LAJEMS
LAFIA JOURNAL OF ECONOMICS AND MANAGEMENT SCIENCES
Volume 10, Issue 1; 2025
ISSN: 2550-732X
Published by Department of Economics, Federal University of Lafia, Nigeria

Trends and Relationship among Electricity Supply, Connsumption and Tariffs

Najeem O. Bashir[1], Risqat F. Lawal[2] & George T. Adeyemi[3]
[1&2]Department of Economics & Actuarial Sciences, Crescent University, Abeokuta, Ogun State, Nigeria
[3]Ogun State Internal Revenue Service, Headquarter Complex, Oke-Mosan Abeokuta, Ogun State, Nigeria
Corresponding Email: tunjibash@cuab.edu.ng

How to cite this paper: Bashir, N. O., Lawal, R. F., & Adeyemi, G. T. (2025). Trends and relationship among electricity supply, connsumption and tariffs. *Lafia Journal of Economics and Management Sciences, 10(*1), 103-122
https://doi.org/10.70118/lajems-10-1-2025-06
Received: March 3, 2025
Accepted: June 12, 2025
Published: June 30, 2025

Abstract
The study describes the trends and determines the relationship among electric power supply, electricity consumption and power tariff in Nigeria. Data spanning 42 years (1981-2023) was analysed using the Pearson Correlation method and Granger causality test. Findings showed that Household income and electricity consumption exhibits positive relationship. So also is Household Income and tariff paid on Electricity Consumption. It was found that tariff paid on electric power influences the level of household electricity consumption but not the other way round. Equally, household income was found to have a causal effect on Tariff paid on electricity. The study recommends that the government, through the Nigerian Electricity Regulatory Commission, may wish to implement a tiered pricing structures so as to incentivize responsible usage across different income levels. Since tariff charged on electric power significantly impact electricity consumption, a tariff structure that charges based on 'peak and off-peak' (Time of Use tariff), will be a reasonable window to explore.
Keywords: Correlation Analysis, Electricity consumption, Tariff
JEL Classification Codes: H4, Q41, Q48

1. Introduction

In the contemporary world, electricity use has been established to enhance all areas of life quality, ranging from its impact on productivity of economic activity, logistics, learning, and up to how individuals expend their private time (Bridge, Adhikari, & Fontenla, 2015). Its transformative impact on human existence, therefore, traverse virtually all areas of existence. The absence of electricity or its dearth could lead to a deterioration in peoples' quality of life and retardation of technological progress (Muhammad & Sabo, 2017). In order for Nigeria, as a developing country to enhance peoples' individual growth and national development, it is therefore, a requirement that electricity be efficiently made available and at low cost. The Electricity Generating Companies GenCo), electricity supply showed an increasing trend in the early part of the current decade. This started in 2021 when more than 35,650 gigawatt hours of electricity were sent out, as against the 35, 030 gigawatt hours recorded in 2019, (National Bureau of Statistics [NBS], 2023).

This increase in power supply was almost immediately out-matched by the up-shoot in the number of consumers, which stood at 11.27 million in 2023, comprising of 5,957,219 Billing customers and 5,309,928 Metered customers. On a year-on-year basis using 2022 figure, this indicates a growth of 10.9 percent when compared with the 4.79 million customers and 1.99 percent when compared with 5.93 customers, for the Billing and Metered customers, respectively (NBS, 2023). As at the beginning of the first quarter of 2023, the growing need for electric power, led to the rise in electricity Kwh price. On request by the DisCos, the regulatory body, revealed a price hike targeted towards the Band A power consumers, on April 2, 2024. The review was done in accordance with the Electricity Act 2023 and the Multi-Year Tariff Order (MYTO) methodology and guidelines, which provide for a bi-annual tariff, review (Tope Adebayo LP, 2023).

The justification for the revision being that rates were last reviewed in 2022 which was two years ago, while macroeconomic factors influencing cost of power distribution have increased in prices. It was also argued that the rate of inflation in the country had almost doubled (22.79% as at July 2023), while the exchange rate which also influences the power distribution operation had also risen and continued to soar. While the effect of the hardship on consumers was said to be noted, the ability of the distribution companies to recoup their investment while earning good return, was equally important.

