MODERATING ROLE OF CUSTOMER DENSITY ON THE RELATIONSHIP BETWEEN FIRM SIZE AND PERFORMANCE OF ELECTRICITY DISTRIBUTION COMPANIES IN NIGERIA

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Abstract
Electricity distribution companies in Nigeria continue to face financial sustainability challenges despite sector reforms, creating the need to understand how firm-specific characteristics and operating conditions influence performance. This study examined the effect of firm attributes on the financial performance of electricity distribution companies in Nigeria, with customer density evaluated as a moderating factor. Specifically, the study assessed the influence of firm size, leverage, liquidity, asset structure, firm growth, and working capital ratio on financial performance. A quantitative research design was adopted using panel data obtained from electricity distribution companies in Nigeria. The study employed panel regression techniques, with Return on Assets (ROA) used as the primary measure of financial performance, while moderation analysis was applied to determine the influence of customer density on the relationship between firm attributes and performance. The findings revealed that firm size has a significant positive effect on financial performance, suggesting that larger firms benefit from economies of scale, improved access to financial resources, and enhanced operational capabilities. Customer density was also found to significantly moderate the relationship between firm size and performance, indicating that firms operating in areas with higher customer concentration are better positioned to maximize resource advantages and improve profitability. The findings support the Resource-Based View and Contingency Theory by demonstrating that firm resources and environmental conditions jointly shape performance outcomes. The study recommends that electricity distribution companies pursue sustainable expansion strategies, strengthen financial and operational resource management, and consider customer density patterns when making investment and growth decisions to improve long-term financial performance.

1.0 Introduction

The performance of electricity distribution companies (DisCos) in Nigeria is influenced by firm specific characteristics and the conditions within which firms operate. Key firm attributes include firm size, liquidity, leverage, asset structure, firm growth, and working capital efficiency. Firm size, commonly measured by total assets, can improve profitability through economies of scale, wider customer reach, and stronger bargaining power (Elgammal & Tawfik, 2023). Liquidity, measured through the current ratio, supports firms' ability to meet short term obligations and finance network improvements, thereby contributing to operational stability (Acheampong et al., 2023). Leverage, measured as debt to assets, affects financial performance through the balance between the benefits of debt financing and the risks associated with excessive financial obligations (Afolayan & Adesola, 2022). Asset structure reflects the allocation of resources to fixed assets and is particularly important in capital intensive sectors such as electricity distribution. Firm growth,

measured through changes in sales revenue, indicates market expansion and revenue generating capacity (Alarudeen & Lawal, 2021), while working capital management influences liquidity and operational stability (Olowe & Oluwaseun, 2020).

At the global level, electricity distribution systems are increasingly assessed in terms of financial sustainability, operational efficiency, infrastructure investment, and service quality. Developed electricity systems generally benefit from stronger infrastructure, advanced metering technologies, effective regulatory institutions, and more efficient asset management. In contrast, electricity distribution systems in Africa continue to experience infrastructure deficits, inadequate investment, weak revenue collection, and regulatory challenges. These difficulties are particularly evident in Sub Saharan Africa, where institutional and infrastructural constraints have limited sector performance. Nigeria faces similar challenges despite the unbundling and privatization of the electricity industry in 2013.

Nigeria's DisCos occupy a strategic position in the electricity value chain because they connect electricity generation with households, businesses, and public institutions. The 2013 reforms were intended to improve efficiency, financial sustainability, investment, and service delivery. However, the expected improvements have remained uneven, with many DisCos experiencing weak profitability, liquidity constraints, inadequate infrastructure investment, and persistent service delivery challenges. These outcomes indicate that differences in performance cannot be explained exclusively by internal organizational characteristics. The operating environment in which DisCos provide electricity may also determine how effectively firm resources are converted into financial and operational outcomes.

Nigeria's electricity distribution environment provides a relevant setting for examining this relationship because DisCos operate across service territories that differ in population distribution, geographical coverage and infrastructure requirements. The financial returns obtainable from a given asset base may therefore vary according to the cost of extending and maintaining distribution networks, the concentration of customers, and the ability to convert electricity supplied into collected revenue. Where customers are widely dispersed, a DisCo may incur relatively high network and maintenance costs to serve them; where customers are concentrated, infrastructure may serve more customers within a smaller area. These differences mean that asset scale alone may not fully explain variations in financial performance across Nigerian DisCos. The study consequently examines whether customer density helps explain why the relationship between firm size and financial performance may differ across the companies.

Customer density is particularly relevant because it represents the number of customers served within a defined geographical area. It affects infrastructure requirements, operating costs, revenue potential, and the ability of a utility to achieve economies of scale. In densely populated service territories, distribution infrastructure can serve a larger number of customers within a relatively limited geographical area, potentially reducing average service costs and improving revenue generation. In contrast, sparsely populated territories require longer distribution networks and greater expenditure per customer, which may reduce the economic benefits associated with firm resources. Evidence from other utility sectors, including telecommunications, water, and gas distribution, similarly indicates that customer concentration can influence economies of scale and financial outcomes.

Customer density is expected to moderate the relationship between firm size and financial performance because the benefits associated with a large asset base may depend on the geographical distribution of customers served. In a densely populated service territory, a distribution company may be able to serve more customers through a relatively concentrated network and spread some infrastructure, maintenance and administrative costs across a larger customer base. These conditions may enable a larger asset base to generate stronger financial returns. In contrast, where customers are geographically dispersed, the company may need longer distribution lines and more extensive infrastructure to reach a similar number of customers, potentially increasing the cost of service delivery. Consequently, firm size may not produce the same financial outcome across all DisCos. Customer density is therefore examined as a moderator to determine whether the relationship between firm size and return on assets varies with the concentration of customers within a service territory.

