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Econometric Analysis of Electricity Consumption, Capacity Utilization and Economic Growth in Nigeria: A Disaggregated Analysis

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Abstract
The study examined the econometric analysis of electricity consumption, capacity utilization and economic growth in Nigeria: A Disaggregated Analysis. The objectives of the study were to determine the causality between economic growth and electricity consumption sources and to determine capacity utilization of the manufacturing industries and electricity consumption sources. Secondary data sourced from the Central Bank of Nigeria (CBN) was used for the study. The study adopted regression analysis and causality tests for the study to achieve the stated objectives. However, the Augmented Dickey Fuller (ADF) test was conducted to determine the properties of variables used in the study and also to test the stationarity. The independent variables were hydroelectricity, coal, natural gas and oil sources of electricity while the dependent variable was economic growth (proxied by real GDP) and capacity utilization was used as a function of electricity sources. The result of granger causality tests showed the existence of uni-directional relationship between oil and RGDP. No causality was found between RGDP and other variables. The regression analysis results showed that coal, hydroelectric and natural gas sources were the factors contributing to economic growth.
For capacity utilization, the results found a bi-directional relationship between capacity utilization and hydroelectric sources, oil sources; uni-directional relationship existed between capacity utilization and natural gas. No causality was observed between coal and capacity utilization. The economic implication of this finding is that energy enhancement policy could enhance economic growth in Nigeria. The study concluded that hydroelectricity and natural gas were factors that contributed mainly to electricity consumption in Nigeria.
Keywords: Electricity consumption, Capacity utilization, Regression analysis, Causality test and Augmented Dickey Fuller test.

1.0 Introduction

Electricity plays a very important role in the socio-economic and technological development of every nation. Electric demand in Nigeria far outstrips the supply, and the supply is epileptic in nature (Ajao *et. al.*, 2009). Nigeria is blessed with abundant renewable energy resources at her finger tips to satisfy the energy wants of her populace, the significant ones being solar energy, biomass, wind, small and large hydropower with the potential for hydrogen fuel, geothermal and ocean energies, though energy demand in Nigeria is mainly met by hydro-power with a total of 356, 667 sq miles (923,768 sq km), of which 351,649 sq miles (910,771 sq km or 98.6% of total area) is land. The national physical and political attributes present challenges for the effective provision of power needs to all nooks and crannies of the country. It is therefore opined that, in order to provide adequate power in Nigeria with a view to competing with industrialized nations, it was advocated that three critical activities must be effectively achieved; Adequate power must be generated; the power must effectively be transmitted to all parts of the country and finally, the power must be efficiently distributed to the final consumers (Sambo *et. al.*, 2008).
A power system is known worldwide except Nigeria as a versatile, relatively cheap and cost effective means of providing energy in any Nation or community. It consists of three main hierarchical stages or subsystems known respectively as generation, transmission and distribution. It is effective and indispensable machinery for the rapid industrial and economic growth (Emovon *et. al.*, 2011).
Energy efficiency does not just connote a reduction in utility cost but it involves increasing revenue through greater productivity. Oviemuno (2006) agreed that "Energy efficiency is the indispensable component of any effort to improve Productivity" and of course contribute to economic wealth. Majority of Nigerian are dependent on fossil fuel and fuel wood (firewood). The over dependence on fossils and fuel wood (used mainly by poor rural commuters) have not yielded enough capacity to meet increasing demands. Table 1 shows the Nigeria future install electricity generation capacity by fuel type in various years, 2015, 2020, 2025 and 2030 respectively. It has been observed in recent years that, Nigeria is yet to meet its electricity consumption demand, which really calls for urgent study with a view to enhancing the power generation potentials of the country.

Table 1: Nigeria Future Installed Electricity Generation Capacity by Fuel Type (%).

Fuel type	2015	2020	2025	2030
Coal	9.9	13.8	15.3	15.6
Gas	48.5	53.5	53.0	59.0
Hydro	18.9	13.6	10.7	8.6
Nuclear	9.4	5.3	8.3	6.7
Solar	13.1	11.0	10.4	8.3
Wind	0.1	2.9	2.3	1.8

Source: Sambo, A.S. "Electricity Generation and the Present Challenges in the Nigerian Power Sector", 2008

1.1. Concept of Capacity Utilization

Electricity consumption brings about the concept of capacity utilization in the manufacturing sector of the Nigerian economy. Energy supplies to all sectors of the Nigerian economy have been very unreliable over the years. For example, most manufacturing, industrial and communication companies operating in Nigeria have in place active power generation facilities to compliment the very unreliable power supplies from the national grid. As such, manufacturing companies operating in the country have had to channel a significant portion of investible funds available to them to provide onsite standby power supplies, thus diverting the resources needed to fund their core manufacturing businesses. This has negative ramifications for domestic productivity, not to talk of the ability to compete internationally in a continuously changing global market (Iyoha, 2005).

One of the most used definitions of capacity utilization rate is that, the ratio of actual output to the potential output, the potential output being the optimum level of output. When an economy is operating under full capacity, it has a direct impact on its economic growth as well as its standard of living. This is because, all of its installed capacity and available resources are put into their most efficient use.

The average manufacturing capacity utilization dropped from 73.3 percent in 1984 to 45 percent in 2010 leading to a gradual decline in the contribution of the manufacturing sector to the Gross Domestic Product (GDP). One of the major reason for this decline is power outage. Member-companies continued to spend huge amount of financial resources and time on power generation; which gulps about ten per cent of manufacturing costs, and even more in some cases. Government seems not to support manufacturing in the country. