both positively correlated with bank profitability.

Haron (2014) examined the impact of several determinants of bank profitability, including asset structure, inflation, deposit composition, liquidity, and the money supply, on both bank profitability and the capital asset ratio. Demirgüç-Kunt (2012) reported a positive relationship between bank capitalization and profitability in a study on bank performance, while also identifying a negative relationship between reserves and profitability. Similarly, Margarida and Mendes (2012) found that well-capitalized banks face lower expected and funding costs and higher asset interest margins. Their findings further indicate that stricter minimum capital adequacy ratios are associated with stronger revenue generation, leading them to conclude that a higher capital-to-asset ratio serves as a buffer that enhances bank soundness.

Wanjohi and Magure (2013) investigated growth determinants including capital, interest rates, liquidity, and asset base in their study of factors affecting the growth of small and medium-sized enterprises (SMEs) in rural Kenya, using time-series data and multiple regression techniques. Their results suggest that financial institutions with a higher capital base tend to be more profitable than those with a lower capital base. Related studies have also examined the role of interest-earning assets, particularly loans, in explaining bank profitability. Demirgüç-Kunt (2012) reported that interest-earning assets may contribute to low profit margins and identified a negative relationship between loans and bank profitability. In contrast, Guru and Shanmugam (2014) found that loans, as a major component of bank assets, contribute significantly to bank profitability.

Kosmidou (2010) examined the effects of bank-specific characteristics, macroeconomic conditions, and financial market structure on net interest margins and return on average assets in the UK commercial banking industry over the period 1995-2002, using a desk survey approach. The findings revealed that capital strength was a key determinant of bank performance, thereby supporting the argument that well-capitalized banks face lower expected bankruptcy costs. This, in turn, reduces funding costs and/or lowers reliance on external financing, resulting in higher profitability.

Similarly, Alexandre (2016) observed that banks with strong capital positions are better able to pursue business opportunities and possess greater time and flexibility to address challenges arising from unexpected losses. This enhanced financial resilience ultimately contributes to improved profitability.Naceur (2016) investigated the effects of capital regulation on the cost of intermediation and bank profitability, finding that the capital adequacy ratio positively influenced banks' profitability. White and Morrison (2011) argued that capital requirements ensure that banks maintain sufficient capital at risk, thereby promoting financial stability. Bechel and Blom (2015) supported this view, contending that such regulations not only reduce negative externalities, such as a general loss of confidence in the banking system, but also contribute to overall economic growth.

Cotter (2016) observed that, in contexts where shareholders' interests dominate, capital represents a key managerial decision variable, with the bank's capital position influencing both its capital structure and lending policies. Similarly, Hassan (2011) examined the performance of Islamic banks between 1994 and 2001 using multiple regression models. By analyzing a range of internal and external banking characteristics, the study found that higher capital levels were associated with greater profitability. Abreu (2012) found that high-capitalized banks face lower expected bankruptcy costs and, consequently, lower funding costs, resulting in improved profitability. Majnoni (2011) argued that the introduction of higher capital requirements led to a slowdown or contraction in aggregate bank credit. Bank credit, as the major source of banks' income, implies that its contraction negatively affects the bank's performance.

It is worthy of note that in the reviewed literature, some scholars were merely exploratory in that:

i. They discussed the benefits, challenges, and consequences of the capital adequacy of deposit money banks, as well as whether or not its goals were met (Majnoni, 2011; Cotter 2016; Bichesel and Blom, 2015; White and Morrison, 2011 and Bernaver; Hassan, 2011 &Koubi, 2012).

ii. In addition, some studies on capital adequacy have been inconclusive, with inconsistent relationships (Bechel and Blom, 2015; Alexandru, 2016; Murthy & Sree, 2013).

iii.Currently, few studies focused on capital adequacy and operational efficiency in Nigeria without decomposing capital adequacy. Hence, the need for this study.

3.0 Methodology

An ex post facto (historical) research design was adopted for this study, as the events under investigation had already occurred and were beyond the researcher's control. This design is appropriate for examining causal relationships using existing data without manipulation of the study variables.The study selected fifteen deposit money banks in Nigeriausing annual bank reports and the Central Bank of Nigeria (CBN) Statistical Bulletin.from 2014-2024, using a purposive sampling technique. This approach was employed because the fifteen selected banks

met specific criteria relevant to the objectives of the study and provided the necessary data required for empirical analysis. The analysis was based on secondary data obtained from various editions of the Central Bank of Nigeria Statistical Bulletin covering the period 2014 to 2024. The study employed descriptive statistics and Panel Estimated Generalized Least Squares (EGLS) multiple regression model, incorporating fixed effects and cross-sectional effects. The choice of Panel EGLS was motivated by the presence of potential heteroskedasticity and cross-sectional dependence in panel data, as documented in prior empirical study ofEzenwakwelu (2018), who adopted a similar methodological approach.The functional specification, and the corresponding econometric equation of the study is presented as follows:

ROE = F (total assets, equity capital, capital adequacy ratio and Leverage ratio)

$ROE_it = \beta_0 + \beta_1 TAS_it + \beta_2 ECP_it + \beta_3 CAR_it + \beta_4 LVR_it + \varepsilon_it$

Whereas:

ROE = Return on equity (measures efficiency of bank i at a time t).

