Energy Economics Letters
ISSN(e): 2308-2925
DOI: 10.55493/5049.v12i1.5423
Vol. 12, No. 1, 34-45.

URL: www.aessweb.com

Nerlovian stock adjustment approach to electric power consumption among households' in Nigeria

Najeem O. Bashir[1+]
Abu Kadiri[2]
Isiaka B. Bisiriyu[3]

[1]*Department of Economics and Actuarial Sciences, Crescent University PMB 2104 Sapon, Abeokuta, Ogun State, Nigeria.*
Email: tunjibash@cuab.edu.ng
[2]*Engineering and Performance Monitoring Division, Nigerian Electricity Regulatory Commission, NERC, Plot 1387 Cadastral Zone A00, PMB 136 Garki, Abuja, Nigeria.*
Email: abu.kadiri@nerc.gov.ng
[3]*Academic Planning Unit, Establishment Office, Fountain University, Osogbo, Osun State, Nigeria.*
Email: delebisiriyu@gmail.com


(+ Corresponding author)

Article History
Received: 22 April 2024
Revised: 26 May 2025
Accepted: 12 June 2025
Published: 24 June 2025

Keywords
ARDL
Dynamic electricity demand
ECT
Energy model
Nigerian households
Nerlovian stock adjustment.

JEL Classification:
D1; Q41; Q49.

ABSTRACT

The research examined the impact of time on households' current electricity demand among households in Nigeria. Specifically it examined the effects of consumers' previously earned income and acquired electrical appliances on their current energy consumption, hence a dynamic demand analysis. The study analyzed 42 years annual series spanning 1981 through 2023. Household Income, Electricity demand and tariff are the study variables. An ARDL regression and other robustness checks were fitted. Results showed that previous Electricity demand caused current demand to significantly rise by 37%. Increase in households' past and current income also led to an increase in current power demand. About 91.8% of the short and long run imbalances among the series are corrected in subsequent years, as indicated by the estimated ECT(-1). It is concluded that past electricity demand and previous income positively and significantly influenced households' current power demand, albeit the dampening effect of power tariff. As tariff-increase polices are been implemented, regular income review is recommended. If tariff increase was necessary, it should be mildly administered given its dampening effect on real income.

Contribution/ Originality: Dynamic Electricity Demand is an electricity-specific demand analysis rarely found to have been used in related studies. The DED, analyzed using the ARDL, demonstrated that current electricity demand is amplified by both past consumption and income. This extends the knowledge frontier beyond the static nature in which energy transition and demand had been previously discussed.

1. INTRODUCTION

It is no coincidence that living standard in Nigeria is low and has continued to drop when compared with nations with access to better electricity. In the result of the 2022 Multidimensional Poverty Index (MPI) Survey carried out by the federal government, sixty three percent of persons living within Nigeria, representing about 135 million people, were reported to be multi-dimensionally poor, and cook with dung, wood or charcoal, away from cleaner and better energy, (National Bureau of Statistics, 2022). Electricity sector in the country accounts for just 9% of households' total energy consumption. Currently, Nigeria supply's approximately 5,000 MW of power to the population of over 200 million people, putting the per capita electricity consumption around 400 megawatt per hour, (Nnodim, 2023). When compared with over 40,000 MW of energy produced for 62 million people by South

Africa with per capita electricity consumption of over 3000-Kilowatt hour, the deficit in power availability in Nigeria becomes glaring. The low proportion of households' total energy consumption in the country thus mentioned is largely, attributable to this. More than 80 million Nigerians have been found not to have access to electricity, placing the country after India and the first in Sub-Saharan Africa, in electricity deficiency (Ochayi, 2017).

During the Fourth Republic in 1999 when democracy returned to Nigeria, the electricity issue was included in the seven-point agenda of the government as a critical focus area in the country's power sector. This necessitated the introduction of a reformation Roadmap plan for the sector in the following year of the government. The reformation agenda prioritized, among others, decentralization and electric power consumption metering users. However, not all the reforms could be said to have achieved the goals for which they were intended. It is worrisome that the problem seems to persist despite various government efforts. Amongst others, ineffectiveness of past reforms, which reflect government incompetency, and lack of commitment among officials across affected agencies and ministries, and inadequate knowledge of the informal sector are part of the bane to electric power growth.

The electric power need of the informal sector in Nigeria, estimated to be between 45 percent and 60 per cent of that of labour in the urban settlements, represent a strain on the insufficient power supply in the country, (Kayode, Akhavan, & Ford, 2013). The informal sector in Nigeria is the largest in Africa with various forms of economic activities taking place, but an exact figure has yet been put to it. Due to lack of precise knowledge of the quantum of the informal sector, it is a difficult task to understand the electricity consumption dynamics of not only the sector but also the country as a whole. By implication, this disallows for adequate identification of incidence of electric power consumption on the development of various regions of the country, hence its influence on policy recommendation and implementation. The purpose, therefore, for which the Nigeria Power sector was privatized cannot be said to have been achieved after over twenty years. The veil that remained to be uncovered is the identification and characterization of those factors that influence electricity demand in order to develop reliable electricity demand projections, which are, in turn, important for policymakers.

