NIPES

Journal of Energy Technology and Environment

Journal homepage: www.nipesjournals.org.ng

A Study on the Impact of Energy Consumption on the Nigerian Economy

Okeoma, T.F[a], Nwachukwu E. I [b] Ezeonye, C.S[c], and Osatemple M[d]

[a]Department of Mechanical Engineering, Gregory University, Uturu, Abia State, Nigeria
[b]Department of Mechanical Engineering, Abia State Polytechnic, Aba. Nigeria
[c]Department of Electrical/Electronics Engineering, University of Agriculture and Environmental Sciences, Umuagwo, Imo State, Nigeria.
[d]Department of Petroleum Engineering, Gregory University, Uturu, Abia State, Nigeria
*Corresponding Author Email: okeomatochukwufranklin@gmail.com

Article information

Article History
Received 21 December 2022
Revised 10 January 2023
Accepted 25 January 2023
Available online 10 March 2023

Keywords:
Energy Consumption, Economic Growth, Electricity Consumption, Crude Oil Consumption

https://doi.org / 10.5281/zenodo.7741150

https://nipesjournals.org.ng
© 2023 NIPES Pub. All rights reserved

Abstract

This study evaluated the impact of energy consumption on economic growth in Nigeria covering the period of 1981 to 2018. The objectives of the study were to investigate the impact of energy consumption on economic growth in Nigeria and to ascertain the long-term relationship between energy consumption and economic growth in Nigeria. The study adopted ex-post facto method of research design, Ordinary Least Square (OLS) regression technique and Johansen co-integration test in arriving at a decision. Gross fixed capital formation, electricity consumption, and crude oil consumption have a positive and significant impact on economic growth in Nigeria while coal consumption has a positive but insignificant impact on economic growth in Nigeria also there exist a long-term relationship between energy consumption and economic growth in Nigeria. based on the result of the findings the following recommendations were made; government should undertake cogent approach towards improving *the electricity supply in such a way that it will lead to increased industrial production and economic growth respectively. Government privatization policy of the electricity sub-sector should be highly monitored to provide enough electricity generation and consumption to encourage mass employment of skilled and unskilled labour in the economy. More attention should be given to the crude oil and coal* economy *in the country in order to galvanize the manufacturing sector. This will not only spur the manufacturing sector but create employments and reduce poverty. Thus, leading to economic growth and development in Nigeria.*

1. Introduction

Energy is a fundamental resource in the economy. Almost all activities requires energy in some form. Consequently, economic growth is directly related to energy consumption. As Alam [1] puts it that energy is the indispensable force driving all economic activities. Energy is widely regarded as a propelling force behind any economic activity and indeed industrial production. Therefore, high

grade energy resources will amplify the impact of technology and create tremendous economic growth.

High grade resources can act as facilitator of technology while low grade resources can dampen the forcefulness of new technology. According to Ojinnaka [2] energy consumption runs hand in hand with the national productivity. Hence, the scale of energy consumption per capita is an important indicator of economic modernization. In general, countries that have higher per capita energy consumption are more developed than those with low level of consumption. The importance of energy lies in other aspect of development - increase in foreign earnings when energy products are exported, transfer of technology in the process of exploration, production and marketing; increase in employment in energy industries; improvement of workers welfare through increase in worker's salary and wages, improvement in infrastructure and socio-economic activities in the process of energy resource exploitation. Thus, in the quest for optimal development and efficient management of available energy resources, equitably allocation and efficient utilization can put the economy on the part of sustainable growth and development. Arising from this argument, adequate supply of energy thus becomes central to the radical transformation of the nation's economy.

Government, professionals and academics alike are concerned about the impact of energy consumption on the economy. Similarly, it evaluates whether the economic benefit from the high energy consumption can neutralize the positive externality inflicting on the society or not [3]. Today, Nigeria is seen as one of the greatest developing nations in Africa with highly endowed natural resources including potential energy resources. However, increasing access to energy in Nigeria has proved to be not only a continuous challenge but also a pressing issue with the international community [4]. Thus, to meet its growing needs of energy, Nigeria must address its persistent energy crisis which according to Iwayemi [5], has weakened the industrialization process, and significantly undermined the effort to achieve sustained economic growth, increased competitiveness of domestic industries in domestic, regional and global markets and employment generation. The current concern about global warming also poses a question about how economic growths in Nigeria will be reconciled with stabilization in the use of both traditional and fossil fuels. However, for any such policy making it is essential to determine the causal relationship between energy consumption and general economic activities. Although the causal relationship between energy consumption and economic growth has been widely studied, no consensus regarding this so-called energy consumption-growth nexus has yet been reached [6, 7].

