

Impact of Household Electricity Consumption on Standard of Living in Nigeria

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Abstract

This study examined the impact of household electricity consumption on standard of living in Nigeria with level of education, poverty rate, per capita income and life expectancy as proxy for standard of living. Deviating from the popular electricity consumption and economic growth nexus, this present study focused on the impact of electricity consumption on the components of standard of living within the period of 1981 to 2017. The study adopted the Autoregressive Distributed Lag (ARDL) Bound Test in estimating the long-run and short-run relationship of the variables of the model. The study, therefore, found a positive long-run relationship between household electricity consumption and level of education, poverty rate, per capita income and life expectancy. The study also found significant short-run relationship between household electricity consumption and level of education, poverty rate, per capita income and life expectancy. From the outcome of the study, the researcher concluded that household electricity consumption impacted positively on standard of living in Nigeria although the impact is not large as expected. The study, therefore, recommends amongst others, that government should significantly improve power generation and distribution in order to enhance access to electricity consumption among her citizens in order to improve standard of living.

Keywords: Household Electricity Consumption (HHEC), Standard of living, Poverty rate, Income per capita and Educational enrollment

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1. Introduction

Standard of living is a complex phenomenon, in that, it means different thing to people, group and country. According to Olarinde and Omojolaibi (2014), it is the necessities, comfort and luxuries which a person is accustomed to enjoy. They further stated that standard of living refers to the level of wealth, comfort, material goods, and necessities available to a certain socioeconomic class in a certain geographic area, usually a country, and can be measured with factors such as income, poverty rate, health, education level. Sustainable improvement in the aforementioned factors promotes standard of living, and household electricity consumption inclusive. Masduzzaman (2012), asserts that household (residential) electricity consumption is the volume of electricity consumed by households in the course of their daily activities upon which their living standard anchors. Joyeux and Ripple (2007), posits that household electricity consumption is widely viewed as enhancing tool for standard of living which in turn promotes electricity consumption. This view may be succinctly expressed in a causal manner thus: first, health will be improved through refrigeration, air-conditioning and other household electrical appliances etc; second, education will be facilitated with lighting and improved communications via household computer and phone usage, radio and television; and third, income will be enhanced due to increased household productivity. The improvement in health, education, income and poverty promotes economic growth which in turn enhances electricity production which will also increase electricity consumption (Joyeux & Ripple, 2007). Accordingly, our premise is that electricity consumption at the household level is a key indicator of standard of living for residents of a country, and Nigeria alike. In modern economy, according to Joyeux and Ripple (2007), the effect of energy consumption on standard of living has become an issue of great concern and worry irrespective of the rationales in electricity consumption.

The rationale for electricity consumption no doubt are numerous, but first among others certainly are the reduction in environmental noise and pollutions and improvement in health care resulting from clean energy usage such as electricity. Further, enhancement of productivity, reduction of poverty and improvement in education are prioritized as rationales for electricity usage/consumption. The attainment of these rationales in Nigeria are questionable as consumption of alternative energy sources such as generator and bio-fuel are still high generating environmental discomfort resulting to poor health. Productivity leading to household income, poverty reduction, and quality education of the households are still in doubt. Going from statistical evidence, out of the three major

sectors that consume electricity, that is, the industrial, commercial and street light and residential (household) sectors, the residential sector appears to consume more of the available electricity. This did not corroborate with the outcry in household with regard to electricity consumption. This is an issue of great concern because an average household electricity consumer in Nigeria strongly believes that electricity consumed at the household level is poor. It is claimed that electricity consumption which is meant to reduce poverty, enhance income via productivity improvement and enhance education via information and communication technology have not adequately played that role. Other issue of worry is also the timing of electricity availability. If electricity is available during off-peak period, it will reflect statistically on household consumption, whereas in reality consumers may not have utilized electricity properly in terms of productivity which will boost their income level, improve poverty and enhance educational performance. Finally, following reforms overtime, from NEPA to PHCN and later unbundled into generation, transmission and distribution companies, Nigeria has succeeded in only changing the nomenclature and modus operandi meanwhile the quality of services remained the same. Evidence to this effect is the outcry of the household electricity consumers that electricity consumption is poor and it is believed to have affected their standard of living in terms of poor income level, low education performance, increasing poverty rate and poor health care. However, statistical evidence reflects that household electricity consumption is high, an issue that requires research investigation. Akande (2016) reported that on the individual level, education brings about economic opportunities and improve individual standard of living and on the aggregate level, education improves labour skills leading to increase in productivity and overall standard of living. Diacon and Maha (2015) asserts that there is a stronger relationship between electricity consumption, income and standard of living particularly in the low and high income countries. Poor standard of living according to Chimobi (2010) is determined by the poverty level of the people, which is a reality that depicts a lack of food, clothes, education and other basic amenities such as poor health as is reflected in Nigeria's infant mortality and low life expectancy.

