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Impact of Petroleum Electricity and Hydroelectric and Consumption on Economic Growth in Nigeria

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Abstract

The study examined the impact of hydroelectric and petroleum electricity consumption on economic growth in Nigeria. The research design adopted for the study was ex-post-facto. The data used for the study were drawn from secondary sources. The sources of data were from World Bank statistical database and CBN Statistical Bulletin (2020) for a period of between 1990 and 2019. Based on the research objectives and unit root test of the study, the Autoregressive Distributed Lagged (ARDL) and the Error Correction Model (ECM) were used to determine the relationship between hydroelectric and petroleum electricity consumption variables and economic growth indicators in Nigeria and the impact of hydroelectric and petroleum electricity consumption on economic growth in Nigeria. The Error Correction Model (ECM) of the study and after examining the long-run impact of the independent variables in the model of the impact of hydroelectric and petroleum electricity consumption on economic growth in Nigeria. The result shows that the ECM parameters were negative (-) and significant which are given -0.546. This means that 55 percent disequilibrium in the previous period is being corrected to restore equilibrium in the current period in the respective models. The ARDL long-run results on the impact of hydroelectric and petroleum electricity consumption on economic growth in Nigeria revealed that hydroelectric and Petroleum Electricity Consumption have positive and significant impact on real gross domestic product in Nigeria. Therefore, the study recommended that the government should increase the hydroelectric and petroleum electricity consumption in Nigeria by reducing the unit price of the petroleum electricity consumption in Nigeria in other to increase the household and industrial usage for increase economic activities through the household and industrialisation in Nigeria through the firms and young industries in Nigeria which in turn increase the sustainable economic growth in Nigeria.

Keywords: *Hydroelectric, Petroleum electricity consumption, Economic Growth*

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Background to the Study

Nigeria with its very high population of over 150 million is facing formidable economic, social, industrial, and human development challenges coupled with the poor power supply to sustain the real sector of the economy (Uzochukwu, 2012). As a result of these challenges, the country is seen as one of the poorest countries in the world despite the huge resources from crude oil export. As of the end of 2009, Nigeria installed electricity capacity stood at about 6000 Megawatts (MW) with only a maximum of about 4,000 MW available, this is made up of a mix of 36% hydro and 64% thermal (Uzochukwu, 2012). The Federal Government has invested heavily in expanding generation capacity and has encouraged investments in power production through joint ventures, to make the total installed capacity not less than 15,000 MW by 2010 (Energy Commission of Nigeria, 2010).

It could also be due to the 80 MW export of electricity each to the republic of Niger and Benin. "Apart from serving as a pillar of wealth creation in Nigeria, electricity is also the nucleus of operations and subsequently the engine of growth for all sector of the economy" (Ayodele, 2004). He has indirectly re-echoed that electricity consumption is positively related to economic growth and that the former is a causal factor of the latter. This means that electricity consumption has a diverse impact on a range of socio-economic activities and consequentially the living standards of Nigerians. The essence of electricity in a nation is one so pertinent that generating sets are owned by most Nigerians. This shows that electricity is not only important for fuelling economic activities and growth but it is also necessary for the attainment of sustained comfort.

Uses of electricity are very numerous and increase economic activities in a country. However, in a developing economy like Nigeria where electricity is in short supply, rational use of energy has been professed as a measure to enhance the consumption of electricity. Engineers and scientists have also advocated the potential rational energy use depending on scientific knowledge and technology. This will aid energy conservation and sustainability (Jochem, 2004). Towards this end, the long-term technical potential for rational use of electricity could be driven by various efforts. Among these efforts, increasing electricity efficiency is paramount.

Despite the investment in electricity, the report of the Energy Commission of Nigeria (ECN) and the United Nations Development Programme (UNDP) (2011) indicates that 70% of the population lives below $1 per day. It has been observed that the citizens of many poor nations of the world have less access to electricity, and the richer countries have more access to electricity and consume far more electricity than the poor countries, suggesting that access to electricity is the driving force for sustained economic growth of a nation. In real terms, access to electricity is directly proportional to good living standards and that is why Timothy (2005) asserts that about 2 billion people globally live without access to modern energy services and made it clear that, this number of people is concentrated mainly in rural and urban areas in developing countries in Africa and Asia. Also, Etiosa (2007), had opined that a stable power supply is central to all human activities and is needed to support development.