Among related studies, the bulk of theoretical review on energy demand revolves around the energy transition model and the consumption theory, which are static in nature. Such analysis did not consider effects of past activity, such as consumers' previously earned income and previously acquired electrical appliances on their current energy consumption. These time-bound factors, which had been given less attention in past studies, are critical to the understanding of the reasons why electric power consumption has the potential to keep rising overtime.

This study dynamically examined the effects of consumers' past-earned income and previously acquired electrical appliances on their current electricity demand. The study also examined the influence of various forms of electricity users on electricity demand.

2. REVIEW OF LITERATURE

2.1. Theoretical Review

2.1.1. The Dynamic Electricity Demand Model

The Dynamic Electricity Demand (DED) model hinges on the Nerlovian Stock Adjustment hypothesis. It is a distributed-lag model that explains power demand at any particular time as a function of consumers (firm and household) past electricity demand and income. It tells that consumers decision to purchase electricity in the current period is influenced by their previous levels of electric power purchase and past income, (Jhingan, 2020). Where electrical items that uses electricity are involved, previous acquisition of such 'Stock' appliances clearly affects current and subsequent demand of electrical power. However, the purchased electric power itself is a reflection of power buying habit, which is regarded as 'Flow' because of its continuous direct usage by the acquired electrical appliances, which yield certain level of satisfaction to households.

2.1.2. Theory of Energy Consumption

The utility function of a consumer's electricity demand represents the households level of welfare expressed not only in terms of the electric power consumed, but also as being dependent on the level of consumption of other commodities, (Mankiw, 2018). The consumers demand is a subject of his limited income that he budgets the purchases of all consumed commodities, at their given prices.

$$U = f(Elect, Q_1, Q_2, - - - Q_n) \quad (1a)$$

s.t

$$Y = P_{Elect} + PQ_1 + PQ_2 + - - - + PQ_n \quad (1b)$$

In the above equations, *U* represents the utility function of the household, *Elect* = Electric power purchased, Q_1, Q_2, - - -Q_n = other goods purchased by the household, *Y* = household income, *P* = Household commodity prices. Equation 1a is the demand function that summarizes the household's commodity purchases at their respective prices and at a given income level. The household's indirect utility function is derived when the demand equation (1a) is substituted into initial utility function. Ceteris paribus, household utility either rise or decreases when prices drop or rise. It may either increase or decrease when income rises depending on the direction of change in income. However, it can also remain unchanged when income and prices experienced changes in equal proportions, and in the same direction, (Besanko & Braeutigam, 2011).

However, the demand for electric power depends on the stock of equipment and electrical appliances, (Babatunde & Enehe, 2011; Kayode et al., 2013; Masera, 2000)(. By implication, when electric power tariff rises, the short-term effect of price increase on household's consumption is inelastic, thus causing little or small change in its consumption. This may result when consumers reduce the use of appliances that use electricity which are considered not so necessary. While the demand for electricity depends heavily on appliances owned by electricity consumers, its total consumption depends on the number of appliances households actually use, and the frequency of their usage. Large numbers of electrical appliances may not eventually translate to high electricity consumption because of the derived nature of electric power demand. In the distant future, however, an increase in electric power tariff will considerably affect power demand, as consumers tend to cut their purchases of appliances such as Air conditioners, refrigerators and so forth, and replace them with energy-saving appliances or any other alternative that is suitable to them.

2.1.3. Energy Ladder Model

The energy ladder hypothesis proposed in the late 20th century, addresses issues relating to which energy sources was dominantly used among households, earning different incomes, (Toole, 2015). From very low incomes on the left, to high incomes on the right. The model typified poorest households whose income are very low, to burn and survive on firewoods, dungs and other crop wastes. This household category is found at the bottom of the ladder, (Toole, 2015). They are closely followed by those that survive on charcoal or coal. Households with relatively higher income termed 'the Rich' depends on energy sources such as gas or electricity for survival. Such households are located at the peak of the energy ladder. Households that subsist on firewoods, biomass and coal/charcoal, found from the lower part to the middle of the ladder are referred to as 'solid fuel consumers'. Their usage of solid energy sources high in containment of impurities, exhumes toxic chemicals into the atmosphere, (Oseni, 2012). However, households living on fuels such as gas and electricity, located at the higher steps of the energy ladder, are termed 'clean fuel consumers'.

Figure 1 Shows the Energy Ladder, illustrating Household Energy Transition Path as Income Rises.