Giving the outcry of household electricity consumers and in an attempt to improve standard of living in Nigeria, government has taken some measures (by the privatization of the power sector, which currently was unbundled into generation, transmission and distribution companies) in the power sector since electricity consumption is one of the basic factors that improve standard of living. In addition, budgetary allocation to power sector has been increasing over the decades, between 1999 and 2015, about N2.7 trillion has been spent on the power sector in Nigeria. Uzochukwu and Uche (2012) also reported in affirmation that the budgetary allocations to the power sector within the period has been increasing. In 1999, N315.22b was allocated to the sector, which increased to N851.75b in 2001, N918.30b in 2004, N2,226.39b in 2007, N4,608.62b in 2010 and N4,749.10b in 2012. In spite of the measures, huge budgetary allocation to the power sector and other non power policies, the performance of the power sector to improve standard of living has been in doubt. The problem of improved standard of living and electricity consumption in Nigeria has attracted not only policies and measures but empirical literature also. For instance empirical literature that examined the impact of energy consumption and economic growth submitted different findings such as Omotor (2008) and Chindo (2014) found bidirectional causality, Olatunji (2009) and Muhammad, Naqvi and Muhammad (2012), found unidirectional causality, Babatope, Taiwo and Patrick (2012) and Sama and Tah (2016) found significant relationship among the variables. Literature that examined electricity consumption and economic growth include: Masuduzzaman (2012) and Mehrara and Musai (2012) who respectively found unidirectional causality while Hossain and Saeki (2012), Melike (2013) and Rafal (2014) found bidirectional causality between electricity and economic growth. From the reviewed literature it is observed that focus has been on energy consumption and economic growth, and electricity consumption (aggregate) and economic growth disregarding household electricity consumption and standard of living. However, a study that captured household electricity consumption and standard of living has been conducted by Joyeux and Ripple (2007) in India, but in Nigeria, a study of such has not been conducted to the best of the researcher's knowledge. That notwithstanding, theoretically, energy/electricity is recognized as the drivers of economic growth and social welfare (standard of living) but scholarly articles or researches in Nigeria are focused more on the relationship between energy/electricity consumption and economic growth disregarding the impact of household electricity consumption on standard of living, hence a gap.

Given the identified gap and an attempt to bridge the gap, this study examined the impact of household electricity consumption on standard of living in Nigeria. However, standard of living is decomposed into income, poverty, education and health in order to determine the impact of household electricity consumption on the aforementioned variables. From the problems highlighted, and the research gap identified the following questions were raised: (1) What impact does household electricity consumption have on poverty rate in Nigeria? (2) What impact does household electricity consumption have on income level in Nigeria? (3) What impact does household electricity consumption have on education enrolment in Nigeria? (4) What impact does household electricity consumption have on health care in Nigeria? and (5) what causal link exists between household electricity consumption and standard of living in Nigeria?

1.1 Conceptual Framework

The link between household or residential electricity consumption and standard of living is hereby conceptualized below.