This, in the end, made the DisCos generated revenue to rise from N232.32 billion to N247.33 billion, representing about 6.5 percent increase. Hence, the growth in generated revenue by the Distribution Companies (DisCos). The hike in power tariff not only reduced consumers' real income but also led to a reassessment of energy choices and rationing. In spite of the importance of electric power, over 40 percent of people living in the country still do not enjoy efficient and regular supply of on-grid electricity, (Lawal, 2024; Bashir *et. al.*, 2023; Arawomo, 2017).

Over the years, and despite several reforms in the power sector targeted at enhancing supply of electricity, Nigerians are still experiencing power shortage while groaning under the burden of high price. The largest proportion of residents having no access to electric power were located in the Northern part of the country and the hinterlands. According to the NBS (2023), 79.1 percent of Northern Nigerians never had access to regular and adequate electricity. In spite of the fact that the wide gap between electric power supply and its demand still remained unbridged, its insufficiency is aggravated by the continuous collapse of the national grid. While the national grid collapsed 8 time in 2024 alone, it was reported to have collapsed for about 162 times in the past decade (TALP, 2023).

Inadequate power supply is taking a huge toll on learning, research and development across all level of education in the country. The classroom blackout and stuffiness debars proper teaching and learning for teachers and pupils. Businesses that run on power end up shutting down because the cost of alternative power supply, especially generator, is high and unsustainable for, while households welfare are hampered. Obviously, the imbalance between electric power supply and consumption, couple with the growing tariffs have implication on various economic activities in the country. Both large and small businesses struggle to survive leading to the winding up of those that could not sustain production, and job loss. The production costs of those that remained became excessively high thereby causing reduction in profitability. The poor power situation also discourages intending investors from investing their capital in the country. Living standard is affected. It is difficult for the majority of Nigerian households to use domestic electrical appliances often used to preserve food items and to make available some important basic items for their daily running. These amounts to diminished productivity and reduced living standards.

Table 1: Distribution of Power Consumers Across Discos

Distribution Companies (DisCos)	Energy Billed (GWh)	Non-Metered Customers	Metered Customers	Total
Abuja Electricity DisCo (AEDC)	750	540,645	782,713	1,323,358
Benin Electricity DisCo (BEDC)	563	599,081	615,296	1,214,377
Eko Electricity DisCo (EKEDC)	828	261,854	405,087	666,941
Enugu Electricity DisCo (EEDC)	475	701,412	554,707	1,256,119
Ibadan Electricity DisCo (IBEDC)	666	1,323,853	942,315	2,266,168
Ikeja Electricity DisCo (IEDC)	1005	262,623	810,823	1,073,455
Jos Electricity DisCo (JEDC)	339	480,880	230,709	711,589
Kaduna Electricity DisCo (KDEC)	264	626,857	196,557	823,414
Kano Electricity DisCo (KEDC)	357	484,930	206,471	691,401
Port-Harcourt Electric DisCo	464	266,457	458,915	725,372
Yola Electricity DisCo (YEDC)	141	408,627	106,326	514,953
TOTAL	**5,852**	**5,957,219**	**5,309,919**	**11,267,147**

Source: National Source: Bureau of Statistics, 2023

In spite of several studies conducted in the study area, there has been a seemingly simple yet important relationship aspect that had been neglected. Authors such as Madaki and Akanegbu (2023), Nweke, Adelana, Ngwuta, and Ogah (2020), Kabeyi and Olanrewaju (2012), concentrated on the effects of electric power supply on power tariff. While these studies dwelled on the causal-effect of the variables, this research examined how power supply, its price and consumption relates with one another. Also, other scholarly studies concentrated on factors determining electricity consumption in Nigeria, (Bashiru *et al*, 2024; Ubani, Sam-Amobi, Mba, Idu, Ezeama, and Oforji, 2024; Abubakar, Alola, Bekun, and Onifade, 2024; Murtala and Oyefabi, 2019), some examined the effects of power consumption on growth, at various levels (Anyuabaga, Akawu, Ibbih, and Charles, 2024; Osisanwo, Adeyemi, Babasanya, and Siyanbola, 2023). Other studies only examined the dynamics and trends of electricity consumption (Subair and Oke, 2008; Ojonimi, Kamil, and Akmal, 2019). All these studies inherited the lacuna of the inherent correlation or association that plays among electricity supply, electric power tariff and its consumption. This study focuses on electricity supply, electricity consumption and power tariff. It examines their trends while also determining the relationship among them. The study also determines causality that is inherent among employed variables of interest.

