ANALYSIS OF DETERMINANTS OF ELECTRICITY THEFT IN NIGERIA

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ABSTRACT

The challenge of electricity theft has continuously contributed to unreliable electricity supply and undermined the financial viability of the electricity sector in Nigeria. This study examines the determinants of electricity theft across eleven electricity distribution companies from 2017 quarter 3 to 2024 quarter 3, using a fixed-effect panel model. The findings show that all variables in the analysis are significant determinants of electricity theft, except the metering rate. An increase in the actual price of electricity, the population of registered electricity consumers, and the previous rate of electricity losses exert positive and significant effects on electricity theft. The impact of electricity price was particularly pronounced, with a coefficient of 93.87, indicating that tariff increases without commensurate improvements in service reliability directly exacerbate theft. Conversely, improvements in the quality of electricity supply and revenue collection marginally reduce electricity theft. The study recommends that the Nigerian Electricity Regulatory Commission (NERC) mandate targeted infrastructure investments by DISCOs to enhance supply reliability, while DISCOs' management, fully digitalize payment channels to eliminate cash transactions and improve revenue collection efficiency. These strategies are expected to mitigate electricity theft, enhance service delivery, and strengthen sector financial viability.

Keywords: Determinants, Electricity Theft, Fixed Effect Panel Model, Nigeria
JEL Codes: Q41, Q48, D12, K42, L94

1. INTRODUCTION

The phenomenon of electricity theft remains a complex and persistent problem in Nigeria, arising from several environmental factors that cut across social, economic, and infrastructural gaps (Kumar et al., 2025). This situation, among others, has continuously exacerbated the challenges of electricity supply (Obafemi et al., 2021; Shokoya & Raji, 2020), which lags behind demand for over 200 million Nigerians (Maku et al., 2023). Development in the Nigerian electricity supply dates back to 1886 (Adeoye and Oladimeji, 2020), with available electricity supply hovering around 4000 to 4500 megawatts (MW) against an installed capacity of about 12,500 MW[1] (Henry & Mbamaluikem, 2020). Evidence indicates that about 28,000 MW, 51,000 MW, and 77,000 MW would be required for a 7% economic transformation in 2015, 2020, and 2025, respectively (Sambo, 2008). Despite these targets, the Nigerian power sector continues to face annual supply gap exceeding 60% of demand, contributing to production bottlenecks, reducing competitiveness, and significant economic losses estimated at US$26 billion annually (World Bank, 2021). Therefore, the present electricity supply rate remains insufficient for Nigeria's development.

The literature defines the concept of electricity theft as an embodiment of activities engendering losses between energy consumed and energy billed (Jamil & Amad, 2014; Smith,

[1] https://documents1.worldbank.org/curated/en/099061723133022449/pdf/P1762240038c17010bfb5087a5bcc325b5.pdf

2004; Babar et al., 2022). These activities may occur through meter bypassing or rigging between the energy supplied and the amount billed to consumers. The other dimension involves collection inefficiency in the form of unpaid bills between the amount billed and the amount recovered. These incidents accounts for significant electricity losses in Nigeria (Dodo et.al., 2020; Damian et.al, 2015), creating unprecedented challenges for supply and demand-side management. In Nigeria, aggregate technical, commercial, and collection (ATC&C) losses have hovered around 40% to 57% in the last decade (NERC Quarterly Reports 2015-2015[2]), which is more than double the global benchmark of 15% (World Bank, 2021). Energy theft, as critical component of the commercial and collection losses, contributes disproportionately to this inefficiency. For instance, the NERC report shows that approximately, 34% of revenue inefficiency was recorded in 2024 quarter 2 and 3 alone due to commercial and collection losses, a figure that threatens the financial viability of the distribution companies (DISCOs) and undermines investment for improved service delivery.

The 2023 revised Electricity Act, which repeals the 2005 Electric Power Sector Reform Act (EPSRA), introduced new regulatory frameworks for addressing electricity theft and related offenses through the Nigerian Electric Regulatory Commission (NERC).[3,4] The regulation aims to dissuade destructive behaviors associated with electricity infrastructure vandalism and illegal connections. Specifically, NERC stipulates that electricity theft constitutes a strict offense, punishable under the relevant sections of the criminal and panel codes. However, enforcement remains limited due to weak monitoring systems, low institutional capacity, and widespread socioeconomic pressures. Before the Act, the effectiveness of the electricity theft legislation was largely doubtful because the penalties were rarely enforced, causing massive ATC&C losses (see Figure 1). This situation has inhibited the sector's ability to re-capitalize for growth, resulting in poor service delivery. For Nigerian electricity utility owners, the effects of theft manifest in revenue losses from electricity sales (Akinwole & Akinyemi, 2024), with honest consumers bearing the brunt of overbilling to offset for the revenue shortfalls. Furthermore, government finances are strained, with electricity subsidy reaching N1.94 trillion in 2024[5], due to persistent shortfall in revenue collection efficiencies. This situation further diverts resources from health, education, and infrastructure investments.

