Modelling Household Electricity Consumption and Living Standard in Nigeria

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Abstract

Poor standard of living has remained a source of concern in Nigeria despite enormous resources available to the nation. Concerted efforts have been made through intensive power sector reforms and huge budgetary allocations to the sector, yet the performance of the power sector towards improving the standard of living of the Nigerian households has remained a source of doubt. This study investigated the impact of household electricity consumption on the standard of living in Nigeria over the period 1981 – 2018. The study employed the ARDL bound cointegration test to determine the existence of a longrun relation between the standard of living and the chosen explanatory variables, while the Pairwise Granger was used to establish the direction of causality between the household electricity consumption and standard of living. The results show that household electricity consumption is a significant contributor to an improved standard of living in Nigeria and that a feedback causality flows between the household electricity consumption and standard of living in Nigeria. Based on these findings, the study recommends among other things that the government should improve the level of electricity supply especially for the residential consumption by investing more on infrastructural development via the installation of more transformers that will facilitate electricity distribution across the country.

Keywords: Consumption, Household, Living Standard, Electricity, Nigeria
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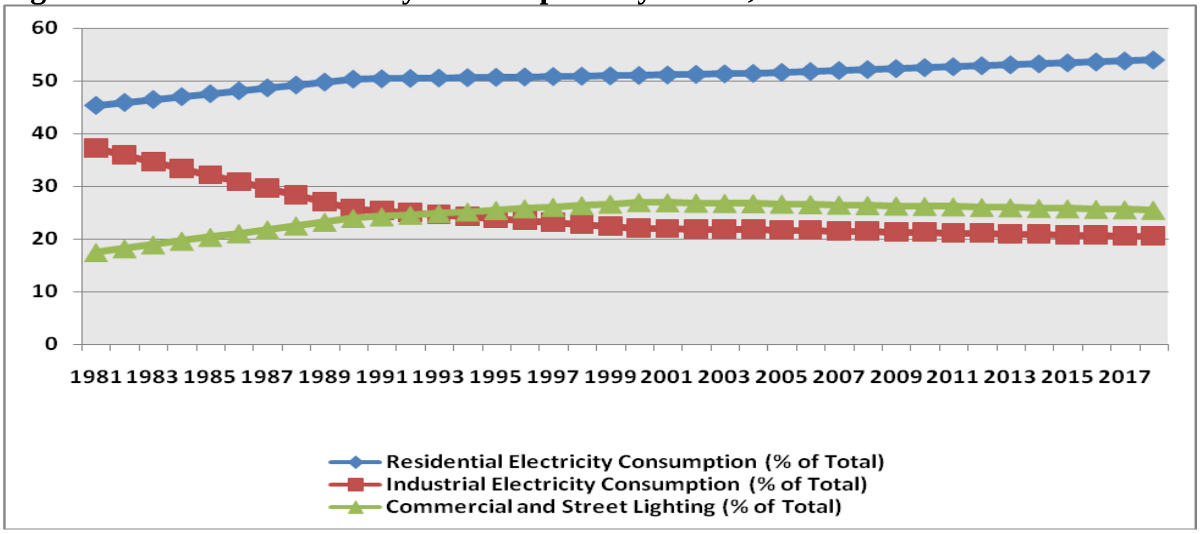
1. Introduction

High standard of living is widely recognized as one of the chief indicators of socioeconomic progress. It covers all the necessities, comforts and luxuries which a person is accustomed to enjoy, which is measured in terms of the quantity and quality of their consumption. Although the standard of living is rather a complex phenomenon since it could mean different thing to different people, group and even countries, it commonly refers to as the level of wealth, comfort, material goods and other necessities of life, which are available to a certain socioeconomic class in a certain geographical area, usually a country. This includes factors such as income, quality and availability of employment opportunities, class disparity, poverty rate, health status, education level, etc (Olarinde & Omojolaibi, 2014). Poor living standard, no doubt affects individual and national output negatively given high poverty rate, low health facilities, inadequate housing, education and income level.

Electricity consumption has been identified as a vital infrastructural component that does not only promote economic growth but also improves the living standard of the household sector (Akomolafe & Danladi, 2014). This is because electricity is one of the major forms of energy that drive production in industries and households, as well as facilitate services. Household (residential) electricity consumption refers to the volume of electricity consumed by households in the course of their daily activities upon which their standard of living is anchored. In all economies, households and companies have extensive demand for electricity, which is driven by such important factors as industrialization, extensive urbanization, population growth rates, a rising standard of living and modernization of agricultural sector (Masuduzzanan, 2012). The amount of electricity used per household may vary widely depending on the living standard of the country, the climate, the age and type of residence. This suggests that electricity consumption and standard of living may be interdependent following the works of Hosain and Sacki (2012) and Omotor (2008) that found evidence of bidirectional causality between electricity consumption and economic growth since the standard of living and economic growth are interwoven.