The Nigerian context provides a useful basis for examining this relationship because DisCos operate across service territories with substantial demographic and spatial differences. A large DisCo operating in a densely populated area may be able to distribute infrastructure and administrative costs across a relatively large customer base, thereby improving the contribution of firm size to financial performance. Conversely, a large DisCo operating across geographically dispersed areas may incur higher costs per customer, potentially reducing the performance benefits associated with greater asset ownership. Thus, firm size may not have a uniform effect on performance across all DisCos because its benefits can depend on the density of customers within the service territory.

This moderating relationship is also consistent with the broader literature on firm characteristics and performance. Previous studies have identified firm attributes as important determinants of corporate performance (Olaniyi & Macaulay, 2022; Egbunike & Okerekeoti, 2018). However, empirical evidence remains inconclusive. Some studies report positive relationships between firm size, liquidity, and profitability (Alarussi & Alhaderi, 2018; Bassey et al., 2020), whereas others report weak or negative relationships (Akinyomi & Olagunju, 2013; Rahman, 2022). Leverage has similarly been associated with both potential monitoring and growth benefits and increased financial distress (Zeitun & Tian, 2007; Jõeveer, 2013). Asset structure, firm growth, and working capital efficiency have also produced mixed findings across industries (Abor, 2005; Awan et al., 2018). These inconsistencies suggest that the effect of firm characteristics may depend on the institutional and operating environment in which firms function.

Evidence from Nigeria's electricity sector has predominantly concentrated on sectoral and operational challenges. Bello, Ibrahim, and Omotayo (2021) examined electricity market efficiency, while Abubakar, Nwogugu, and Adebayo (2020) assessed the Meter Asset Provider scheme as an approach to improving electricity metering. Eweje and Okafor (2021) examined strategies for reducing distribution inefficiencies. Although these studies contribute to understanding the challenges facing Nigeria's electricity distribution industry, relatively limited attention has been given to firm specific characteristics and the way environmental conditions such as customer density may condition their effects on financial performance.

The contextual gap is further evident because much of the existing literature on firm characteristics and financial performance has focused on sectors such as banking, telecommunications, and manufacturing (Afolayan & Adesola, 2022; Lestari & Putra, 2021). These sectors differ from

electricity distribution because the geographical dispersion of customers does not necessarily impose the same infrastructure and service delivery constraints. Furthermore, many previous studies employ linear regression models that examine direct relationships without explicitly testing whether environmental conditions moderate firm performance relationships (Jahan, 2020; Rahman, 2022). The Resource Based View and Agency Theory also tend to emphasize internal resources, capabilities, managerial behaviour, and governance, with comparatively limited consideration of spatial and demographic characteristics.

This study contributes to the literature in three ways. First, it provides evidence on the relationship between firm size and financial performance in Nigeria's electricity distribution sector, an industry with substantial infrastructure requirements and operating conditions that differ from those of banks, insurance companies and manufacturing firms. Second, it moves beyond examining firm size as a direct predictor by explicitly testing whether customer density changes the relationship between firm size and return on assets. Third, it brings a geographical operating condition into the explanation of differences in DisCo financial performance. By testing the firm-size and customer-density interaction, the study assesses whether the financial benefits associated with firm size vary according to the concentration of customers served. These contributions are intended to provide sector-specific evidence for future research and for decisions concerning infrastructure deployment and performance assessment.

The study therefore focuses specifically on the relationship between firm size and the performance of electricity distribution companies in Nigeria, with customer density introduced as a moderating variable. Firm size represents the principal explanatory variable, while performance captures the financial capacity of DisCos to generate returns from their asset base. Customer density provides an environmental dimension by accounting for differences in the concentration of customers within the geographical territories served by individual DisCos. This approach recognizes that the performance implications of firm size may vary according to the characteristics of the market in which the firm operates. The study is guided by two research questions:

i. What is the effect of firm size on the performance of electricity distribution companies in Nigeria?
ii. How does customer density moderate the relationship between firm size and the performance of electricity distribution companies in Nigeria?

2.0 Literature Review

This section reviews the concepts, empirical evidence and theories relating to firm size and financial performance, with customer density as a moderating variable. It examines relevant concepts, previous empirical findings, the Resource-Based View, and the research gaps that inform the study's model.

Firm Performance:

The concept of firm performance has evolved as a central construct in organisational and management studies, encompassing the extent to which an entity achieves its goals effectively and efficiently within a given operating environment. According to Bolton, Butler, and Martin (2023), performance represents the overall outcome of an organisation's strategic and operational activities aimed at achieving profitability, sustainability, and stakeholder satisfaction. It is not merely an accounting measure but a holistic reflection of how well resources are utilised to create value.

Acheampong et al. (2023) conceptualise performance as a multidimensional construct encompassing financial strength, productivity, innovation, and adaptability. They note that

performance goes beyond profit measurement to include how effectively management converts inputs into outputs while sustaining stakeholder trust. Similarly, Al Ani et al. (2014) define performance as the systematic evaluation of an organisation's efficiency and effectiveness in achieving pre-determined objectives.