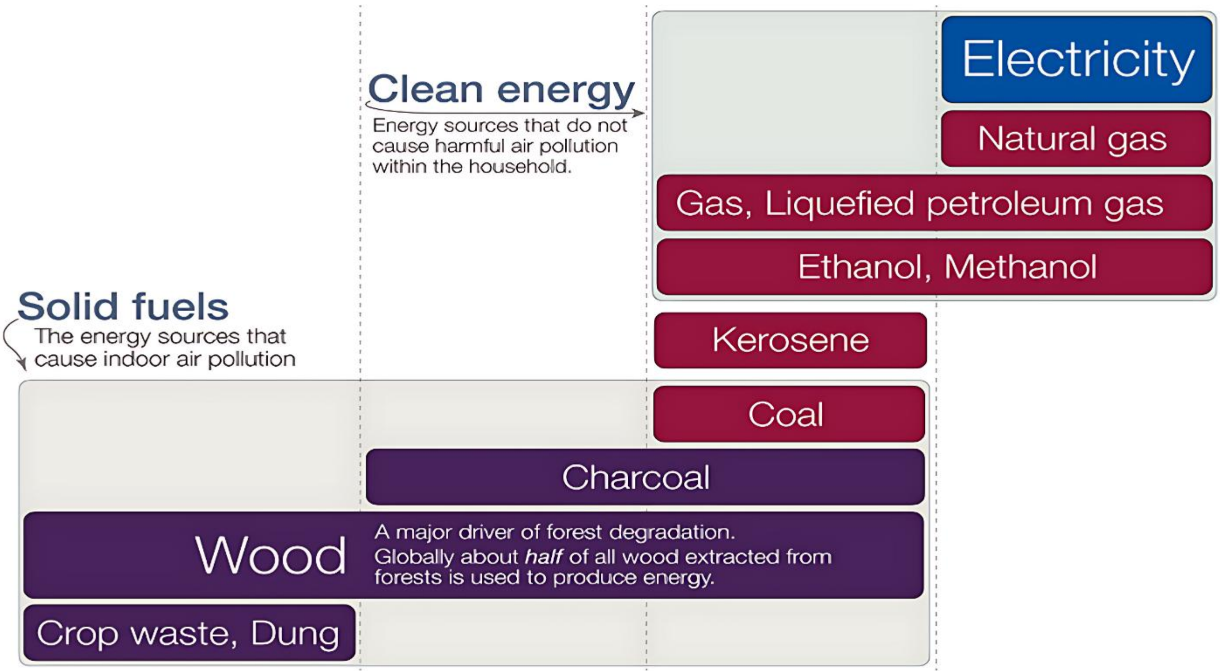

Figure 1. The energy ladder.

Source: World Health Oorganization (2018).

Practically, the energy ladder depicts an interplay between energy demand per capita and growth. As a household, community and a country develops, their energy demand evolves from crude-based energy sources to advanced energy sources.

2.2. Empirical Review

Ale and Oluwabamise (2022) analyzed how electricity supply and demand pattern affects the grid system in Nigeria, (2018 – 2020), using daily data on transmitted and distributed electric power, demand/consumption and internationally connected power transmission to neighbouring countries. The study found that the distribution companies inadequately attended to load demand. Demand issues were compounded by the fact that power was not generated by some generating stations due to shortage of gas feedstock. The study recommends the government to expand its generating stations while more others should be developed.

Onisanwa and Adaji (2020), examined the impact of income per capita, size of electricity consumers and shortages in its distribution on consumption in Nigeria**.** Data on the variables covered the period between 1981 through 2017 and were culled from the World Development Index, WDI and Energy Information Administration, EIA. The ARDL regression technique was used in the estimation. The number of power consumers and their Per capita income were discovered to determine households' future consumption of electric power in Nigeria. Consumption of electricity was found not to increase as income level rises. However, electric power consumption did rose as population increased. Benjamin and Adewumi (2014), proposed forecasting models for electricity supply and demand in Nigeria by analyzing 36 years historic series (1970-2005), obtained from the NBS using the Garch model. Obtained results showed that the mean of electricity demand spike outweighed the supply. This indicated that increased investment in the electricity market would benefit from the large and growing demand.

Audu and Apere (2013), presented an empirical work on the interactions of supply and demand of electric power in Nigeria using series that covers the period between 1970 and 2012. The reduced regression and VECM methods were adopted. In the research finding, government reform in the power sector tends to lead to rise in average price of electricity, which in turn influence electric power consumption. Ogunleye and Ayeni (2012) worked on disaggregated energy demand in Nigeria using gas, electricity and petroleum as study variables, over 1970 through 2007. The Vector Autoregressive method was adopted. The result from the VAR analysis indicated that long-run association among the series was not discovered. The research categorized gas consumption as a luxury given that its demand has a positive income elasticity. In the work of Babatunde and Enehe (2011) where they worked on identifying key determinants of electricity demand among Nigerian households, through the use of information collected from 40 households, and examined using the classical OLS model. Findings showed that household power consumption does not respond to both change in household income and cross-price elasticity. It was also established that determinants of electric power demand in the country were size of household, number of compartments in houses and hours of electric power supply. Udo, Chuku, and Effiong (2011) worked on the dynamics and trends of Nigerian households' electricity demand and its consumption, with a coverage of 1970 through 2008. The study applied the bounds testing method. Per capita income was found to be a key determinant of electric power demand. The research also found that electricity consumption was strongly and significantly influenced by industrial output, population growth and GDP per capita. The study recommended that deregulation of electricity product prices will enhance output growth in the country.