In Nigeria, household electricity consumption is paramount for promoting a high standard of living. Nigeria is known to be Africa's most populous country, with over 180 million people and a land area of 923,768sqkm (World Bank, 2019). Having one of the largest population growth and fertility rates in the world, Nigeria has been categorized among countries undergoing explosive population growth and based on UN report, Nigeria is projected to be one of the countries responsible for most of the world's population increase by 2050 (http://www.unicef.org/Nigeria/1971_2199.html). Thus, access to energy, specifically electricity energy, is a driving force behind economic and social welfare and development (Akomolafe & Danladi, 2014). Electricity, as one of the components of energy, is widely consumed in three major sectors in Nigeria namely: residential/household, commercial sector and street lighting, and industrial sector. Electricity consumption in these sectors is characterized by power shortages, poor quality supply and low voltage. Although electricity consumption (demand) has been on the increase over the years partly due to the convenience of use and population growth, its supply has been inadequate (Akomolafe & Danladi, 2014). In most countries, the industrial sector constitutes the largest consumer of electricity followed by the residential sector and the commercial sector and street lighting. Based on available data, the observed pattern in Nigeria shows the reverse as indicated in Figure 1. The figure reveals that except for the periods between 1970 and 1977 where the industrial sector was leading in electricity consumption, the residential (household) sector had remained the largest consumer of electricity in Nigeria till 2018. The decline in industrial sector electricity consumption could be attributed to the persistent irregular and inadequate power supply in the country, which had compelled the industrial sector into self-generation of electricity through the acquisition of private generating plant, thereby reducing their dependence on the public electric power supply and increase in the consumption of other energy sources. As reported by Ekpo (2010), a survey of firms in the 1980s shows that about 90% of firms had their private generators.

Figure 1: Trends in Electricity Consumption by Sector, 1981 – 2018.



Source: International Energy Indicators (2018)

In light of the foregoing, there is no doubt that household electricity consumption and standard of living are interwoven. The poor standard of living in Nigeria over the years has remained a source of concern, despite the enormous resources available to the nation. This has generally affected the economy as manifested in the consistent decrease in gross domestic product (GDP) growth rate, decrease in per capita income, increase in the poverty rate, poor standard of education, lack of good health, water and housing and increased inflation rates. In attempts to improve the standard of living in Nigeria, successive governments have taken some measures in the power sector since electricity consumption is one of the basic factors that improve the standard of living. The power sector has witnessed different reforms following the Electricity Power Sector Reform Act of 2005, which led to the incorporation of Power Holding Company of Nigeria (PHCN) Plc from NEPA, which was later unbundled into 18 successors companies that were disintegrated into generation, transmission and distribution companies. Also, budgetary allocation to the power sector has been on increase over the decades. Between 1999 and 2015, about N2.7 trillion has been spent on the power sector in Nigeria (http://www.thenewsnigeria.com.ng/2015/0). Despite these measures and huge budgetary allocation to the power sector, the performance of the power sector towards improving the standard of living has been in doubt. This may be one of the reasons for the continuous decrease in economic growth, running into recession, high level of unemployment, increase in poverty level, fall in education standard, health, income level and general poor standard of living.

Interestingly, the link between electricity consumption and economic growth in Nigeria has attracted not only policies and measures but empirical literature also. However, there appears to be a dearth of empirical studies on the link between household electricity consumption and standard of living in Nigeria. For instance, Babatunde and Shuaibu (2008) investigated the residential demand for electricity in Nigeria as a function of real gross domestic product per capita, Akpan and Akpan (2012) studied the link between electricity consumption, carbon emissions and economic growth in Nigeria. Similarly, Akinwale, Jesuleye and Siyanbola (2013); Ayomide (2013); Akomolafe and Danladi (2014); Sebil (2014) and Adeyemi, Opeyemi and Oluwatomisin (2016) studied the link between electricity consumption and economic growth in Nigeria, but all neglected the impact of household electricity consumption on the standard of living. It is against this background that this study investigates the impact of household electricity consumption on the standard of living in Nigeria. In this study, the authors seek to examine the impact of household electricity consumption on the standard of living (measured in terms of household consumption expenditure per capita), as well as unveil the direction of causality between the household electricity consumption and standard of living in Nigeria.

The rest of the paper is structured as follows: following the introduction in the current section (section one), section two has the literature review, while section three outlines the methods used in the study, section four presents the results and discussion of findings, while section five has the conclusion and policy recommendations.

2. Literature Review

a. Energy Consumption and Economic Growth

Omotor (2008) employed the Granger causality test to estimate the causality between energy consumption and economic growth. The estimated results indicate that energy consumption and economic growth are bi-directionally related in Nigeria despite the existence of integrating relationship of variables. This implies that energy consumption causes economic growth and vice versa. Also, Olatunji (2009) tested for a causal relationship between energy consumption and GDP in Nigeria using systematic econometric techniques. The study revealed that unidirectional causality runs from GDP to electricity consumption. The study also found that GDP granger causes gas consumption. Gbadebo and Chinedu (2009) revealed in their study that that crude oil consumption, electricity consumption and coal consumption are positively related to economic growth. Orhewere and Henry (2011) also investigated the causality between GDP and each of the basic subcomponents of energy consumption in Nigeria for the period 1970 - 2005. Based on the VECM Granger causality test, the study found a unidirectional causality from electricity consumption to GDP both in the short-run and long-run, unidirectional causality from gas consumption to GDP in the short-run and bidirectional causality between the variables in the long-run.