This study fills an important gap in the literature by establishing the determinants of electricity theft from both technical and socio-economic perspectives. While the literature has identified prevailing socio-economic conditions as push factors engendering the phenomenon of electricity theft (Yakubu et al., 2018; Razavi, 2019; Wabukala et al., 2023), there remains a critical knowledge gap: limited empirical studies have examined the socio-economic determinants of electricity theft in Nigeria at a national scale over an extended period. In countries with weakly developed power sectors like Nigeria, solutions to electricity losses are often approached through technical fixes (Shokoya & Raji, 2020; Obafemi et al., 2021; Adoghe et al., 2023), neglecting broader social and economic drivers. Elsewhere, several approaches, including the socio-economic dimension, have been considered (Estache et al., 2006; Gaur and Gupta, 2016; Wabukala et al., 2023). Razavi et al. (2019) estimated that 87% of distribution losses globally occur due to socio-economic factors. This consideration is also important in countries with high socio-economic challenges. In Nigeria, statistics indicate a 67% (about 133 million) multidimensional poverty index, with deprivation experienced across several

[2] https://nerc.gov.ng/resource-category/nerc-reports/

[3] https://placng.org/i/wp-content/uploads/2023/06/Electricity-Act-2023.pdf
[4] https://www.lexology.com/library/detail.aspx?g=7ed74ca2-ccba-47fd-9786-37efa8565357

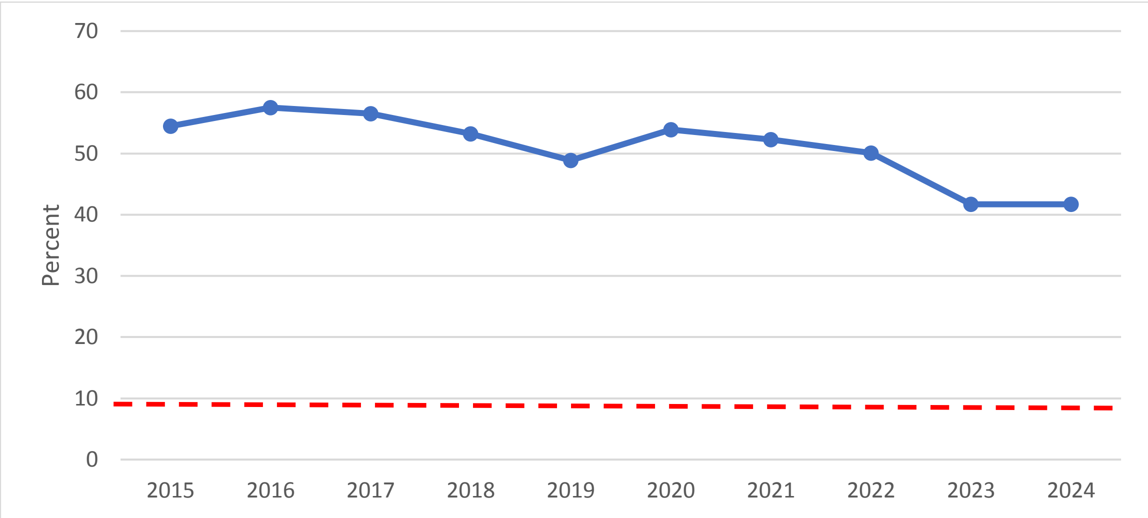
[5] guardian.ng/news/electricity-subsidies-cost-fg-₦1-94-trillion-in-2024-nerc/

dimensions, including energy access. Likewise, the level of income measured by per capita GDP remains grossly low at US$877 in 2024 (Statista, 2025). Using a novel dataset spanning 2017Q3 to 2024Q3, this study integrates socio-economic indicators to provide a more robust understanding of the underlying causes of electricity theft in Nigeria, an approach rarely adopted in previous research.

The federal government of Nigeria has introduced various strategies to mitigate inefficiencies in the electricity sector, including those arising from energy theft. The most recent is the Distribution Sector Recovery Programme (DSRP, 2021-2026), aimed at strengthening supply reliability and improving the operational performance of DISCOs. A broader policy intention to curb electricity theft is enshrined in the 2023 Electricity Act. By leveraging empirical evidence from recent national datasets, this study offers actionable insights for policymakers, regulators and utility companies. The findings will help guide regulatory reforms to improve enforcement. Ultimately, reducing electricity theft will enhance distribution company performance, improve supply reliability, reduce government subsidy expenditure, and contribute to Nigeria's long-term economic transformation.

The remainder of this paper is structured as follows: Section 2 provides a comprehensive review of the relevant literature, while Section 3 outlines the dataset and details the methodology employed in the analysis. Section 4 presents and discusses the empirical results, and the final section concludes the study by summarizing the key findings and providing policy recommendations.