TAS = Total assets ratio (measures net current asset plus current liabilities of bank i at time t).

CAR = Equity capital ratio (measures total regulatory capital (tie 1 plus tie 2 to risk weighted assets as a percentage) of bank, i at a time t.

ECP = Equity capital (measures the proportion of total shareholders' equity to total assets) of bank i at a time, t.

LVR = Leverage ratio (measures total liabilities to total assets) of bank i at a time t.

a_0 = Constant term (intercept) which shows the level of ROE

b_1-b_4 = The parameters

e = Error term

4.0 Results and Discussions

Table 1 presents the descriptive statistics of the study variables. The minimum and maximum values of return on equity (ROE) for commercial banks range from 2.5 to 5.0. This indicates a moderate dispersion in profitability levels, suggesting differences in operational efficiency across the sampled banks.Equity capital ranges from 3.0 to 5.0, reflecting a relatively narrow spread. This suggests that most commercial banks maintain comparable levels of equity capitalization. In contrast, total assets range from 5.0 to 8.0, indicating substantial variation in bank size and scale of operations within the sample.The capital adequacy ratio ranges from 5.00 to 7.99, implying variability in the degree of capitalization and financial resilience among the banks. The leverage ratio varies between 5.0 and 6.0, suggesting that leverage positions are relatively similar across the commercial banks.The skewness statistics reveal that all variables are positively skewed, indicating that the distributions are characterized by a higher concentration of low-to-moderate values and relatively fewer extreme high values.

Table 1:
Descriptive Statistical Analysis

Statistic	ROE	ECP	TAS	CAR	LVR
Minimum	2.50	3.00	5.00	5.00	5.00
Maximum	5.00	5.00	8.00	7.99	6.00
Sum	254.00	256.00	258.00	253.00	260.00
Mean	3.95	4.04	4.03	3.95	4.07
Standard Dev.	0.57	0.38	0.62	0.54	0.42
Variance	0.34	0.15	0.37	0.26	0.17

Skewness	1.02	1.14	1.26	1.34	0.25
Kurtosis	0.05	0.88	0.75	0.54	0.73

Source: Eviews Output, 2026.

For the correlation matrix in Table 2, return on equity shows moderate positive correlations with all variables. The relationship between return on equity and total assets was positive (0.565). Banks with larger total assets tend to have higher return on assets. Furthermore, return on assets and leverage ratio had a strong correlation (0.548). Higher leverage is associated with higher return on assets, likely because leverage magnifies returns. In another development, return on assets and equity capital showed a weak correlation (r = 0.442). Banks with higher equity capital showed moderately higher return on equity**.** The association between return on equity and capital adequacy ratio was also positive (0.415). Better-capitalized firms tend to have higher ROE, though witha weak relationship. Return on equity increases with firm size, leverage, and capital strength. Overall, equity capital aligns closely with firm size and capital adequacy ratio. Larger firms tend to maintain stronger capital adequacy. The correlation between leverage ratio and total assets was strong (0.631)**,** moderated by Return on equity (0.548), Equity capital (0.582), and Capital adequacy (0.567). In summary, leverage increases with firm size, equity, capital adequacy, and bank efficiency.

Table 2:
Correlation Matrix

	ROE	ECP	TAS	CAR	LVR
ROE	1.000				
ECP	0.442	1.000			
TAS	0.565	0.697	1.000		
CAR	0.415	0.621	0.647	1.000	
LVR	0.548	0.582	0.631	0.567	1.000

Source: Eviews Output, 2026.

Table 3 belowshows Panel Estimated Generalized Least Squares (EGLS) fixed effects results presented in Table 3, the adjusted coefficient of determination (Adjusted R^2) is 0.92 (92%). This indicates that approximately 92% of the variation in return on equity (ROE) is explained by the equity capital ratio, total asset ratio, capital adequacy ratio (CAR), and leverage ratio. The remaining 8% of the variation is attributable to factors not captured by the model and is absorbed by the error term.

