ELECTRICITY CONSUMPTION AND ECONOMIC GROWTH IN NIGERIA

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ABSTRACT

This study examines the impact of electricity consumption on economic growth in Nigeria between 1980-2022. The study was conducted using time series data which were collected from World Bank database. The data were analyzed using various techniques such as, descriptive analysis, unit root test, Autoregressive Distributed Lag (ARDL) estimation as well diagnostic tests. The long run ARDL model on electricity consumption, employment and Gas exhibit positive relationship to economic growth, and statistically significant at 5% level, while inflation and petroleum reveals a negative relationship and statistically significant at 5% level. The finding of the study suggests that measures be taken towards electricity conservation to enhance efficient consumption of electricity towards increasing economic growth in Nigeria, also the government should make every effort that relates to making electricity available and to ensure efficient and adequate access, by investing heavily in electricity considering the positive influence that electricity consumption has on economic growth in the long-run.

Keywords: *Electricity Consumption, Economic Growth. ARDL Model*

1. INTRODUCTION

The importance of electricity in developing countries like Nigeria, Brazil, and South Africa has been viewed over the years as a significant factor contributing to economic growth and development. Electricity is referred to as a building block for economic growth (Khobai & Le Roux, 2017). It has a direct impact on livelihood and it is an infrastructural input in socio economic development. Energy economists believe that electricity is the main driver of the factors of production and it is vital for manufacturing of goods into final products. This shows that when electricity is scarce, it imposes constraint to the growth of an economy. Electric power is an important component for the development of any economy and hence for prosperity because electricity as a form of secondary energy can be a catalyst for economic growth. More importantly, beside capital and labor, electricity is regarded as a third important production factor in economic models, (Awosope, 2017).

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Electricity is a basic source of energy and its accessibility promotes both residential and domestic needs which has a positive correlation with factor inputs while enhancing a country's export (Narayan and Smyth, 2009), reducing poverty and eventually enhancing the overall standard of living (Poveda & Martinez, 2011). The global economies are energy dependent. Global growth necessitated the economies to require more energy for the operations of different economic sectors, this is in line with its functions as the driver of most economic activities. Electricity has been the major source of energy and its very essential considering her role play in the development of any country's economy. In the past decades, electricity has become very important instrument of technological innovation and advancements.

Human development will not be without having access to electricity, in regard to that, basic household activities are performed using electricity (OECD/IEA, 2021). More recently the Sustainable Development Goal (SDG) have as its goal by 2030 to ensure universal access to affordable, reliable and modern energy. Electricity consumption is considered as one of the necessities in daily life as a result of its relationship with human development that comprises health, population, agricultural productivity, education, and industrial production (Asumadu & Owusu, 2017). The implication is that with increased access to electricity, we can improve quality of life as it relates to having basic amenities.

Energy plays a crucial role in generating wealth in Nigeria by helping and supporting the activities of sectors in the economy. There is a complement identified between energy sector products (such as petroleum and electricity) and other sectors in an economy which includes: agricultural sectors, commerce, mining, and manufacturing which adds up to form a needful output (Amusa & Leshoro, 2013). According to Ojinnaka, (2008) the amount of energy consumed in an economy determines the size of its national product. This implies that the scale of energy consumption per capital serves as a significant indicator of economic modernization and countries with higher per capita energy consumption are ranked more developed than countries with low per capita energy consumption.

Nigeria faces a serious problem of energy shortage. Particularly, the Power Africa Summit 2017 reported that 55% of Nigerians lack access to electricity, while the 45% linked, suffers always from power failure. More importantly the yearly estimated electricity usage per capita in Nigeria was about 150kWh; one of the lowest in Africa. In the same vein, only 3500-5000 MW of the 12.5 GW installed generation capacity, is usually accessible (USAID, 2017). Therefore, lack of access to electricity remains one of the biggest challenges to the development of Nigeria. Many people who do not have access to electricity are living in deficiency and use unsustainable energy sources for lighting, cooking.

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The EPSRA reform liberalized the electric sector by unbundling NEPA into six generating companies; one transmission company and eleven distribution companies. All but the transmission companies were privatized and number of policies has been put in place to increase the production and use of electric power from renewable sources. EPSRA also create NERC as the regulatory body in the electric sector. The main objective of the power sector reform was to improved economic principles. Foster et al. (2017) argued that the reform model also drew heavily on the experience of two pioneering countries that reformed their power sector during the 1980s: Chile and United Kingdom. The plant is expected to be operational in 2007 but yet to commence construction. Despite all the effort put in place, still there are many who lack access to affordable electricity. Particularly, the economic growth of developing nations heavily depends on electricity consumption. Hence, a decline in electricity supply could leads to a reduction in industrial sector output. Electricity consumption is an important element of economic growth and it is linked to capital and labour (Costantini & Martini, 2010). the growth of a given economy is negatively influenced by the level of energy consumed, then diverse arguments are required to justify such (Ozturk, 2010).