The following section of the study discusses both the theoretical and empirical literature. Section 3 discusses the method of data analysis adopted in the study. Here, types and sources of data are discussed while the estimated models for correlation and Granger tests

are also specified. Results and discussions are presented in section 4 while the last section of the study presents the conclusion and recommendation.

2. Literature Review

2.1 Theoretical Review

Electricity demand follows the behaviour of a normal good, and its consumption is often times a derived demand (Mankiw, 2018). Broadly, it is influenced by income and electricity prices. Income level of consumers as a major determinant of electric power consumption, captures consumers' living standard. It determines quantity of electrical items and services that an economic agent acquires, and rate at which they are being acquired (Bashiru *et al.*, 2024). Such electrical appliances include television, refrigerators, air-conditioners, and so forth, the acquisition of which increases as income level increase (Besanko & Braeutigam, 2011). Given the derived-demand nature of electricity, it follows that there is direct relationship between income and electric power consumption. Price of electricity, often referred to as tariff, is a discouragement towards higher level of power consumption. This is because as the price of electricity goes up, consumers' real income reduces, thus reducing their welfare benefits, (Mankiw, 2018; Besanko & Braeutigam, 2011).

Higher prices discourage electricity consumption. This therefore portrays a negative relationship between the price of electricity and its usage or consumption. In modelling electricity demand, other factors aside income and price also play key roles. If alternative power sources are available to consumers, its price will determine the quantity of electricity they will consume and the rate at which it is being consumed. While the number of people who consumes electricity could also influence its demand, climatic conditions may also be considered when examining demand for electricity (Ojonimi, Kamil, & Akmal, 2019).

2.1.1 Consumer Theory of Demand

The consumer theory of demand by Smith (1776), which represents the other side of supply and demand theory, is based on what people prefer to consume. It is therefore contingent on the premise that the choice that economic agents make determines what they like. Hence the behavior of economic agents in relation to their consumption (Mankiw, 2018). Given that they are limited by their

budget and prices of commodities they consume, consumers are constrained to make a budget of their income towards the optimum amount of the goods and services they purchase, after giving preference to the most pressing, in order to ensure their utility is maximized (Ekanem & Iyoha, 1990). The consumer's affordable consumption bundles, therefore, are the combination of the goods and services whose cost do not go beyond their income, which represents their budget constraint. The relation between their intended utility and money income available to be expended on their basket of goods and services are expressed as:

$$U = f(XY.....Z) \quad (1)$$
$$M = PxX + PyY + ……+ PzZ$$

U = Consumers' Utility level: X,Y….Z = Basket of goods and services that consumers can purchase; PxX = Consumer's expenditure on good X; PyY = Consumer's expenditure on good Y; PzZ = Consumer's expenditure on good Z; M = Consumers money income. The optimization of equation (1) will yield consumers highest possible level of satisfaction given their income.

2.1.2 The Optimal Electricity Tariff Theory

The optimal electricity tariff theory propounded in the 20th Century by Steiner (1971), postulates that the willingness to pay (WTP) for electric power, otherwise referred to as capacity, depends on the discounted marginal costs of the produced electric power. The incremental willingness to pay is exhibited in the tendency to consume the produced electricity, while the price difference between the peak and off-peak power demand is differentiated by each period's distinctive feature .While taking into cognizance nature of the grid power electricity as a public good, the summation of consumers' willingness to pay is considered to be necessary in order to obtain adequate incremental charges for the wheeled power supply. Given that this approach sums together the valuation by electric power consumers across various tiers of power utilization, it makes it avails the electricity generating sector the opportunity to determine the adequate electricity needed to be supplied through the balancing the power plant investment estimation and the expenditure attributable to the designed base and peak loads. The optimal electricity tariff theory also covers the uncertainties of intended investment and power generation inherent in the electricity industry models. As such, it

induces both suppliers and power consumers to maximize investment profit and ensures social optimality, respectively.

2.1.3 Ramsey Pricing Model

The Ramsey pricing model is an optimal price determinant for regulated industries that operates a multi-product firm such as utilities where electricity belong. The model is an option when a firm or outfit needs to cover its operating costs while also ensuring consumer welfare and utility are maximized (Ramsey, 1927).

The charged price are set beyond the marginal costs but with a higher markup on commodities with inelastic demand, where the consumer of the commodities rarely adjust their consumption to price changes. However, it ensures a lower markup on commodities whose demand are elastic. The Ramsey pricing model, which is a representation of a price structure required for a national grid power is an adequate and cost-effective model for electric power regulators to apportion capacity cost-covering price to respective users, based on their demands. Hence, the establishment of equilibrium in the electricity market. The attendant effectiveness from the price model encourages efficient competition in the value-chain sequence of electric power. In the face of healthy competition, equilibrium price of electric power generation tends to be the best, and therefore, would be chosen in the market.

2.2 Empirical Review

In the study conducted by Ubani e*t al*. (2024), on factors that determines the consumption of electric power among households' in five Nigeria cities, a multistage cluster sampling method was adopted gather a sample of 769 households through the administration of questionnaires among metered customers, and a multiple linear regression was fitted. The study found that in addition to the demographic variables used in the research, electrical items and frequency of their usage, house type and its location, were other significant determinants of power consumption.

Anyuabaga *et al*. (2024) in their work on impact of power consumption on Nigeria's output growth (1980-2023), where time series on RGDP, residential electricity consumption and special tariff electricity consumption were used, the fully modified ordinary least square model was estimated. It was found that electric power consumption has impact on growth in Nigeria. While residential

electric power consumption has positive impact on RGDP in the country, its impact was found not to be significant. However, the Special Tariff Electricity Consumption was noted to negatively impact RGDP. The government were advised to prioritize infrastructure investments to ensure uninterrupted power supply, while putting in place supportive policies that will encourage industrialization and value addition in the energy sector.

Abubakar *et al.* (2024) investigated the impact of socioeconomic and demographic factors on energy usage of households' using health and demographic survey data collected in 2018. It was discovered that when compared to modern energy sources, energy from traditional sources dominated among the households thus examined. The study established that male-headed households tend to use modern energy sources more than the female-headed households. It was further found that the usage of energy from traditional sources was prevalent among northwestern households compared to south westerners. Finally, the fitted results of the logit analysis showed a significant positive effect of wealth index, education, wealth and geopolitical location on utilization of energy from modern sources. Among others, the study recommended that the government could venture into the construction of energy-efficient housing units in collaboration with energy- specialist private sectors

Bashiru *et al*. (2024) studied the determinants of electric power demand and consumption in Nigeria using data covering thirty-eight years (1980- 2018). Nonlinear ARDL was used in the research. The study found that only negative price shock caused electricity demand to rise. Both positive and negative shock caused by electricity Access made power consumption to rise. It was recommended by the study that more efforts by government is required to improve electricity supply from the grid and the access rate. In a similar work by Ubani *et al.* (2024) prepaid electricity users in five cities in Nigeria were examined. The study linked power deficit to the inadequacies of knowledge of the actual factors or indices influencing electric power usage. The research thus suggested that policies made in line with the study findings will provide empirical basis to energy planners for accurate and estimation of actual determinants of households' electricity consumption in the country.

Amuji, Nwachi, Tasie, Mbachu, and Owolabi (2023) did a relationship analysis of electricity users expenditure and the actual quantity of consumed electricity. Other variables used in the study are

tariffs and VAT. Electricity users were observed to spent more on the same amount of electricity, overtime. The study further found an inverse relationship between the two variables. Also, tariff rate and value added tax negatively relate to electric power consumption. Given the general observation that more is spent on electricity than in the past, the study recommended the government to cushion the price effect on the masses, as electricity is a necessity to every household.