There is also the fact that the Nigerian economy has reflected a steady increase in growth over the years even with a power sector that functions below par (Chinedu, Daniel, and Ezekwe, 2019). More than ten years after the new investors of electricity took over the assets of the Power Holding Company of Nigeria (PHCN), most electricity consumers begin to testify that the power supply in Nigeria has improved slightly. In Lagos, customers in some areas under the Ikeja and Eko Electricity Distribution Companies (IKEDC) have testified that supplies to the area have improved (Asubiojo, 2017). In Awka, power is stable except for the few minutes that residents experience power outages (Asubiojo, 2017). This shows that the power supply has improved in some areas in Nigeria.

Even after the deregulation of electricity in Nigeria, there is still a perennial shortage of supply; A situation exacerbated by a grossly inefficient and poorly maintained distribution system. However, when the electricity goes on and off, this creates serious problems in the economy. Equipment and goods at various stages of manufacturing are damaged by electricity surges that usually accompany epileptic supply. The industry's response has been to run permanently on internal generating plants and use PHCN supply as standby. Therefore, this study aims to provide the methodology to examine the impact of electricity consumption on economic growth in Nigeria.

The economy of Nigeria is though faced with the challenges of erratic electricity supply and consequently, the high cost of generation from private electricity generators (Onugu, 2005; Aremu and Adeyemi, 2011). Unavailability of electricity has been a critical problem in Nigeria, as it is widely acknowledged that most Sub-Saharan Africa states are in the midst of a power crisis (UN 2007). Outages are not just frequent and long but also erratic. According to the World Bank enterprise surveys, pertaining to the years 2006-2010, the average length of an outage is 6.6 hours. According to Jones (2011), more than 50% of Africa businesses surveyed cite inadequate power supply as a major infrastructural challenge that dampens development. The situation is more challenging in Nigeria, as many businesses have relocated to neighbouring countries due to poor electricity infrastructure and the rising cost of production, also, power shortages are adjudged a major deterrent to SMEs development and culminating in rising unemployment and civil disturbances.

Only 40% of Nigerians have access to electricity (Energy Information Administration, 2007). Currently, the energy demand of over 40,000MW is far less than available hovering around 2,900MW – 4,000MW (Omorogiuwa and Okpo, 2015). It is therefore obvious that electricity demand is way above its supply, the inefficient generation, as well as inadequate transmission facilities to boost electricity supply, has also been a major cause of the increasing gap between demand and supply of electricity, hence resulting in the overloading and stressing of the network beyond their stability and thermal limit (Omorogiuwa and Ike, 2014; Odularu and Okonkwo, 2009).

Most of the studies carried out on this subject matter have left researchers with mixed results as the direction of unidirectional causality varies from country to country. Some studies such as Kouakou (2010), Gurgul and Lach (2011), Bildirici and Kayikci (2012), Hu and Lin (2013), Ogundipe and Apata (2013), and Nazlioglu *et al*. (2014) found that there was bidirectional causality between electricity consumption and economic growth. Other studies such as Shiu and Lam (2004), Altinay and Karagöl (2005), and Atif and Siddiqi (2010) have found that there was unidirectional causality from electricity consumption to economic growth; while some studies such as Ozun and Cifter (2007), Ciarreta and Zarraga (2007), Hye and Riaz (2008), Adom (2011) and Akinwale *et al*. (2013) have found that there was unidirectional causality from economic growth to electricity consumption. A relatively few studies such as Yu and Hwang (1984), Ciarreta and Zarraga (2007), and Aktaş and Yilmaz (2008) have reached there was no causality between electricity consumption and economic growth. Olayemi (2012), conducted a study on the influence of electricity power outputs, supply, and consumption in addressing the high rate of unemployment (low productivity) in Nigerians between the periods of 1970 to 2005.

Given the studies examined in this dissertation, some knowledge gaps are identified. No study has comprehensively used hydroelectric power, petroleum, liquefied natural gas, and coal on electricity as proxies for electricity consumption on the gross domestic product as a proxy for economic growth in Nigeria. Also, it could be seen from previous studies that there are different opinions and divergent thoughts on the impact of electricity consumption on economic growth in Nigeria thereby leading to inconsistency in results. Previous studies did not state the extent to which cash flows injected into electricity consumption have brought positive transformation or at least influenced economic growth in Nigeria. In an attempt to fill the existing knowledge gaps, the study, therefore, sought to establish a causal relationship between electricity consumption (hydroelectric power, petroleum, liquefied natural gas, and coal on electricity) and economic growth (real gross domestic product) in Nigeria. This study is therefore necessitated by the fact that there is a need to understudy the analysis of the impact of hydroelectric and petroleum electricity consumption on economic growth in Nigeria.