The electricity reform act of 2005 was provide for the formation of companies to take over the functions, assets, liabilities and staff of the National Electric Power Authority, to develop competitive electricity markets, to establish the Nigeria Electricity Regulatory Commission; to provide for the licensing and regulation of the generation, transmission, distribution and supply of electricity; to enforce such matters as performance standards, consumer rights and obligations; to provide for the determination of tariffs; and to provide for matters connected with or incidental to the foregoing. However, over the years, companies move their production plants from Nigeria to neighbouring countries majorly because of high energy costs and the absence of stable electricity in the country. On 8 June 2023, President Bola Tinubu signed the Electricity Act, 2023 (the Act) into law. The Act repeals the Electric Power Sector Reform Act 2005 (EPSRA) and aims to consolidate the laws relating to electricity in Nigeria across the entire value chain of the Nigerian Power Sector, including the integration of renewable energy to Nigeria's energy mix. In addition, the Act aims to encourage state government participation in the power sector and increase private sector investment. Prior to the enactment of the Act, the EPSRA saw to the unbundling of the then National Electric Power Authority (NEPA) and enabled private sector participation in the power sector by the further unbundling of the Power Holding Company of Nigeria (PHCN) into six (6) Gencos, eleven (11) Discos and the TCN. However, eighteen (18) years after the passage of the EPSRA and about ten (10) years after the full privatisation of the Gencos and Discos, it appears that not much significant progress has been made with regards to stability of power supply in the country. The 2023 Electricity Act allows constructing, owning, or operating an

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undertaking for generating electricity not exceeding one megawatt in aggregate at a site, or an undertaking for distribution of electricity with a capacity not exceeding 100 kilowatts in aggregate at a site, or such other capacity as the commission may determine from time to time, without a licence. The Act mandates electricity-generating companies to generate power from renewable energy sources, purchase power generated from renewable energy or procure any instrument representing renewable energy generation. Though a state can regulate its electricity market by issuing licences to private investors who can operate mini-grids and power plants within the state, the act, however, says that until a state has passed its electricity market laws, the Nigerian Electricity Regulatory Commission will continue to regulate electricity businesses in such states. With the seeming lackadaisical attitude of the majority of governors, it appears the new Electricity Act may not yield the much-desired result, as the country grapples with epileptic power supply (Mohammed, 2023).

Nigeria's electricity crisis is striking for a variety of reasons. First is its occurrence despite the enormous endowment of non-renewable and renewable primary energy resources. The resource endowments of crude oil and natural gas currently estimated at 35 billion barrels and 185 trillion cubic feet respectively (Koetse et al., 2015). These resources are more than adequate to fuel much of Sub-Saharan Africa (SSA) energy demand several decades. The poor supply of power imposes a huge cost on the firm which in most cases has led to closure of small firms. For instance in the information and communication sector, without stable power supply firms would find it difficult to breakeven (Ley et al. 2015). For aggregate economy, this has seriously undermined Nigeria's growth potential and the attractiveness of the economy of external investors. Therefore, this study tends to investigate the relationship between electricity consumption and economic growth in Nigeria.

2. LITERATURE REVIEW

2.1 Concept of Economic Growth

Economic growth is the rate of increase in an economy's full employment, real output or income over time (Milton, 1980). However, growth can be classified as actual or potential. The actual growth is what an economy is able to produce using it productive resources at a given period of time, while the potential growth has to do with what an economy could have produce if the available resources are optimally utilized (Milton, 1980). Economic growth refers to an increase in the market value of the goods and services produced by an economy over time (Agarwal, 2022). economic growth is a process of quantitative, qualitative and structural changes, with a positive impact on economy and on the population's standard of

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life, whose tendency follows a continuously ascendant trajectory (Awal et al., 2019).

2.2 Energy Consumption in Nigeria

Electricity consumption patterns in the world today shows that Nigeria and indeed African countries have the lowest rates of consumption, (AEO, 2022). Nevertheless, Nigeria suffers from an inadequate supply of usable energy due to the rapidly increasing demand, which is typical of a developing economy. Paradoxically, the country is potentially endowed with sustainable energy resources. Nigeria is rich in conventional energy resources, which include oil, natural gas, lignite, and coal. It is also well endowed with renewable energy sources such as wood, solar, hydropower, and wind (Okafor & Joe-Uzuegbu, 2010). The patterns of energy usage in Nigeria's economy can be divided into industrial, transport, commercial, agricultural, and household sectors (ECN) (2003). The household sector accounts for the largest share of energy usage in the country - about 65%. This is largely due to the low level of development in all the other sectors. The major energy-consuming activities in Nigeria's households are cooking, lighting, and use of electrical appliances. Cooking accounts for a staggering 91% of household energy consumption, lighting uses up to 6%, and the remaining 3% can be attributed to the use of basic electrical appliances such as televisions and pressing irons (ECN, 2005).