Figure 1: Aggregate Technical Commercial and Collection Losses, 2015-2024



Source: NERC Quarterly Reports, 2015-2024

2. LITERATURE REVIEW

2.1 Theoretical Review

The Expected Utility Theory (EUT), developed by Von Neumann and Morgenstern (1944), forms the theoretical foundation of this study by explaining the rational decision-making processes that underpin electricity theft behavior. According to EUT, individuals act as rational agents who make choices based on maximizing their expected utility by carefully weighing potential benefits against possible costs. In the context of Nigeria's electricity sector, households and firms evaluate whether bypassing meters, connecting illegally, or refusing to pay bills provides greater economic benefits than complying with regulations. When the perceived benefits-such as reduced expenses, uninterrupted electricity supply, and avoidance of inflated tariffs- outweigh the perceived costs of detection, disconnection, or penalties, consumers are more likely to engage in theft. Conversely, strong monitoring, strict enforcement, and meaningful penalties decrease the expected utility of illegal behavior, thereby discouraging theft. This rational decision-making process underscores why electricity theft is more prevalent in settings characterized by weak institutional oversight, ineffective billing systems, and low enforcement capacity, challenges that persist in Nigeria's electricity sector.

Empirical evidence supports the relevance of EUT to electricity theft studies globally. For example, Razavi et al. (2019) applied EUT to analyze household electricity theft behavior in Iran and found that households expecting higher financial savings from avoiding payments were 62% more likely to tamper with meters. Similarly, Babar et al. (2022) used survey-based data from Pakistan and revealed that weak monitoring systems and low penalties significantly increased the expected utility of illegal consumption. These findings are consistent with the Nigerian context, where inadequate enforcement mechanisms, low revenue collection efficiency, irregular billing practices, and unstable power supply heighten the incentives for theft. By grounding this study in EUT, the study provides a framework to examine how socioeconomic characteristics-such as population and electricity pricing- metering coverage, quality of supply, and collection efficiency interact to influence the decision-making process behind electricity theft. This theoretical perspective addresses a significant gap in Nigerian literature, where past studies have largely emphasized technical losses while giving limited attention to the socioeconomic considerations driving electricity theft, thus enabling a more comprehensive understanding of the underlying dynamics.

2.2 Empirical Review

A plethora of literature highlights that socioeconomic characteristics are central to explaining electricity theft in developing countries. Yakub et al. (2018) found that electricity theft in Ghana is driven by poor quality of power supply, rising electricity prices, corruption, weak law enforcement, and the inability of the electricity regulatory commission to safeguard consumer interests, using qualitative analysis based on primary data. Similarly, Kwakwa (2018), employing Fully Modified Ordinary Least Squares (FMOLS) to analyze Ghana's electricity losses between 1971 and 2013, showed that education, electricity prices, capital investment, income, manufacturing, and population significantly influence theft levels. These findings are consistent with evidence from Pakistan, where Jamil (2018) and Babar et al. (2022) demonstrated that increasing electricity tariffs, collusion among corrupt utility employees, and weak monitoring by distribution companies are key drivers of illegal consumption, using correlation and regression analysis to establish these relationships. In Turkey, Marangoz (2013) analyzed data from 67 cities across seven regions using an Ordinary Least Squares (OLS) regression model and found that terrorist attacks, regional disparities, and high illiteracy rates foster electricity theft, whereas higher per capita income, lower unemployment rates, and effective governance mitigate the phenomenon. Likewise, Yurtseven (2015), using IV-GMM and 3SLS estimation techniques, identified education, income, social capital, rural population size, temperature index, and agricultural production rate as critical determinants of electricity theft in Turkey, with provinces in the Southeastern Anatolia Region particularly vulnerable to higher theft incidences.

Further evidence from Brazil underscores the role of socioeconomic drivers in shaping electricity theft behavior. Mimmi et al. (2010), applying an Instrumental Variables (IV) Probit model and a Bivariate Probit model to investigate illegal electricity connections in low-income favelas of Belo Horizonte, found that poor energy provision, inefficient use of appliances, and informal in-house businesses drive widespread illegal connections. Similar patterns are observed elsewhere in Africa. Mhaule (2017), using a mixed-method approach in South Africa, showed that affordability issues, entitlement perceptions, and delays in electricity delivery explain high theft levels, while Wabukala et al. (2023) identified affordability constraints as a major factor sustaining illegal connections in rural Ugandan households. Collectively, these studies provide strong evidence that electricity theft is strongly associated with socioeconomic pressures, structural inequalities, and affordability constraints.

Beyond socioeconomic drivers, governance and institutional factors have also emerged as critical determinants of electricity theft in the literature. Golden et al. (2012) demonstrated a strong positive association between electricity theft and the electoral cycle in Uttar Pradesh, India, from 2000 to 2009, showing that political manipulation of electricity provision often facilitates theft during elections. Similarly, Kumar et al. (2025) highlighted that corruption and poor governance practices significantly influence theft rates across both rural and urban India. In Nigeria, Obafemi et al. (2021) adopted descriptive and inferential analysis and reported that weak enforcement of anti-electricity theft laws in Lagos State contributes significantly to the prevalence of illegal consumption among households. Extending this strand of inquiry, Gaur and Gupta (2016), employing Feasible Generalized Least Squares (FGLS) across 28 Indian states, found that lower corruption levels, higher tax-to-GDP ratios, improved revenue collection efficiency, reduced poverty rates, higher literacy, and greater income significantly reduce electricity theft. These findings highlight the institutional dimension of the problem and underscore the importance of political accountability, regulatory enforcement, and governance reforms in curbing illegal electricity consumption.