In 2011, Babatunde and Shuaibu (2011) examined the demand for electric power by residence among Nigerian, covering a period of 37 years, (1970-2007). ARDL by bounds testing approach was used in the study analysis. Income and price of alternative power sources were found to mainly influence demand for electric power in the country. In addition, electric power tariff was found to have insignificant effect on electric power demand in the country.

3. METHODOLOGY

3.1. Type and Sources of Data

Secondary data spanning 1981 through 2023, (42 years), was used for analysis in the research work. While data on Household Electricity Demand was collected from the National Bureau of Statistics, data on Household Income was gotten through various Central Bank of Nigeria's published statistical bulletin. Series on Price of Electricity was collected through the World Development Indicator, WDI.

3.2. Theoretical Framework

Following the Nerlove's Stock Adjustment Principle, the Dynamic Electricity Demand (DED) model posits that consumers electric power purchases in the current period is as a result of their previously acquired electrical equipments, and by extension their electric power purchase and past income, (Jhingan, 2020). A model for households income and their electric power purchase, specified in a generalized distributed lag form, is expressed as.

$$Et = f(T_t, T_{t-1}, ---, E_{t-1}, E_{t-k}, ---, M_t, M_{t-1}, ---) \quad (2)$$

Where E_t = Electric power purchase, T_t = Tariff/Price of purchased electricity, T_{t-1} = Tariff/Price of purchased electricity in the past, Et_{-1} to E_{t-k} = Past Electricity demand, M_t = Current income of the consumer, M_{t-1} = Consumer's Past income.

With respect to household acquired electrical appliances, consumer habitual character criterion is applied in the demand equation such that current demand of electricity E_t, is a function of past purchases of power-reliant items, contingent on household's nature of consumption, (E_{t-k}). The form taken by the demand equation is given as.

$$E_t = a + \lambda_1 P_t + \lambda_2 \Delta P_t + \lambda_3 Y_t + \lambda_4 \Delta Y_t + \lambda_5 X_{t-k} \quad (3)$$

In *eq.3*, E_t = Electric power purchase, a = constant, T_t = Tariff of purchased electric power, ΔT_t = change in tariff of purchased electric power, M_t = Current income of the consumer, ΔM_t = change in current income of the consumer, and λ_1 to λ_5 = parameters to be estimated.

3.3. Methods of Data Analysis

The features of the study variables were described by examining their mean, median, standard deviation, skewness and their distribution. Stationarity levels of the variables were tested using the Augmented Dickey-Fuller and the Phillip-Perron Unit root tests. The ARDL bound test was thereafter fitted to analyze the Electricity consumption among households' in Nigeria during the study period.

3.4. Estimation Technique

3.4.1. ARDL Model

Capturing the lagged values of consumers' previous income and demand of electricity, as separate variables that influences their current power demand along with others, the estimated model in the study is given by.

$$LnHEC_t = \alpha + \beta_1 LnPRE_t + \Sigma_{i=1} \beta_2 LnHEC_{t-1} + \beta_3 LnHOI_t + \Sigma_{i=1} \beta_4 LnHOI_{t-1} + \mu_t \quad (4)$$

Where: HEC_t = Household electricity demand, (Kwh); HEC_{t-1} = Households' previous electricity demand, (Kwh); PRE_t = Price of electricity, (₦/Kwh); HOI_t = Household Income, (₦'Billion); HOI_{t-1} = Previous Household Income, (₦'Billion); Ln = Natural logarithm; μ_t =Error Term

3.4.2. Bound Test

The estimated bound test models to determine long run relationship among adopted series in the research are specified below.