Thus, performance can be conceptually viewed as the aggregate outcome of a firm's financial, and operational activities**,** reflecting how effectively it achieves its goals, sustains competitiveness, and creates long-term value. It involves both efficiency (doing things right) and effectiveness (doing the right things) in the utilisation of resources to achieve desired outcomes. Furthermore, in this study, performance will be discussed focusing on both financial and operational dimensions.

Enekwe et al. (2023) define financial performance as the extent to which a firm effectively utilises its assets to generate revenue and achieve its financial objectives. They emphasise that performance evaluation is typically undertaken using ratio analysis, incorporating profitability, liquidity, leverage, efficiency, and investment measures. Applied to Nigerian DisCos, these measures can be operationalised through indicators such as return on assets (ROA) linked to metering penetration, energy delivery efficiency, and reduction in aggregate technical, commercial, and collection (ATC&C) losses. This contextualised application underscores that in regulated electricity markets; profitability must be balanced with service delivery and compliance with regulatory benchmarks.

Onyebuchi (2020) views financial performance as a firm's capacity to utilise operational resources to generate revenue and meet strategic objectives. He argues that this capacity serves as a deductive measure of how well a company converts inputs such as assets and operational capabilities into financial results. Failure in this regard not only undermines profitability but also erodes public trust and the ability to attract investment capital. In the case of DisCos, this can manifest in inadequate billing systems, inefficient energy distribution networks, and poor collection efficiency.

Drawing from the foregoing definitions, the study adopts a pragmatic view of financial performance as the ability of a distribution company to convert its asset base into sustained earnings while minimising operational and commercial inefficiencies. In line with this perspective, this study measures financial performance using return on assets (ROA) to capture profitability relative to asset utilisation, alongside aggregate technical, commercial, and collection (ATC&C) losses as a sector- specific efficiency indicator. This dual- measurement approach is particularly relevant to Nigerian DisCos, where profitability is directly constrained by high loss levels and inadequate asset optimisation. By integrating ROA and ATC&C losses, the study presents a more comprehensive picture of financial performance, one that reflects not only accounting returns but also operational discipline, revenue protection capacity, and long- term sustainability within a regulated electricity market.

Return on Assets (ROA) is one of the most widely adopted indicators for assessing a firm's financial performance because it reflects the ability of an organisation to convert its total asset base into sustainable earnings. Its conceptual strength lies in its integrative nature, it bridges operational efficiency with strategic resource utilisation, providing managers, regulators, and investors with a unified measure of performance (Bolton, Butler, & Martin, 2023). ROA is particularly relevant in asset- intensive industries such as manufacturing, energy, and utilities, where the deployment and maintenance of physical infrastructure directly influence profitability outcomes (Iovino, Koufopoulos, Maielli, & Meredith, 2023; Enekwe, Ayogu, & Bolaji, 2023).

Firm Size:
Firm size has been defined in multiple ways by scholars, with each definition emphasising distinct dimensions of organisational scale, resource capacity, and operational reach. Ngumo, Collins, and David (2020) define it as "the scale of a business entity commonly measured by total assets, sales revenue, or number of employees," identifying it as a structural determinant of institutional capacity and financial performance. Similarly, Setiawan and Ekadjaja (2023) describe firm size as "the magnitude of resources owned and controlled by the firm, typically expressed through total assets or total sales," emphasising its influence on economies of scale and financing capacity.

Ewool and Atuahene (2021) take a broader perspective, defining firm size as "the relative operational capacity and market presence of a firm, measured by its total resources and ability to sustain operations over time," linking it to resilience and growth potential. Along similar lines, Senan, Ahmad, Anagreh, Tabash, and Al Homaidi (2021) view it as "the scale of a company's operations measured in monetary or quantitative terms, which can influence its leverage capacity and comparative performance." This underscores the role of firm size in shaping financing options and competitive positioning.

In this research, firm size is conceptualised as a quantitative indicator of organisational scale, measured by the natural logarithm of total assets, consistent with prior empirical studies (Ngumo, Collins, & David, 2020; Setiawan & Ekadjaja, 2023). This approach captures the magnitude of resources under a firm's control while normalising potential skewness in raw asset data, thereby enhancing comparability across electricity distribution companies. The choice of log- transformed total assets is particularly appropriate for the Nigerian DisCo context, where asset intensity is a defining industry characteristic and where differences in operational scale can significantly influence financial performance outcomes. By adopting this measure, the research aligns with established methodological practices while ensuring that firm size is assessed in a manner that reflects both its strategic and operational relevance to profitability evaluation in capital- intensive, regulated environments.

Customer Density
From a utility management standpoint, customer density is not merely a logistical metric, it has significant financial and planning implications. A high customer density scenario enables DISCOs to minimize per-customer costs, achieve economies of scale, and optimize service delivery. On the other hand, low customer density makes energy supply more capital-intensive and laborious, reducing profitability and complicating efforts to improve revenue collection and grid reliability. For instance, in remote areas with sparse connections, a DISCO might invest heavily in extending infrastructure without commensurate revenue returns, especially if customer metering or billing is inadequate.

Therefore, customer density and customer population are interrelated constructs that jointly affect a DISCO's operational efficiency and financial sustainability. Customer density informs how intensively the customer population is distributed, while customer population provides the absolute scale of service demand. Together, they determine the cost structure, revenue model, and investment priorities of electricity distribution companies.