The intercept term is 1.14 (p = 0.00), indicating a positive and statistically significant. This implies that, holding all explanatory variables constant, ROE is expected to increase by 1.14 units. Furthermore, equity capital exhibits a significant negative relationship with ROE, suggesting that a 1% increase in equity capital reduces ROE by 0.054%.The policy implication of the result is that banks with higher equity capitalization may adopt more conservative risk profiles, as a strong capital base reduces the need for aggressive lending and investment strategies. The negative association may therefore reflect a trade-off between solvency and profitability, suggesting that well-capitalized banks prioritize financial stability over short-term profit maximization. This finding is consistent with Majnoni (2011) and Cotter (2016), who reported an inverse relationship between equity capital and return on assets.

In contrast, the total asset ratio demonstrates a positive and statistically significant relationship with ROE. Specifically, a 1% increase in total assets leads to a 0.21% increase in ROE. This finding aligns with Gordard (2014), who reported a similar positive association. The implication is that as banks expand their asset base, they benefit from economies of scale, whereby fixed operating costs are spread over a larger volume of assets, thereby enhancing efficiency and profit margins. Larger banks also possess greater capacity to engage in income-generating activities, including lending, investment operations, and fee-based services.

Similarly, the capital adequacy ratio exhibits a positive and statistically significant effect on ROE as a 1% increase in CAR results in a 0.17% increase in ROE. This finding corroborates the results of Margarida and Mendes (2012) and Naceur (2016), who concluded that well-capitalized banks face lower expected distress costs and achieve superior returns. Adequate capitalization enhances financial stability and solvency, thereby translating into improved operational efficiency and profitability. Well-capitalized banks are therefore better positioned to convert capital into sustainable profits.

The leverage ratio, however, displays a negative and statistically significant effect on ROE. A 1% increase in leverage reduces ROE by 0.01%. This finding is consistent with Okoi, Ogar, Hogan, and Nkiri (2025), who documented a similar negative relationship between leverage decisions and bank profitability in Nigeria. The result suggests that excessive reliance on debt financing diminishes shareholder returns. Increased leverage raises financial risk and interest obligations, which may outweigh the benefits of debt financing and consequently erode ROE. This underscores the importance of prudent capital structure management in the banking sector.

The Durbin-Watson statistic of 0.58 indicates the presence of positive autocorrelation in the residuals. The overall significance of the model is confirmed by the F-statistic of 244.6, which is statistically significant at the 1% level. This demonstrates that the explanatory variables jointly exert a significant effect on ROE and that the model possesses strong explanatory power. The high R^2 value is therefore not attributable to random variation but reflects a good model fit.

The Random Effects EGLS results reveal that equity capital significantly reduces ROE, while total assets, capital adequacy ratio, and leverage ratio exert positive and statistically significant effects. The variance decomposition shows that approximately 59% of the total variation in ROE is attributable to cross-sectional differences among DMBs. The model is jointly significant at the 1% level. Compared with the fixed effects specification, the leverage ratio appears to exert its influence primarily through cross-sectional heterogeneity rather than through within-bank temporal variations.

The Hausman specification test produces a Chi-square statistic of 22.924 ($p = 0.0001$), leading to rejection of the null hypothesis that the random effects estimator is consistent. This indicates that the cross-sectional effects are correlated with the explanatory variables, thereby justifying the preference for the fixed effects model. Under the preferred fixed effects specification, equity capital and leverage ratio reduce ROE, whereas total assets and capital adequacy ratio exert positive and statistically significant effects. These findings confirm the presence of firm-specific heterogeneity influencing bank profitability and validate the appropriateness of the fixed effects estimation approach.

Table 3:
Fixed Effects

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LECP	-0.054225	0.028695	-1.889708	0.0596
LTAS	0.206395	0.024797	8.323506	0.0000
LCAR	0.171096	0.014152	12.08983	0.0000
LLVR	-0.012618	0.058008	-0.217516	0.8279
C	1.143657	0.166649	6.862667	0.0000
	Effects Specification			
Cross-section fixed (dummy variables)				
	Weighted Statistics			
R-squared	0.925389	Mean dependent var		3.351826
Adjusted R-squared	0.921605	S.D. dependent var		2.282339
S.E. of regression	0.291273	Sum squared resid		30.11812
F-statistic	244.6101	Durbin-Watson stat		0.586237
Prob(F-statistic)	0.000000			
	Unweighted Statistics			
R-squared	0.853443	Mean dependent var		2.438669
Sum squared resid	34.42214	Durbin-Watson stat		0.601134

Source: Eviews Output, 2026.