Abalaba and Dada (2013) in their study found controversial evidence of longrun relationship between energy consumption and real output and adopted standard Granger causality test using r first three lags. The results provided no causal evidence one way or two way between energy consumption and economic growth in Nigeria since the hypothesis of no causality was upheld in directions. Interestingly, Adegbemi, Adegbemi and Olalekan (2013), established a direct and positive relationship between the total energy consumption, petroleum consumption, gas consumption, electricity consumption, and coal consumption and the growth of Nigeria's economy. In effect, increased energy consumption is a strong determinant of economic growth in Nigeria and should before be given more relevance by exploiting the opportunities in the sector to increase economic growth.

Energy consumption in term of domestic fuel consumption with an emphasis on petrol, kerosene and diesel and economic growth in Nigeria has been examined also by Nwosa (2013). The study adopted the Error Correction Model (ECM) approach. The longrun estimate showed that the consumption of the three domestic fuels had an insignificant impact on economic growth. However, the shortrun estimate revealed that the overall impact of petrol consumption was positive and significant while the overall impact of diesel consumption was negative and significant. Chindo (2014) investigated the causal relationship between energy consumption, C02 emissions and economic growth in Nigeria over the period, 1971 - 2010 using a modified version of granger causality test suggested by Toda-Yamamoto causality. The empirical results of the TY causality test indicate unidirectional causality running from C02 emissions to economic growth; energy consumption to C02 emissions and bidirectional causality between energy consumption and economic growth. Contrarily, Rasheed, Adagunodo and Abalaba (2014) investigated the relationship between total energy consumption and economic growth in Nigeria, using the Granger Causality approach. The two variables they studied - energy consumption and real GDP were found to exhibit unit root property that is non-stationary. The study found no clear relationship between energy consumption and economic growth. However, the work of Okoligwe and Okezie (2014) investigated the relationship between electricity consumption, inflation rate, unemployment rate, labour force and real GDP in Nigeria during the period of 1971-2012, and found that causality runs from electricity consumption to income (GDP). Ogwumike, Ozughalu and Abiona (2014) examined household energy use and its determinants in Nigeria based on the 2004 Nigeria Living Standard Survey Data obtained from the National Bureau of Statistics. The study utilized Descriptive Statistics and Multinomial Logit Models and found that most households in Nigeria use firewood as cooking fuel and kerosene for lighting. This shows that most Nigerian households do not have adequate access to environmentally friendly modem energy sources.

b. Electricity Consumption and Economic Growth

A unique work by Babatunde and Shuaibu (2008) examined the residential demand for electricity in Nigeria as a function of real gross domestic product per capita, and the price of electricity, the price of substitute and population between 1970 and 2006. Bounds testing approach was applied to cointegration within an Autoregressive Distributed Lag (ARDL) model framework. In the longrun, it was found that income, price of substitute and population emerges as the main determinant of electricity demand in Nigeria, while electricity price is insignificant. Per capita income and population were found to determine household electricity consumption. By implication, household electricity consumption is expected to influence the level of income per capita. Akpan and Akpan (2012) also investigated the longrun and causal relationship between electricity consumption, carbon emissions and economic growth in Nigeria over the period 1970- 2008. The Autoregressive Distributed Lag (ARDL) bounds test was applied to examine the longrun cointegrating properties of the variables. Also, the shortrun and longrun causality relationships between the variables were examined using a multivariate Vector Error Correction Model (VECM), while the variance decomposition analysis was conducted to check the strength of the causality beyond the sampled period. The empirical analysis returns evidence of longrun relationship among the variables. In the long run, real income was found to be associated with an increase in carbon emission in the Nigerian case, while electricity consumption and emissions he negatively related. This negative relationship could be a reflection of the large deficit in the supply and surplus demand for electricity in Nigeria. Akinwale, Jesuleye and Siyanbola (2013) found that the series are non-stationary at levels and the unit root of the series was removed by differencing the series through the ADF test. The empirical results indicate that there is a longrun relationship between economic growth and electricity consumption, and the results established the existence of Granger causality running from economic growth to electricity consumption without any feedback effect. Adeyemi and Ayomide (2013) also found the existence of a unique co-integrating relationship among the variables in the model with the indicator of electricity consumption impacting significantly on growth. They further observed that evidence of a bi-directional causal relationship between electricity consumption and economic growth. These two works though published same year have a conflicting performance. The true nature of the relationship between electricity consumption and economic growth appears to be inconclusive, which gives this our study mother impetus to further look at the specific impact of residential electricity consumption on the standard of living in Nigeria.