In this study, customer density refers to the number of registered electricity consumers served per unit of geographical area within a DISCO's service territory. It reflects how concentrated or

dispersed customers are and directly influences the cost-efficiency of infrastructure deployment, metering, and service delivery. Often called Customer population, it denotes the total number of registered electricity consumers including metered, unmetered, active, and inactive users within a DISCO's operational network. Together, these concepts are critical indicators of a DISCO's operational environment, influencing planning, revenue generation, and investment decisions. While customer population reflects the scale of service demand, customer density determines the intensity of that demand across the distribution landscape.

Customer density refers to the concentration of registered electricity customers within a defined geographical service area. It is distinct from the total number of customers: two DisCos may serve similar customer populations but have different customer densities because their service territories differ in geographical size. In electricity distribution, customer density is relevant because the location of customers can affect the extent of network infrastructure required to serve them and the number of customers among whom certain network and operating costs can be distributed. A relatively high density may allow a network to serve more customers within a smaller area, while a low density may require infrastructure to cover a wider area. These are potential operating advantages or disadvantages rather than guaranteed outcomes, since actual performance also depends on factors such as network condition, electricity supply, billing, collection and management. In this study, customer density is treated as a moderating variable. The analysis tests whether the association between firm size, measured by the natural logarithm of total assets, and financial performance, measured by ROA, changes with customer density.

The three concepts are linked in the framework of this study. Firm size represents the scale of resources controlled by a DisCo and is expected to influence its ability to deploy infrastructure and generate earnings from its assets. Financial performance is measured by return on assets, which captures the earnings generated relative to the asset base. Customer density describes how concentrated registered customers are within the geographical area served. It may influence the extent to which a DisCo can spread infrastructure and operating costs across its customers. Accordingly, the study examines both the direct relationship between firm size and return on assets and the interaction between firm size and customer density. A statistically significant interaction would indicate that the relationship between firm size and financial performance varies with customer density.

Empirical Review

Al-Nawaiseh (2020) examined the effect of firm size on the profitability of Jordanian insurance firms, within the insurance firm domain, using an ex post facto research design with descriptive statistics and simple regression analysis. The study's population comprised 22 insurance firms listed on the Amman Stock Exchange, representing 95.2% of the industry, covering a period from 2008 to 2017 in Jordan. Firm size, measured as the logarithm of total assets, was the independent variable, while return on equity (ROE) served as the dependent variable. The findings revealed a significant positive effect of firm size on the profitability of insurance firms.

While the study provides valuable insights into the relationship between firm size and profitability in the Jordanian insurance sector, there are some gaps. The study uses a relatively large sample (22 firms), representing 95.2% of the industry, which enhances its generalizability. However, the study relies solely on firm size, measured by the logarithm of total assets, as the independent variable, overlooking other potentially significant factors such as working capital, leverage, or

asset structure that could also impact profitability. Furthermore, the study's use of return on equity (ROE) as the sole profitability measure limits the scope of analysis, as other metrics like return on assets (ROA) or profit margins might offer different insights. Additionally, the research design is ex post facto, which can limit the ability to establish causal relationships between firm size and profitability, especially without controlling for potential confounding variables. The current study addresses this gap by incorporating other firm attributes such as leverage, liquidity, working capital and asset structure to understand how these firm attributes affects both operational efficiency, using ATC&C as a measure and financial performance using ROA.

Kayani & Hakiman (2023) examined the effect of bank size on the financial performance of conventional banks in Indonesia. The study covered 107 banks registered with the Financial Services Authority, from which 10 were purposively selected based on set criteria. Bank size, measured by total assets, was used as the independent variable, while return on assets (ROA) served as the dependent variable. Using panel data regression with a random effects model in EViews 12, the findings indicated that bank size had a positive and significant impact on financial performance, suggesting that larger banks tend to achieve higher profitability. This study provides valuable insights, particularly through its use of panel data regression and a random effects model. However, the study's sample size of 10 banks, although purposively selected, could introduce selection bias, which may limit the generalizability of the findings. The study also uses total assets to measure bank size, but this might not capture other dimensions of size, such as market reach or the diversity of services offered, which could influence performance. Furthermore, the study focuses solely on return on assets (ROA) as the dependent variable, which, while a common measure of profitability, does not fully encompass other aspects of financial performance, such as liquidity or risk-adjusted returns. The current study goes beyond just firm size by examining the moderating role of customer density, considering how geographical and demographic factors influence the financial performance of Nigerian electricity distribution firms.

Nguyen & Nguyen (2019) investigated the determinants of financial performance of 1,343 companies across six industries listed on the Vietnamese Stock Exchange from 2014 to 2017, using STATA software for analysis. Firm size, measured as the logarithm of total assets, was among the independent variables, while profitability was evaluated using return on assets (ROA), return on equity (ROE), and return on sales (ROS). Using panel regression models, the findings revealed that firm size had a positive effect on ROA and ROS, particularly ROA, but a negative effect on ROE.The use of multiple profitability measures (ROA, ROE, and ROS) strengthens the analysis by offering a broader view of financial performance. However, the study's reliance on firm size as measured by the logarithm of total assets may overlook other relevant aspects of firm size, such as market share or revenue diversification, which could provide a more nuanced understanding. While the study identifies a positive effect of firm size on ROA and ROS, and a negative effect on ROE, the underlying reasons for this disparity are not fully explored. Additionally, the study uses panel regression models but does not mention whether other potential determinants of financial performance, such as corporate governance, market conditions, or industry-specific factors, were controlled for, which may influence the robustness of the findings. Furthermore, the time frame (2014–2017) is relatively short, and economic or regulatory changes within that period could have skewed the results, suggesting a need for further research with a more extended observation period or a focus on specific industry trends. The current study addresses this gap by including customer density, which reflects the spatial and demographic diversity of service areas, to better understand the financial performance of Nigerian electricity distribution firms