It is glaring that sustainable development needs sustainable supply of energy resources and an effective and efficient utilization of the energy resources. Energy is capacity of matter to perform work as the result of its motion or its position in relation to forces acting on it (Encarta, 2009). We use energy for everything we do, from making a jump to sending astronauts into space. The same concept according to Zhao et al [8] can be expressed as the amount of heat that must be transferred, exchanged or used up to effect a process or deliver a good to a particular point in the economic system. Energy exists in various forms, including atomic, electrical, chemical, mechanical, nuclear, radiant and thermal. Although energy can be transferred from one form to another but it cannot be created or destroyed. Energy can be extracted from a variety of resources that can be categorized as primary and secondary; commercial and non-commercial; conventional and nonconventional; renewable and non-renewable and traditional and non-traditional energy. Therefore, this study examines the impact of energy consumption on economic growth in Nigeria.

In as much as man needs air to live, every country and economy needs energy to actualizes her potential, Nigeria has seen various stage of energy evolution, but the most challenging fact is that

amidst the abundant sources of energy resources at the disposal of the country, underutilization of this resources has been a major problem in Nigeria energy sector.

Furthermore, economic growth has continued to be a key macroeconomic concept of interest among most researchers and policy makers around the world [9]. The sustain interest in this macroeconomic indicator stems from its pivotal role in impacting other integral segment of an economy and livelihoods. Today, Nigeria is seen as one of the greatest developing nations in Africa with highly endowed natural resources including potential energy resources. However, increasing access to energy in Nigeria has proved to be not only a continuous challenge but also a pressing issue with the international community [10]. Economic growth is a requirement for a nation to move from a third world country to a developed country. For a developing country like Nigeria, the greater the economic growth, the better its chances to become more developed; with adequate use of energy potentials to meet the demand, the nation would experience high levels of economic growth. That is why this study is embarked upon to address the impact of energy consumption on the economic growth

The broad objective of the study is to empirically examine the impact of energy consumption on economic growth in Nigeria. The specific objectives are:

i. To evaluate the impact of energy consumption on Real Gross Domestic (RGDP) in Nigeria.
ii. To ascertain the long run relationship between energy consumption and Real Gross Domestic (RGDP) in Nigeria.

The study was guided by following hypothesis stated in null form:
Ho_1: Energy consumption has no significant impact on Real Gross Domestic (RGDP) in Nigeria.
Ho_2: There is no long run relationship between energy consumption and Real Gross Domestic.

Bekhet and Othman [11] employed the vector error correction model to examine the causal relationship between energy consumption (EC), consumer price index (CPI), gross domestic product (GDP) and foreign direct investment (FDI) in Malaysia for the 1971 to 2009 period. All variables were found to be co integrated indicating the existence of long run relationship among them, the study finds significant long run causality from energy consumption to FDI, GDP growth and inflation.

Gbadebo, [12], investigated the relationship between energy consumption and the Nigerian economy from the period of 1980 to 20016. The energy sources used to test for this relationship were crude oil, electricity and coal. By applying the cointegration technique, the results derived infer that there exists a positive relationship between current period energy consumption and economic growth. With the exception of coal which was positive, a negative relationship was noted for lagged values of energy consumption and economic growth. The implication of the study is that increased energy consumption is a strong determinant of economic growth having an implicit effect in lagged periods and both an implicit and explicit effect on the present period in Nigeria. Thus, it is pertinent that this sector should be given more relevance even by exploiting the opportunities laden in the sector to increase economic growth.

Ogunjobi, [13], analyzed the relationship between energy consumption and industrial growth in Nigeria. The study makes up time series data covering the period between 1980 and 2012 and the data collected were analyzed using co-integration and error correction techniques to estimate the short-run and long-run dynamics of the research models respectively. The result established that in the long-run, there is a significant positive relationship between industrial growth and electricity

consumption, electricity generation, labour employment and foreign exchange rate while it showed a negative relationship between industrial growth and capital input (proxied by gross capital formation). The study therefore recommends that government should undertake cogent approach towards reforming the electricity supply in such a way to increase industrial production and to monitor the privatization policy of the electricity sub-sector to provide employment to reduce high rate of unemployment in Nigeria.