$$\left.\begin{aligned} \Delta lnHEC_t &= \lambda_{01} + \delta_{11} lnHEC_{t-1} + \delta_{21} lnPRE_{t-1} + \delta_{31} lnHOI_{t-1} + \Sigma\, \lambda_{1i}\, \Delta lnHEC_{t-1} \\ &\quad + \Sigma\, \lambda_{2i}\, \Delta lnPRE_{t-1} + \Sigma\, \lambda_{3i}\, \Delta lnHOI_{t-1} + e_{1t} \\ \Delta lnPRE_t &= \lambda_{02} + \delta_{12} lnHEC_{t-1} + \delta_{22} lnPRE_{t-1} + \delta_{32} lnHOI_{t-1} + \Sigma\, \lambda_{1i}\, \Delta lnPRE_{t-1} \\ &\quad + \Sigma\, \lambda_{2i}\, \Delta lnHEC_{t-1} + \Sigma\, \lambda_{3i}\, \Delta lnHOI_{t-1} + e_{2t} \\ \Delta lnINC_t &= \lambda_{03} + \delta_{13} lnHEC_{t-1} + \delta_{23} lnPRE_{t-1} + \delta_{33} lnHOI_{t-1} + \Sigma\, \lambda_{1i}\, \Delta lnHOI_{t-1} \\ &\quad + \Sigma\, \lambda_{2i}\, \Delta lnHEC_{t-1} + \Sigma\, \lambda_{3i}\, \Delta lnPRE_{t-1} + e_{3t} \end{aligned}\right\} \quad (5a)$$

Bound Test hypotheses for the Long-run coefficients in equation *5a* above

$$\left.\begin{aligned} H_0&: \delta_{11} = \delta_{12} = \delta_{13} = 0 \\ H_1&: \delta_{11} \neq \delta_{12} \neq \delta_{13} \neq 0 \end{aligned}\right] \quad (5b)$$

$$(i = 1, 2, 3)$$

The ECM thus estimated in the study as necessitated by the presence of cointegration is specified as.

$$\Delta lnHEC_t = \alpha_0 + \Sigma_{i=1} \delta_{11} \Delta lnHEC_{t-1} + \Sigma_{i=1} \delta_{21} \Delta lnPRE_{t-1} + \Sigma_{i=1} \delta_{31} \Delta lnHOI_{t-1} + \lambda ECT_{t-1} + e_t \quad (6)$$

4. RESULTS AND FINDINGS

4.1. Descriptive Analysis

Features of household electricity demand (HEC), price of electricity (PRE) and household income (HOI) are as presented in Table 1;

Table 1. Descriptive statistic of variables.

Variable	Mean	Median	Std dev.	Skew	Kurt	J-B Prob	Obs.
(HOI)	3.89	4.06	1.08	-0.31	1.67	0.15	43
(HEC)	2.00	2.00	0.12	-0.32	2.23	0.41	43
(PRE)	1.68	1.58	0.58	0.24	1.59	0.14	43

While household income and electricity price are expressed in Naira, and electricity consumption in KiloWatt-hour (KWh), their descriptive statistics thus explained is rendered in rates. The rate of average household income growth is 3.8907. The average rate of electricity consumption is 2.0042KWh while average price of electric power 1.6748. Household income having the highest mean value, over the period, is an indication that may be adduced to the recent minimum wage rise. The degree of dispersion of the series around their respective means, captured by the standard deviation, shows that household income has the highest deviation of 1.0819, while household electricity demand has the lowest rate of 0.1241. The high income deviation is a reflection of the pronounced inflation rate in the country, leading to continuous agitation for more pay rise by workers, (Fabiyi, Abdulmalik, & Tiamiu, 2016). In terms of normality, the probability of JB statistic of all the variables are beyond the 0.05 level. Thus, all the series are normally distributed for the period under review

4.2 Inferential Analysis

4.2.1. Test for Stationarity

The stationarity of adopted data were determined using Phillip-Perron and Augmented Dickey-Fuller unit root tests. The results are presented below

Table 2. Unit root test result.

Variable	ADF		Phillip-Perron	
	T-stat & P-value	*Order*	*T-stat & P-value*	*Order*
LnHOI	-3.54 (0.00)	I(1)	-3.46 (0.01)	I(1)
LnHEC	-3.92 (0.02)	I(0)	-9.36 (0.00)	I(1)
LnPRE	-7.63 (0.00)	I(1)	-7.63 (0.00)	I(1)

The study variables were subjected to both the ADF and Phillip-Perron random walk test techniques to determine their order of integration, with their results shown in Table 2 above. The ADF results indicate that households' income and tariff of electricity are integrated of order one, that is I(1), while household electricity demand is stationary at level at the 5% critical level. However, the Phillip-Perron test indicates that all variables are integrated of first order, I(1) at 5% critical level.

4.2.2. ARDL Regression

The result of the ARDL regression model fitted to capture effect of the previous values of households' income, their electric power demand and price of electricity on their current demand, is presented and discussed below.

Table 3. ARDL Output

Variable	Coefficient	Std. error	t-statistic	P-value
LnHEC(-1)	0.37	0.12	3.13	0.00
LnHOI	0.28	0.16	1.80	0.08
LnHOI(-1)	0.32	0.14	2.35	0.04
LnPRE	-0.18	0.05	-3.67	0.00
C	1.09	0.20	5.49	0.00
R-squared	0.88	Mean dependent var.		2.03
Adj. R-squared	0.86	S.D dependent var.		0.12
S.E. of regression	0.04	Akaike info criterion		-3.35
Log likelihood	75.3	Schwarz criterion		-3.14
F-statistics	64.4	Hannan-Quinn criter		-3.27
Prob(F-statistics)	0.00	Durbin-Watson stat		1.77

Note: Dependent Variable: Household electricity demand (HEC).