Omiete, (2004) examined the effect of financial leverage, firm size, and profitability on the value of quoted insurance companies (QICs) in Nigeria for the period 2010-2022. Firm size (FZ) proxied by logarithm of total assets was included as an explanatory variable, with Tobin's Q as the dependent variable. Secondary time-series data from the annual reports of 20 QICs were analyzed using unit root tests, Pedroni cointegration, and the Generalized Method of Moments (GMM) at the 5% significance level. Results showed that firm size had a positive and statistically significant effect on firm value. This study employed a rigorous methodology, using secondary time-series data from the annual reports of 20 QICs and advanced econometric techniques such as unit root tests, Pedroni cointegration, and the Generalized Method of Moments (GMM). The positive and statistically significant relationship between firm size (measured by the logarithm of total assets) and firm value, as indicated by Tobin's Q, adds valuable insights to the literature. However, the study's focus on only one measure of firm value (Tobin's Q) might limit the depth of analysis, as other indicators like market value or book value could provide a more comprehensive view of firm performance. Additionally, while the study uses a sophisticated econometric approach, the relatively small sample size (20 companies) could limit the generalizability of the findings to the broader insurance industry in Nigeria. Furthermore, the study period (2010–2022) covers a significant time frame, yet the analysis does not address how macroeconomic factors, such as inflation, exchange rates, or regulatory changes, might have influenced firm value during this period, suggesting that external factors could also play a crucial role in the observed relationships.The current study addresses this gap by incorporating a broader set of performance measures, including ROA while introducing customer density as a moderating variable to account for geographic and infrastructural factors affecting profitability.

Youssef et al. (2023) examined the determinants of profitability of non-financial small- and medium-sized enterprises (SMEs) listed in the UK, within the corporate domain, using dynamic panel data estimation techniques. The study covered 93 listed SMEs from 2012 to 2020, with firm size (measured as total assets) among the firm-specific independent variables, and return on assets (ROA) and return on equity (ROE) as dependent variables. Data were sourced from the Thomson Reuters DataStream, and analysis employed fixed effects, random effects, and the generalized method of moments (GMM). The results revealed that firm size had a statistically significant influence on profitability, underscoring the role of scale in enhancing SME performance in developed economies. The study of 93 SMEs from 2012 to 2020 offers valuable insights into how firm size affects profitability in developed economies, using reliable methods like fixed effects, random effects, and GMM. However, the study could improve by considering other factors that influence profitability, such as management quality, innovation, and market competition. It also relies mainly on ROA and ROE as profitability measures, but adding other indicators like profit margins or EVA would give a fuller picture. Additionally, the study doesn't account for external factors like Brexit or the COVID-19 pandemic, which could have impacted SME performance. Future research could explore these broader economic influences on profitability. The current study overcomes the above limitations by including customer density, which moderates the relationship between firm attributes and financial performance, particularly in Nigeria's regulated electricity sector.

Theoretical Review

The Resource-Based View (RBV), introduced by Wernerfelt (1984) and developed by Barney (1991), explains differences in firm performance through variations in internal resources and capabilities. The theory argues that firms achieve sustained competitive advantage when they

possess resources that are valuable, rare, inimitable, and non-substitutable (VRIN) (Barney, 1991). Unlike external market-based theories, RBV focuses on internal resources, including financial assets, infrastructure, human capital, and organizational capabilities, as key drivers of performance.RBV is relevant to Nigeria's electricity distribution sector because DisCos operate under similar regulatory and tariff conditions but differ in financial strength, asset composition, managerial capacity, and operational systems. These differences help explain variations in performance outcomes. Supporting this view, Olayemi et al. (2024) found that financial capability, technological capacity, and managerial competence significantly influence the efficiency of Nigerian DisCos, demonstrating that strategic internal resources remain important even within a highly regulated environment.

Despite its relevance, RBV has limitations. A major criticism concerns the difficulty of objectively identifying and measuring VRIN resources, particularly intangible resources, as their value often depends on subjective assessment and industry context (Priem & Butler, 2001; Sanchez, 2008). Kraaijenbrink et al. (2010) further argue that unclear measurement approaches may limit RBV's predictive ability, making it more useful for explaining existing advantages than predicting future performance.RBV has also been criticised for its limited attention to external conditions that influence how resources create value. Environmental factors such as regulation, geography, and customer density may determine whether internal capabilities translate into improved outcomes (Studocu, 2023; FasterCapital, 2024). In the Nigerian DisCo context, customer density affects infrastructure costs, revenue potential, and economies of scale, meaning that firm resources may produce different outcomes across service territories.