Akomolafe and Danladi (2014) established unidirectional causality from electricity consumption to real gross domestic product. The longrun estimates, however, supports the Granger causality tests by revealing that electricity consumption is positively related to the real gross domestic product in the long run. The investigation further indicates that there is unidirectional causality from capital formation to real gross domestic product. This implies that Nigeria being a country highly dependent on energy - will have capital formation's contribution to the economy relatively determined by adequate electricity. Contrary, using ARDL Bound test for Nigeria is the work of Sebil (2014), he revealed the existence of longrun equilibrium between the variables when real GDP was treated as the dependent variable and electricity consumption as its longrun forcing variable. The VECM Granger causality test results show no evidence of shortrun causality. However, the results suggest the existence of a longrun bidirectional causal relationship between electricity consumption and real GDP. This further shows the inconclusive nature of the relationship between electricity consumption and economic growth in Nigeria. Adeyemi, Opeyemi and Oluwatomisin (2016) investigated the relationship between electricity consumption and economic development using an extended neoclassical model for the period 1970-2011. The study incorporates the uniqueness of the Nigeria economy by controlling for the role of institutions, technology, emissions, and economic structure in the electricity consumption-development argument. The study adopted a cointegration analysis based on the Johansen-Juselius Maximum Likelihood approach and a vector error correction model. To ensure robustness, the study adopted the Wald Block Endogeneity causality' test to ascertain the direction of the causal relationship between electricity consumption and economic development. The empirical analysis of the study found the existence of a long-run cointegration relationship among our variables. The study also found that electricity consumption impacts a significant inverse relationship to economic development. They further stated that the cause of this inverse relationship might not be unconnected with highly erratic nature of power in Nigeria which led to the displacement of industries to neighbouring countries due to high cost of generating electricity privately.

3. Methodology

Theoretical Framework and the **Model**

This study is built on the Extended Neoclassical Growth theory as reviewed in the previous section of this work. The Extended Neoclassical theory is a growth model popularized by (Solow, 1974). The theory shows that an effective combination of energy and other factors of production could lead to economic growth and improved social welfare. The theory shows that capital, labour, as well as energy (resource endowment), play a vital role in economic growth. Thus, energy should be considered among other primary factors of production (Okwanya, Ogbu, & Alhassan, 2015). Energy is the driver of growth in any economy (Kaufmann, 1994). The theory argued that energy is an indispensable factor of production because energy consumption increases with an increase in production (Okwanya et al, 2015). The Solow growth theory was also known as the exogenous theory because it professed technology as an exogenous factor which determines growth. One of the basic assumptions of the Solow model is the diminishing returns to labour and capital and constant returns to scale as well as competitive market equilibrium and constant savings rate. However, what is crucial about the Solow model is the fact that it explains the longrun per capita income growth by the rate of technological progress, which comes from outside the model. Since all production involves the transformation of inputs into output in some ways, it, therefore, means that all such transformations require energy. In this way, ecological economists consider energy as an essential factor of production. From the foregoing, we can derive the aggregate production function as follow:

$$Y = f\left(A, K, L\right) \qquad 1$$

Where: Y = aggregate real output; K = stock of capital; L = labour force, and A = technology (or technological advancement as proxy for electricity consumption (EEC)). Since economic growth (aggregate output) is directly related to the standard of living (Will, 2018), equation 1 can be modified as follows:

$$SOL = f\left(EEC, K, L\right) \qquad 2$$

Where: SOL is standard of living as a proxy for aggregate output or economic growth. Based on the theoretical framework and in line with the core objective of this study, the empirical model of this study is based on equation 2 and, with modifications, specified as follows:

$$SOL = f\left(HEC,\ GCF,\ LAB,\ INF,\ POP,\ GDP\right) \qquad 3$$

Where SOL = standard of living as a proxy for social welfare/output (Y); HEC = household electricity consumption as specific study of aggregate electricity consumption (EEC); GCF = gross fixed capital formation (K); LAB = labour force (L); INF = inflation rate, POP = population growth rate, and GDP = real gross domestic product as additional control variable. Specifying in full econometric form and applying the natural logarithm transformation of the model, our model becomes:

$$LSOL = \beta_0 + \beta_1 LHEC + \beta_2 LGCF + \beta_3 LLAB + \beta_4 LINF + \beta_5 LPOP + \beta_6 LGDP + \mu \qquad 4$$

Where: β_1 - β_6 are the parameters of interest; μ is the error term and L is the natural log notation. A priori Expectation: β_1, β_2, β_3, and $\beta_6 > 0$; β_4 and $\beta_5 < 0$.

Estimation Technique

This study used a Single-Equation Multiple Regression Model (SEMRM) to investigate the impact of household electricity consumption on the standard of living in Nigeria. The Ordinary Least Squares (OLS) was used as the estimation technique. The choice of this (OLS) technique is built on the premise that the OLS among other estimators provides a researcher with unique estimates of the parameters of economic relationship that have the smallest standard errors. However, applying OLS directly without accounting for the time-series properties of the relevant data may result in spurious regression. To overcome the impending problems associated with time series, the study engaged in some pre-test analyses such as unit root and cointegration tests. In to avoid the problem of spurious regression that characterize OLS regression of non-stationary time series, there is a need for unit root test (that is, to test whether a variable is stationary or not). The followings are the methods people use in testing for the stationarity of economic variables: Dickey-Fuller (DF) test; the Augmented Dickey-Fuller (ADF) test; Philip-Person (PP) test; and the Sargan-Bhagara Cointegration Regression Durbin-Watson (CDRW) test. This study employed the Augmented Dickey-Fuller (ADF) test.

Following the stationarity tests, cointegration test was carried out using the Autoregressive Distributed Lag (ARDL) bound testing approach to cointegration as proposed by Pesaran et al (2001). This procedure is adopted because it has better small sample properties than alternative methods (ie Engel-Granger, Johansen-Julius, and Philip-Hansen). Another advantage of ARDL bounds testing is that unrestricted ECM seems to take satisfactory lags that captures the data generating process in a general-to-specific framework of the specification. This method also avoids the classification of variables as I(1) and I(0) by developing bands of critical values which identifies the variables as being stationary or non-stationary processes. Unlike other cointegration techniques (e.g., Johansen's procedure which require certain pre-testing for unit roots and that the underlying variables to be integrated of the same order), the ARDL model provides an alternative test for examining a long-run relationship regardless of whether the underlying variables are purely I(0) or I(1), or even fractionally integrated. Therefore, the previous unit root testing of the variables is unnecessary. Moreover, traditional cointegration method may also suffer from the problems of endogeneity bias while the ARDL method can distinguish between dependent and explanatory variables. Thus, estimates obtained from the ARDL method of cointegration analysis are unbiased and efficient, since they avoid the problems that may arise in the presence of serial correlation, and endogeneity. Note also that the ARDL procedure allows for uneven lag orders, while the Johansen's VECM does not. However, Pesaran and Pesaran (1997) contended that appropriate modification of the orders of the ARDL model is sufficient to simultaneously correct for residual serial correlation and problem of endogenous variables. In summary, it can be seen that ARDL bound test can be used with a mixture of I(0) and I(1) data; it involves just a single-equation set-up, making it simple to implement and interpret; and different variables can be assigned different lag-length as they enter the model.

The ARDL bound test is based on F-test whose asymptotic distribution is nonstandard and depends upon: (i) whether variables included in the ARDL model are I(0) or I(1); (ii) the number of regressors; and (iii) whether the ARDL model contains an intercept and/or a trend. Two sets of critical values are reported in Pesaran et al. (2001): one set is calculated assuming that all variables included in the ARDL model are I(0) and the other is estimated considering the variables are I(1). We reject the null hypothesis of no cointegration when the F-statistic exceeds the upper critical bounds value. We do not reject the null hypothesis if the F-statistic is lower than the lower bounds. Finally, the decision about cointegration is inconclusive, if the calculated F-statistic falls between the lower and upper-bound critical values. If a stable longrun relationship is confirmed from the ARDL bound test, then we shall estimate the shortrun dynamic coefficients through the following error correction model to reconcile the longrun behaviour of variables with their shortrun responses. Also, a Pairwise Granger causality test was conducted to establish the direction of causality between household electricity consumption and standard of living in Nigeria. Granger causality test is a time series-based test of hypothesis for determining whether a variation in one variable (known as the cause) had led to a follow-up variation in another variable (known as effect) after some time lags. This test is based on F-statistic and the decision rule is that we reject the null hypothesis of no causality if the probability of the F-test is less than 0.05.

4. Results and Discussion of Findings

We begin this section with presentation and discussion of the results of the various pre-tests such as the unit root test, cointegration and error correction mechanism (ECM).

Table 1: The ADF Unit Root Test Result

Variable	ADF Stat.	Order of Integration
LSOL	-7.151861**	I(1)
LHEC	-5.822847**	I(1)
LGCF	-5.547684**	I(1)
LLAB	-5.858748**	I(1)
LINF	-5.379778**	I(1)
LPOP	-3.173022*	I(0)
LGDP	-4.620000**	I(1)

** (*) denotes rejection of the unit root hypothesis at the 1% (5%) level.

Source: Authors' Computation using Eviews 10.

From the ADF unit root test result in Table 1, it is evident that the variables are fractionally integrated given the combination of I(0) and I(1). Except for LPOP which is I(0), all other variables are I(1) according to the ADF unit root test. Since the model consists of I(0) and I(1) variables, the adoption of the ARDL bound test for cointegration is validated. The result of the ARDL bound cointegration test is reported in Table 2.

Table 2: The ARDL Bound Cointegration Test Result

Test Statistic	**Value**	**Number of Regressors**
F-statistic	4.971398**	6
	Critical Value Bounds	
Significance	**Lower bound I(0)**	**Upper Bound I(1)**
10%	2.12	3.23
5%	2.45	3.61
2.5%	2.75	3.99
1%	3.15	4.43

** denotes rejection of the null hypothesis of no cointegration at the 1% level.

Source: Authors' Computation using Eviews 10.

As shown in Table 2, the value of the F-statistic is about 4.97 which is greater than the upper bound critical value at the 1% level (i.e. 4.97 > 4.43). Therefore, we reject the null hypothesis of no cointegration and conclude that there exists a longrun relationship between the dependent (LSOL) and independent variables. This implies that there may be shortrun disequilibrium (equilibrium error), but that is temporary as equilibrium is restored in the longrun. Also, this is suggestive that a consistent estimate of longrun coefficients is guaranteed. Thus, the result of the estimated longrun coefficients is reported in Table 3.