Table 3 displays results of ARDL regression. Previous electricity demand is positive and has a significant effect on its current demand. A percentage rise in its previous demand will cause its current demand to rise by about 37%. Also, a percentage increase in households' past income leads to an increase of about 32% in their current Electric power consumption. The estimate is significant at 5%. This outcome confirms the theoretical proposition of the

Nerlovian approach to Dynamic Electricity Demand, (Jhingan, 2020). Empirically, electricity demand and income have been established to have positive relationship, as shown by this result, (Ezeh, Nwogwugwu, & Ezindu, 2020; Umeh, Ekezie, & Igbo-Anozie, 2022). The coefficient of price of electricity is negative. Estimate indicates that a percentage increase in price of electricity will induce households' demand for electric power to reduce by 18%, (-0.183756). This negative effect of price of electricity on power demand is significant at 1%. Theoretically, the demand for a normal good is inversely related to its price, and so does electricity demand and its price in this study, (Mankiw, 2018). It has also been previously confirmed that in Nigeria, price of electricity dampens its demand, (Babatunde & Enehe, 2011; Bashiru, Isiaka, & Lawal, 2024). As a reflection of negative price effect, when the government, through the Nigerian Electricity Regulatory Commission, (NERC) in April 2024, announced the increment in the tariff of electricity for consumers on band A from N68/kwh to N225/kwh and from N206.8/kwh to N209.5/kwh for Band B users, it took time before the tension doused, (Esiedesa, 2024). This is because the increase in tariff will cause citizens' real income to reduce.

As indicated by the R-squared stat of 0.874541, over 80% of changes in household electricity demand is captured by price of electricity and households' previous demand. The F-stat of 64.47917 validates the joint significance of adopted regressors in the research.

4.2.3. The Bound Test

Long run relationship among the series that are used in the research was examined using bound test. The results and discussion are presented below;

Table 4. Bound Test Result.

F-bound	***Null hypothesis: No long-run relationship exist***			
Test stat	***Value***	***Sig.***	***I_0 bound***	***I_1 bound***
F-stat.	10.8	10%	3.17	4.14
k	2	5%	3.79	4.85
		2.5%	4.41	5.52
		1%	5.15	6.36

Bound test result is depicted in Table 4. It shows that estimated F-statistic value of 10.80334 is greater than 4.85 upper bound value, at 5%, leading to rejection of the null hypothesis. Therefore, there exist cointegration among the variables. An ECM is fitted to analyze the long run association and the inherent adjustment speed.

4.2.4. Error Correction Regression

The result of the fitted ECM and discussion are presented as shown below.

Table 5 Presents the Error Correction Regression Result showing Variables Adjustment after Short-run Deviation

Table 5. Error correction regression result.

Variable	**Coefficient**	**Std error**	**t-statistic**	**P-value**
C	-0.01	0.02	-0.67	0.51
D(LnHEC(-1))	0.33	0.18	1.87	0.07
D(LnHOI(-1))	0.14	0.14	0.96	0.34
D(LnPRE(-1))	0.07	0.11	0.64	0.53
ECT(-1)	-0.92	0.24	-3.78	0.00
R-squared	0.32	Mean Dependent var.		0.01
Adj. R-squared	0.24	S.D dependent var.		0.05
S.E. of regression	0.04	Akaike info criterion		-3.46
Log likelihood	75.8	Schwarz criterion		-3.25
F-statistics	4.21	Hannan-Quinn criter		-3.38
Prob(F-statistics)	0.006744	Durbin-Watson stat		2.031835

From the ECM result above, it was further established that electricity demand by household tends to move along with their past demand and past income. The coefficient of the ECT (-1) estimated as -0.918295, imply that 91.8% of discovered imbalance in the short and long run association among the variables would be corrected in subsequent years. The estimated ECT is statistically significant at 1%.

4.3. Diagnostic Tests

Serial correlation and test for homoscedasticity were carried out to validate the results that were gotten from the study analysis.

4.3.1. Serial Correlation

Result of test to determine the presence or otherwise of serial correlation among series of interest in the regression model is presented and discussed below.

Table 6 Shows the Result of Serial Correlation to Check the Relationship between Present and Past Values of adopted Variables

Table 6. Test for serial correlation.

F-stat	0.07	Prob. F(1,35)	0.79
Obs*R-squared	0.08	Prob. Chi-square(1)	0.78

The null hypothesis of the test thus carried out asserts that there is no correlation. The p-value of the estimated F stat is 0.7920, (79.2). The study could not reject the null hypothesis, hence the absence of serial autocorrelation.