The predominant energy resources for domestic and commercial uses in Nigeria are fuel wood, charcoal, kerosene, cooking gas and electricity (Famuyide, Anamayi & Usman, 2011). Other sources, though less common, are sawdust, agricultural crop residues of corn stalk, cassava sticks, and, in extreme cases, cow dung. In Nigeria, among the urban dwellers, kerosene and gas are the major cooking fuels. The majority of the people rely on kerosene stoves for domestic cooking, while only a few use gas and electric cookers (Abiodun, 2003). The rural areas have little access to conventional energy such as electricity and petroleum products due to the absence of good road networks and transmission network. Petroleum products such as kerosene and gasoline are purchased in the rural areas at prices very high in excess of their official pump prices. The rural population, whose needs are often basic, therefore depends to a large extent on fuel wood as a major traditional source of fuel. It has been estimated that about 86% of rural households in Nigeria depend on fuel wood as their source of energy (Williams, 1998). A fuel wood supply/demand imbalance in some parts of the country is now a real threat to the energy security of the rural communities (ECN, 2003). The energy consumption per capita in Nigeria is very small - about one-sixth of the energy consumed in developed countries. This is directly linked to the level of poverty in the country.

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2.3 Empirical Reviews

The link between electricity consumption and economic growth has attracted the attention of researchers and scholars, various empirical studies were reviewed. A study by Bayar and Ozel, (2014) examined the relationship between economic growth and electricity consumption in the emerging economies over the period, 1970-2011, using Pedroni, Kao and Johansen co-integration and Granger causality tests. They result suggest that electricity consumption has a positive impact on economic growth. They also observed a bi-directional causality between growth and electricity consumption. Again, Adeyemi and Ayomide (2015) examine the relationship between electricity and economic growth in Nigeria from 1980-2008 using VECM, Pairwise Granger Causality test The result found out that there is long run relationship between electricity consumption and economic growth and sets the double-direction causal relationship between electricity consumption and economic growth. Again, Okorie and Manu (2016) evaluated the causal relationship between electricity consumption and economic growth in Nigeria for the period of 1980 to 2014. Employed the analysis of Johansen co-integration and VAR-based techniques. A long run relationship exists among the variable. The result shows that in the long run, electricity consumption has a similar movement with economic growth, following the positivity hypothesis.

Awal et al., (2019) investigated the impact of electricity consumption on economic growth in Nigeria for the period 1981–2017. Using Distributed Lag (DL) mechanism was used to capture both the immediate and remote impact of electricity consumption on economic growth in Nigeria. The study found that both the current and past level of electricity consumption has significant impact on economic growth in Nigeria. Ekeocha et al., (2020) re-evaluated the relationship between energy consumption and economic growth in Nigeria over the period 1999-2016 using an asymmetric NARDL model and an ARDL-ECM specification which presumes a linear relationship rather than a nonlinear one. The study found out that the role of energy consumption as a driver of growth remained negligible throughout. However, the Granger causality tests revealed a unidirectional causality running from energy consumption to economic growth.

Furthermore, Anokwuru and Ekpenyong (2020) studied electricity and economic growth in Nigeria from 1971 to 2018. The study found that electricity consumption conforms to economic theory, meaning there is a positive relationship between electricity consumption and economic growth. Electricity generation also have a negative relationship with economic growth, while electricity distribution and losses have a negative relationship with economic growth. Topolewski (2021) examined the relationship between energy consumption and economic growth. From 2008–2019, using 34 European countries, 27 of which are

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currently members of the European Union. Dynamic panel models were used. The results made it possible to identify the relationship between energy consumption and economic growth. It was found that, in the short term, increases in production will result in a statistically significant increase in energy consumption. On the other hand, the short term increases in energy consumption do not cause changes in the rate of economic growth. Similarly, another study by Mohammed, (2023) investigate the impact of electricity consumption on economic growth in Nigeria from 1986 to 2021 by using the Autoregressive Distributed Lag (ARDL) model. The findings of the ARDL bond test indicate the present cointegration. Evidence from the short run reveals that the speed of adjustment is negative and statically significant, the results also show that energy consumption, inflation, and industrial product are statistically significant and positively affect Nigeria's short and long-run economic growth. At the same time, unemployment is negative and statistically significant both in the short and long run.

2.4 Theoretical Framework

The autonomous energy consumption hypothesis was prominently discussed by (Mansour, Hamid and Hossain) in the late 20th century, particularly in the context of energy economics and development studies. The Autonomous Energy Consumption Hypothesis suggests that energy consumption can drive economic growth independently of other factors. This theory is particularly relevant in the context of developing economies where energy access and consumption can significantly influence overall economic activity. The Autonomous Energy Consumption Hypothesis suggests that energy consumption is driven by various factors that are not necessarily linked to economic growth or energy efficiency improvements. This hypothesis implies that certain aspects of energy consumption such as lifestyle changes, technological advancements, and demographic shifts can lead to increased energy use independently of economic performance (Selden & Song, 1994).