Enu, & Havi, [14], examined the extent to which energy consumption influences economic growth in Ghana and also determine, if it is electricity consumption that causes economic growth in Ghana or otherwise. The study employed Augmented Dickey-Fuller test, Cointegration test, Vector Error Correction Model and Granger Causality test. The study revealed that, in the long term, a hundred percent increase in energy power consumption will cause real gross domestic product per capita to increase by approximately fifty-two percent. However, in the short run, energy consumption negatively affects real gross domestic product per capita. The study again revealed that unidirectional causality run from electricity consumption to economic growth meaning that any policy actions taken to affect the smooth consumption of electricity in Ghana will definitely affect her gross domestic product per capita. Therefore, the current load shedding policy due to low supply of electricity will definitely affect the Ghanaian economy negatively, that is lower production levels, high inflation, and high rates of unemployment and lower standard of living. Therefore, the government of Ghana should invest massively into electricity infrastructure and conservation measures to meet the needs of the various sectors of the Ghanaian economy.

Masuduzzaman, [15] in his study examined Energy Consumption and Aggregate Income in Italy: Cointegration and Causality Analysis, from literature it is observed that unidirectional causality run from economic growth to energy consumption; this implies that a country is not entirely dependent on electricity for its economic growth, and that energy conservation policies will have little or no adverse effects on the economic growth of that country. On the other hand, if unidirectional causality runs from energy consumption to economic growth, it means that economic growth is dependent on electricity consumption, and a decrease in electricity consumption will likely restrain economic growth (that is unemployment, budget deficit, low income, etc) and that the country should employ additional resources in subsidizing energy prices and securing long term and stable energy sources for its economy. There is also bidirectional causality between energy consumption and economic growth, which implies that energy and economic growth complement each other. That is increases in economic growth raised electricity consumption and increasing electricity consumption increases economic growth. These hypotheses have been tested in many energy consumption and economic growth literature. The direction of causality between energy consumption and economic growth varies from country to country, the reasons might be due to different economic structure of particular countries being studied; different economies have different consumption pattern and various sources of energy and also the kind of methodology used for the study. Some of such findings are illustrated below. Akomolafe et al. [16] examined the relationship between energy consumption and economic growth for the period 1990 to 2011. The study employed Augmented Dickey Fuller test and Philip Perrron unit roots test; Johansen test for cointegration, vector error correction and Granger Causality test. The results of the study showed unidirectional causality from energy consumption to real gross domestic product.

Bayer [17] examined the relationship between economic growth and energy consumption in emerging countries during the period 1970 to 2011. The study made use of Pedroni, Kao and Johansen co-integration tests and Granger causality tests. The findings demonstrated that electricity consumption has a positive impact on the economic growth in the whole panel and electricity has the largest impact on economic growth in Hungary, while it had the smallest impact in Indonesia. The Granger causality test demonstrated that there was bidirectional causality between economic

growth and electricity consumption. The study suggested that emerging countries should diversify energy supply and increase the share of renewable energy sources in energy consumption by considering their highly dependence on electricity.

Adhikari et al. [18] investigated the long-run relationship between energy consumption and economic growth for 80 developing countries during the period 1990 to 2009. The 80 countries were divided into upper middle-income countries, lower middle-income countries, and low-income countries. They employed panel unit root tests, panel co-integration test and dynamic ordinary least squares estimator. The empirical result revealed strong relation running from energy consumption to economic growth for upper middle-income countries and lower middle income countries, and a strong relation running from economic growth to energy consumption for low-income countries.

Akinwale et al. [19] examined the causal relationship between energy consumption and economic growth in Nigeria for the period 1970 to 2005. The paper adopted the methods of Augmented Dicky Fuller test, Vector Auto Regressive (VAR) and Error Correction Model (ECM) to test the causality between real GDP and energy consumption. The result showed that there is a unidirectional causality from real GDP to electricity consumption without feedback effect. From the reviewed literature, it is imperative to mention that there are scare studies on impact of energy consumption on the Nigerian Post-COVID Economy. This study intends to fill the gap.