Objectives of the Study

Thus, the main objective of this study is examine the impact of hydroelectric and petroleum electricity consumption on economic growth in Nigeria. The specific objectives were to:

i. Assess the impact of petroleum electricity consumption on economic growth in Nigeria

ii. Examine the impact of hydroelectric power consumption on economic growth in Nigeria.

The study formulated the following hypotheses for the study:

H_{01}: Petroleum electricity consumption does not have a positive significance on economic growth in Nigeria

H_{02}: Hydroelectric power consumption does not have a positive significance on economic growth in Nigeria

Conceptual Review

Electricity

Electricity is a form of energy resulting from the existence of charged particles (like electrons and protons), either statically as an accumulation of charge or dynamically as a current

(Thompson, 1995). Regarding electrons, Hydro Québec (2011), defines electricity as an invisible phenomenon created by the movement of electrons in a conductor. KPMG (2013) defines electricity as a type of energy fuelled by the transfer of electrons from positive and negative points within a conductor. The concept of electricity according to Igwemezie (2016), can be traced far back to the 1740s, as a phenomenon that was on people's minds but not in the way we perceive and think about it today. It was used in the 1740s as a way of creating magic tricks by creating sparks and shocks and scientists at the time used electricity in conducting experiments. Even though it was used by scientists, scientific thinking about electricity up to 10 years after the 1740s had not changed much. Electricity was still not useful. The concept of electricity as it is being used today was developed by Benjamin Franklin in 1759 following a discovery he made about the similarity between electricity and lightning as two phenomena that created light, made loud sounds when they exploded, were attracted to metal, and had a particular smell (Hirram, 2013).

Electricity Consumption

Electricity consumption is the necessity for energy input to make available for production and services (McCraken, 2005). The energy demand is also the amount of energy consumed in a process by an organization or society (Brown 2006). Electricity consumption according to Abosedra and Ghosh (2009) shows the total amount of electrical energy consumed by each industry and household in an economy. Electricity consumption is the form of energy consumption that uses electric energy (McCraken, 2005). Electricity consumption is the actual energy demand made on the existing electricity supply (Institute for Energy Research, 2015). Electricity consumption is measured in kilowatt-hour (KWh) and represents the amount of electricity that has been consumed over a certain period (Brown, 2006). Electricity consumption is dependent on how many hours your equipment was on: that is multiplied by demand by time and you get consumption (Kouakou, 2010). Electricity consumption measures the production of power plants and combined heat and power plants less transmission, distribution, and transformation losses and own use by heat and power plants (Gurgul and Lach, 2011).

Economic Growth

Economic growth as a concept is viewed differently by different scholars. The economic growth of a country can be defined in various ways: as "an increase in the gross domestic product, in the real GDP or the per capita GDP" (Saez and Goswam, 2010) Economic growth refers to an increase in a country's potential GDP, although this differs depending on how the national product has been measured (Nworji, et. al., 2012). Jhingan (2006) views economic growth as an increase in output. He explains further that it is related to a quantitative sustained increase in a country's per capita income or output accompanied by an expansion in its labour force, consumption, capital, and volume of trade. Economic growth has long been considered an important goal of economic policy with a substantial body of research dedicated to explaining how this goal can be achieved (Fadare, 2010). Economic growth has received much attention among scholars. According to Khorravi and Karimi (2010), classical studies estimate that economic growth is largely linked to labour and capital as factors of production. The emergence of the endogenous growth theory has encouraged specialists to question the role of other factors in explaining the economic growth phenomenon (Bogdanov, 2010). Economic growth represents the expansion of a country's potential GDP or output. For instance, if the social rate of return on investment exceeds the private return, then tax policies that encourage can raise the growth rate and levels of utility. Growth models that incorporate public services, the optimal tax policy lingers on the characteristic of services (Olopade and Olopade, 2010). Economic growth has provided insight into why a state grows at different rates over time, and this influences the government in its choice of tax rates and expenditure levels that will influence the growth rates.

Empirical

Adom (2011), determined the causality between electricity consumption and economic growth from the period 1971 to 2008. The study employed a unit root test, ARDL Bounds Cointegration Analysis, and Toda and Yomamoto Granger Causality Test. The study revealed that data on Ghana supports the Growth-led-electricity hypothesis. The results implied that electricity conservation measures are a viable option for Ghana. The study failed to determine the extent to which energy consumption influence economic growth in Ghana. Based on the empirical evidence above, there are mixed findings from one study to another for individual countries and regions. For Ghana, the extent to which electricity consumption influences economic growth is not established. As a result, this study aims at (1) determine the extent to which electricity consumption influences economic growth in Ghana; and (2) determine if the current load shedding policy measure is good for the growth process of Ghana.