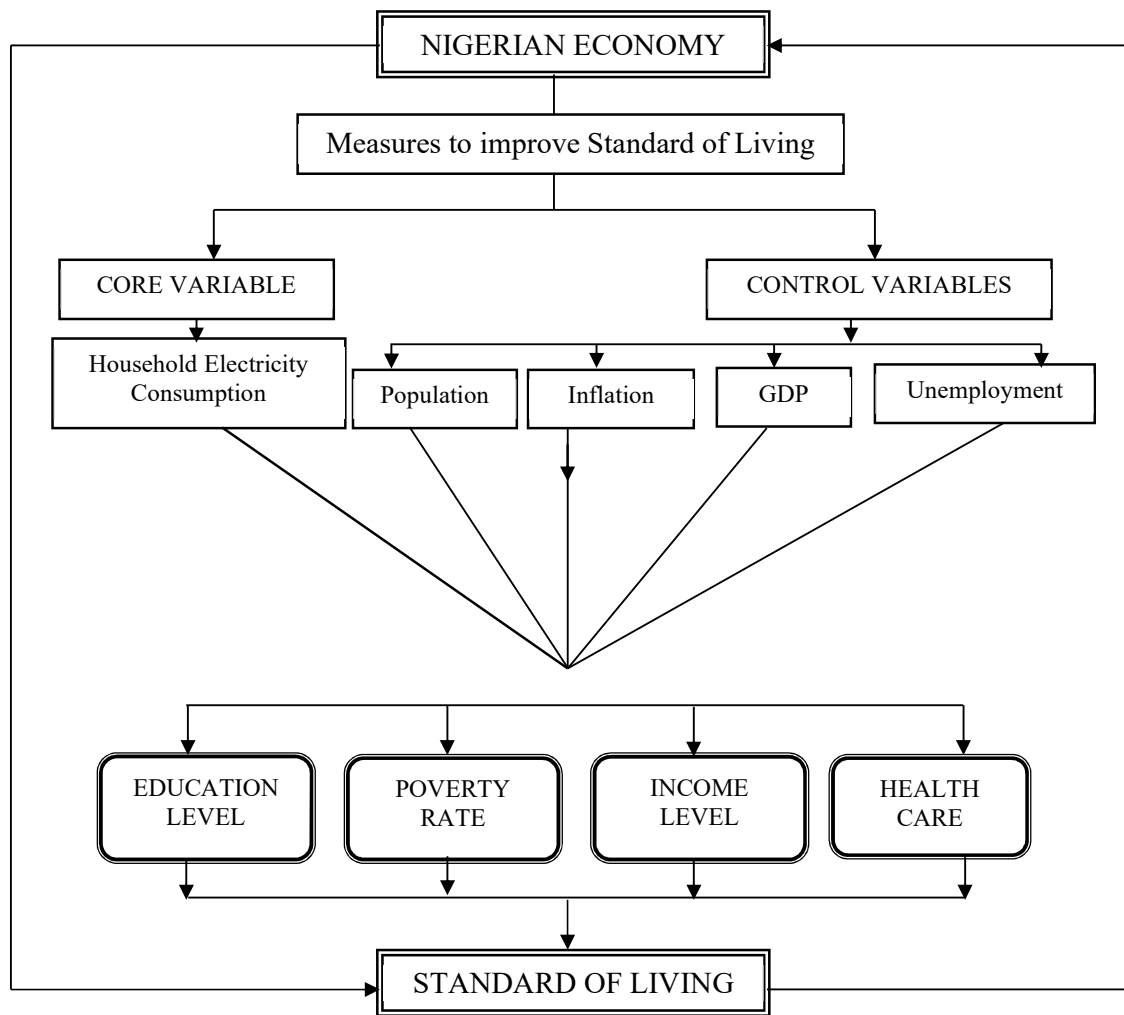


Figure 1: Structural connection between the Nigerian economy and standard of living
 Source: Researcher's Conception

Figure 1 above shows the conceptual framework of the structural connection between the Nigerian economy and standard of living. The determinants of standard-of-living are connected into core variable and control variables. The core variable conceptualized is household electricity consumption, which influences standard of living alongside with control variables as shown. The control variables includes: population, inflation, gross domestic product (GDP), and unemployment rate. These have their respective impacts on the education level, poverty rate, income level and health care as the measures or indicators of standard of living. The improvement in standard of living will enhance economic growth, which will in turn improve electricity consumption. Household electricity consumption in reality is expected to impact on education, poverty, income level and health care positively or negatively. Theoretically, there is a positive relationship between household electricity consumption and education level, income and health care. It is expected also that an increase in household electricity consumption will reduce poverty rate. Population and inflation respectively increase are expected to impact negatively on education, increase poverty level, reduce income level and health care. But GDP has a positive relationship with education level, reduces poverty rate, increases (improve) income and health care and all together will impact on standard of living. Increase in unemployment level is expected to decrease education, income levels and health care and increase the level of poverty. An improved standard of living has positive feedback effect on the economy and when the economy is well developed, the living standard of the people will also improve.

2 Literature Review

Studies on energy consumption and economic growth in Nigeria have been largely examined including that of electricity consumption and economic growth. Apart from the works of Joyeux and Ripple (2007) who studied the household energy consumption versus income and relative standard of living: a panel approach on East Indian Ocean countries" none has been done to the best of the researcher's knowledge, on the relationship between household electricity consumption and standard of living in Nigeria. Since standard of living has a direct relationship with economic growth and due to the scanty nature of the empirical literature, we therefore adopt the earlier studies on energy/electricity consumption and economic growth which also include the studies of Kraft and Kraft (1978), Yu and Choi (1985), Erol and Yu (1987), Abosedra and Baghestani (1989), Masih and Masih (1996), Soyatas and Sari (2003), and Wolde-Rufail (2005), among others. This study however, reviews the recent studies in this regard.

Melike (2013) investigated the relationship between electricity consumption and economic growth by using Autoregressive Distributed Lag (ARDL) bounds testing approach and vector error-correction models (VECM) in Cameroon, Cote D'Ivoire, Congo, Ethiopia, Gabon, Ghana, Guatemala, Kenya, Senegal, Togo and Zambia for period 1970-2010. He found from the ARDL results that there is cointegration relation between electricity consumption and economic growth in ten of the eleven countries. The results also revealed that income elasticity of electricity consumption, electricity consumption is luxury good for Gabon and Guetemela, necessity good or Engel's good for Senegal and inferior good for Zambia. The causality analysis reports that growth hypothesis exists in Cameron, Congo Rep., Ethiopia, Kenya and Mozambique and the conservation hypothesis in Senegal and Zambia. For Gabon, Ghana and Guatemala, there exists the bidirectional causality between economic growth and electricity consumption, while Masduzzaman (2012) found a unidirectional causality running from electricity consumption to economic growth.