2. Materials & Methods

2.1 Research Design

The *Ex-post facto* research design was used for this study. Ex post facto design, also known as "after-the-fact" research, is defined as a research method that looks into how an independent variable (groups with certain qualities that already exist prior to a study) affects a dependent variable. This entails particular characteristics or traits of a participant that cannot be manipulated This design was adopted because the study intends to use what already exist and look backwards to explain why. This kind of study is based on analytical examination of dependent and independent variables. More so, independent variables are studied in retrospect for seeking possible and plausible relations and the likely effects, the changes in independent variables produce on a dependent variable.

Ordinary Least Square (OLS) regression was employed in the study to ascertain the veracity of the model. The data used for this study are secondary data from Central bank of Nigeria statistical bulletin form the period of various issues. Ordinary Least Squares regression (OLS) is a common technique for estimating coefficients of linear regression equations which describe the relationship between one or more independent quantitative variables and a dependent variable (simple or multiple linear regression).

2.2 Model formulation

This study is been anchored on the endogenous growth theory employed by Gbadebo [12], therefore the study adopts the model of Gbadebo [12], based on the objectives of the study, we specify the model to be;

Functional form;

$$RGDP = f(GFCF, COC, ETC, CLC) \quad (1)$$

Econometric form;

$$RGDP = \beta_0 + \beta_1 GFCF + \beta_2 COC + \beta_3 ETC + \beta_4 CLC\ \mu_t \quad (2)$$

Where;
RGDP = Real Gross Domestic Product
GFCF = Gross Fixed Capital Formation
COC = Crude Oil Consumption
ETC = Electricity Consumption
CLC = Coal Consumption
β_0 = Intercept.
β_1, β_2, β_3 β_4 ,= Parameters.
μ_t = Error disturbance term.

2.2.1 A - priori expectations of variables

β_1 GFCF> 0 (positive) β_2 COC > 0 (positive) β_3 ETC > 0 (positive) β CLC > (positive).

3.0 Results and Discussions

3.1 Pre- Estimation Test Result

A. Unit Root test: The Unit Root test was carried out to test for stationarity among the choice variables. To achieve stationarity, the variables were differenced at I (0) and subsequently I(1). Below are the results of the stationarity tests.

Table 1: Unit Root test Results

Variable	ADF Test Statistic at Level Form	ADF Test Statistic at First Difference Form	Mackinnon Critical Value at 5%	Order of Integration	Assessment
CLC				I(1)	STATIONARY
	-1.537840	-6.841697*	-3.552973		
COC				I(0)	STATIONARY
	-4.744549*	-6.528781	-3.536601		
ETC				I(1)	STATIONARY
	-3.178529	-5.977306*	-3.544284		
GF CF				I(0)	STATIONARY
	-3.622736*	-5.417903	-3.536601		
RGDP				I(1)	STATIONARY
	-1.697521	-7.132007*	-3.540328		

Source: Generated result from E-views.

Note: The asterisks (*) sign is used to indicate stationarity at 5% significance level.

From table 1 it can be deduced that apart from COC and GF CF which were integrated at order zero that is level form I(0), all variables were integrated at order one I(1). This means that CLC, ETC and RGDP were integrated after first difference using the Augmented Dickey-Fuller test. Thus, because the absolute values are greater than the critical values at 5% level of significance, we therefore conclude that COC, GFCF, ETC, CLC and RGDP are stationary.

*B. Cointegration Test***:** The cointegration test is conducted to test whether there is a long run relationship between the dependent and the independent variables in the model. The cointegration test was carried out using the Johanson Cointegration test, it is used to test for cointegration among the variables in the model.

Decision Rule: If trace statistic > 0.05 at critical values reject **H_0** and accept **H_1**, if Trace statistic < 0.05 at critical values reject **H_1** and accept **H_0**

Table 2: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.541997	71.48425	69.81889	0.0126
At most 1	0.377997	35.71525	47.85613	0.4108
At most 2	0.265209	20.04650	29.79707	0.4197
At most 3	0.244581	9.876908	15.49471	0.2903
At most 4	0.018642	0.620989	3.841466	0.4307

Trace test indicates 1 cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Generated result from E-views.

Trace statistics (71.48425) > 0.05 critical value (69.81889)
From table 2: Since the Trace statistics is greater than the 0.05 critical values, we conclude that there is cointegration among the variables and that the variables are cointegrating series. Similarly, there is a long run relationship between the variables.