4.3.2. Heteroscedasticity

The heteroscedasticity test examined the variance of the residuals for homoscedasticity or otherwise, and the result and discussion are presented as shown.

Table 7. Heteroscedasticity test.

F-stat	**0.070589**	**Prob. F(4,36)**	**0.4613**
Obs*R-squared	3.81	Prob. Chi-square(4)	0.43
Scaled explained SS	4.75	Prob. Chi-square(4)	0.31

The test's null hypothesis infer that the residual variance is constant. As shown in Table 7, the estimated F statistic given as 0.070589 is not significant, and then the null cannot be rejected. It follows therefore that the residuals of the variance of te regression output in the study are homoscedastic.

5. VALIDATION OF FINDINGS

The empirical validation of the Nerlove's Stock Adjustment Principle in relation to the Dynamic Electricity Demand analysis, practically shown by households inherent in past studies, is here discussed.

The body of work on household electricity demand and consumption are unanimously of the opinion that income is a major propeller of electricity consumption, (Ansu-Mensah & Kwakwa, 2022; Bashiru et al., 2024; Masera, 2000; Onisanwa & Adaji, 2020). Onisanwa and Adaji (2020) specifically emphasized on the long-run effect of income on electricity demand. Implicit therein, is the fact that past income which help households to amass items such as electrical appliances overtime, influences the amount of electric power they will have to need in order to run the appliances. The impact of home ownership and increase in gadgets make their rate of power demand to rise with time, (Twerefou & Abeney, 2020). While high technological electrical appliances usage in households' daily activities require high consumption of energy, lagged electricity consumption is also responsible for current electric power consumption, (Mahirah, 2013). Adom, Bekoe, and Akoena (2012) did not only expatiated on the part where income cannot be overemphasized in electric power demand as postulated by the DED, it came out with the finding that non-poor households demanded and consumed more electricity than the poorer households. Inherent in the findings of Ansu-Mensah and Kwakwa (2022) where the induced effect of increase in electricity consumption was established, the exposition of the influence of past consumption on present and future power demand by households, is indirectly subsumed in the study findings. It is important to mention that same response from households toward electric power demand was found in other countries, (Kolawole, Adesola, & De Vita, 2017; Twerefou & Abeney, 2020). Also, the behavior emanated by group of people and communities with higher economic standard as measured by their income, confirmed their need for higher electricity requirement in order to run their day to day activities compared with people with lower living standards, (Blimpo & Postepska, 2018). Pertinent to note here is that the electric power demand and consumption of these respective higher and lower standard communities turns out to induce their current and subsequent economic activities. This is a justification that high take-up rate of electricity by households' increase with higher income.

6. LIMITATION OF THE STUDY

The Dynamic Electricity Demand by Nerlovian approach, employed in the study requires detailed data on electrical appliances, household income, electric power usage and their charged tariff. However, Nigeria is fraught with the challenges of inadequate and inconsistent metering which goes a long way in influencing the quality and quantity of available data on power consumption. The challenges is furthered by the fact that available data is largely an under-representation of power consumers in the country given the large size of Nigeria's informal sector.

Panel data segregated household consumption analysis where various determinants of electricity demand such as type of settlement (whether rural or urban), income categories and others will be separately tailored towards different consumers, may be a promising perspective to circumvent the problem. This will take care of the challenges posed by the inadequate data resulting from poor metering and the informal sector.

7. CONCLUSION AND RECOMMENDATION

Based on Nerlove's Stock Adjustment Principle, the study employs the Dynamic Electricity Demand model, (DED) to examine the impact of time on households' current electricity demand. It was found that past electricity demand by households' and their previous income have positive and significant effects on their current electric power demand. The parameter of price of electricity is negative, hence its adverse effect on power demand. The research also established that price of electricity hampers its demand among households' in Nigeria. Given the long run association found among household electricity demand and other variables, the speed of adjustment shows that 91.8% of the disequilibrium among the variables would be corrected in subsequent years. The study recommends that when government embarks on tariff increase policy, the effect should be cushioned through regular upward review of people's income in the country. It is further recommended that if tariff increase was necessary, it should be mildly administered because of its dampening effect on power demand.

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not applicable.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Data Availability Statement: Upon a reasonable request, the supporting data of this study can be provided by the corresponding author.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Adom, P. K., Bekoe, W., & Akoena, S. K. K. (2012). Modelling aggregate domestic electricity demand in Ghana: An autoregressive distributed lag bounds cointegration approach. *Energy Policy, 42*, 530-537.

Ale, T. O., & Oluwabamise, A. A. (2022). Electricity demand pattern and supply availability on Nigeria grid system. *Journal of Applied Science & Process Engineering, 9*(1), 1042-1053.

Ansu-Mensah, P., & Kwakwa, P. A. (2022). Modelling electricity consumption in Ghana: the role of financial development indicators. *Green Finance, 4*(1), 54–70.