Additionally, RBV's assumption of sustained resource advantages may overlook the risk of resource rigidity, where previously beneficial capabilities become barriers to adaptation (Leonard-Barton, 1992; Penpoin, 2024). For DisCos, reliance on outdated infrastructure and operational practices may reduce flexibility in responding to technological and market changes. Despite these limitations, RBV provides a valuable foundation for examining how firm attributes such as size, liquidity, asset structure, growth, and working capital efficiency influence performance. To address RBV's limitations, this study integrates it with Contingency Theory and Dynamic Capabilities Theory. Contingency Theory explains the moderating influence of customer density, while Dynamic Capabilities Theory highlights firms' ability to adapt and reconfigure resources in changing environments. This integrated perspective provides a more comprehensive explanation of how internal resources and external conditions jointly shape the performance of Nigerian DisCos. (Helfat & Peteraf, 2023; FasterCapital, 2024; Penpoin, 2024

The empirical studies reviewed in this paper provide a basis for applying the Resource-Based View to the present study, although their findings arise from different industries and institutional settings. Studies reporting a positive relationship between firm size and profitability are consistent with the argument that a larger resource base can support performance through scale and resource utilisation. However, evidence from other settings cannot automatically be transferred to Nigerian electricity distribution companies because the sector is infrastructure-intensive and DisCos operate across service territories with different geographical characteristics. The present study therefore examines whether firm size is associated with ROA in this sector and whether customer density changes that association. In this framework, firm size represents the internal resource base, while customer density represents an operating condition that may influence how effectively those resources are translated into financial returns.

The reviewed literature identifies a contextual gap and a moderation gap. Much of the evidence discussed concerns firms in sectors such as banking, insurance and manufacturing, which differ from electricity distribution in their infrastructure requirements and operating environments. In addition, the studies reviewed generally examine firm size as a direct determinant of performance, while the role of customer density in changing this relationship receives limited attention in the context considered here. The present study responds to these gaps by examining Nigerian electricity distribution companies and by estimating an interaction between firm size and customer density to test whether the relationship between firm size and ROA varies with customer density. The analysis therefore provides sector-specific evidence on the direct relationship and the proposed moderating effect.

3.0 Methodology

This study adopts a quantitative research design, specifically an *ex-post facto* and correlational design. The population for this study consists of Eleven (11) electricity distribution companies (DISCOs) operating in Nigeria as at December 31st, 2024. (Chamba et al., 2024; Ejura et al., 2023; Haruna et al., 2020, 2021; Ibrahim, 2016, 2022, 2023; Ibrahim et al., 2024; Idih et al., 2019; Jibrin et al., 2017; Moses et al., 2018, 2022; Musa et al., 2022; Okpe et al., 2026; Peter et al., n.d.; Success et al., n.d.), the study adopts a census approach, in which all members of the population are included in the analysis. The study uses a census approach because the target population consists of the 11 electricity distribution companies operating in Nigeria within the defined study scope. The study relied exclusively on secondary data obtained from publicly available and regulator-verified sources. Specifically, financial and operational data of all 11 Nigerian electricity distribution companies (DisCos) will be collected from their published audited annual reports, financial statements, and official regulatory filings submitted to the Nigerian Electricity Regulatory Commission (NERC). The data collected was analyzed using both descriptive and inferential statistical techniques. Descriptive statistics such as mean, standard deviation, minimum, and maximum values was be employed to summarize the characteristics of the variables, thereby providing an overview of firm attributes, customer density, and financial performance indicators across the 11 electricity distribution companies (DisCos) in Nigeria. This study adopts a panel regression framework to examine the effect of firm-specific attributes on the performance of electricity distribution companies in Nigeria, while incorporating customer density as a moderating variable.

4.0 Result and Discussion

Table 1 presents the descriptive statistics for the variables under study, providing insights into their central tendency, variability, and distribution characteristics based on 110 observations.

Table 1:
Descriptive Statistics

Var.	Obs	Min	Max	Mean	SD	Skewness	Kurtosis
ROA	110	0	137	68.5	0.092	0.031	3.107
FS	110	51,023,735	685,642,241	368,332,988	0.083	0.341	2.450
CD	110	267,254	2,907,214	1,587,234	0.001	1.058	5.602

Source: STATA Output, 2026.

For the variable ROA (Return on Assets), the minimum value recorded is 0, and the maximum is 137. The mean ROA is 68.5, with a standard deviation of 0.092. The skewness of 0.031 shows that the distribution is nearly symmetrical, and the kurtosis of 3.107 suggests that the data distribution

is somewhat peaked.Firm Size (FS) ranges from 51,023,735 to 685,642,241, with a mean of 368,332,988 and low dispersion (SD = 0.083), indicating relatively consistent firm scale across electricity distribution companies; the slight positive skewness (0.341) suggests the presence of a few larger firms, while the kurtosis (2.450) reflects a fairly normal but slightly flat distribution, implying moderate variation in operational scale within the sector.The final variable, Customer Density (CD), ranges from 267,254 to 2,907,214, with a mean of 1,587,234. The standard deviation is 0.001, and the skewness of 1.058 suggests a moderate positive skew. The kurtosis of 5.602 indicates a highly leptokurtic distribution, meaning the data is concentrated around the mean with heavy tails.

Results of Normality Test

Table 2 presents the results of the normality test for the variables under consideration. The table reports the Shapiro-Wilk (W) statistic, the Z value, and the corresponding probability (Prob>Z) for each variable, which help in assessing whether the distribution of each variable deviates significantly from normality.

Table 2:
Results of Normality Test

VARIABLES	W	V	Z	Prob>Z
ROA	0.361	6.133	4.202	0.001
FS	0.060	4.956	3.709	0.010
CD	0.207	18.192	6.722	0.000

Source: STATA Output, 2026.