Rafał (2014) investigated the relationship between electricity consumption and economic growth in Poland for the period 2000 to 2012 using Granger Causality and OLS methods. The obtained results indicate that there is the causal relationship between electricity consumption and economic growth in Poland and the relationship is bi-directional. He also discovered the bi-directional causality between capital and economic growth. On the basis of the causality results he estimated a one-sector aggregate production function, where the electricity consumption was one of the input variables. The evaluated growth model showed that electricity consumption is a pro-growth variable, so the results indicate that economic growth of Poland is electricity-dependent. This implies that electricity is not a limiting factor to economic growth of Poland. This implies that both variables, that is electricity consumption and economic growth influences each other.

Sama and Tah (2016) studied the effect of energy consumption on economic growth in Cameroon, from the period of 1980 to 2014. The energy sources used to test for this relationship were petroleum and electricity. The study made use of secondary time-series data. Using the Generalized Method of Moments technique, the results obtained shows that Gross Domestic Product (GDP), population growth rate and petroleum prices, have a positive relationship with petroleum consumption. Also, there was an established positive relationship between Gross Domestic Product (GDP), population growth rate, electricity prices and electricity consumption. Again, the study found a positive and significant relationship between petroleum consumption, electricity consumption, Gross domestic investment (GDI) and population growth rate and economic growth. Furthermore, the empirical result revealed that the rate of inflation and economic growth are positively related. Sama and Tah affirmed further that there exists a positive relationship between electricity consumption and economic growth. It is expected by implication that electricity consumption will improve economic growth and economic growth to improve electricity consumption as well. This could also be attributed to standard of living, given that good standard of living determines economic growth. But the study could not show specifically whether household electricity has any relationship with the living standard of the people with respect to how it affect the poverty level, per capita income and the level of education which gives this researcher another impetus for dynamic study in this area.

Al-Abdulrazag (2016) investigated the short-run and long-run causal relationships between electricity consumption and economic growth in Jordan between 1976 and 2013, utilizing the Autoregressive Distributed Lag (ARDL) model. Estimates revealed the existence of a long-run equilibrium relationship between the said variables. The VECM model results indicated a long-run, bidirectional causality between the two variables as seen from the negative and significant error correction terms. The results of Granger-Causality test within VECM disclosed a bidirectional weak and strong short-run causality between electricity consumptions per capita and economic growth. The estimation results provide a strong support for the feedback hypothesis in Jordan. The work of Rafal (2014) and Al-Abdulrazag (2016) equally affirm that bidirectional relationship exists between electricity consumption and economic growth in Poland and Jordan. This researcher would want to examine and also affirm the reality of this causal relationship in Nigeria with regard to standard of living.

Okwanya and Abah (2018) investigated the impact of energy consumption on poverty reduction in a panel of 12 African countries over a period of 1981-2014. Using the Fully Modified Ordinary Least Square (FMOLS) method, the study shows that a long-run negative relationship exists between energy consumption and poverty level, which underscores the importance of energy in poverty reduction in the selected African countries. The result also indicates that other variables such as capital stock and political stability have significant effect on poverty implying that these factors play critical role in reducing poverty. Furthermore, the granger causality test shows that a short-run unidirectional causality runs from energy consumption to poverty. The findings clearly suggest that increasing energy consumption leads to a decline in poverty level. Among all the global evidences reviewed, the work of Okwanya and Abah (2018) appears to be more specific and closely related to this research. The study shows that energy consumption reduces poverty level among the 12 African countries observed but could not specifically show the impact of household electricity consumption on standard of living in terms of education, poverty and other major indicators of standard of living. This research therefore, seeks to bridge that gap using Nigerian economy.

Studies on energy/electricity consumption and economic growth directly on Nigerian economy were also reviewed. Abalaba and Dada (2013) in their study found a controversial evidence of long-run relationship between energy consumption and real output and adopted standard Granger causality test using the 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 both directions. Adegbemi, Adegbemi and Olalekan (2013), established 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 therefore be given more relevance by exploiting the opportunities in the sector to increase economic growth. Energy consumption in term of domestic fuel consumption with emphasis on petrol, kerosene and diesel and economic growth in Nigeria is examined also by (Nwosa, 2013). He adopted an Error Correction Model (ECM) approach. Johansen's multivariate co-integration test showed that the variables are co-integrated and the long run estimate showed that the consumption of the three domestic fuels had insignificant impact on economic growth. However, the short run estimate revealed that the overall impact of petrol consumption was positive and significant while the overall impact of diesel consumption was negative and significant. The overall impact of kerosene consumption was negative and insignificant. This paper concludes that petrol consumption is crucial for growth in Nigeria and energy policy on petrol consumption would hamper economic growth. These three empirical works from different authors showed contradicting results of the impact of energy consumption on economic growth. This implies that the actual relationship or impact of the energy consumption on economic growth in Nigeria is yet inconclusive. Given this fact, this study critically examined the specific impact of household electricity consumption on the standard of living in Nigeria.