The key components of Autonomous Energy Consumption Hypothesis (AECH): Independent Driver, that the hypothesis posits that increases in energy consumption can lead to economic growth, suggesting that energy use is a primary factor driving economic activity, rather than merely a byproduct of it. Again, the energy as a necessity, in many economies, especially those in the early stages of development, energy is essential for industrialization, infrastructure development, and the provision of services. Thus, without sufficient energy supply, economic growth may be constrained. Furthermore, the causal relationship, that the hypothesis often implies a one-way causation where energy consumption stimulates economic growth, as opposed to the reverse relationship where growth drives energy consumption. This is particularly important in analyses of energy policies and investments. In addition, developmental context, that the developing countries, where energy infrastructure may be limited, enhancing energy consumption (through investments in energy production and distribution) can lead to significant economic improvements, job creation, and poverty reduction.

Overall, the Autonomous Energy Consumption Hypothesis emphasizes the critical role of energy in driving economic growth, particularly in developing contexts, highlighting the importance of energy policies in fostering sustainable economic development. However, critics argue that the hypothesis might oversimplify the complex interactions between energy consumption and other economic factors, such as technology, labor, and capital. Technological Efficiency:

3. METHODOLOGY

3.1 Model Specification

To examine the long-run relationship between electricity consumption and Economic Growth in Nigeria and also investigate the direction of causality relationship between electricity consumption and economic growth in Nigeria. Autoregressive Distributed Lag (ARDL) model will be used to examine the long-run relationship between electricity consumption and Economic Growth in Nigeria (First objective), Toda-Yamamoto model to investigate the direction of causality between electricity consumption and economic growth in Nigeria.

The study is built essentially from determinants of electricity consumption captured by the Biophysical theory. This study adopt the model specified by Chinedu, et al., (2019) which determined the relationship between electricity consumption and economic growth in Nigeria. The variables in the model are growth proxy by real gross domestic product, electricity consumption, petroleum, gas, inflation and employment.
The present study specified the following model in a functional form:

$$RGDP = F(ECON, PETRO, GAS, INFL, and\ \ EMPL) \tag{1}$$

Where: RGDP = Real Gross Domestic Product (Dependent variable), INFL = Inflation (Independent variable), EMPL = Employment (Independent variable), PETRO = petroleum Oil (Independent variable), GAS = Liquefied Natural Gas (Independent variable), ECON = Electricity consumption (Independent variable), Where β’s are parameters to be estimated and, u_i = Error term.
This functional form, specified the equation (1) into econometric

$$RGDP_t = a_0 + a_1 ECON_t + a_2 PETRO_t + a_3 GAS_t + a_4 INFL_t + a_5 EMPL + U_t \tag{2}$$

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This functional form, specified the equation (1) into mathematical form

$GDP_t = \beta_o + \beta_1 ECON_t + \beta_2 PETRO_t + \beta_3 GAS + \beta_4 INFL_t + EMPL$

taking the natural log of equation (2) yields

$$LRGDP_t = a_0 + a_1 LECON_t + a_2 LPETRO_t + a_3 LGAS_t + a_4 INFL_t + a_5 LEMPL + U_t \quad (3)$$

Where: RGDP = Real Gross Domestic Product (Dependent variable), INFL = Inflation (Independent variable), EMPL = Employment (Independent variable), PETRO = petroleum Oil (Independent variable), GAS = Liquefied Natural Gas (Independent variable), ECON = Electricity (Independent variable), Where β's are parameters to be estimated and, μi = Error term.

The symbol a_0 is the intercept, μ is the error term.

3.1.1 Stationarity Test

This is done to avoid misleading results. However, this may be necessary for economic time series. This test would consist of the Unit root test which will be carried out to determine the stationary of variables, and also the order of integration of the regression variables and will be carried out using the Augmented Dickey Fuller test and Phillips-Perron test statistic, before proceeding for the cointegration bound test. According to Elliot, (2022), most economic time series are non-stationary and only achieve stationary at the first difference level or a higher level.

This test will be carried out to determine the stationarity properties of the time series data included in the model using the Augmented Dickey-Fuller test Dickey and Fuller (1979) and Phillips-Perron test. In other words, the test is used to ascertain the presence or otherwise of a unit root in the regression variables. The ADF test and PP test are method of testing the size of the coefficient in the equation.

$$\Delta_x = \alpha 0 + a x_{t-i} + ab \sum \Delta_{x_{t-i}} + \mu_t \quad (4)$$

Where:

Ut is a white noise error term, and Δ is the first difference operator. The test hypotheses that there is a unit root or the variable is not stationary.