Madaki and Akanegbu (2023) employed ARDL bounds testing method to analyze data on supply of electric power culled out of various editions of the CBN Bulletin and the NERC which covered the period between 1971 and 2021. Result showed that, at all point in time, electricity supply is impactful, having direct influence on the price of electricity and the country's output. The growth of electricity therefore causes its tariff and the country's GDP to also rise. As recommendation, the study felt it was essential that the electricity market in Nigeria be developed, so as to have an equilibrium power tariff that ensures smooth interaction of power supply and the tariff that is charged, while taking into consideration reasonable investment return margin.

Osisanwo *et al.* (2023) investigated the extent to which demand for electricity impacted output growth in Nigeria, over 22 years (2000-2022) by employing the use of covariance analysis and multi-regression ECM. It was found that at all times, electric power demand positively impact output growth in the country. The research recommended increased investment in the electricity sector, in order to propel the supply of electric power so as to meet rising demands.

Kabeyi and Olanrewaju (2012) worked on the relationship between economic growth and electricity consumption in Nigeria. The study established that the relationship that exist between electric power and economic growth tends to be stronger compared to coal and other energy sources. However, the causality results yielded a mixed relationship among energy tariff, economic growth and consumption. The study concluded that since a positive relationship was established between electricity consumption and the growth of gross domestic product, subsequent studies that considers electricity demand modeling needed to put into consideration the inclusion of GDP as a key variable.

Nweke *et al*. (2020) worked on implication of the billing system on electricity consumption in Nigeria, necessitated by the problems of inaccurate consumption and irrational monthly billing

system that consumers are subjected to. Using Abakaliki in Ebonyi State, the study covered 4,500 on prepaid meter users, 10,843 postpaid meter users and 32,358 unmetered customers, giving a total of 47,701 customers. It was evident from the study results that larger proportion of power consumers were still highly billed on estimation. This was because readings were gotten from the estimated billing receipts. The study recommended concerted efforts towards ensuring that customers be provided with prepaid meters to ensure that what they pay commensurate their consumption.

Ojonimi, Kamil, and Akmal (2019) focused on modelling and forecasting electricity consumption among Nigerian residents using multiple linear regression method. The model predicted a high observed electricity consumption value, and also forecasted an annual growth rate of 567.01 GWh electricity consumption by the residential sector of power consumers in the country. The study recommended that with such yearly increase in electric power utilization by residents, fast and adequate steps to improve electric power generation that will take care of current residential customers need while catering for future demand, should be expedited**.**

Murtala and Oyefabi (2019) assessed the effect of electric power market deregulation on its utilization by Nigerians, from 1980 to 2017 using annual data on electricity consumption by residents, power tariff, income level and deregulation-proxied dummy. The study analysed the data using the ADF and Phillip-Perron unit root test, co-integration test and the VECM. The variables long term relationship and elasticities were found to respond to changes in market deregulation. The result further showed that deregulation, as proxied for by the dummy, caused a reduction in electric power utilization, given its negative and significant estimated coefficient. Recommendation was made by the study that while higher energy efficiency standards for electricity appliances should be met with appropriate pricing policy, it should be ensured that there is reliable development of the electricity market.

Fabiyi *et al.* (2016) explored the causes of inconsistent power supply in Nigeria. The study used question nares to acquire data in Minna, Niger State. Simple percentage analysis was used to analyse te data. While findings showed that, the rate of electricity supply in Nigeria is below requirement, usage of old equipment, adequate maintenance and corruption, were mentioned to be the major causes of the deplorable state of electrical power supply in the country. The

study recommended urgent attention in the area of overhauling the generating equipment, while blocking areas of fund leakages through corruption

Subair and Oke (2008) worked on aggregate electricity consumption trends and its privatization in Nigeria. While the trend revealed that electricity has significant influence on infrastructure, living standard and socio-economic activities in the country, power outages and its epileptic supply were found to be a draw-back to development. Some have argued that privatizing electricity supply through the unbundling of power generation arm of National Electric Power Authority (NEPA) now Power Holding Company of Nigeria (PHCN) will ensure its efficiency. The study established that privatization of the sector and other adopted reforms have not succeeded in fully addressing the inadequacies. It is recommended that pragmatic implementation and follow-ups of the reform, by the government, is required.