Kwakwa (2012), examined the causality between the disaggregated energy consumption and economic growth in Ghana for the period 1971 to 2007. The study employed a unit root test, cointegration test, and Granger causality test. The empirical results found that electricity consumption and fossil consumption do not Granger causes overall economic growth while aggregate growth Granger causes electricity consumption and fossil consumption. When growth was disaggregated, the study found unidirectional causality from agriculture to electricity consumption both in the short run and long run. Also, bidirectional causality was found between manufacturing and electricity consumption but a unidirectional causality from manufacturing to fossil consumption in the short run and long run. The study recommended that efforts should be geared towards ensuring a high supply of energy to the manufacturing sector to sustain its contribution to the economy. The study did not determine the extent of electricity consumption on economic growth.

Akomolafe and Danladi (2014), used the vector error correction (VEC) model and granger causality test and found a unidirectional causality from electricity consumption to real GDP. The long-run estimates affirm that electricity consumption is positively related to real GDP in the long run. Okoligwe and Ihugba (2014), employed the Johansen Cointegration test, error correction model (ECM), and Granger causality test to evaluate the relationship between energy consumption and economic growth in Nigeria from 1971 to 2012. They found unidirectional causality from energy consumption to economic growth. Also, Mustapha and Fagge (2015) examined the causal relationship between energy consumption and economic growth in Nigeria, using annual data from 1980 to 2011 with the cointegration and VEC model and granger causality test. They did not find any causality, instead, their variance decomposition showed capital and labour as more important in increasing output growth than energy consumption. Ekeocha and Penzin, Ogbuabor (2020), evaluated the relationship between energy consumption and economic growth in Nigeria over the period 1999Q1-2016Q4 using alternative model specifications. Specifically, the study used a nonlinear (or asymmetric) ARDL model and an ARDL-ECM specification which presumes a linear relationship rather than a nonlinear one. Overall, we find that the role of energy consumption as a driver of growth remained negligible throughout, suggesting that a lot still needs to be done to ensure that the expected role of energy begins to manifest in the Nigerian economy. The granger causality tests revealed a unidirectional causality running from energy consumption to economic growth, indicating that Nigeria can attain high levels of sustainable growth with an improved and stable energy supply. Thus, the study concludes that these findings constitute a wake-up call on governments and policymakers in Nigeria and other Sub-Saharan African economies that share structural similarities with it that there is an urgent need to evolve and implement policies that will address the energy challenges of these economies.

Methodology

Research Design

This study adopted the ex post facto research design in establishing the causal relationships between Petroleum Electricity Consumption and Hydroelectric Power Consumption and economic growth indicators in Nigeria. According to Brown, Durbin, and Evans (1975) Ex post facto method of research seeks to establish causal relationships between events and circumstances. The researcher then studies the independent variables in retrospect for their possible relations to, and effects on, the dependent variable or variables. Specifically, the study seeks to empirically determine the impact of electricity consumption variables and economic growth indicators in Nigeria.

Methods of Data Collection and Analysis

This study used secondary data because of the nature of the study. The data for the study were obtained from secondary sources. The secondary data on the electricity consumption variables such as Data collected include Petroleum Electricity Consumption (PETR) and Hydroelectric Power Consumption (HEP). And also, the Real Gross Domestic Product (RGDP) in Nigeria serves as a proxy for economic growth indicators in Nigeria. The data were sourced from the Central Bank of Nigeria Statistical Bulletin for the periods covering from 1986 to 2020.

Based on the research objectives and unit root test of the study, the Autoregressive Distributed Lagged (ARDL) and the Error Correction Model (ECM) were used to determine the relationship between electricity Hydroelectric and Petroleum Electricity consumption variables and economic growth indicators in Nigeria and the impact of Hydroelectric and Petroleum electricity consumption on economic growth in Nigeria. Thus, the Autoregressive Distributed Lagged (ARDL) model was used to determine the research-specific objectives of the study while the Error Correction Model (ECM) was used to test the short-run dynamic impact of hydroelectric and petroleum electricity consumption on economic growth in Nigeria. The term error-correction relates to the fact that last periods deviation from a long-run equilibrium, the *error*, influences its short-run dynamics. Thus, ECM will be used to directly estimate the speed at which a dependent variable returns to equilibrium after a change in other variables.