Technical and operational inefficiencies also play a vital role in explaining electricity theft patterns across developing countries. Razavi et al. (2019) established that 87% of transmission and distribution (T&D) losses could be explained using a combination of socioeconomic indicators and utility performance metrics, highlighting the intertwined nature of consumer behavior and infrastructural deficiencies. Kawoosa et al. (2024) developed a detection model showing that anomalies in electricity consumption patterns can be used to identify potential theft cases, indicating that consumer behavior and technical monitoring are deeply connected. Similarly, Sousa et al. (2024) demonstrated that integrating consumption profiling with advanced diagnostics significantly improves the detection and mitigation of energy theft. These studies emphasize that addressing electricity theft requires combining behavioral insights with operational improvements, including better metering systems, advanced monitoring infrastructure, and enhanced distribution company performance.

In the Nigerian context, several recent studies provide relevant insights that, although not directly focused on electricity theft, are highly significant for understanding electricity sector dynamics and improving service delivery, which can indirectly reduce theft potential. For instance, Ebhotemhen (2021), using an ARDL model, found that electricity prices, installed capacity, and economic growth significantly influence electricity generation, while rainfall and gas consumption exert a negative long-run effect. Similarly, Okungbowa and Abhulimen (2021) reported mixed effects of electricity consumption on industrial output, recommending sectoral-based energy policies to enhance productivity. The study on prepaid electricity services (Noma, et at., 2025) demonstrated that prepaid metering, electricity consumption, and generation significantly affect Nigeria's GDP, while advocating for investments in renewable energy to strengthen generation capacity. Additionally, the study by Danpome et al., (2025) established that stronger governance structures and better policy implementation significantly improve energy sector development and electricity access in Nigeria. While these studies do not examine theft directly, they collectively highlight that improving generation capacity, enhancing billing systems, and strengthening institutional frameworks are critical pathways for improving electricity sector performance and, consequently, reducing incentives for electricity theft.

Overall, the reviewed studies provide valuable insights into the socioeconomic, governance, and technical drivers of electricity theft, but they also expose notable gaps, particularly in Nigeria-specific research. Most existing studies in Nigeria, such as Obafemi et al. (2021), remain limited in scope, focusing on localized contexts without capturing broader national dynamics. Moreover, many studies adopt descriptive or small-scale approaches and fail to integrate socioeconomic, institutional, and technical dimensions within a unified analytical framework. This limitation highlights the need for more comprehensive, data-driven analyses of electricity theft in Nigeria using nationally representative datasets and robust econometric techniques to better inform policies aimed at improving electricity sector performance and reducing non-technical losses.

METHODOLOGY

3.1 Theoretical Framework

The EUT theory provides the foundation to examine the dynamics within Nigeria's electricity sector, focusing on the rational decision-making process that influences consumer behavior towards electricity theft. The theory explains how individuals make decisions under risk and uncertainty by evaluating the expected benefits and potential costs of alternative choices. It assumes that individuals act rationally, seeking to maximize their expected utility based on available information and perceived probabilities of outcomes. Within the context of Nigeria's electricity sector, EUT provides a lens to understand how consumers weigh the gains from stealing electricity, such as avoiding bill payments or bypassing meters, against the potential losses associated with detection, penalties, or service disconnection. Where the perceived benefits of theft exceed the expected risks, individuals are more likely to engage in illegal consumption, especially in environments where enforcement mechanisms are weak, service quality is poor, and monitoring infrastructure is inadequate.

This theoretical framework is particularly relevant to the variables examined in this study. Electricity price represents the direct financial cost of legal consumption; when tariffs increase, the incentive to engage in theft often rises, especially among low-income households. Metering rate serves as a proxy for the probability of detection; low metering coverage reduces the perceived risks of being caught, thereby increasing the likelihood of theft. Similarly, the quality of electricity supply, captured through customer complaints, reflects consumer satisfaction with service delivery; unreliable or inconsistent supply can lower consumers' willingness to pay, increasing the propensity for illegal connections. The number of registered customers influences the monitoring capacity of distribution companies; where customer bases are large, enforcement resources are stretched thin, making it more difficult to detect theft. Finally, revenue collection efficiency reflects institutional strength and governance capacity; higher collection efficiency suggests effective monitoring systems and stronger deterrents against theft, while weak enforcement encourages non-compliance. By adopting EUT, this study integrates the dimensions of electricity theft in Nigeria, providing a comprehensive framework for understanding how rational decision-making interacts with sectoral inefficiencies to shape theft patterns.