A close examination of the body of the above discussed works found in literature, reveal that a good number of the studies either concentrated on cause-effect between electricity supply and consumption. Several others were concerned on the country's GDP as impacted by electricity supply and demand. Few other studies considered the effect of tariff charged on electricity on its consumption, as part of their study variables. All the studies are therefore incomplete without considering or examining the extent or degree of relationship that exist among power supply, its price and consumption. Hence this study.

3. Methodology

3.1 Data and Sources

This correlational research work examines trends and relationships among electricity supply, consumption, and tariffs over a period of 42 years (1981-2023) in Nigeria. The study utilized annual time series for its analysis. Variables of interest were sourced from various published CBN Annual Reports and the World Bank official website. The adopted study variables are household Income level, household electricity consumption, electricity supply and price/tariff of electricity. Descriptive analysis and graphs are used to identify trends, while correlation and causality tests explore relationships among variables.

3.2 Model Specification

Correlation analysis was analysed to determine the relationship among the study variables. This follows the work of Amuji *et al*. (2023) where correlation technique was used to analyse the electric power consumption and bills of Enugu Electricity Distribution Company. The functional form of the correlation model is given as:

$$r = CovXi, Yi/\sigma Xi \times \sigma Yi \quad (2)$$

The Pearson correlation analysis model estimated in the study is adapted from Gujarati (2004), and specified in equation (3).

$$r = \frac{n\sum X_i Y_j - (\sum X_i)(\sum Y_j)}{\sqrt{\left[n\sum X_i^2 - (\sum X_i)^2\right]\left[n\sum Y_j^2 - (\sum Y_j)^2\right]}} \quad (3)$$

Where;
r = correlation coefficient
X & Y = Variables between which relationship is tested
n = Number observation
In order to achieve the study objective that captures causality, equation (4) is estimated.

$$lnHECt = \beta 0 + \Sigma\beta 1 lnHECt - 1 + \Sigma\beta 2 lnESt - 1 + Ut$$

$$lnESt = \beta 3 + \Sigma\beta 4 lnESt - 1 + \Sigma\beta 5 lnHECt - 1 + Ut$$

$$lnTRF = \alpha 0 + \Sigma\alpha 1 lnTRFt - 1 + \Sigma\alpha 2 lnHECt - 1 + Ut \quad (4)$$

$$lnHEC = \alpha 3 + \Sigma\alpha 4 lnHECt - 1 + \Sigma\alpha 5 lnTRFt - 1 + Ut$$

$$lnTRFt = \delta 0 + \Sigma\delta 1 lnTRFt - 1 + \Sigma\delta 2 lnESt - 1 + Ut$$

$$lnESt = \delta 3 + \Sigma\delta 4 lnESt - 1 + \Sigma\delta 5 lnTRFt - 1 + Ut$$

Where; TRF = Tariff of Electricity (N/Kwh); HEC = Household Electricity Consumption (Kwh); ES = Electricity Supply (Kwh); t = 1981-2023; U_t = Stochastic error term.

4. Results and Discussion

4.1 Descriptive Analysis

Table 2: Descriptive Statistic of Variables

Variable	Mean	Median	Std Dev.	Skew	Kurt	J-B Prob	Obs
HOI	45962.3	11501.5	62607.6	1.4	4.1	0.00	43
HEC	109.9	100.9	29.9	0.1	1.6	0.19	43
ES	86559.4	89307.4	39339.3	-0.3	2.3	0.45	43
TRF	104.4	37.9	127.5	1.5	4.6	0.00	43

Source: Author's Computation, 2025

Table 2 presents attributes of the variables used in the study. These include household income, electricity consumption, electricity supply and electricity price. It is important to state that the variables are not measured in the same terms. While the household income and electricity price are expressed in naira, electricity consumption is measured in KiloWatt-hour (KWh) and electricity supply is expressed as Gigawatt-hour (GWh). As shown in the table 1, the mean is based on individual variable. The household income shows an average of ₦45962.3billion, electricity consumption recorded a mean of 109.9KWh and electricity supply as 86559.4GWh among others. It is obvious that electricity supply show the highest mean value (since it is measured in Gigawatt), followed by household income over the periods. This may be attributed to the continuous increment in minimum wage as often agitated by the Labour Union and rising investment in power supply by the Nigerian government over the years.