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 modern energy sources. Energy use in Nigeria supports fuel stacking rather than energy ladder hypothesis. Among the factors that significantly influence household energy use for cooking are educational levels of father and mother, per capita expenditure and household size. This implies that the living standard of the people equally determines the level of household energy use, which further suggests that the use of electricity by the household might have significant impact on the standard of living in Nigeria. The increase in the use of firewood and kerosene as indicated in this study shows that there is inadequate supply of environmentally friendly modern energy sources such as electricity.

Akomolafe and Danladi (2014) established unidirectional causality from electricity consumption to real gross domestic product. The long run estimates however, supports the Granger causality tests by revealing that electricity consumption is positively related with real gross domestic product in the long run. 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 long run equilibrium between the variables when real GDP was treated as the dependent variable and electricity consumption as its long run forcing variable. The VECM Granger causality test results show no evidence of short run causality. However, the results suggest the existence of a long run 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 and Juselius (1988) Maximum Likelihood approach and a vector error correction model. In order to ensure robustness, the study adopted the Wald Block Endogeneity causality test to ascertain the direction of causal relationship between electricity consumption and economic development. The empirical analysis of the study found an existence of a long-run cointegration relationship among our variables. The study also found that electricity consumption impacts a significant inverse relation on 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 neighboring countries due to high cost of generating electricity privately.

Okwanya, Ogbu and Alhassan (2015) analyzed the relationship between total energy consumption and poverty rate in Nigeria and finds that the level of total energy consumed significantly affect poverty rate in Nigeria since increasing total energy consumption by 1 percent reduces poverty by 0.33 percent. The study also shows that increase in GDP and adult literacy does not reduce poverty in Nigeria. They explained further that this may be due to high level of unemployment prevailing in the country. They also show that bi-directional causality runs from total energy consumption to poverty rate in Nigeria. This means energy consumption plays a critical role in empowering people towards achieving financial independence that will pool them out of the shackles of poverty. This study will further look at the specific impact of household electricity other than total energy has on the standard of living given the poverty rate in Nigeria.

Akande (2016) investigated the relationship between education and standard of living in Nigeria. He employed the Johanson Cointegrated test and Vector Error Correction Model (VECM) and the variables used include per capita real GDP, government expenditure on education and health. The result suggests a long run relationship between the variables, implying a rapid adjustment towards equilibrium. The research further states that education brings about awareness and increases opportunities for growth and development. On the individual level education brings about economic opportunities and improves labour skills leading to standard of living. Akande (2016) could not examine the impact of electricity consumption by the household on the educational performance which is assumed by his study to improve labour skills. However, this study intends to bridge that gap by examining the impact of household electricity consumption on standard of living using variables as poverty, education and income as measures for standard of living.

Akinola, Oginni, Rominiyi and Eiche (2017) carried out a study on the comparative study of residential household energy consumption in Ekiti State-Nigeria using primary analysis. Primary data were collected through a well structured questionnaires administered on households. Direct and personal observations were used to corroborate same information obtained from the questionnaires used to present more accurate information in the paper. Data obtained were analyzed using both independent and paired t-tests conducted at 5 and 10% levels of significance in the annual energy consumption between the low and high income earners in the visited areas respectively. The result revealed that, the densely populated area remains the larger consumer of energy content of 827,411.20 MJ (63%) against the sparsely populated areas with 486,267.60 MJ (37%), while on the basis of households' income level; the energy consumed by the low income earners (790,719.30 MJ) is significantly higher than the high income earners (522,959.49 MJ). The study established that, fuel wood was the poor man's energy source (6.5%) as well as charcoal (11.2%) majorly used in sparsely populated areas with high demand. Kerosene consumption (29.6%) was positively and significantly influenced by income and population in both locations while, LPG (44.9%) and electricity (7.8%) were used mainly in the densely populated areas. However, the results implied that, there is a positive link between income and choice of energy consumption by households that showed the low income earners consumed more energy than the high income earners due to their cooking frequency and unit energy purchase index. However, this study concentrates more on the household electricity consumption as it impact on the level of education, poverty and income as disaggregated measure for standard of living in Nigeria.

3. Methodology

The theoretical framework guiding this study is the Extended Neoclassical Growth Theory, where the empirical models of this study are drawn. Extended neoclassical theory is a growth model popularized by (Solow, 1974). The theory shows how effective combination of energy and other factors of production lead to economic growth and social welfare as supported in Solow (1956) as cited in Eric (2017). The theory shows that capital, labour as well as energy (resource endowment) plays a vital role in economic growth. From the forgoing, we can derive the

aggregate production function as follow:

$$Y = A F(K, L) \quad (3.1)$$

Where:

Y = aggregate real output

K = stock of capital as proxy with capital formation

L = stock of labour or labour force

A = Technology (or technological advancement as proxy with electricity consumption (EEC))

Since aggregate output is directly related to standard of living (Will, 2018), the Solo growth model in equation (3.1) can be modified as

$$SOL = F(EEC, K, L) \quad (3.2)$$

Where: SOL is standard of living.