Model Specification

The study adopted and modified the model of Asafu-Adjaye, (2000), examined the relationship between energy consumption, energy prices, and economic growth: time series evidence from Asian developing countries; including coal, petroleum, gas, and electricity from the period 1970-1998. However, the model was modified to have the functional representation of the model for this study as;

$$RGDP = f(HEP, PETR) \quad (1)$$

The econometric model becomes:

$$RGDP = \beta_0 + \beta_1 HEP + \beta_2 PETR + U \quad (2)$$

RGDP	=	Real Gross Domestic Product
HEP	=	Hydroelectric Power consumption in Nigeria
PETR	=	Petroleum consumption in Nigeria
β_0	=	Intercept
$\beta_1 - \beta_2$	=	Coefficient (slopes) of the independent variables
U	=	Error Term

The econometric model above expresses multiple linear relationships between the Real Gross Domestic Product of Hydroelectric Power and Petroleum electricity consumption in Nigeria.

$$\Delta RGDP_t = \beta_0 + \sum_{i=1}^{d} \beta_{1i} RGDP_{t-i} + \sum_{j=1}^{e} \beta_{2i} HEP_{t-i} + \sum_{k=1}^{f} \beta_{3i} PETR_{t-i} + \beta_{6i} RGDP_{t-i} + \beta_{7i} HEP_{t-i} + \beta_{8i} PETR_{t-i} + \varepsilon_t \quad (3)$$

Equation (3) is the Autoregressive Distributed Lagged (ARDL) model that represents the impact of hydroelectric power consumption and petroleum electricity consumption on economic growth in Nigeria model. To formulate Error Correction Model (ECM). The Error Correction Model (ECM) that was used for estimation and analysis is formulated as follows:

$$\Delta RGDP_t = \beta_0 + \sum_{g=1}^{m} \beta_{1i} RGDP_{t-1} + \sum_{h=1}^{n} \beta_{2i} \Delta HEP_{t-1} + \sum_{i=1}^{o} \beta_{3i} \Delta PETER_{t-1} + \beta ECM_{t-1} + \varepsilon_t \quad (4)$$

The model was used to adjust the estimation until the ECM turned negative. The negative sign of the coefficient of the error correction term ECM (-1) shows the statistical significance of the equation in terms of its associated t-value and probability value (Pesaran and Pesaran, 1997). The ECM equation (4) represents the impact of hydroelectric power consumption and petroleum electricity consumption in Nigeria and economic growth in Nigeria.

Presentation and Discussion of Result

Descriptive Analysis

Table 1: Descriptive Analysis

	RGDP	PETR	HEP
Mean	47297.98	12.11429	15.86071
Median	19795.64	11.00000	15.00000
Maximum	289520.0	19.00000	26.00000
Minimum	596.0400	7.500000	8.000000
Std. Dev.	63993.28	3.616189	7.170236
Skewness	2.188429	0.865172	0.218484
Kurtosis	8.359414	2.499705	1.369260
Jarque-Bera	55.86025	3.785116	3.325296
Probability	0.000000	0.150686	0.189636
Sum	1324343.	339.2000	444.1000
Sum Sq. Dev.	1.110001	353.0743	1388.132
Observations	28	28	28

Source: Author's Computation from E-views 9.0, 2022.

The summary of descriptive statistics which comprises the mean, median, standard deviation as well as the skewness and kurtosis measures of our variables of interest are given. The mean values of the Real Gross Domestic Product (RGDP), Petroleum Electricity Consumption (PETR) and Hydroelectric Power Consumption (HEP) are 47297.98 Billion Naira, 12.11 Megatonne (Mt), 15.86 Terawatt-hours (TWh) respectively. Their respective that is the standard deviations of Real Gross Domestic Product (RGDP), Petroleum Electricity Consumption (PETR) and Hydroelectric Power Consumption (HEP) is 63993.28 Billion Naira, 3.616 Megatonne (Mt) and 7.17 Terawatt-hour (TWh) respectively. Also, the maximum values of Real Gross Domestic Product (RGDP), Petroleum Electricity Consumption (PETR) and Hydroelectric Power Consumption (HEP) are 289520.0 Billion Naira, 19.0 Megatonne (Mt) and 26.0 Terawatt-hours (TWh) respectively. while minimum values of the Real Gross Domestic Product (RGDP), Petroleum Electricity Consumption (PETR) and Hydroelectric Power Consumption (HEP) are 596.04 Billion Naira, 7.50 Megatonne (Mt) and 8.0 Terawatt-hours (TWh) respectively. The Jarque-Bera test of normality shows that the error term in our specified equation is normally distributed. This is evidenced by the respective insignificant Jarque-Bera statistics of the relevant variables.