Table 3: Normalized Longrun Coefficients based on ARDL Framework

Dependent Variable: LSOL			
Variable	Coefficient	t-Statistic	Prob.
LHEC	0.678754**	3.047689	0.0034
LGCF	5.810010*	2.205612	0.0243
LLAB	1.828707	0.337676	0.7434
LINF	-0.517430**	-3.534397	0.0016
LPOP	-73.76050	-0.500639	0.6286
LGDP	0.011866**	4.061475	0.0002
C	-1.003453	-1.843576	0.0875
R-squared	0.868659	F-statistic/Prob.(F-statistic)	13.24609 (0.000196)
Adjusted R-squared	0.798234	Durbin-Watson stat	1.896269

** (*) denotes significance at the 1% (5%) level.

Source: Authors' Computation using Eviews 10.

The result in Table 3 shows that the estimated model is robust given the adjusted R-squared of about 0.80 and a significant F-ratio. The value of Durbin-Watson stat (1.896) also suggests that the model is free from serial correlation problem. The estimates show that household electricity consumption (LHEC), gross fixed capital formation (LGCF), the labour force (LLAB) and real gross domestic product (LGDP) have positive coefficients, while inflation rate (LINF) and population growth rate (LPOP) have negative coefficients in relation to the standard of living (LSOL). This is in line with the theoretical expectation of this study. In terms of significance, only the household electricity consumption (LHEC), gross fixed capital formation (LGCF), inflation rate (LINF) and real gross domestic product (LGDP) were individually statistically significant at the 5% level of significance, while the rest were not statistically significant and thus, not much could be inferred on them.

As shown in Table 3, the household electricity consumption has a significant positive impact on the standard of living in Nigeria. A percentage increase in household electricity consumption is expected to translate to about 0.68% improvement in the living standard in Nigeria. This finding implies that any policy action targeted towards changing the level of household electricity consumption in Nigeria is expected to significantly change the standard of standard. In other words, an increase in the amount of electricity consumed by the household sector is expected to translate to an improved standard of living. Interestingly, this finding stands in contrast to that of Adeyemi, et al. (2016) which concluded that electricity consumption has a negative impact on economic growth in Nigeria, while it is consistent with the conclusion drawn by Okoligwe and Okezie (2014) who posited that electricity consumption precedes economic growth in Nigeria. Electricity is a major source of energy for households in Nigeria. This is because other household production depends on the availability of electric energy. Therefore, for an average household to enjoy a certain level of living, electricity consumption by the household sector is highly needed. Similarly, investment in the form of gross fixed capital formation is a serious determinant of the living standard in Nigeria based on our result. A unit change in the level of gross fixed capital formation has more than proportionate positive effect on the living standard. Also, the standard of living in Nigeria depends greatly on the level of real gross domestic product, while the inflation rate has a significant declining effect on the living standard in Nigeria. This is not surprising as an increase in inflation rate means a reduction in purchasing power and ability of an average household to meet its daily consumption needs.

Other significant determinants of the standard of living in Nigeria include gross fixed capital formation (a proxy for stock of capital), inflation rate and real gross domestic product. The gross fixed capital formation has a significant positive impact on the standard of living in Nigeria according to the results of this study. In terms of the magnitude of impact, gross fixed capital formation exerts more than the proportionate impact on the standard of living. For instance, a percentage increase in the level of gross fixed capital formation will bring about 5.8% improvements in the living standard in Nigeria. Therefore, policy actions geared towards increasing the gross capital formation is expected to translate to an improved standard of living to the magnitude of 5.8% for a percentage increase in gross fixed capital formation. The inflation rate has a significant negative impact on the standard of living in Nigeria following the results of this study. According to our results, a percentage increase in household electricity consumption will bring about 0.52% decline in the standard of living of the Nigerian people. This finding is not peculiar to us as rising inflation rate reduces the purchasing power of an average household. For instance, a percentage increase in the general price level of goods and services reduces the value of money by half, which in turn translates to lower purchasing power. Lower purchasing power by the household translates to the inability of the household sector to meet its daily needs which includes electricity demand and consequently reduces their standard of living. Furthermore, the real gross domestic product has a significant positive impact on the standard of living in Nigeria. A percentage increase in the real gross domestic product is expected to significantly bring about 0.01% improvement in the living standard in Nigeria. This implies that effective growth policies could serve as a road map towards achieving a high standard of living in Nigeria.

Table 4: The Pairwise Granger Causality Test

Null Hypothesis (H_0)	Obs.	F-statistic	Prob.	Remark
LHEC does not Granger cause LSOL	38	5.03378**	0.0034	Reject (H_0)
LSOL does not Granger cause LHEC	38	3.27634*	0.0428	Reject (H_0)
LGCF does not Granger cause LSOL	38	1.38425	0.2666	Accept (H_0)
LSOL does not Granger cause LGCF	38	0.06651	0.9358	Accept (H_0)
LLAB does not Granger cause LSOL	38	1.45111	0.2508	Accept (H_0)
LSOL does not Granger cause LLAB	38	0.09075	0.9135	Accept (H_0)
LINF does not Granger cause LSOL	38	2.61999	0.0900	Accept (H_0)
LSOL does not Granger cause LINF	38	1.75165	0.1913	Accept (H_0)
LPOP does not Granger cause LSOL	38	0.77422	0.4704	Accept (H_0)
LSOL does not Granger cause LPOP	38	5.19886**	0.0029	Reject (H_0)
LGDP does not Granger cause LSOL	38	1.94493	0.1612	Accept (H_0)
LSOL does not Granger cause LGDP	38	0.10830	0.8977	Accept (H_0)

** (*) denotes significance at the 1% (5%) level.

Source: Authors' Computation using Eviews 10.