3.1 Model Specification

From the above equation (3.2) the appropriate model for this study is modified to be

$$SOL = f(HHEC, K, L, INFR, POPR, RGDP, UNEM) \quad (3.3)$$

Where SOL is standard of living as proxy for social welfare/output (Y), HHEC is household electricity consumption as specific study for electricity consumption (EEC), K and L as defined above, INFR is inflation rate, POPR is population rate, RGDP is real gross domestic product and UNEM is unemployment rate as additional/control variables.

Standard of living (SOL) is decomposed into other variables such as Education Level (EDU), Poverty Rate (POVR), Income Level (PCI) and Health Care (HC). Then equation (3) is further decomposed into four equations as:

$$EDU = f(HHEC, K, L, INFR, POPR, RGDP, UNEM) \quad (3.4)$$

$$POVR = f(HHEC, K, L, INFR, POPR, RGDP, UNEM) \quad (3.5)$$

$$PCI = f(HHEC, K, L, INFR, POPR, RGDP, UNEM) \quad (3.6)$$

$$HC = f(HHEC, K, L, INFR, POPR, RGDP, UNEM) \quad (3.7)$$

The econometric form of the respective equation (3.4) to (3.7) is presented as:

Model 1:

$$EDU = a_0 + a_1HHEC + a_2K + a_3L + a_4INFR + a_5POPR + a_6RGDP + a_7UNEM + u_t \quad (3.8)$$

Where $a_0 - a_7$ and u_t are the parameters and error term

By a priori expectation, the expected relationship between education level (EDU) as one of the components of standard of living conceptualized and the explanatory variables in equation (3.8) are a_1, a_2, a_3 and $a_6 > 0$; a_4, a_5 and $a_7 < 0$.

Model 2:

$$POVR = b_0 + b_1HHEC + b_2K + b_3L + b_4INFR + b_5POPR + b_6RGDP + b_7UNEM + \varepsilon_t \quad (3.9)$$

Where $b_0 - b_7$ and ε_t are the parameters and error term

By a priori expectation, the expected relationship between poverty rate (POVR) as one of the components of standard of living conceptualized and the explanatory variables in equation (3.9) are b_1, b_2, b_3 and $b_6 < 0$; b_4, b_5 and $b_7 > 0$.

Model 3:

$$PCI = c_0 + c_1HHEC + c_2K + c_3L + c_4INFR + c_5POPR + c_6RGDP + c_7UNEM + \theta_t \quad (3.10)$$

Where $c_0 - c_7$ and θ_t are the parameters and error term

By a priori expectation, the expected relationship between per capita income (PCI) as one of the components of standard of living conceptualized and the explanatory variables in equation (3.10) are $c_1, c_2, c_3,$ and $c_6 > 0$; c_4, c_5 and $c_7 < 0$.

Model 4:

$$HC = d_0 + d_1HHEC + d_2K + d_3L + d_4INFR + d_5POPR + d_6RGDP + d_7UNEM + \varphi_t \quad (3.11)$$

Where $d_0 - d_7$ and φ_t are the parameters and error term

By a priori expectation, the expected relationship between health care (HC) as one of the components of standard of living conceptualized and the explanatory variables in equation (11) are $c_1, c_2, c_3,$ and $c_6 > 0$; c_4, c_5 and $c_7 < 0$.

4. Empirical results

Table 4.1: Augmented Dickey-Fuller (ADF) Unit Root Test.

Variables	ADF	Critical 5%	Order	Remarks
Dependent variables				
EDU	-7.364332	-2.948404	I(1)	Reject H ₀
POVR	-5.744563	-2.948404	I(1)	Reject H ₀
PCI	-5.819397	-2.948404	I(1)	Reject H ₀
HC	-3.812456	-2.948404	I(1)	Reject H ₀
Independent variables				
HHEC	-8.053049	-2.948404	I(1)	Reject H ₀
K	-4.173070	-2.948404	I(1)	Reject H ₀
L	-52.04461	-2.976263	I(0)	Reject H ₀
INFR	-3.238436	-2.945842	I(0)	Reject H ₀
POPR	-4.326335	-2.951125	I(1)	Reject H ₀
RGDP	-3.374176	-2.948404	I(1)	Reject H ₀
UNEM	-7.576787	-2.948404	I(1)	Reject H ₀

Source: Authors Compilation using E-views 9.

From unit root test hypothesis and decision rule, it is obvious that the variables are fractionally stationary at order I(1) and I(0), we therefore reject H₀ across all the variables and conclude that the variables are not purely I(1) or purely I(0) rather stationary of I(1) and I(0). Since the variables are stationary at I(1) and I(0), this study therefore adopts ARDL Bounds Testing co-integration developed in 2001 by Pesaran, Shin and Smith (Pesaran, Shin & Smith, 2001).