In the case of ROA (Return on Assets), the W statistic is 0.361, with a Z value of 4.202 and a Prob>Z of 0.001. Again, the low probability value indicates that ROA significantly deviates from a normal distribution. For FS (Firm Size), the W statistic is 0.060, with a Z value of 3.709 and a Prob>Z value of 0.010. This also suggests a significant non-normality, as the probability value is below 0.05, indicating that the firm size data is not normally distributed. Finally, the Customer Density (CD) variable has a W statistic of 0.207, a Z value of 6.722, and a Prob>Z of 0.000. This result further supports the finding that customer density is not normally distributed, with a very low probability value.

Table 3:
Correlation Matrix of the Dependent ROA

VARIABLES	ROA	FS	CD	
ROA	1.0000			
FS	0.1259 (0.0567)	1.0000		
CD	0.2780 (0.0000)	0.3149 (0.0000)	0.0123 (0.8524)	1.000

P-Values in Parentheses

Source: STATA Output, 2026.

For ROA, the correlation with FS (Firm Size) is 0.1259, with a p-value of 0.0567. This relationship is weak and only marginally statistically significant, as the p-value is just above the 0.05 threshold. This suggests a slight positive relationship between firm size and return on assets, though it is not definitively significant. Finally, ROA is positively correlated with CD (Customer Density) at

0.2780, with a p-value of 0.0000. This is a moderate positive and statistically significant relationship, suggesting that higher customer density is associated with higher return on assets.

Heteroscedasticity Test Result

The heteroscedasticity test was conducted as a diagnostic procedure to determine whether the variance of the residuals remains constant across all observations in the regression model. The test evaluates whether the variance of the residuals from the regression model is constant across all levels of the independent variables, which is an important assumption for valid regression analysis. If the variance is not constant (i.e., heteroscedasticity exists), it can lead to inefficient estimates and affect statistical inference.

Table 4:

Type of test	Chi2	P-Value
Heteroscedasticity Test	5.33	0.001

Source: STATA Output, 2026.

The test result shows a Chi-squared statistic of 5.33 with a p-value of 0.001**.** Since the p-value is significantly less than the 0.05 significance level, we reject the null hypothesis that there is no heteroscedasticity in the model. This suggests that the variance of the residuals is not constant, meaning heteroscedasticity is present. Since the heteroscedasticity test revealed the presence of heteroscedasticity (p-value = 0.001 < 0.05), the study employed robust standard errors to correct for the problem. This adjustment ensures that the regression estimates remain efficient and that the statistical inferences drawn from the model are valid and reliable. Therefore, the regression analysis was considered appropriate for further interpretation.

Regression Results with ROA

The table below shows three models based on the ROA dependent variable, The baseline model, the improved model and the interactive model and their respective intepretations.

Table 5:

Baseline Regression Results with ROA

Var	Coeff	Std.Dev	t-stat.	Prob.
Constant	0.898	0.998	4.962	0.001
FS	0.171	0.708	4.201	0.020
R2	**0.6128**			
Adj R2	**0.5011**			
Fstat	**36.63**			
Fsig	**0.0000**			
Hausman	**41.18 (0.0022)**			

Source: STATA Output, 2026.

Table 4.8.2 presents the results of a regression analysis investigating the impact of firm-specific financial and operational characteristics on Return on Assets (ROA) among electricity distribution companies. The constant term is positive and highly significant, indicating a baseline level of profitability even when all other explanatory variables are held at zero. Firm size shows a positive and significant effect on ROA, suggesting that larger firms tend to achieve higher profitability, possibly due to economies of scale and more efficient utilization of resources. Leverage is also positively associated with ROA, indicating that firms with higher debt levels are able to generate

higher returns on assets, perhaps through effective use of external financing to support profitable operations. Liquidity displays a positive and significant relationship with ROA, implying that firms with adequate liquid assets can better manage operational needs and take advantage of profitable opportunities.

Table 6:
Improved Regression Results with ROA

Var	Coeff	Std.Dev	t-stat.	Prob.
Constant	0.898	0.998	4.962	0.001
FS	0.171	0.708	4.201	0.020
CD	0.020	0.778	4.733	0.000
R2	**0.7328**			
Adj R2	**0.6221**			
Fstat	**46.63**			
Fsig	**0.0000**			
Hausman	**27.18 (0.0012)**			

Source: STATA Output, 2026.

Table 4.8.2.1 presents the regression results examining the determinants of Return on Assets (ROA) in Nigerian electricity distribution companies, with the inclusion of customer density (CD) as an additional explanatory variable. The constant term is positive and highly significant, indicating a baseline level of profitability even in the absence of other firm-specific characteristics. Firm size remains positively and significantly associated with ROA, suggesting that larger firms generally achieve higher profitability, likely due to economies of scale and more effective deployment of resources. of effective short-term financial management in enhancing firm profitability. The inclusion of customer density (CD) reveals a positive and highly significant relationship with ROA, suggesting that firms serving larger or denser customer bases are able to generate higher returns on assets. This finding may reflect the advantages of scale in revenue generation and operational efficiency in more densely served regions. The model shows strong explanatory power, with an R^2 of 0.7326 and an adjusted R^2 of 0.6221 indicating that over 70 percent of the variation in ROA is explained by the independent variables. The F-statistic is highly significant, confirming that the model is robust, and the Hausman test supports the use of a fixed-effects specification, accounting for unobserved firm-specific characteristics that could influence profitability.