3.2 Discussion of Results

Table 3: Presentation of Error Correction Model
Dependent Variable: DRGDP
Method: Least Squares
Date: 10/01/23 Time: 17:55
Sample (adjusted): 1983 2018
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1638.004	219.0531	7.477657	0.0000
DLOGGFCF	24.96932	10.94894	2.280524	0.0307
DETC	13.23844	12.41280	6.066515	0.0000
DCOC	3.858648	7.097917	4.543631	0.0012
DCLC	9.685179	13.08292	0.740292	0.4655
ECT(-1)	-0.633125	0.170717	-3.708619	0.0010

R-squared	0.899666	Mean dependent var	1675.164
Adjusted R-squared	0.707011	S.D. dependent var	1543.295
S.E. of regression	1188.427	Akaike info criterion	17.16161
Sum squared resid	38133660	Schwarz criterion	17.43371

Log likelihood	-277.1666	Hannan-Quinn criter.	17.25316
F-statistic	23.92781	Durbin-Watson stat	1.771364
Prob(F-statistic)	0.000000		

Source: Results from e- views.

A. Discuss of Findings

Based on the findings and theoretical assumptions, we would evaluate the above result to verify if they conform to the principles of economic theory (that is, if they conform to a prior expectation in signs and magnitude).

Error correction Model (ECM): The duration of long run in the system is -0.633125, this implies that the system adjusts to the equilibrium at the speed of 63.3% in the long run.

Constant (C): In the model, the coefficient of the constant is 1638.004. This shows that the dependent variable increases by 1638.0 units on the average, when all the explanatory variables are held constant.

Gross Fixed Capital Formation: The slope coefficient of gross fixed capital formation is 24.96932. This shows a positive relationship with real gross domestic product in Nigeria. Thus, 1% increase in gross fixed capital formation will lead to 24.9% increase in real gross domestic product in Nigeria. Thus, this conforms to the a priori expectation sign of variable.

Electricity consumption: the coefficient of electricity consumption is 13.23844. This identifies a positive relationship with real gross domestic product in Nigeria and it conforms to the a priori expected sign of variable. It is expected that 1 billion increase in electricity consumption will lead to 13.2 magnitude increase in real gross domestic product in Nigeria.

Crude oil consumption: crude oil consumption shows a positive relationship with real gross domestic product in Nigeria. This was indicated by the coefficient value 3.858648, which confirms with a priori expected sign of variable. Thus, 1 billion increase in crude oil consumption will lead to 3.8 magnitude increase in real gross domestic product in Nigeria.

Coal consumption: the slope coefficient of coal consumption indicates a positive relationship with economic growth in Nigeria. This was revealed by the coefficient value standing at 9.685179. Thus, implies that 1 billion increase in coal consumption will lead to 9.6 magnitude increase in real gross domestic product in Nigeria. This also confirms with a priori expected sign of variable.

Table 4: A priori expected and obtained signs

Variable	Expected signs	Obtained signs	Conclusion
C	(+)	(+)	Conforms
CLC	(+)	(+)	Conforms
COC	(+)	(+)	Conforms
ETC	(+)	(+)	Conforms
GF CF			

Source: Results from e- views.

The statistical criteria or first order tests aim at evaluating the statistical significance/reliability of the estimates and parameters of the model from simple observations. These statistical tests were carried out based on the following; multiple coefficients of determination (R^2), student t-test and the f-statistic test.

The coefficient of determination (R^2) measures the proportion of the variation in DRGDP which is explained by DLOGGFCF, DETC, DCOC, and DCLC. The coefficient of determination measures the goodness of fit of the estimated model. The result of the estimations reveals that R^2 is 0.899666. This implies that approximately 89.9 % of the total variations in the dependent variable RGDP is explained by the independent variables DLOGGFCF, DETC, DCOC, and DCLC. This implies that the model is a good measure of fit.
In estimating the t-statistic, we compare the estimated probability value of t- statistic with 5% level of significance. The working hypothesis is stated thus;
H_0: $\beta_0=0$ (there is no significant impact of the explanatory variables on DRGDP)
H_1: $\beta_0\neq0$ (there is significant impact of the explanatory variables on DRGDP).