Trend and Graphical Analyses

The Real Gross Domestic Product (RGDP) has fair progressive trend within the period under study. The curve had an increase between 1994 to 1996 and later decline in 1997, from that 1997 Real Gross Domestic Product (RGDP) has smooth progression from 1998 to 2011 but in 2012 the progression declined. Finally, from 2013 the Real Gross Domestic Product (RGDP) experienced upward and progression to 2019. This implies that the Real Gross Domestic Product (RGDP) trend has not been consistent and this shows fluctations in the economic activities and this may due to changes in some economic variables like energy consumptions. The Hydroelectric Power Consumption in Nigeria (HEP) has a fairly smooth progression and trend within the period under study. However, there were some moments of slit decline in the trend and progression. The Hydroelectric Power Consumption in Nigeria had smooth progression from 1990 to 2008 and later declined in 2009 and increase its progression in 2010 to 2013. Finally, Hydroelectric Power Consumption later decline slightly in 2014 with fair progression to 2018.

The Petroleum Electricity Consumption in Nigeria (PETR) had a high fluctuations and declines within the period. Petroleum Electricity Consumption (PETR) increase in 1992 and later declined in 1994. In 1996 it increases and had fairly smooth progression to 2006 and from 2007 it experienced a decline to 2012. However, in 2013 Petroleum Electricity Consumption in Nigeria has increase to 2015 and in 2016 decrease occurred, finally, it had a fairly progression to 2018. This implies that high fluctuations and declines will reduce the productivity in the economy which in turn affect the economic growth.

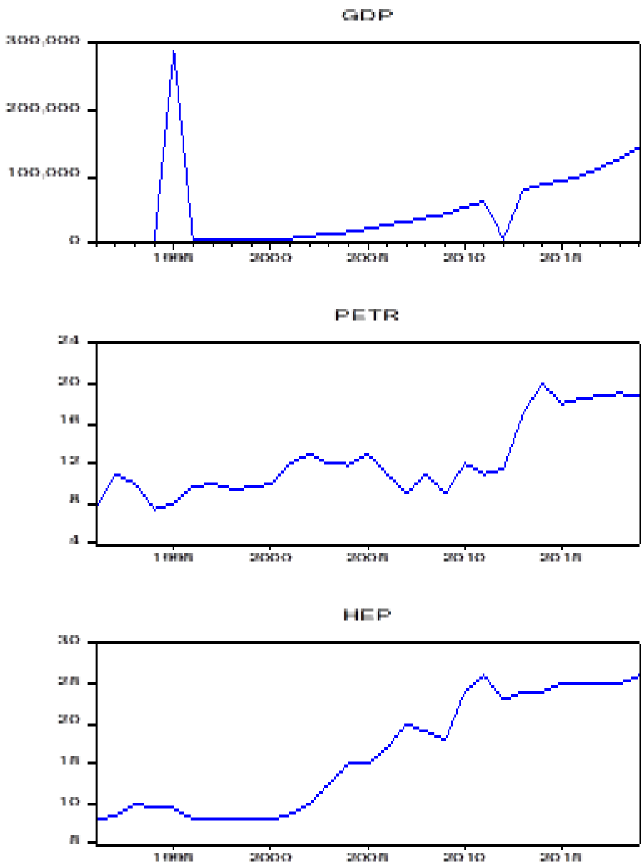

Figure 1: Trend and Graphical Analyses

Stationary Tests (Unit Root Tests)

Table 2: Augmented Dickey-Fuller Test Results

Variables	Augmented Dickey-Fuller Test		
	ADF Stat.	5% CV	Difference
RGDP	-4.700795	-3.580623	1(0)
PETR	-5.628294	-3.587572	1(1)
HEP	-5.067744	-3.595026	1(1)

Source: Author's Computation from E-views 9.0, (2022).

Table 2 shows the Augmented Dickey-Fuller stationarity test result of the five economic variables used in this study analysis. From the result, it shown that Petroleum Electricity Consumption (PETR), and Hydroelectric Power Consumption (HEP) as the independent variables are co-integrated at first difference and at 5% level of significance. While the Real Gross Domestic Product (RGDP) which is the dependent variable was stationary at level that is at 1(0) and at 5% level of significance. This implies that the economic variables are fit and suitable to been used for the analysis. Given the unit-root properties of the variables, the study proceeded to conduct the ARDL Bound Test to ascertain the co-integration among the economic variables used in the study. This implies that the economic variables are fit and suitable to been used for the analysis.