The degree of variable fluctuation (standard deviation) indicates the highest value of household income as ₦62607.2billion, followed by electricity supply at 39339.3GWh. It is not surprising as the individual income is usually influenced by the rate of inflation in the country which determines the purchasing power of a household. Poor infrastructure and power sector reforms also facilitate the fluctuation or unstable power supply in Nigeria as shown in Table 2. Furthermore, all the series are positively skewed except electricity supply. The kurtosis which explains the degree of variable peakedness show high value of the price charged for electricity. This shows the speed at which the price of electricity in Nigeria increases, following the unbundling of National Electric Power Authority (NEPA) which gave birth to the Power Holding Company of Nigeria (PHCN) under the Former President of Nigeria, Olusegun Obasanjo in March 2005.

In terms of normality, the probability of JB statistic of household electricity consumption and electricity supply are greater than 0.05 while that of household income and price of electricity are less than 0.05. Thus, only electricity consumption and electricity supply are normally distributed for the period under review.

4.2 Trend Analysis

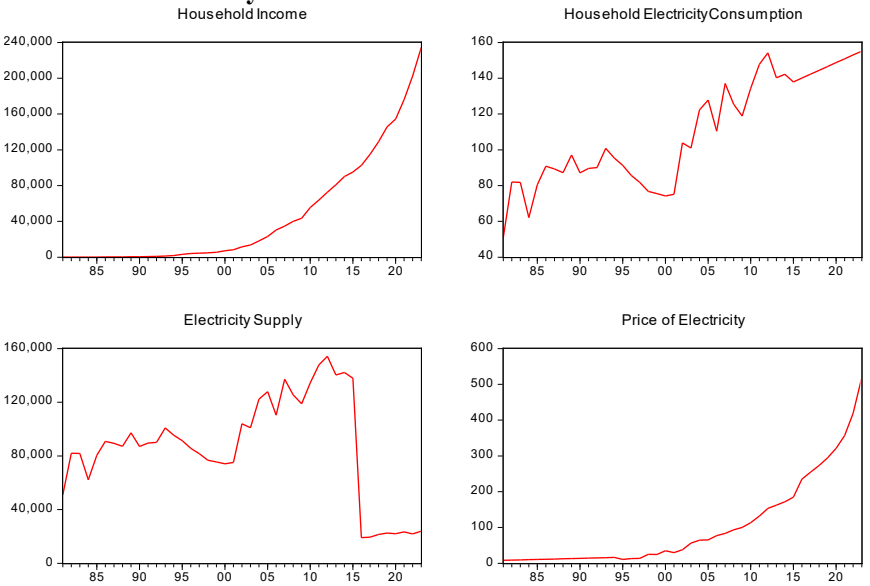

Figure 1: Trends of Variables
Source: Author's Sketch, 2025

Figure 1 shows the trends of household income, household electricity consumption, electricity supply and the price charged for electricity between 1981 and 2023. The least and highest income of household was seen in 1981 and 2023, showing ₦139.3billion and ₦234425.9billion respectively. Expectedly, similar trends were observed in electricity consumption and the price charged for electricity in 1981 and 2023 as the least and highest figure was found in the same year. However, a downward trend was discovered in the electricity supply in 2023 as the Nigeria's electricity supply does not commensurate with the persistent increase in price of electricity and household income in the recent years. This could be attributed to the incessant collapse of national power grid in Nigeria. Taking a cursory look at the trends of electricity consumption and supply, it was

discovered that after the first three years of persistent increase (1981, 1982 and 1983), there exists of a sudden decline in electricity consumption and supply in the fourth year (1984). Similar upsurge was observed in the flow of 1985 and 1986 before unexpected fall in electricity supply and consumption in 1987 and 1988. The unstable trend of these two variables followed the same patterns until 2016 when there is a sudden decline in power supply owing to the breakdown of power grid in Nigeria.

4.3 Correlation Analysis

The study also employed the correlation analysis to check the direction and strength of relationship among the used variables is presented below

Table 3: Correlation Analysis Result

	HOI	HEC	ES	PRE
HOI	1.00	-	-	-
HEC	0.83	1.00	-	-
ES	-0.47	-0.01	1.00	-
TRF	0.99	0.82	-0.49	1.00

Source: Author's Computation, 2025

The results of the correlation analysis are shown in Table 3. Among the explanatory variables, only electricity supply has negative and moderate correlation with household income. However, positive and high correlation exists between HOI/HEC and HOI/TRF. This is because the extent of electricity consumption by individuals and the price charged for the electricity has a direct proportion with the individual's level of income. Thus, ability to pay the electricity charges and increasing usage of electricity consumption depend on the volume of household's income. Similarly, the same scenario occurs between household electricity consumption and electricity price as high and positive correlation was reported by the analysis. However, negative and moderate correlation exists between electricity supply and electricity price. Finally, low and negative interaction was found between household electricity consumption and electricity supply for the periods under review

4.4 Causality Test

The direction of causality among the study variables is determined through the use of Granger Causality test. The result is as presented in Table 4.

Table 4: Causality Test Result

Null hypothesis	F-Statistic	P-value
LnTRF does not Granger Cause LnHOI	0.13562	0.8736
LnHOI does not Granger Cause LnTRF	6.05504	0.0054
LnTRF does not Granger Cause LnHEC	5.51817	0.0081
LnHEC does not Granger Cause LnTRF	1.70330	0.1964
LnTRF does not Granger Cause LnES	1.11791	0.3380
LnES does not Granger Cause LnTRF	0.06867	0.9338

Source: Author's Computation, 2025

The degree of granger causality between variables is determined by their respective probability values. Thus, a bi-directional link or granger causality exists if the P-value of the two variables are less than the 5% threshold. However, a unidirectional association occurs between the variables when the p-value of one variable is less than the 5% and that of the second variable exceeds the critical value. Based on the results of causality test, one-way effect is found between Household Income and Tariff paid on Electricity. The result specifically show that Household Income granger causes Tariff paid on Electricity at 0.0054 (0.54%). Tariff paid on Electricity granger causes Household Electricity Consumption at 0.0081 (0.81%). Thus, it can be inferred that the relationship among these variables are unidirectional.

4.5 Discussion of Findings

The movement in both household income in Nigeria and their electricity consumption was found to be at par. Electricity price in the form of tariff also follow the same trend, indicating that electricity is a normal goods because as its demand increased, the price also rose. However, the observed downward trend in power supply towards the end of the study period reflects a supply-demand gap that the country is still struggling to fill. The deficit in power supply emanates from the usage of aged equipment, poor maintenance, high rate of corruption, poor reform of power sector among others. Some of these factors have also been identified and discussed in the work of Fabiyi

et al. (2016), as reasons for the unstable power supply in Nigeria. A clear indication from the study is that households are infringed by tariff to consume electricity to their satisfaction. This has implication for their individual and collective economic activities because high power tariff increases households' expenditure and thus reduces their real income.

Rise in electricity consumption following an increase in household income, as revealed in the research. More often, households' stock of electrical appliances increase as their income increases overtime. This drives up power demand and by implication, the tariff as well. It can also be inferred that hike in tariff has a dampening effect on household electricity consumption, forcing consumers to cut down on their energy usage so as to balance their spending between cost of electricity and other consumables. However, Bashir *et al*. (2024) found that tariff of electricity did not granger cause its consumption.

5. Conclusion and Recommendations

The study describes the trends and examined the relationship among electricity supply, electricity consumption and power tariff in Nigeria. The positive relationship of household income and electricity consumption is an indication that households are able to afford more energy-intensive appliances and increased use of electricity-powered services, given their income. Their ability to maintain or cater for the tariff they pay on electricity given their income level, is an indication of the one-way causality that exists between income and tariff. Increased usage of electricity also account for the increase in tariff accrued to households, as shown by the uni-directional causality from electricity consumption to tariff. Based on the research findings the following recommendations are made;

i. Government through the Nigerian Electricity Regulatory Commission (NERC) should implement a tiered pricing structure to incentivize responsible usage across different income levels. Since Tariff charged on electric power significantly impact electricity consumption, a tariff structure that charges based on 'peak and off-peak' (Time of Use tariff), will be a reasonable window to explore.

ii. More efforts still needed to go into ensuring electricity supply is increased in order to match the increasing demand.

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