Decision Rule: Accept null hypotheses when p-value of the T-statistic is greater than 0.05 and reject alternative hypothesis.
Gross fixed capital formation
Since 0.0307 /</0.05/**,** we reject the null hypothesis (H_0) and conclude that the slope coefficient of gross fixed capital formation is statistically significant at 5% level of significance.
Electricity consumption
Since /0.0000/</0.05/**,** we reject the null hypothesis (H_0) and conclude that the slope coefficient of electricity consumption is statistically significant at 5% level of significance.
Crude oil consumption
Since/ 0.0012 /</0.05/**,** we reject the null hypothesis (H_0) and conclude that the slope coefficient of crude oil consumption is statistically significant at 5% level of significance.
Coal consumption
Since/ 0.4655 />/0.05/**,** we do not reject the null hypothesis (H_0) and conclude that the slope coefficient of coal consumption is statistically insignificant at 5% level of significance
Constant
Since /0.0000/</0.05/, we reject the null hypothesis (H_0) and conclude that the slope coefficient of constant is statistically significant at 5% level of significance.

Table 5: Tabular representation of the T-statistic results

Variables	P-value	5% Level	Conclusion
C	0.0000	0.05	Statistically significant
DLOGGFCF	0.0307	0.05	Statistically significant
DETC	0.0000	0.05	Statistically significant
DCOC	0.0012	0.05	Statistically significant
DCLC	0.4655	0.05	Statistically insignificant

Source: Results from e- views.

The F-Test is carried out to determine the joint effect or impact of all the explanatory variables on the dependent variable. The F-test measures the overall significance of the model and follows the F-distribution. The underlying hypothesis for the F-test is stated thus;
H_0: $\beta_1=\beta_2=\beta_3=0$ (the overall model is insignificant)
Against
H_1: $\beta_1\neq\beta_2\neq\beta_3\neq 0$ (the overall model is significant)

Decision Rule: Accept null hypotheses when p-value of the F-statistic is greater than 0.05 and reject alternative hypothesis.
Since 0.000000 < 0.05, we reject the null hypothesis (H_0) and conclude that the variables in the model are jointly statistically significant.

3.3 Post – Estimation Test Result

A. Test for Autocorrelation

Here, autocorrelation tests whether the error terms are serially correlated in the regressions. A fundamental assumption of OLS is the absence of serial correlation between the error terms. The Breusch- Godfrey serial correlation test will be used.

H_0: No serial correlation

H_1: There is serial correlation.

Decision rule: Using the Probability of Chi- Square, Reject **H_0** if the probability Chi-Square of Observed R^2 is less than 5%.

Table 6: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.469281	Prob. F(2,25)	0.6309
Obs*R-squared	1.194074	Prob. Chi-Square(2)	0.5504

Source: Results from e- views.

From table 6, the result of the Prob. Chi-Square (2) is 0.5504 > 0.05

Thus, we reject **H_1** and accept **H_0** and conclude that there is no autocorrelation.

B. Test for Heteroscedasticity

The heteroscedasticity test is used to determine whether there is constant variance. This test is carried out using the White general Heteroscedasticity Test (with cross terms). The test asymptotically follows a Chi-square distribution with degrees of freedom equal to the number of explanatory variables (excluding intercept term).

Hypothesis

H_0: No Heteroscedasticity

H_1: There is Heteroscedasticity

Decision rule: If the probability of the Chi-Square distribution < 0.05, reject **H_0**. If otherwise, reject **H1**.

Table 7: Heteroskedasticity Test: White

F-statistic	1.577646	Prob. F(20,12)	0.2101
Obs*R-squared	23.90761	Prob. Chi-Square(20)	0.2465
Scaled explained SS	13.57045	Prob. Chi-Square(20)	0.8516

From table 7, the result of probability Chi-square is 0.2465 > 0.05, we do not reject **H_0** and thus we conclude that there is the absence of heteroscedasticity in the model. There is therefore the presence of homoscedasticity.

The study revealed that energy consumption has a significant impact on economic growth in Nigeria indicated by the probability value of the f-test standing at 0.000000 which is less than 0.05. Thus, implies rejection of the null hypothesis.

Similarly, hypothesis two confirms rejection of the null hypothesis as the result revealed that there exists a long run relationship between commercial bank loan and economic growth in Nigeria. This was indicated by the trace statistics trace statistics (71.48425) which is greater than critical value (69.81889). Thus, there is a long run relationship between energy consumption and economic growth in Nigeria.