Audu, N. P., & Apere, O. (2013). The dynamics of demand and supply of electricity in Nigeria. *Dynamics, 3*(3), 25-33.

Babatunde, A. M., & Enehe, J. E. (2011). Determinants of household electricity demand in Nigeria. *Economic and Financial Review, 49*(2), 73-90.

Babatunde, M. A., & SHUAIBU, M. I. S. (2011). The demand for residential electricity in Nigeria. *Pakistan Journal of Applied Economics, 21*(1 & 2), 1-13.

Bashiru, N. O., Isiaka, M. A., & Lawal, S. A. (2024). Determinants of electricity demand in Nigeria: A non-linear autoregressive distributed lag (NARDL) analysis. *International Journal of Research and Scientific Innovation, 11*(4), 767-783.

Benjamin, O. O., & Adewumi, A. A. (2014). Models for forecasting the demand and supply of electricity in Nigeria. *American Journal of Modeling and Optimization, 2*(1), 25-33.

Besanko, D., & Braeutigam, R. (2011). *Microeconomics* (4th ed.). New Jersey: John Wiley and Sons, Inc.

Blimpo, M. P., & Postepska, A. (2018). *Why is household electricity uptake low in Sub-Saharan Africa? World Bank Working Paper*. Washington, D.C: World Bank.

Esiedesa, O. (2024). *DisCos hike band A July tariff by 1.3% to N209/kWh. Vanguard*. Retrieved from https://www.vanguardngr.com/

Ezeh, M. C., Nwogwugwu, U. C. C., & Ezindu, O. N. (2020). Impact of household electricity consumption on standard of living in Nigeria. *Journal of Energy Technologies and Policy, 10*(1), 47–59.

Fabiyi, S. D., Abdulmalik, A., & Tiamiu, H. (2016). Dwindling electrical power supply in Nigeria: Causes and possible solutions. *International Journal of Science and Research, 5*(5), 635-639.

Jhingan, M. L. (2020). *Advanced economic theory* (14th ed.). New-Delhi, India: Vrinda Publications Limited.

Kayode, R., Akhavan, F. M., & Ford, A. (2013). *Analysis of household energy consumption in Nigeria*. Paper presented at the Department of Environment and Architecture, School of Built, London South Bank University.

Kolawole, A., Adesola, S., & De Vita, G. (2017). A disaggregated analysis of energy demand in sub-Saharan Africa. *International Journal of Energy Economics and Policy, 7*(2), 224-235.

Mahirah, K. (2013). Electricity consumption in developing countries. *Asian Journal of Research in Social Sciences and Humanities, 2*(2), 84-90.

Mankiw, N. G. (2018). *Principle of microeconomics* (8th ed.). 20, Channel Centre Street, Boston MA 02210, USA: South Western Cengage Learning.

Masera, O. R. (2000). From linear fuel switching to multiple cooking strategies: A critique and alternative to the energy ladder model. *World Development Report, 28*(12), 2083-2103.

National Bureau of Statistics. (2022). *Nigeria multidimensional poverty index*. Retrieved from https://www.undp.org/

Nnodim, O. (2023). *Power supply crisis hits manufacturers' revenue, products fail global test. The Punch*. Retrieved from https://punchng.com/power-supply-crisis-hits-manufacturers-revenue-products-fail-global-test/

Ochayi, C. (2017). *80 million Nigerians lack access to electricity – world bank*. Retrieved from https://www.vanguardngr.com/

Ogunleye, E., & Ayeni, R. (2012). Energy demand in Nigeria: A disaggregate analysis. *International Research Journal of Finance and Economics, 86*, 52-62.

Onisanwa, I. D., & Adaji, M. O. (2020). Electricity consumption and its determinants in Nigeria. *Journal of Economics and Management, 41*, 87-104.

Oseni, M. O. (2012). Households' access to electricity and energy consumption pattern in Nigeria. *Renewable and Sustainable Energy Reviews, 16*(1), 990-995.

Toole, R. (2015). *The energy ladder: A valid model for household fuel transition in Sub-Saharan Africa?* Retrieved from https://sites.tufts.edu/MaryDavis/files/2015/06/ThesisFinal.pdf

Twerefou, D. K., & Abeney, J. O. (2020). Efficiency of household electricity consumption in Ghana. *Energy policy, 144*, 111661.

Udo, N. E., Chuku, C. A., & Effiong, E. L. (2011). The dynamics of electricity demand and consumption in Nigeria: Application of the bounds testing approach. *Current Research Journal of Economic Theory, 3*(2), 43-52.

Umeh, A. C., Ekezie, E. O., & Igbo-Anozie, U. A. (2022). Impact of household electricity consumption on standard of living in Nigeria. *Journal of Energy Technologies and Policy, 10*(1), 47–59.

World Health Oorganization. (2018). *Fact sheet - household air pollution and health.* Retrieved from https://ourworldindata.org