3.2 Model Specification

The study adopts the model by Jamil and Amad (2014) to analyze the determinants of electricity theft in Nigeria. Their model provides valuable insights into the underlying drivers of electricity theft; however, this study modifies some of their assumptions to better reflect the Nigerian context. For instance, the analytical framework developed by Jamil and Amad (2014), which also employs the fixed-effect panel model, is specified as follows:

Where:

Elect = f (Theft, Fine, Temp, Price. Quality, Pc, Elect) (1)

Elect= electricity theft

Theft =theft detection probability

Fine= Fine imposed on theft

Temp= Temperature index

Price= Electricity price

Quality=Load shedding

Pc= per capita income

The analytical framework in equation (1) is adapted to suit the peculiarities of the Nigerian context, based on data availability. In the model specification by Jamil and Amad (2014), Transmission and Distribution (T&D) losses are used to measure electricity theft, hence the adoption in this study. This measure has become a widely accepted indicator (Smith, 2004; Gaur & Gupta, 2016). Based on the rule of thumb derived from various European Energy Reports (1999), up to 50% of T&D losses can be attributed to electricity theft, depending on the level of inefficiency. In highly efficient systems with about 6% T&D losses, theft may account for only 1–2% of total losses (Smith, 2004). However, in Nigeria, T&D losses are captured under the Aggregate Technical, Commercial, and Collection (ATC&C) losses, which provide a broader index encompassing the combined effects of technical inefficiencies, commercial losses, and revenue collection challenges.

Since direct data on theft detection probability is unavailable in Nigeria, this study adopts the metering rate as a proxy for detection infrastructure. The provision of meters improves transparency and enables energy audits (NERC, 2022), thereby reducing illegal consumption. The metering rate is calculated as the ratio of metered customers to registered customers within each utility. A higher metering rate is expected to improve the detection of illegal connections, thereby reducing electricity theft, while a lower metering rate creates opportunities for higher theft.

Similarly, a uniform indicator of electricity price across all utility companies is unavailable. Consequently, the study uses the actual price of electricity, measured as the ratio of total revenue collected to total electricity supplied by each utility company. This approach captures the effective tariffs paid by consumers rather than relying on the Multi-Year Tariff Order (MYTO) framework, which often assumes a uniform pricing structure that does not reflect variations in actual collections. Additionally, this measure represents the average effective price of electricity across different categories of end-users (residential and commercial) without disaggregation. Higher electricity prices are expected to encourage illegal connections, particularly among consumers facing unreliable supply and perceived inequities in billing (Depuru et al., 2011; Yakubu et al., 2018). However, the relationship between price and theft may vary depending on price changes and consumer behavior.

The literature also establishes a significant relationship between the quality of electricity supply and electricity theft (Kumar et al., 2025). In the original Jamil and Amad (2014) model, electricity supply quality is proxied by load shedding, but this narrow indicator may fail to capture other service quality dimensions. In this study, electricity supply quality is measured using customer complaints reported to the distribution companies (DISCOs). This composite indicator incorporates multiple indices reflecting consumer-reported irregularities, including load shedding, billing inefficiencies, connection delays, power interruptions, metering delays, and voltage fluctuations (NERC Quarterly Reports, 2017–2024). Poor service quality is expected to increase consumers' incentives to engage in electricity theft.

The study also incorporates the number of registered customers as a determinant, since customer volume influences a utility company's ability to monitor consumption effectively. A utility with a larger customer base may experience challenges in conducting routine audits, thus increasing opportunities for electricity theft. Conversely, smaller customer bases may enable closer monitoring and better enforcement.

Additionally, following Gaur and Gupta's (2016) framework, the revenue collection efficiency of each utility company is included as an explanatory variable. Collection efficiency reflects governance quality and the effectiveness of internal monitoring systems. High revenue collection efficiency may imply strong managerial oversight and improved compliance, thereby reducing electricity theft. Conversely, low collection efficiency often signals institutional weaknesses, which can exacerbate theft levels.

Two variables in the original model, temperature and per capita income, are excluded due to data unavailability at the required quarterly frequency across DISCOs. Although per capita income data is available at the national level, the absence of consistent utility-level and quarterly-specific data necessitates its exclusion.

The explicit form of the modified model is presented in equation (2) and is estimated using a fixed-effect panel estimation technique. This model allows intercepts to vary across DISCOs while keeping slope coefficients constant, thereby accounting for unobserved heterogeneity. According to Kelejian and Piras (2017), the fixed-effect model assumes that cross-sectional differences are captured in the intercepts while treating slope coefficients as homogeneous. A Hausman test was conducted to determine the appropriate specification, yielding a statistic of 86.26 with a p-value of 0.000, thereby rejecting the null hypothesis of no correlation between individual effects and explanatory variables. Consequently, the fixed-effect model is adopted. To improve estimation accuracy, all variables, except rates, are analyzed in their natural logarithmic form.

$$Elect_{i,t} = f(Metering_{i,t}, Price_{i,t}, Quality_{i,t}, Customers_{i,t}, Revenue_{i,t}) \quad (2)$$

The dynamic empirical model is specified in equation (3):

$$Elect_{i,t} = \beta_{0,i} + \beta_1 Metering_{i,t} + \beta_2 Price_{i,t} + \beta_3 Quality_{i,t} + \beta_4 Customers_{i,t} + \beta_5 Revenue_{i,t} + \beta_6 Elect_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

Where subscript i denotes the *jth* utility (i=1, ..., N), and t represents the *jth* year (t = 1, …, T). The subscript i on the intercept implies that intercepts may vary across utilities, while slope coefficients remain constant. The intercept is denoted byβ_0 and the slope coefficients by β_1 to β_6.