Table 4.2: ARDL Bounds Test (Co-integration) for Model One

Test Statistic	Value	Number of Independent Variables (k)
F-statistic	7.045686	7
Critical Value Bounds		
Significance	Lower OR I(0) Bound	Upper OR I(1) Bound
10%	2.03	3.13
5%	2.32	3.50
2.5%	2.60	3.84
1%	2.96	4.26

Source: Authors Compilation, using E-views 9.

Since F-statistic (7.04) is greater than 5% Upper bound (3.5), we therefore reject H_0 and conclude that the variables are co-integrated. If two or more variables are co-integrated it means that there is a long-run or equilibrium relationship between the variables. Of course, in short-run there may be disequilibrium. The error term in short-run equation is treated as equilibrium error. Correction of such error is the major import of Error Correction Mechanism or Model (ECM). We can use this error term to tie the short-run behavior of the dependent variable (Gujarati. 2004).

Table 4.3: ARDL Bounds Test (Co-integration) for Model Two

Test Statistic	Value	Number of Independent Variables (k)
F-statistic	8.102077	7
Critical Value Bounds		
Significance	Lower OR I(0) Bound	Upper OR I(1) Bound
10%	2.03	3.13
5%	2.32	3.50
2.5%	2.60	3.84
1%	2.96	4.26

Source: Authors Compilation, using E-views 9.

Given that the F-statistic (8.10) as shown in Table 3 is greater than 5% Upper bound (3.5), we reject H_0 and conclude that the variables are co-integrated. It therefore means that there is a long-run or equilibrium relationship between the variables of this model.

Table 4.4: ARDL Bounds Test (Co-integration) for Model Three

Test Statistic	Value	Number of Independent Variables (k)
F-statistic	5.464936	7
Critical Value Bounds		
Significance	Lower OR I(0) Bound	Upper OR I(1) Bound
10%	2.03	3.13
5%	2.32	3.50
2.5%	2.60	3.84
1%	2.96	4.26

Source: Authors Compilation, using E-views 9.

Table 4 reveals the result of ARDL bounds test of Model Three. It suggests that F-statistic (5.46) is greater than 5% Upper bound (3.5). We therefore reject H_0 and conclude that the variables are co-integrated. By implication, there is a long-run relationship between the variables of the model.

Table 4.5: ARDL Bounds Test (Co-integration) for Model Four

Test Statistic	Value	Number of Independent Variables (k)
F-statistic	8.030685	7
Critical Value Bounds		
Significance	Lower OR I(0) Bound	Upper OR I(1) Bound
10%	2.03	3.13
5%	2.32	3.50
2.5%	2.60	3.84
1%	2.96	4.26

Source: Authors Compilation, using E-views 9.

Table 5 reveals the result of ARDL bounds test of Model Four. It suggests that F-statistic (8.03) is greater than 5% Upper bound (3.5). We therefore reject H_0 and conclude that the variables are co-integrated. By implication, there is a long-run relationship between the variables of the model.

Table 4.6: ARDL Error correction Test (short-run test)

Variable	Coefficient	t-Statistic	Prob.*
Model one			
ECM(-1)	-0.130789	3.472234	0.0091
Model two			
ECM(-1)	-0.746581	3.827665	0.0043
Model three			
ECM(-1)	-0.978904	14.46024	0.0000
Model four			
ECM(-1)	-0.426431	2.207359	0.0371

Source: Authors Compilation, using E-views 9.

Since the ecm_{t-1} of all the models is both negative and significant, we then conclude that there exist short-run relationship between the independent variables and dependent variables of the study. As a result, the study analysis will rely on short run.

Model One:

Table 4.7: ARDL Error Correction Model (short-run test)

Dependent Variable	EDU		
Variable	Coefficient	t-Statistic	Probability
Independent Variables			
EDU(-1)	0.765754	3.247689	0.0147
HHEC	0.143778	2.833324	0.0250
K	5.710010	-1.900373	0.0898
L	1.728707	-0.337676	0.7434
INFR	-0.517430	-3.534397	0.0064
POPR	-73.76050	-0.500639	0.6286
RGDP	0.011866	4.061475	0.0028
UNEM	-1.668376	-1.734769	0.0956
ECM(-1)	-0.130789	3.472234	0.0091
Other test statistic			
Variables	Values		
R-squared	0.875659		
Adjusted R-squared	0.726531		
F-statistic and Prob(F-statistic)	14.25607 (0.000086)		
Durbin-Watson stat	1.855862		
Information criteria			
Akaike info criterion	6.945595		
Schwarz criterion	7.963263		
Hannan-Quinn criterion	7.277329		

Source: Authors Compilation using E-views 9.