The result of the above study implies that; increase in electricity consumption and crude oil consumption will lead to increase in economic growth in Nigeria. Also, gross fixed capital formation

is a significant determinate on economic growth in Nigeria while coal consumption is an insignificant determinant on economic growth in Nigeria which was proxied by real gross domestic product.

4. Conclusions

The study investigated the effect of energy consumption on economic growth in Nigeria. From the result of the data analysis, the following are the major findings:

i. Gross fixed capital formation has a positive and significant impact on economic growth in Nigeria.
ii. Electricity consumption has a positive and significant impact on economic growth in Nigeria.
iii. Crude oil consumption has a positive and significant impact on economic growth in Nigeria.
iv. Coal consumption has a positive but insignificant impact on economic growth in Nigeria.
v. There exists a long run relationship between energy consumption and economic growth in Nigeria.

Based on the finding of the study the following recommendation were made:

i. Since it has been established through the study that electricity consumption plays a positive role in economic growth of the country, therefore government should undertake cogent approach towards refining the electricity supply in such a way that it will lead to increased industrial production and economic growth respectively.
ii. Government privatization policy of the electricity sub-sector should be highly monitored to provide enough electricity generation and consumption to encourage mass employment of a skilled and unskilled labour in the economy.

More attention should be given to the crude oil and coal in the country in order to galvanize the manufacturing sector. This will not only spur the manufacturing sector but create employments and reduce poverty. Thus, leading to economic growth and development in Nigeria.

References

[1] M. S. Alam (2016). Economic Growth with Energy. MPRA Paper No. 1260.
[2] I. J. Ojinnaka (2017). Energy Crisis in Nigeria, the Role of Natural Gas. Bullion, The Publication of Central Bank of Nigeria, Vol. 22(4), pp. 78-97.
[3] M. A. Adelman (2013). The Economics of Petroleum Supply, MIT Press.
[4] G. O. Odularu and C. Okonkwo (2015). Does Energy Consumption Contribute to Economic Performance? Empirical Evidence from Nigeria. *Journal of Economics and International Finance* 1(3), pp. 1255-1260.
[5] A. Iwayemi (2014). Nigeria's Dual Energy Problems: Policy Issues and Challenges, International Association for Energy Economics, Fourth Quarter 2008.
[6] C. Chima and R. Freed (2013). Empirical Study of the Relationship Between Energy Consumption and Gross Domestic Product in the U.S.A. International Business & Economics Research Journal, Vol. 4(12), pp. 12-15
[7] A. Belke, F. Dobnik, and C. Dreger (2011). Energy Consumption and Economic Growth: New Insights into the Cointegration Relationship. Energy Economics, Vol. 33(5), pp. 782-789.
[8] X. Zhao, L. Lui, J. Wang, and X. Chen (2012). Empirical Analysis about Influence Factors of Energy Consumption in China. Energy Procedia, Vol. 17(B), pp. 1255-1260.
[9] R. Abaidoo (2015). Economic Growth and Energy Consumption in an Emerging Economy: Augmented Granger Causality Approach. Research in Business and Economic Journal, Vol. 1(1), pp. 1-2.
[10] A. A. Ogundipe, A. Apata (2013). Electricity Consumption and Economic Growth in Nigeria. Journal of Business Management and Applied Economics, Vol. 8(4), pp. 1-2.