Phillips and Perron (1988) developed the PP test to be employed which is similar to ADF tests. However, the PP test is more comprehensive because the test incorporates an automatic correction to the Dickey-Fuller procedure to allow for Auto-correlated residuals and heteroscedasticity. Also, unlike the ADF test, the PP

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test does not require the specification of the lag length (P). The PP test is based on the $t - statistic$ calculation specified:

$$t_{\alpha}^{pp} = t_{\alpha} \left(\frac{\gamma_0}{f_0}\right)^{1/2} - \frac{T(f_0-\gamma_0)(s_{\eth})}{2f_0^{1/2}s} \quad (5)$$

Where: f_0 = Residual estimator; Y_0 = Error varioance estimator with

Frequency = 0; $s_{\eth}$ = standard error coefficient; s=standard Error.

Generally, the unit root test involves the test of stationarity for variables used in regression analysis. The importance of stationarity of time series used in regression borders on the fact that a non-stationary time series is not possible to generalize to other periods apart from the present. This makes forecasting based on such time series to be of little practical value. Moreover, regression of a non-stationary time series on another non-stationary time series may produce a spurious result. Thus, the Augmented Dickey-Fuller (ADF) test and Phillips-Perron test will be employed to analyse unit roots.

3.1.2 ARDL Long run and Bound Testing Approach

According to Pesaran et al., (2001), testing for the co integration between electricity consumption ECON = electricity Consumption, PETROL= Petroleum oil, GAS=gas, INFL=Inflation, EMPL=Employment and economic growth, both in the short run and the long run, by estimating the following ARDL unrestricted error correction model (UECM) as well as the following F- joint test on the lagged one period of the level variables as follows:

$$\Delta RGDP = \omega_0 + \sum_{i-1}^{n-1} w_{1i}\Delta RGDP_{t-1} + \sum_{i-0}^{n-1} w_{2i}\Delta \text{ECON}_{t-1} + \sum_{i-0}^{n-1} w_{3i}\Delta PETRO_{t-1} + \sum_{i-0}^{n-1} w_{4i}\Delta GAS_{t-1} + \sum_{i-0}^{n-1} w_{5i}\Delta INFL_{t-1} + \sum_{i-0}^{n-1} w_{4i}\Delta EMPL_{t-1} + \delta_1 RGDP_{t-1} + \delta_2 \text{ECON}_{t-1} + \delta_3 PETRO_{t-1} + \delta_4 GAS_{t-1} + \delta_5 INFL_{t-1} + \delta_6 EMPL_{t-1} + U_t \quad (6)$$

Where the symbol: Δ, is the difference operator. The long run relationship between the variables is determined by the joint significance test of the following hypothesis: a null hypothesis of no co integration given by:

$\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = 0$ can be tested against their alternative hypothesis that suggests the presence of cointegration as $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq 0$. If the upper bound critical value falls below the calculated F-statistic values, the null hypothesis of no relationship are rejected and co integration exist among the variables that give the opportunity to estimate both long run and short run coefficients. The null hypothesis cannot be rejected if the lower bound is above the F-statistics.

Furthermore, cointegration can only be determined using other methods if the F-statistic falls between the asymptotic lower and upper critical values. However, Narayan (2005); Muktar et al., (2022) argue that the critical values generated by Pesaran and Pesaran (1997) and Pesaran et al. (2001) are for large sample size observations. Therefore, this study adopts small sample size critical values computed in Narayan (2005) for the bound testing process.

3.1.4 Diagnostics Test

A diagnostic test is performed to ascertain the robustness or otherwise of the estimated model. These tests comprise the following: Test for Normality on the residual of the model, the heteroscedasticity; one of the basic assumptions of classical linear regression model is that the disturbance appearing in the population regression function is homoscedastic, that is, they have the same variance. Test for Serial Correlation: Serial correlation or Autocorrelation refers to a correlation between members of series of observation ordered in time. The classical linear regression model assumes that such autocorrelation does not exist in the distribution.

3.2 Definition and Measurement of Variables

This section presents how variables were measured in the form of dependent variable and independent variables.

3.4.1 Dependent Variable

Gross domestic product implies that the GDP is measured using a constant price, i.e. the value of the GDP for different year is measured, using the price of the base year. This is used as a proxy for economic growth as done by Salisu and Moronkeji, (2022) and Aminu and Aminu (2015).

3.4.2 Independent Variables

Petroleum oil: Petroleum oil includes crude oil, condensates, natural gas liquids, refinery feed-stocks and additives, other hydrocarbons (including emulsified oils, synthetic crude oil, mineral oils extracted from bituminous minerals such as oil shale, and bituminous sand) and petroleum product.

Natural Gas: Electricity production from natural gas sources (% of total) is the share of natural gas, which is natural gas but not natural gas liquids, in total electricity production which is the total number of GWh generated by power plants separated into electricity plants and CHP plants. The International Energy Agency

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(IEA) compiles data on energy inputs used to generate electricity and consultation with national statistical offices, oil companies, electric utilities, and national energy experts, following the work of Chinedu et al., (2019) and that of Adegoriola and Agbanuyi, (2020).