In the equation (3), the $Elect_{i,t}$ variable enters the model as its one-period lag ($Elect_{i,t-1}$) to mitigate potential simultaneity bias. This accounts for the possibility that current electricity theft levels could influence current electricity revenue, prices, or metering rates, which may otherwise introduce endogeneity. By using lagged values, the risk of reverse causality between the dependent and explanatory variables is reduced.

3.3 Sources of Data

The dataset used in this analysis comprises panel data obtained from the eleven Electricity Distribution Companies (DISCOs) covering the period from the third quarter of 2017 (Q3 2017) to the third quarter of 2024 (Q3 2024). This period falls within the post-privatization era of the electricity distribution companies in Nigeria, making it suitable for analyzing sectoral performance and theft dynamics. While the privatization period started in 2013, most data were not available until 2017 quarter 3, however the referenced period for the analysis gave a total of 308 balanced panel observations. All data were sourced from the quarterly reports published by the Nigerian Electricity Regulatory Commission (NERC). Table 1 provides a detailed description of the dataset.

Table 1: Description of Dataset Used

S/N	Acronym	Variable Definition	Unit of Measurement	Source
1	Elect	Electricity theft (proxy by Aggregate Technical, Commercial & Collection Loses)	Percentage	Nigeria Electricity Regulatory Commission Quarterly Reports
2	Metering	Metering Rate (percent of registered Customers)	Percentage	Nigeria Electricity Regulatory Commission Quarterly Reports
3	Price	Electricity Price/KW (Ratio of revenue to electricity supplied)	Ratio	Nigeria Electricity Regulatory Commission Quarterly Reports
5	Quality	Quality of Electricity Supply (Proxied by customers complaints customers)	Number of customers complaints	Nigeria Electricity Regulatory Commission Quarterly Reports
6	Customers	Registered customers	Number of registered customers	Nigeria Electricity Regulatory Commission Quarterly Reports
7	Revenue	Revenue collection efficiency	Percentages	Nigeria Electricity Regulatory Commission Quarterly Reports

Source: Author's Compilation (2025)

4. RESULTS AND DISCUSSION OF FINDINGS

4.1 Summary Statistics

Table 2 presents the summary statistics of the dataset used in the empirical analysis. The six indicators in the analysis have 308 observations each. The average rate of electricity theft across the utility companies is about 50.16%, with a standard deviation of 15.73 around the mean value. The incidence of electricity theft engenders energy loss ranging from 12.44% to 83.44% during the observed period. Likewise, the overall metering rate averaged about 40.52%. The average price of electricity is around N0.04/kWh, while revenue collection efficiency stood at about 66.71 percent on average, hovering between 31.01% to 65.71% in the period of analysis.

Table 1:Descriptive Statistics of Variables Used

Variable	Obs	Mean	Std. Dev	Min	Max
Elect	308	50.16	15.73	12.44	83.44
Metering	308	40.52	14.73	14.4	77.70
Price	308	0.04	0.01	0.02	0.09
Quality	308	8077.49	13791.30	141	64987
Customers	308	970897.60	484351	326260	2582740
Revenue	308	66.71	16.84	31.01	65.71

Source: Author's Computation (2025)

Note: Recall that price (i.e. electricity price/kw) is measured as ratio of revenue to electricity supplied (see section 3 for more explanation)

4.2 Unit Root Test

Table 3 presents the results of the panel unit root tests conducted using the Levin-Lin-Chu (LLC) and Im-Pesaran-Shin (IPS) approaches, which are more appropriate for panel data than individual time-series tests such as the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP). The purpose of the tests is to determine the stationarity properties of the variables and avoid the risk of spurious regression that may arise when non-stationary series are used in estimation.

The results indicate that the variables exhibit a mixed order of integration. Specifically, Elect, Price, and Quality are non-stationary at levels but become stationary after first differencing, implying they are integrated of order one, I(1). Conversely, Metering, Revenue, and Customers are stationary at levels, indicating they are integrated of order zero, I(0). Given these outcomes, the subsequent regression analysis in Table 4 was conducted following the stationarity properties of the variables to ensure valid and reliable estimations.

Table 3: Unit Root Test

	Levin-Lin-Chu	Im-Pesaran-Shin	
Variable	Intercept& Trend	Intercept& Trend	Remarks
Elect	-6.58***	-10.70***	I (1)
Metering	-4.67***	-4.71***	I (0)
Price	-8.76***	-9.37***	I (1)
Quality	-6.83***	-7.88***	I (1)
Customers	-466***	-6.63***	I (0)
Revenue	-3.37***	-10.61***	I (0)

Source: Author's Computation with Eviews 10 (2025)

Note: (*) Significant at the 10 percent; (**) significant at the 5 percent; (***) and significant at the 1 percent

4.3 Panel Fixed Effect Estimation

Table 4 presents the fixed-effect panel estimates of the determinants of electricity theft across the eleven electricity distribution companies (DISCOs) in Nigeria. The results are based on two models: the original model and the sensitivity analysis. The first model follows the specification in Equation (2), while the second model excludes the metering variable to test the robustness of the model to variable selection.