[11] G. E. Bekhet and F. Othman (2011). The Vector Error Correction Model to Examine the Causal Relationship Between Energy Consumption (EC), Consumer Price Index (CPI), Gross Domestic Product (GDP) and Foreign Direct Investment (FDI) in Malaysia. Kamla-Raj Journal, Vol. 6, pp 83-92.
[12] O. O. Gbadebo (2017). The Relationship Between Energy Consumption and the Nigerian Economy. Journal of Economics and Business, Vol. 12(2), pp.
[13] J. O. Ogunjobi (2015). The Relationship Between Energy Consumption and Industrial Growth in Nigeria. *Journal of Economics and Sustainable Development.* 2(4), pp. 15-21
[14] V. E. Enu and F. Havi (2014). The Extent to which Energy Consumption Influences Economic Growth in Ghana. Journal of Economics and Social studies. Vol. 18, pp. 34-49.
[15] C. Magazzino (2011). Energy Consumption and Aggregate Income in Italy: Cointegration and Causality Analysis. Unpublished Paper.
[16] F. D. Akomolafe, E. Asafu and N. Y. Adjaye (2014). Examined the Relationship Between Energy Consumption and Economic Growth for the period 1990 to 2011. Journal of energy Economics, Vol. 22, pp. 615-625.
[17] T. Bayer (2014). The Relationship Between Economic Growth and Energy Consumption in Emerging Countries During the Period 1970 to 2011. International Journal of Energy Economics and Policy, Vol. 1(1), pp, 18-31.
[18] M. V. Adhikari, Y. Akinwale, O. Jesuleye and W. Siyanbola (2013). The Long-Run Relationship Between Energy Consumption and Economic Growth. British Journal of Economics, Management and Trade, Vol. 3(3), pp. 277-295.
[19] H. Akinwale, K. J. Akomolafe and J. D. Danladi (2013). The Causal Relationship Between Energy Consumption and Economic Growth in Nigeria. International Journal of Economics, Finance and Management, Vol. 3(1), pp. 28-33.

Appendix

Table A1: DATA TABLE

YEAR	RGDP ₦ billion	CLC Percentage (%)	COC Percentage (%)	ETC Percentage (%)	GFCF Million $ US
1981	15,258.00	94.4	200	50.87	58,697,580,000
1982	14,985.08	45.2	215	81.85	45,521,220,000
1983	13,849.73	36.3	202	81.69	29,852,230,000
1984	13,779.26	58,.4	210	62.03	19,106,380,000
1985	14,953.91	95.4	222	80.41	18,036,360,000
1986	15,237.99	83.2	208	90.83	15,657,770,000
1987	15,263.93	88.6	218	89.25	11,966,730,000
1988	16,215.37	34.7	234	87.09	12,500,150,000
1989	17,294.68	36.3	244	97.01	12,750,120,000
1990	19,305.63	47.7	251	87.03	17,678,030,000
1991	19,199.06	72.6	259	89.55	17,610,710,000
1992	19,620.19	57.2	265	90	17,083,320,000
1993	19,927.99	18.8	271	100.83	19,815,760,000
1994	19,979.12	28.3	252	95.5	17,802,710,000
1995	20,353.20	22.8	284	91.43	13,139,250,000
1996	21,177.92	18.8	286	85.86	15,516,810,000
1997	21,789.10	11.6	277	81.96	16,888,390,000
1998	22,332.87	13.1	260	76.93	16,034,250,000
1999	22,449.41	18.1	252	75.72	15,565,120,000
2000	23,688.28	13.3	246	74.45	18,216,170,000
2001	25,267.54	13.3	306	75.53	14,261,890,000
2002	28,957.71	47.6	304	104.6	17,162,800,000
2003	31,709.45	25.3	288	101.87	25,768,070,000
2004	35,020.55	8.8	277	123.57	19,582,550,000
2005	37,474.95	8.8	312	129.26	17,534,380,000

2006	**39,995.50**	**8.8**	**284**	**111.69**	**27,947,620,000**
2007	**42,922.41**	**25**	**232**	**138.84**	**39,609,860,000**
2008	**46,012.52**	**35.5**	**263**	**127.18**	**39,322,420,000**
2009	**49,856.10**	**37.7**	**253**	**120.57**	**52,994,310,000**
2010	**54,612.26**	**42.1**	**283**	**136.36**	**61,099,010,000**
2011	**57,511.04**	**35.5**	**287**	**150.13**	**56,060,380,000**
2012	**59,929.89**	**53.4**	**279**	**156.73**	**57,490,890,000**
2013	**63,218.72**	**53.2**	**280**	**142.68**	**62,012,450,000**
2014	**67,152.79**	**55.7**	**267**	**144.48**	**70,338,540,000**
2015	**69,023.93**	**60.4**	**290**	**150.78**	**69,410,290,000**
2016	**67,931.24**	**67.3**	**361**	**215.87**	**72,433,543,000**
2017	**68,490.98**	**59.2**	**250**	**245.06**	**74,653,877,000**
2018	**71,653.76**	**67.5**	**300**	**213.64**	**81,432,907,000**

Source: Central Bank of Nigeria Statistical Bulletin and international monetary fund (IMF)