Electricity: Electricity production is total number of kWh generated by power plants separated into electricity plants and CHP plants. The International Energy Agency (IEA) compiles data on energy inputs used to generate electricity. IEA data for countries that are not members of the Organization for Economic Co-operation and Development (OECD) are based on national energy data adjusted to conform to annual questionnaires completed by OECD member governments.

Inflation: Inflation is measured by the rate of increase in a price index, but actual price change can be negative. The index used depends on the prices being examined. The GDP deflator reflects price changes for total GDP. It is defective as a general measure of inflation for policy use because of long lags in deriving estimates and because it is often an annual measure, following the work of Adegoriola and Agbanuyi, (2020); Okorie and Manu, (2016).

Employment: Employment is defined as persons of working age who were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangement. following the work of Adegoriola and Agbanuyi, (2020); Mohammadi and Parvaresh, (2014).

3.5: Sources of Data

The data for used in this study are generated from world development indicators of World Bank and the study data will cover the periods of 1980 to 2022.

4. RESULT AND DISCUSSION

4.1 Descriptive Statistics

The result of the descriptive statistics provides the statistical deviation, minimum and maximum of the employment, inflation, electricity, petroleum, gas and real gross domestic product. Again, to determine the simple relationship between the variables, a pair wise correlation is used it indicates that the results of the explanatory variables are positively (electricity consumption, employment, inflation, petroleum and gasoline price positively correlate with RGDP.

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Table 1: Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-49.97820	NA	0.049283	2.665549	2.750860	2.696157
1	4.603782	100.7667*	0.003685*	0.071601*	0.327534*	0.163427*
2	7.703654	5.404905	0.003867	0.117761	0.544316	0.270805
3	10.05850	3.864367	0.004229	0.202128	0.799304	0.416390
4	11.82139	2.712134	0.004786	0.316852	1.084650	0.592331

Source: Author's Computation (2024) using Eveiws10

The lag order structure result from the selection criteria of the model based on the following criteria, the sequential modified LR likelihood ratio statistics (each test at 5% level), the * indicates lag order selected by the criterion of the final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ). The appropriate or selected model base on the number of lags is lag 1 which has the smallest value across all the information criteria.

4.2 Unit Root Test

The unit root test has been conducted to determine the stationary condition of the time series; and also to know their order of integration. Augmented Dickey Fuller (ADF) and Phillips-Perron test were employed. The result test is presented below:

Table 2: Unit Root Test Result (ADF and PP Test)

Variables	ADF Test Result		PP-Test Result		
	At-Level	At-First Diff	At-Level	At-First Diff	ORDER
RGDP	-0.311710	-6.366183***	0.311710	-6.366183***	I(1)
ELECT	-1.254471	-9.447799***	-1.313646	-10.25282***	I(1)
GAS	-6.410032	-8.792841***	-3.575276	-9.175286***	I(1)
PETRO	-3.568490	-7.955580***	-1.922258	-6.623224***	I(1)
EMPLY	-0.804745	-3.631153***	0.176483	-5.630620***	I(1)
INFL	-3.188706	-6.929132***	-3.032537	-12.85202***	I(1)

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***Note**: ***, ** and * represent significance level at 1%, 5% and 10% respectively. The figures are the t-statistics for testing the null hypothesis that the series has unit root. The lag length is determined and fixed as 8 based on Schwartz (1987). The critical values for intercept without trend are -3.479, -2.883 and -2.578 whereas, for intercept with trend the values are -4.028, -3.443 and -3.146 for 1%, 5% and 10% respectively*

Source: Author's Computation (2024) using Eveiws10

Table 2 revealed ADF unit root test result. According to the result, Gas (GAS), Petroleum (PETRO) and Inflation (INF) are stationary at level. This is true since the ADF test statistics for these variables are less than the 5% critical values with the p-values being less than 0.05 respectively, indicating the rejection of the unit root null hypothesis and accepting the alternative at 5% level of significance. While the Real Gross Domestic Product (RGDP), Electricity Consumption (ECON), and Employment (EMPL) are found to be non-stationary at level. This is true since the ADF test statistics for these variables are greater than the 5% critical values with the p-values being more than 0.05 respectively. This indicates non rejection of the unit root null hypothesis at 5% level of significance.

Similarly, all the variables (RGDP, ECON, EMPL, GAS, PETRO and INFL) became stationary at first difference given the 5% level of significance, since the absolute value of the calculated ADF are less than the absolute value of 5% critical value of the ADF. Therefore, the variables are all stationary at first difference and integrated of the same order I(1) and it justified the used of (ARDL) model. Furthermore, the PP test has validated the stationarity test result from ADF, which shows the same result, that all the variables are economic growth, electricity consumption, employment, gasoline, petroleum and inflation are stationary at first differenced.