In Model 1, all variables except metering are statistically significant in explaining the incidence of electricity theft. The coefficient of electricity price is 93.87, meaning that a one-unit increase in electricity price leads to a 93.87-unit increase in the incidence of electricity theft. This result highlights the affordability challenge within Nigeria's power sector, where higher tariffs directly worsen theft. Given widespread poverty and low-income levels, consumers are particularly price-sensitive.

Moreover, persistent unreliability of electricity supply magnifies the effect of price hikes, as many customers perceive increased tariffs as unjustified when service quality does not improve. Consequently, consumers may resort to bypassing meters, line hooking, or illegal tapping to offset rising costs (Yurtseven, 2015). These findings are consistent with Yakubu et al. (2018), who showed that rising electricity prices, poor quality of supply, and weak enforcement drive widespread theft in Ghana. Similarly, Jamil (2018) and Babar et al. (2022) reported that tariff hikes without corresponding improvements in service provision significantly increase electricity theft in Pakistan. Collectively, these cross-country results highlight that pricing reforms in developing economies are most effective when combined with improvements in supply reliability and consumer engagement.

Improvements in the quality of electricity supply significantly reduce theft, with the elasticity estimate showing that a 1% increase in quality reduces electricity losses by about 0.9%. In the Nigerian context, better service quality means fewer outages, shorter load-shedding durations, accurate billing, prompt fault resolution, and improved customer service delivery (NERC, 2024). This finding aligns with Mimmi et al. (2010), who showed that poor energy provision and inconsistent service quality fuel widespread illegal connections in Brazil's low-income settlements. Similarly, Mhaule (2017) and Wabukala et al. (2023) found that unreliable supply and affordability constraints contribute significantly to illegal connections in South Africa and Uganda, respectively. These studies, combined with the Nigerian evidence, reinforce that strengthening service delivery is a critical pathway to curbing electricity theft.

The coefficient of registered customers is positive and significant at the 10% level, showing that a 1% increase in the number of registered customers is associated with about a 0.9% increase in electricity theft. This finding suggests that DISCOs may lack the operational and monitoring capacity to manage their expanding customer base effectively. Furthermore, the rapid growth of registered customers without a commensurate increase in infrastructure investment leads to poor service delivery, creating frustration among consumers and pushing some towards unauthorized connections. This contrasts with findings from Gaur and Gupta (2016) in India, where population growth had no significant effect on theft, suggesting that Nigeria's infrastructural and institutional weaknesses amplify the vulnerability of its electricity sector to theft as customer bases expand.

Revenue collection efficiency shows a negative and significant elasticity, meaning that a 1% improvement in revenue collection efficiency leads to about a 0.8% reduction in electricity theft. This finding aligns with Gaur and Gupta (2016), who reported that improved collection systems, stronger governance, and efficient billing reduced theft in India. Similar evidence from Razavi et al. (2019) underscores that enhancing operational efficiency, particularly through digital monitoring and improved billing systems, is critical for reducing non-technical losses in developing economies. In the Nigerian context, higher collection efficiency reflects better managerial oversight, stronger customer engagement, and technological integration, which collectively improve compliance and reduce theft.

The coefficient of lagged electricity theft remains positive and significant, showing persistence in theft behavior. Areas with higher theft in the previous quarter are more likely to continue experiencing losses in subsequent quarters. This persistence reflects weak regulatory enforcement, low detection rates, and inadequate punitive measures. Where penalties are minimal and monitoring systems weak, consumers are likely to sustain illegal practices, exacerbating DISCOs' financial losses. This persistence effect aligns with findings from Golden et al. (2012), who showed that weak enforcement, coupled with political manipulation during electoral cycles, sustains illegal electricity consumption in India.

The insignificance of the metering rate is counterintuitive and requires further explanation. While broader metering coverage should theoretically reduce theft by improving billing accuracy, the results suggest otherwise. This may be due to widespread meter bypassing, poorly calibrated or faulty meters, limited integration of metering data into digital monitoring systems, or sample variability in DISCO records. In many Nigerian households, the installation of meters does not eliminate illegal practices because consumers collude with technicians to manipulate consumption records. Similar challenges have been documented by Sousa et al. (2024) and Kawoosa et al. (2024), who demonstrated that advanced diagnostics and real-time monitoring are necessary to address meter bypassing and improve theft detection. Addressing these issues requires targeted investment in tamper-proof smart meters, integrated real-time monitoring systems, and stronger regulatory frameworks to ensure effective enforcement and minimize bypassing.

The findings from Model 2, which excludes the metering variable, confirm the robustness of the results. The coefficients of price, quality, customers, and revenue collection efficiency remain consistent in both sign and statistical significance, with only marginal differences in magnitude.