Random Effects

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LECP	-0.086238	0.031474	-2.740004	0.0064
LTAS	0.208464	0.029340	7.105005	0.0000
LCAR	0.193753	0.020535	9.435370	0.0000
LLVR	0.252119	0.062444	4.037531	0.0001
C	0.456843	0.192130	2.377787	0.0179
	Effects Specification			
			S.D.	Rho
Cross-section random			0.365496	0.5939
Idiosyncratic random			0.302204	0.4061

Weighted Statistics			
R-squared	0.569284	Mean dependent var	0.398234
Adjusted R-squared	0.564615	S.D. dependent var	0.469525
S.E. of regression	0.309893	Sum squared resid	35.43636
F-statistic	121.9283	Durbin-Watson stat	0.622375
Prob(F-statistic)	0.000000		

Unweighted Statistics			
R-squared	0.397002	Mean dependent var	2.438669
Sum squared resid	141.6269	Durbin-Watson stat	0.155724

Source: Eviews Output, 2026.

Correlated Random Effects - Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	22.924092	4	0.0001

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
LECP	-0.121559	-0.086238	0.000067	0.0000
LTAS	0.225572	0.208464	0.000132	0.1359
LCAR	0.197811	0.193753	0.000030	0.4570
LLVR	0.242057	0.252119	0.000305	0.5648

Cross-section random effects test equation:
Dependent Variable: LROE
Method: Panel Least Squares
Sample: 2014 2024

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.434891	0.175813	2.473594	0.0138
LECP	-0.121559	0.032518	-3.738253	0.0002
LTAS	0.225572	0.031504	7.160184	0.0000
LCAR	0.197811	0.021247	9.310068	0.0000
LLVR	0.242057	0.064843	3.732951	0.0002

Effects Specification
Cross-section fixed (dummy variables)

R-squared	0.861962	Mean dependent var	2.438669
Adjusted R-squared	0.854962	S.D. dependent var	0.793525
S.E. of regression	0.302204	Akaike info criterion	0.494040
Sum squared resid	32.42128	Schwarz criterion	0.693401
Log likelihood	-73.38557	Hannan-Quinn criter.	0.573196
F-statistic	123.1526	Durbin-Watson stat	0.693283
Prob(F-statistic)	0.000000		

Source: Eviews Output, 2026.

5.0 Conclusion

The study investigates the impact of capital adequacy on the operational efficiency of deposit money banks in Nigeria. The panel Estimated Generalized Least Squares (EGLS) fixed effects results indicate that total assets and the Capital Adequacy Ratio (CAR) exert positive and statistically significant effects on return on equity (ROE). This finding implies that higher capitalization significantly enhances banks' ROE, suggesting that well-capitalized banks tend to exhibit superior profitability. The statistical robustness of this relationship leads to the rejection of the null hypothesis of no effect. Moreover, the positive effect of total assets suggests the existence of economies of scale and improved intermediation efficiency, implying that asset expansion enhances shareholder value within the banking sector.

Conversely, equity capital exhibits a negative but weakly significant effect on ROE, while the leverage ratio demonstrates no statistically significant influence on bank efficiency. The negative coefficient of equity capital implies that excessive reliance on equity financing may reduce profitability; however, the marginal statistical significance indicates that this effect should be interpreted with caution. A higher proportion of equity financing may increase the overall cost of capital, potentially eroding returns on equity. Thus, the adverse relationship may reflect suboptimal capital structure decisions in which the balance between debt and equity is inefficient. The insignificance of the leverage ratio suggests that variations in leverage do not systematically explain changes in shareholder returns. Consequently, leverage does not appear to be a robust determinant of profitability within the estimated model, and shareholders should not rely solely on leverage adjustments to enhance ROE. The findings also provide limited support for the pecking order theory, which emphasizes a preference for internal financing.

The inclusion of cross-sectional fixed effects indicates the presence of unobserved heterogeneity across banks, thereby validating the appropriateness of the fixed effects specification. Overall, the results suggest that while increases in capital adequacy enhance profitability, excessive equity capitalization may reduce returns, albeit weakly.

Capital adequacy constitutes a critical financial decision for bank management, as it directly influences shareholder returns and risk exposure. The study concludes that adequate capitalization is essential for the sustainability of deposit money banks in Nigeria. Accordingly, it recommends that banks strengthen and implement effective strategies to attract additional equity funding while maintaining an optimal capital structure. Deposit money banks should also monitor asset quality to ensure that asset growth translates into sustainable returns. Furthermore, banks should avoid overreliance on leverage adjustments as a strategy for improving ROE. Policymakers are encouraged to reinforce prudential regulations to ensure adequate capitalization within the banking sector.

This study contributes to the existing body of knowledge by providing empirical evidence that capital adequacy significantly influences the efficiency of deposit money banks in Nigeria. Future research should extend this line of inquiry by examining the implications of capital adequacy for selected manufacturing firms in Nigeria to enhance comparative sectoral insights.

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