Co-integration ARDL Bounds Test

Table 3: ARDL Bounds Test of Co-integration

Null Hypothesis: No long-run relationships exist		
	Model II	
Test Statistic	Value	K
F-statistic	48.36300	2
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.63	3.35
5%	3.10	3.87
2.5%	3.55	4.38
1%	4.13	5.00

Source: Output from E-views 9.0 (2022)

Table 3 shows the ARDL bounds test for co-integration that was carried out, Thus, the results revealed that the F-statistic derived from the ARDL bounds test is 48.3 and when compared with the critical values obtained from the Pesaran Table at 5% level of significance, its value exceeded both 2.86 and 4.01 for 1(0) and 1(1) respectively. Based on this, it can be said that the variables are co-integrated or show long-run relationships (co-movements), and Using the ARDL Bound test with the critical value from Narayan (2005), the variables were co-integrated at 1per cent level of significance since the Wald F- statistics is greater than the critical lower and upper bound. This implies that Petroleum Electricity Consumption (PETR), and Hydroelectric Power Consumption (HEP) as the independent variables are co-integrated at first difference and at 5% level of significance. While the Real Gross Domestic Product (RGDP) which is the dependent variable was stationary at level that is at 1(0) and at 5% level of significance.

The Regression Results

Table 4: ARDL Estimates of Financial Sector Development in Nigeria

Short-run estimates	
Dependent variable	$\Delta RGDP_t$
ECM_{t-1}	-0.546**(0.0000)
$\Delta RGDP(-1)$	1.063*(0.0000)
$\Delta PETR$	0.877*(0.1158)
ΔHEP	6.000**(0.0001)
Long-run estimates	
Dependent variable	$RGDP_t$
$PETR$	0.920** (0.0005)
HEP	1.9776** (0.000)
C	2.5158**(0.000)
Adjusted R^2	0.95
F-stat	48.36 [0.0001]
***Note**: ***, **, * indicate the statistical significance of coefficients at 1%, 5%, and 10% respectively, and the values in parentheses and block brackets are the probabilities*	

Source: Author's Computation, 2022

Discussion of Regression Results

Table 4. shows the results of the Error Correction Model (ECM) of the study and after examining the long-run impact of the independent variables in the model of the impact of Petroleum Electricity Consumption (PETR) and Hydroelectric Power Consumption (HEP) on economic growth in Nigeria, using the ARDL model, it is necessary to test for short-run impact and speed of adjustment of the economic variables. The result shows that the ECM parameters were negative (-) and significant which are given -0.546. This means that 55 percent disequilibrium in the previous period is being corrected to restore equilibrium in the current period in the respective models. It has been established that the variables are cointegrated and also have a short-run relationship and impact established from the ECM.

The result shows that the lagged value Real Gross Domestic Product (RGDP) that is RGDP (-1) has a positive impact on the current value of the Real Gross Domestic Product (RGDP) and the impact was statistically significant in explaining any variation in Real Gross Domestic Product (RGDP). Also, the short-run result shows that the short-run result shows that the Petroleum Electricity Consumption (PETR) has a positive impact on Real Gross Domestic Product (RGDP) given the coefficient value of 0.877 and based on probability value of 0.12 the Petroleum Electricity Consumption (PETR) has a positive and insignificant impact on Real Gross Domestic Product (RGDP) at a 5% level of significance. On the other hand, Hydroelectric Power Consumption (HEP) has a positive impact on Real Gross Domestic Product (RGDP) given the coefficient value of 6.00 and based on a probability value of 0.0001 Hydroelectric Power Consumption (HEP) has significant impact on Real Gross Domestic Product (RGDP) at a 5% level of significance.

The ARDL long-run result shows that Petroleum Electricity Consumption (PETR) has a positive impact on Real Gross Domestic Product (RGDP) given the coefficient value of 0.920 and based on the probability value of 0.0005 the Petroleum Electricity Consumption (PETR) has a positive and significant on Real Gross Domestic Product in Nigeria (RGDP) at a 5% level of significance. Similarly, Hydroelectric Power Consumption (HEP) has a positive impact on Real Gross Domestic Product (RGDP) given the coefficient value of 1.9776 and based on the probability value of 0.0000 Hydroelectric Power Consumption (HEP) has a positive and significant on Real Gross Domestic Product (RGDP) at a 5% level of significance.