Overall, the results indicate that electricity price, service quality, customer growth, and revenue collection efficiency are significant determinants of electricity theft in Nigeria, while metering, under current implementation strategies, remains ineffective. This aligns with Danpome et al. (2025), who emphasized that improving governance structures and institutional capacity is essential for addressing inefficiencies in Nigeria's energy sector. These findings call for urgent policy action, including sustained investment in digital metering infrastructure, linking tariff reforms to tangible improvements in service delivery, expanding electricity infrastructure alongside customer growth, and integrating digital technologies for revenue collection and theft monitoring.

Finally, the statistical diagnostics confirm the robustness of the model. The explanatory variables collectively explain about 93% of the variation in electricity theft, and the Durbin-Watson statistics (~2.0) suggest no serious autocorrelation. These results validate the reliability of the specifications and make the estimates appropriate for policy inferences.

Table 4: Fixed Effect Panel Model Regression

	Model 1			Model 2		
Variable	Coef.	Std. Error	Prob	Coef.	Std. Error	Prob
Metering Rate (-1)	0.02	0.03	0.57	-	-	-
Price	93.87***	24.90	0.00	94.80***	24.85	0.00
Quality	-0.86***	0.21	0.00	-0.84***	0.21	0.00
Customers	0.86*	0.46	0.07	0.81*	0.45	0.08
Revenue	-0.12***	0.02	0.00	-0.13***	0.02	0.00
Elect (-1)	0.65***	0.06	0.00	0.65***	0.06	0.00
Constant	15.88**	7.37	0.03	17.13**	7.06	0.02
R2	0.93			0.93		
F-Stat.	209.90			223.63		
D-Watson	1.99			1.99		

Source: Author's Estimation with Eviews 10 (2025)

Note: (*) Significant at the 10percent; (**), significant at the 5 percent; (***) and significant at the 1 percent

Additionally, Table 5 presents the Variance Inflation Factor (VIF) results for the explanatory variables in the model. The computed VIF range from 1.22 to 2.06. Since none of the variables exhibit VIF values above 10, the results suggest that multicollinearity is not a major concern in the estimated model.

Table 5: Variance Inflation Factor Test

Variable	VIF	Tolerance (1/VIF)
Price	2.06	0.48
Metering	1.46	0.69
Quality	1.24	0.81
Customers	1.22	0.82
Revenue	1.75	0.57

5. CONCLUSION AND POLICY RECOMMENDATIONS

This study examines the determinants of electricity theft in Nigeria. The study analyzed a panel model to identify the underlying determinants of electricity theft across the eleven utility companies. The adopted factors are significant determinants of electricity losses, conforming with empirical expectations.

In summary, an increase in actual electricity price, registered electricity consumers, and previous energy losses motivates the act of electricity theft. Among these indicators, the role of electricity price was prominent on electricity theft in the period from 2017 quarter 3 to 2024 quarter 3. It has a positive relationship and a strong coefficient of 93.87. While the Nigerian 2020 Multi-year Tariff Order (MYTO) attributes the increase in electricity tariff to macroeconomic and industry dynamics, persistent upward review of price may incentivize the phenomenon of electricity theft since changes are not commensurate with service delivery. For instance, the 2024 supplementary MYTO, which commenced in the second quarter, brought about a 194% increment in electricity price from N70/kWh to N206/kWh for a certain class of electricity consumers. However, the ATC&C losses rose by about 13% from 34.7% in 2024 quarter 3 to 39.1% in 2024 quarter 4, coinciding with the period of the sharp tariff review. This situation suggests the possibility of increased electricity theft across the utility companies, except for two companies that experienced a marginal decline (NERC, 2024 Quarter Three Report). Sustained increases in electricity prices without improved supply reliability may exacerbate dishonest practices that affect electricity supply-side efficiency and honest consumers. Accordingly, the Nigerian Electricity Regulatory Commission (NERC) should mandate that DISCO management boards prioritize infrastructure investments to enhance supply reliability. Such actions would reduce service interruptions, motivate consumers to desist from electricity theft, and improve overall sector efficiency.

Further, an improvement in the quality of electricity supply and revenue collection efficiency marginally reduces electricity theft. Therefore, NERC and the Ministry of Power should oversee targeted infrastructure upgrades and reliability programs in collaboration with DISCOs to improve service delivery. Likewise, utility companies should fully digitalize revenue collection channels to enhance efficiency. Although Nigerian electricity utility companies currently use digital channels such as mobile applications and point-of-sale terminals, cash transactions are still allowed in area offices. There is evidence of cash transactions between officers and customers continue, creating avenues for improper accounting and corrupt practices that may inhibit higher revenue collection efficiency. To address this, DISCOs management, should enforce cashless payment systems, expand mobile and online payment platforms, and implement routine audits to minimize fraud.

This study may not have exhausted all underlying factors of electricity theft in Nigeria. The study may be limited in terms of the granular intricacies of electricity theft, considering the peculiarity of the demand side of the Nigerian electricity market, which is categorized into five tariff classes based on the hours of electricity supplied. Future research may consider tariff-specific and socioeconomic dynamics, to provide deeper insights into electricity theft and inform more targeted regulatory and operational strategies.

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