Table 4 presents the results of the Pairwise Granger causality test, aimed at addressing the second objective of this study. The essence of this test is to find out whether household electricity consumption policies are sufficient for an improved standard of living or should be complemented with house expenditure policies (welfare policies) in expectation of enhanced household electricity consumption. Based on the result in Table 4, the null hypotheses of no Granger causality between the household electricity consumption and standard of living were rejected at the 5% level of significance. Thus, we found evidence of bidirectional causality between household electricity consumption and standard of living in Nigeria. In other words, household electricity consumption Granger causes standard of living and in return, improved standard of drives household electricity consumption. While this finding supports those of Ayomide (2013) and Sebil (2014) who affirmed the bidirectional causality, it stands in contrast to those of Akomolafe and Danladi (2014) and Akinwale, et al. (2013) who reported unidirectional causality running from economic growth to electricity consumption in Nigeria. The implication of the feedback causality between household electricity consumption and standard of living is that for improved living standard, enhance electricity consumption by the household sector is required, and vice versa. As households move from a lower level of living to a higher level, the amount of electricity demanded and consumed increases, which further improves the standard of living.

5. Conclusion/Policy Recommendations

The study investigated the impact of household electricity consumption on the standard of living in Nigeria over the periods 1981 – 2018. The study employed the ARDL bound cointegration test to determine the existence of a longrun relation between the standard of living and the chosen explanatory variables, while the Pairwise Granger was used to establish the direction of causality between the household electricity consumption and standard of living. Based on its findings and in line with its specific objectives, the study concludes that household electricity consumption is a significant contributor to standard of living in Nigeria and that household electricity consumption and standard of living in Nigeria are interdependent. This has serious policy implications for improvement in the living standard as much as enhancement in the level of household electricity consumption in Nigeria. Thus, we recommend that the government should improve the level of electricity supply especially for the residential consumption by investing more on infrastructural development via the installation of transformers and electricity distribution. This will improve the standard of living in Nigeria. The presence of bidirectional causality between household electricity consumption and standard of living suggests that government can either improve the standard of living as a way to enhance household electricity consumption or encourage consumption of electricity by the household sector as a way to improve the standard of living in the country. Therefore, there is a need for an optimal policy mix between household electricity consumption and household expenditure per capita for the best outcome.

References

Abalaba, B. P., & Dada, M. A. (2013). Energy consumption and economic growth nexus: new empirical evidence from Nigeria. *International Journal of Energy Economics and Policy* 3 (4), 412-423.

Adeyemi, A. O., & Ayomide, A. (2013). Electricity consumption and economic growth in Nigeria. *Journal of Business Management and Applied Economics, II* (4).

Adeyemi, A. O., Opeyemi, A., & Oluwatomisin, M. O. (2016). Electricity consumption and economic development in Nigeria. *International Journal of Energy Economics and Policy,* 6(1), 134-143.

Akande, R. (2016). Impact of education on living standard in Nigeria. *International Journal of Development and Management Review (INJODEMAR), 11,* 215-220.

Akinola, A., Oginni, O., Rominiyi, O., & Eiche, J. (2017). Comparative study of residential household energy consumption in Ekiti State-Nigeria. *British Journal of Applied Science & Technology, 21* (2), 1-10.

Akinwale, Y., Jesuleye, O., & Siyanbola, W. (2013). Empirical analysis of the causal relationship between electricity consumption and economic growth in Nigeria. *British Journal of Economics, Management & Trade,* 3(3).

Akomolafe, A. K., & Danladi, J. (2014). Electricity consumption and economic growth in Nigeria: A multivariate investigation. *International Journal of Economics, Finance and Management,* 3(4).

Akpan, G. E., & Akpan, U. F. (2012). Electricity consumption, carbon emissions and economic growth in Nigeria. *International Journal of Energy Economics and Policy*, 2(4), 292- 306.

Alam, M. (2006). *Economic growth with energy* (2nd Edition ed.). Maclean World Publication Limited.

Amadi, C., Amadi, N., & Anyim, E. (2013). Analysis of energy balance on Nigeria's economic growth: Evidence on electricity sector: 1970-2010. *Report and Opinion, 5* (10).

Babatope, O., Taiwo, O., & Patrick, E. E. (2012). Disaggregated analysis of energy consumption and economic performance in Nigeria. *Energy technology and* *infrastructure for development* (p. 385396). Ibadan, Nigeria: Proceedings of the 2012 NAEE Conference.

Babatunde, M. A., & Shuaibu, M. I. (2008). The demand for residential electricity in Nigeria: A bound testing approach. *JEL Classification: Q41, C22.*

CBN. (2017). Central Bank of Nigeria Statistical Bulletin and Annual Report and Statement of Account.