Normality Test

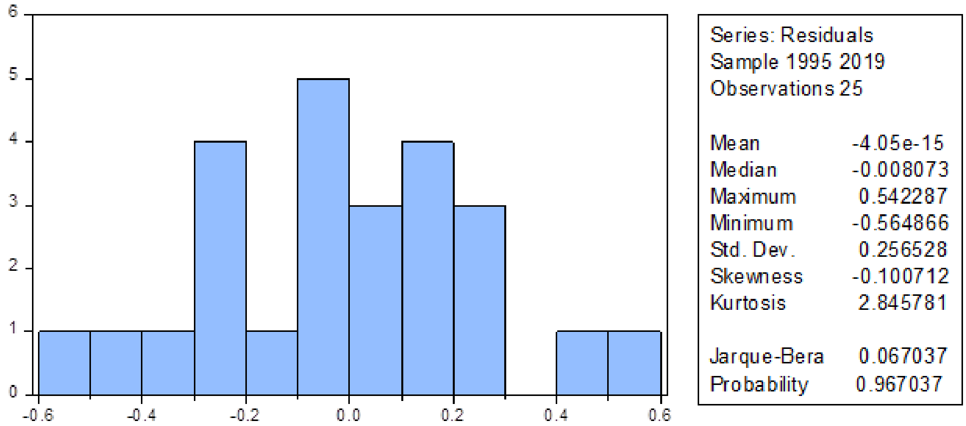

Figure 2: Normality chart

The normality test is conducted to ensure that the data employed in this study are normally distributed. Observing from the normality diagram in Figure 2 as well as the Jarque-Bera value of 0.067037 and its corresponding p-value of 96 % which is greater than 5 % significant level, it confirms that the data are normally distributed.

Test for Heteroskedasticity

Table 5: Test for Heteroskedasticity

F-statistic	0.275148	Prob. F(13,11)	0.9848
Obs*R-squared	6.134569	Prob. Chi-Square(13)	0.9411
Scaled explained SS	1.096073	Prob. Chi-Square(13)	1.0000

Source: Author's Computation, 2022

Table 5 shows the test for Heteroskedasticity. It indicates that the variables are free from the problem of Heteroskedasticity since the p-values of F-stat. and Obs*R-squared of 0.9848 and 0.9411 respectively are greater than the 5% significance level. This outcome is further strengthened by the p-value of 1.0000 for the Scaled explained SS which also suggests the absence of Heteroskedasticity.

Conclusion and Recommendations

Based specific objective one which assessed the impact of petroleum electricity consumption on economic growth in Nigeria, the ARDL long-run result shows that petroleum electricity consumption in Nigeria has a positive and significant on economic growth in Nigeria at a 5% level of significance. This implies that a unit change in petroleum consumption for electricity in Nigeria on average, holding the other independent variables constant will lead to a 5.28-unit increase in economic growth in Nigeria. Thus, the study is supported the work of Adegbemi, Adegbemi, Olalekan and Babatunde (2013), investigation the causal relationship between energy consumption and Nigeria's economic growth for showed that in the long run, oil consumption for electricity had a similar movement with economic growth except for coal consumption.

Based on the specific objective one which examined the impact of hydroelectric power consumption on economic growth in Nigeria, the ARDL long-run result shows that hydroelectric power consumption has a positive and significant on economic growth in Nigeria at a 5% level of significance. This implies that a unit change in hydroelectric power consumption in Nigeria on average, holding the other independent variables constant will lead to a 2.99-unit increase in economic growth in Nigeria. Also, the Okonkwo et al (2009) applied cointegration technique in their study; the result showed that there exists a positive relationship between hydroelectric power consumption and economic growth in Nigeria. Similarly, Alawiye (2011), used qualitative research method to critique the impact of electricity and industrial development in Nigeria. The findings indicate that there is a positive impact from the power sector on the industrial development of Nigeria. In the same vein.

Therefore, the following recommendations were raised based on the specific objectives and research findings which are:

i. The government should increase the petroleum electricity consumption in Nigeria by reducing the unit price of the petroleum electricity consumption in Nigeria in other to increase the household and industrial usage for increase economic activities through the household and industrialisation in Nigeria through the firms and young industries in Nigeria which in turn increase the sustainable economic growth in Nigeria.

ii. The government should increase the hydroelectric power consumption in Nigeria by reducing the unit price of the hydroelectric power consumption in Nigeria in other to improve the effective demand for increased productivity and industrialisation in Nigeria which in turn increase the economic growth in Nigeria.

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