Model Two:

Table 4.8: ARDL Error Correction Model (short-run test)

Dependent Variable	POVR		
	Independent Variables		
Variable	Coefficient	t-Statistic	Probability
POVR (-1)	0.006812	0.124325	0.9021
HHEC	0.083901	4.705587	0.0001
K	0.029200	3.603467	0.0014
L	6.624508	1.316693	0.2091
INFR	-0.010924	-3.847347	0.0007
POPR	-46.92745	-2.070691	0.0574
RGDP	9.917605	0.305542	0.7644
UNEM	0.001634	0.079090	0.9376
ECM(-1)	-0.746581	3.827665	0.0043
Other test statistic			
Variables	Values		
R-squared	0.771629		
Adjusted R-squared	0.696205		
F-statistic and Prob(F-statistic)	41.54659 (0.000000)		
Durbin-Watson stat	1.949576		
Information criteria			
Akaike info criterion	3.271020		
Schwarz criterion	4.095497		
Hannan-Quinn criterion	3.544311		

Source: Researchers' Compilation using E-views 9.

Model Three:

Table 4.9: ARDL Error Correction Model (short-run test)

Dependent Variable	PCI		
	Independent Variables		
Variable	Coefficient	t-Statistic	Probability
PCI(-1)	0.233739	5.058903	0.0000
HHEC	0.426428	5.200318	0.0000
K	0.443245	12.26447	0.0000
L	1.632512	-3.126391	0.0122
INFR	-2.479007	1.391109	0.1976
POPR	-0.001127	-8.490259	0.0000
RGDP	2.500009	0.956917	0.3636
UNEM	-0.232113	-0.013279	0.9895
ECM(-1)	-0.978904	14.46024	0.0000
Other test statistic			
Variables	Values		
R-squared	0.799539		
Adjusted R-squared	0.598464		
F-statistic and Prob(F-statistic)	67.14781 (0.000000)		
Durbin-Watson stat	2.002670		
Information criteria			
Akaike info criterion	20.60480		
Schwarz criterion	19.58713		
Hannan-Quinn criterion	20.27306		

Source: Researchers' Compilation using E-views

Model Four:

Table 4.10: ARDL Error Correction Model (short-run test)

Dependent Variable	HC		
Variable	Coefficient	t-Statistic	Probability
HC(-1)	0.911145	17.25097	0.0000
HHEC	0.102310	3.866783	0.0023
K	0.002261	1.022040	0.3170
L	0.002345	-1.938058	0.0645
INFR	-0.000141	-0.181329	0.8576
POPR	-0.092134	-1.937203	0.0646
RGDP	0.341222	10.245627	0.0001
UNEM	-0.001084	-0.060138	0.9525
ECM(-1)	-0.426431	2.207359	0.0371
Other test statistic			
Variables	Values		
R-squared	0.879975		
Adjusted R-squared	0.855423		
F-statistic and Prob(F-statistic)	1725.330 (0.000000)		
Durbin-Watson stat	1.730302		
Information criteria			
Akaike info criterion	-10.68791		
Schwarz criterion	-10.23898		
Hannan-Quinn criterion	-10.53482		

Source: Researchers' Compilation using E-views

5. Conclusion

This study examined the impact of household electricity consumption on standard of living in Nigeria with specific interest in determining the impact of household electricity consumption on EDU, POVR, PCI and HC as the measure for standard of living in Nigeria from 1981 to 2017. The study adopted the ADF unit root test to determine the level of stationarity of the variables, ARDL bound test cointegration, short-run ARDL error correction model and Pairwise Granger Causality test (as shown on the appendix). The pre-tests reveal using ADF unit root that all the variables are stationary after taking their first differences except that of L and INFR which were stationary at level. Secondly, it reveals that there is a long-run relationship among the variables in the models. Thirdly, the results also reveal that household electricity consumption (HHEC) is positively and statistically significant to standard of living in Nigeria. Finally, the causal link between HHEC and standard of living in Nigeria are independent (as shown on the appendix). From the results obtained from the technique of analysis adopted in the study, the researcher therefore conclude that household electricity consumption have not impacted positively as expected in improvement in the level of education, per capita income and life expectancy and reduction the level of poverty in Nigeria given its low positive impacts. We therefore recommend amongst others, that government should significantly improve power generation and distribution in order to enhance access to electricity consumption among her citizens in order to improve standard of living.

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Appendix

Pairwise Granger Causality Tests

Date: 07/13/19 Time: 01:35

Sample: 1981 2017

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
HHEC does not Granger Cause EDU	35	1.33329	0.2788
EDU does not Granger Cause HHEC		1.84021	0.1763

Pairwise Granger Causality Tests

Date: 07/13/19 Time: 09:56

Sample: 1981 2017

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
HHEC does not Granger Cause POVR	35	0.19796	0.7169
POVR does not Granger Cause HHEC		0.01363	0.9865

Pairwise Granger Causality Tests

Date: 07/13/19 Time: 18:48

Sample: 1981 2017

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
HHEC does not Granger Cause PCI	35	2.85562	0.0732
PCI does not Granger Cause HHEC		1.20727	0.3131

Pairwise Granger Causality Tests

Date: 09/25/19 Time: 22:14

Sample: 1981 2017

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
HHEC does not Granger Cause HC	35	2.04368	0.1472
HC does not Granger Cause HHEC		2.63052	0.0886