CBS. (2018). *Standard of living and happiness.* Centre for Bhutan Studies & GNH. http://www.grossnationalhappiness.com/9- domains/standard-of-living-and-happiness/

Central Intelligence Agency (2011). *World factbook.* Retrieved from: https://www.cia.gov/library/publications/the-worldfactbook/

Chen, S.-T., Kuo, H. I., & Chen, C.-C. (2007). The relationship between GDP and electricity consumption in 10 Asian countries. *Energy Policy, 35,* 2611-2621.

Chindo, S. (2014). The causality between energy consumption, Co2 emissions and economic growth in Nigeria: An application of Toda and Yamamoto procedure. *Advances in Natural and Applied Sciences, 8* (8), 75-81.

Chukwu, P., Ibrahim, I., Ojosu, J., & Iortyer, H. (2014). Sustainable energy future for Nigeria: The role of engineers. *Journal of Sustainable Development Studies, 6* (2), 242-259.

Ekpo, U. (2010). Assessment of the impact of electric power supply on productivity in Nigeria, using estimated production function (1970-2004). *Unpublished PhD seminar presented at the Department of Economics, University of Uyo, Akwa-Ibom State.*

Gbadebo, O., & Chinedu, O. (2009). Does energy consumption contribute to economic performance? Empirical evidence from Nigeria. *Journal of Economics and International Finance*, 1(2), 044-058.

Hossain, M. S., & Saeki, C. (2012). A dynamic causality study between Electricity consumption and economic growth for the global panel: Evidence from 76 countries. *Asian Economic and Financial Review, 2* (1), 1-13.

Kaufmann, R. (1994). The relation between margin product and price in US energy markets: Implications for climate change. *Energy Economics,* 16 (2), 145-158.

Kinberly, A. (2018). *Standard of Living.* Retrieved Sept 12, 2019, from www.thebalance.com/standard-of-living-3305758

Krizanic, F. (2007). *The European market of electricity and natural gas*. Ljubljana: EIB forum.

Masuduzzanan, M. (2012). Electricity consumption and economic growth in Bangladesh: Cointegration and causality analysis. *Global Journal of Management and Business Research***,** 72 (11), 46-56**.**

Nwosa, P. I. (2013). Long run and shortrun effects between domestic fuel consumption and economic growth in Nigeria. *Journal of Sustainable Development in Africa*, 15(4).

Ogwumike, O. F., Ozughalu, M. U., & Abiona, A. G. (2014). Household energy use and determinants: evidence from Nigeria. *International Journal of Energy Economics and Policy, 4* (2), 248-262.

Okoligwe, N., & Okezie, A. I. (2014). Relationship between electricity consumption and economic growth: evidence from Nigeria (1971-2012). *Academic Journal of Interdisciplinary Studies*, 3(5).

Okwanya, I., Ogbu, M., & Alhassan, A. (2015). Economic linkages between, energy consumption and poverty reduction: implication on sustainable development in Nigeria. *International Journal of Innovative Social Sciences & Humanities Research, 3* (2), 110- 117.

Qlarinde, M., & Omojolaibi, J. (2014). Electricity consumption, institutions and economic growth in Nigeria: what does the evidence say so far? *Energy Access for Economic Development: Policy, Institutional framework and Strategic Option* (pp. 1-21). Abuja: 7th Annual NAEE/IAEE Conference.

Olatunji, A. (2009). Does energy consumption cause economic growth? An empirical evidence from Nigeria. *University of Dundee.*

Omotor, D. (2008). Causality between energy consumption and economic growth in Nigeria. *Pakistan Journal of Social Sciences*, 8(5), 827-835.

Orhewere, B., & Henry, M. (2011). Energy consumption and economic growth in Nigeria. *JORIND*, 9(1).

Pesaran, M. H. & Pesaran, B. (1997). *Working with microfit 4.0: Interactive econometric* analysis. Oxford: Oxford University Press.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16(3)*, 289-326.

Phorio. (2012). *annual electricity consumption.* Retrieved from http://standards.phorio.com/?t=definition&code=9081023048

Rasheed, O., Adagunodo, M., & Abalaba, B. (2014). Energy consumption and economic growth in Nigeria: A causality analysis. *International Journal of Sustainable Energy and Environmental Research*, 3(1), 53-61.

Sebil, O. O. (2014). Electricity consumption and economic growth in Nigeria: Evidence from bounds test. *The Empirical Econometrics and Quantitative Economics Letters*, 3(4), 66- 77.

Solow, R. (1974). Integration equity and exhaustible resources. *Review of Economic Studies, Symposium of the Economics of Exhaustible Resources*, 29-46.

Stem, D. (2012). Economic growth and energy. *Encyclopedia of Energy*, 2, 35-51.

United Nations Development Programme (2016). *Summary: Human Development Report Nigeria.* Abuja: UNDP.

Uzochukwu, A. & Uche, C. N. (2012). Financing energy development in Nigeria: Analysis of impact on the electricity sector. *Australian Journal of Business and Management Research*, 2 (3), 54-61.

Will, K. (2018). *Standard of living.* Abuja: Investopedia https://www.investopedia.eom/terms/s/standard-of-living.asp.

World Bank. (2019). World Development Indicators. Washington, D.C., *The World Bank (producer and distributor).* Available at: http:data.worldbank.org/data-catalog/world-development-indicators.