4.4 Autoregressive Distributive Lag (ARDL) Results

The result of ADF and PP test are of stationarity after first difference necessitated the need to run ARDL long run result, to check if there is existence of a long run relationship between electricity, petroleum, gas, employment, employment and real gross domestic product. This became necessary because all the variables contained unit root at first difference and ARDL Long-run form and Bound test is the appropriate dynamic modelling technique for the variables, as presented in table 5. Bound Test for co-integration is performed to check the presence of long run relationship among the variables.

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Table 3: Bound Test for Cointegration Result

Test Statistic	Value	Signif.	I(0)	I(1)
	Asymptotic: n=1000			
F-statistic	6.329952	10%	2.08	3
K	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15
			Finite Sample: n=40	
Actual Sample Size	39			
		10%	2.306	3.353
		5%	2.734	3.92
		1%	3.657	5.256

Source: Author's Computation (2024) using Eveiws10

From the result, its reveal that the F statistics values of the bound test for cointegration is 6.329952, which is greater than the probability values at 1%, 5% and 10% respectively, and the finite sample is 40. Thus, it is concluded that there is evidence of long run relationship between economic growth, electricity consumption, inflation, gas price, petroleum and employment.

Table 4: ARDL Long Run Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	200.5602	65.49087	3.062415	0.0057
RGDP(-1)*	-0.717875	0.163617	-4.387535	0.0002
ECONS	2.985783	1.971564	1.514424	0.0442
EMPL	0.949824	0.253394	3.748411	0.0011
INFL	-0.568327	0.190679	-2.980547	0.0069
PETRO*	-9.187431	3.016597	-3.045628	0.0059
GAS	0.049289	0.029116	1.692830	0.1046

Source: Author's Computation (2024) using Eveiws10

The table 4 above presents the estimated long run result for the autoregressive distributive lag model. The coefficient of electricity consumption exhibit positive relationship to economic growth at one lag period, meaning that one percent increase in electricity consumption leads to 3% increase in economic growth in the long run, and from the probability values of less than 5% the result is statistically significant, meaning that in the long run a higher electricity consumption for production and other sectors shows that economic would growth over time, as more and more goods and service would be produce. Furthermore, the impact of employment on economic growth is positive and statistically significant at 5% level in long run, meaning

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that one percent increase in employment will result in 1% increase in economic growth in the long run. The finding from this study is in conformity with the findings of Kasperowicz (2014); Behera, (2015); Sama and Tah (2016) and that of Nadeem and Munir (2016) whose positive relationship between electricity consumption and economic growth within various economies.

On the other hand, the effect on inflation on economic growth are negative meaning that one percent increase in inflation leads to 0.6% decrease on economic growth in the long run, and the result is statistically significant given the probability value at less than 5% level. Again, the effect of petroleum price on economic growth is negative and statistically significant at 5% level given the probability value, this result implies that one percent increase inflation would leads to 9% decrease in economic growth in the long run. Furthermore, the effect of gas price on economic growth is positive, that is one percent increase in gas price lead to 0.05% increase in economic growth in the long run, however, the result is statistically not significance at 5% level given the probability value.

Table 5: ARDL Short Run Dynamic Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RGDP(-2))	0.250245	0.105190	2.378970	0.0265
D(RGDP(-3))	0.218680	0.104714	2.088363	0.0486
D(ECONS)	2.566977	0.828236	3.099329	0.0052
D(ECONS(-1))	2.870098	0.829102	3.461697	0.0022
D(ECONS(-2))	2.091639	0.801102	2.610952	0.0160
D(EMPL)	0.103996	0.166645	0.624058	0.5390
D(EMPL(-1))	0.940087	0.248887	3.777162	0.0010
D(INFL)	-1.524845	0.359893	-4.236944	0.0003
D(INFL(-1))	-4.856345	0.714383	-6.797959	0.0000
D(GAS)	-0.039254	0.023444	-1.674343	0.1082
CointEq(-1)*	-0.717875	0.095594	-7.509601	0.0000

Source: Author's Computation (2024) using Eveiws10

The table 5 presents the short run dynamic result for the autoregressive distributive lag model. The coefficient of electricity consumption exhibit positive relationship to economic growth via two different lag period, meaning that one percent increase in electricity consumption leads to 2.566977% increase in economic growth in the short run, that is increase and from the probability values of less than 5% the result is statistically significant, Again, the effect of increase in electricity consumption would result in larger increase in economic growth over two different lag period, the overall effect in the current period will result in 2years increase in economic growth.

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Furthermore, the impact of employment on economic growth is positive and statistically significant after one lag period year in short run, meaning that one percent increase in employment will result in 0.940087 increase in economic growth in the short run. However, the effect on inflation on economic growth is negative meaning that one percent increase in inflation leads to -1.524845% decrease in economic growth, this finding is supported by the finding of Samuel et al., (2019) and that of Xuan et al., (2018) and Zahid, (2017), moreover the effect of inflation would continue to reduce economic growth for one-year period as the first lag of inflation is -4.856345% in the short run, and result is statistically significant from the probability value at 5% significance level. Again, the effect of gas price on economic growth is negative, that is one percent increase in gas price lead to -0.039254% decrease in economic growth in the short run, however, the result is statistically not significance at 5% level, the finding is in conformity with the findings of Quadri and Bukola, (2022); Runganga and Mishi (2020) and that of Salisu and Moronkeji (2022).