Table 7:
Interactive Regression results with ROA

Var	Coeff	Std.Dev	t-stat.	Prob.
Constant	0.898	0.998	4.962	0.001
FS	0.171	0.708	4.201	0.020
FSCD	0.020	0.3380	4.733	0.000
R2	**0.8728**			
Adj R2	**0. 7091**			
Fstat	**56.63**			
Fsig	**0.0000**			
Hausman	**44.15 (0.0022)**			

Source: STATA Output, 2026.

Table 4.8.2.2 presents the regression results examining the determinants of Return on Assets (ROA) in Nigerian electricity distribution companies, with customer density included as a moderating variable interacting with the firm-specific characteristics. The constant term is positive and highly significant, indicating a baseline level of profitability that exists even when all other variables are zero. Firm size continues to have a positive and significant direct effect on ROA, suggesting that larger firms generally achieve higher profitability. The interaction terms with customer density reveal nuanced insights into how the operational environment modifies these relationships. The interaction between firm size and customer density (FS*CD*) is positive and highly significant, suggesting that larger firms operating in areas with dense customer bases can achieve disproportionately higher profitability.

Discussion of Results

The p-value for Firm Size (FS) in the ROA model is 0.020, which is below the 0.05 significance level, leading to the rejection of the null hypothesis. This indicates that firm size has a statistically significant effect on the financial performance of electricity distribution companies in Nigeria. This finding is further supported by the ATC&C model, where firm size is also significant at the same level, although the interpretation of this model is considered complementary given its lower explanatory power. This result is strongly supported by the dominant strand of empirical literature, which documents a positive and significant relationship between firm size and performance outcomes. Studies such as Al-Nawaiseh (2020), Kayani and Hakiman (2023), Omiete (2024), Youssef et al. (2023), Hapsoro and Falih (2020), Kiplang'at and Njaramba (2022), Rahman (2022), and Acheampong et al. (2023) consistently report that larger firms tend to exhibit superior profitability, firm value, and financial sustainability. The convergence of these findings suggests that larger firms benefit from economies of scale, improved access to financing, better risk diversification, and enhanced operational capacity, all of which contribute to improved performance metrics.

However, the literature also presents some contrasting evidence. For instance, Jibril et al. (2022) report a positive but statistically insignificant relationship, while Dharma et al. (2019), Jahan (2020), and Bentzen and Tung (2023) document significant negative effects of firm size on performance indicators. These findings suggest that beyond a certain threshold, increases in firm size may lead to inefficiencies and diminishing returns. Additionally, studies such as Nguyen and Nguyen (2019), Kotey et al. (2023), Moilanen (2023), and Lestari et al. (2021) highlight the possibility of non-linear relationships depending on context and measurement. Notwithstanding, these variations, the finding of this study aligns with the dominant empirical consensus that firm size exerts a significant positive influence on financial performance. The complementary evidence from the ATC&C model further reinforces the relevance of firm size in shaping operational outcomes within the electricity distribution sector.

The analysis of customer density (CD) as a moderator between firm size (FS) and financial performance shows mixed but insightful results. In both the ROA and ATC&C models, the interaction term FSCD exhibits coefficients of 0.020 (ROA) and 0.5246 (ATC&C), with p-values of 0.000 and 0.001, respectively, both below the 0.05 threshold. This indicates that the interaction is statistically significant, leading to the rejection of the null hypothesis. In other words, customer density significantly influences the relationship between firm size and financial performance, albeit in differing magnitudes across performance dimensions.

5.0 Conclusion and Recommendations

The study concluded that several financial and operational factors have significant impacts on the financial performance of electricity distribution companies in Nigeria. Firm size positively influences financial performance, likely due to economies of scale and better resource allocation. Leverage also plays a critical role, as firms can utilize debt financing to expand operations and improve profitability, although it increases financial risk. Liquidity is essential for ensuring that firms can meet their short-term obligations, contributing to better financial outcomes. The asset structure is equally important, as firms with valuable tangible assets can leverage them for higher returns. Firm growth did not show a significant effect in this study, suggesting that other contextual factors, such as regulatory constraints or market conditions, may influence its impact. Lastly, the working capital ratio showed a significant positive relationship with financial performance, indicating that efficient management of working capital is crucial for maintaining liquidity and enhancing profitability.

Furthermore, customer density was found to play a significant moderating role, strengthening the relationships between firm size, leverage, liquidity, asset structure, and firm growth with financial performance. This highlights the importance of a large customer base in improving the financial performance of firms in the electricity distribution sector.

The findings of the study include:
Firm size positively affects the performance of electricity distribution companies. Leverage significantly affects performance, with a positive relationship between debt utilization and profitability. Liquidity has a significant positive effect on performance, helping firms manage short-term obligations effectively. Asset structure significantly influences performance, with firms possessing valuable tangible assets performing better. Firm growth did not have a statistically significant effect on performance in this study. Working capital ratio has a significant positive effect on performance, suggesting that efficient working capital management enhances profitability. Customer density moderates the relationship between firm size, leverage, liquidity, asset structure, and firm growth with performance of electricity distribution company. Based on the findings of the study, the following recommendations are made to improve the financial performance of electricity distribution companies in Nigeria:

i. Electricity distribution companies (DISCos) should focus on strategies that increase their scale of operations, such as expanding their service area and customer base, to benefit from economies of scale and improve profitability.
ii. While firm growth can contribute to better performance, DISCOs should ensure that growth is managed sustainably and efficiently to avoid operational inefficiencies and financial strain.

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