Furthermore, the coefficient of error correction term (ECT) is negative and statistically significant which signifies the speed of adjustment. The adjustment term shows -0.717875 it shows that there is going to be convergence to equilibrium and the probability value is statistically significant at 5% percent level, it implies that the disequilibrium would corrected at adjustment speed of 72% percent in the current year.

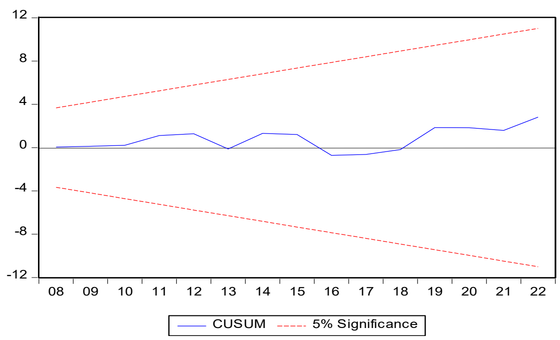
Table 6: Post Estimation Diagnostics Test Results

Type of Diagnostics (Test)	F-Statistics	Prob V.
Breusch-Godfrey Serial Correlation LM Test	0.535394	0.5906
Heteroskedasticity Test: Breusch-Pagan-Godfrey	1.939394	0.0935
Normality: Skewness/ Kurtosis/ J-Bera	0.509413/4.040963/3.44761	0.1783
Functional form: Ramsey Reset Test	2.813126	0.0838
Stability: Cusum	Stable	0.0000
Stability: Cusum of Square	Stable	0.0000

Source: Author's Computation (2024) using Eveiws10

The table 6 above, shows that the diagnostics for autocorrelation model, using Breusch-Godfrey, the F-statistics is 0.535394 and the probability value of 0.5906, which is greater than 5% meaning that the serial correlation LM test shows no evidence of serial correlation in the model.

Furthermore, the diagnostic result for the heteroscedasticity using Breush-Pagan-Godfrey test, with F-statistics of 1.939394 with the probability value of 0.0935 that is greater than the critical value at 5%, it is conclude that the model is homoscedastic. Again, the result of normality distribution and statistics based on the following statistics, which are Skewness of 0.509413, Kurtosis of 4.040963 with a Jarque-Bera value of 3.44761 The probability of 0.8030, which reveals that residual, are normally distributed. From the functional form test of the model using Ramsey reset test, the f statistics is 2.813126with a probability value 0.08 38 shows that the model is correctly specified.



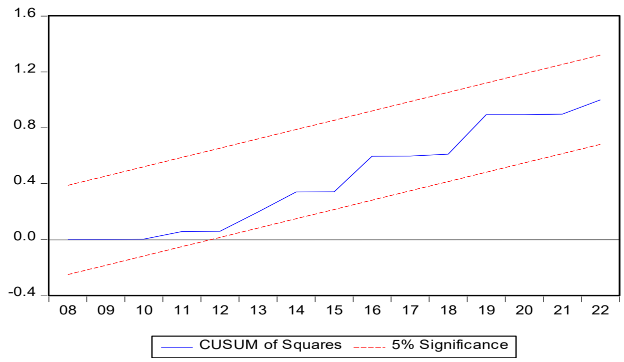


Figure 1: The Cusum Graph **Figure 2: The Cusum of Squares Graph**

The stability diagnostic was conducted using Cusum test as well as Cusum square test. As stated in figure 1 and 2 above, both the Cusum line and Cusum of square laid within the 5 percent significant boundary, therefore it is concluded that the model is stable.

5.1 CONCLUSION

This study concluded that the electricity consumption has significant impact on economic growth in Nigeria. And there is a unidirectional relationship from electricity consumption to real GDP, which means that electricity consumption acts as a stimulus to economic growth. Therefore, there is need for energy infrastructure to be improved and increasing the energy supply are the appropriate options for these country since electricity consumption increases economic growth. Again, employment, Gas reveal a positive relationship with economic growth. Meaning that increase in such variables can also boost economic growth.

5.2 Recommendations

Considering the influence that electricity consumption has on economic growth in the long-run, therefore, the study recommend that the government should make every effort that relates to making electricity available and to ensure efficient and adequate access and Government should increase the budgetary allocation to the sector.

There should be electricity conservation measures to enhance efficient consumption, especially in the business sector which will lead to increasing growth in Nigeria. The government should invest heavily in

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electricity infrastructure; this will ensure enough energy to meet the needs of the agricultural, manufacturing and services sectors of the economy now and in the future.

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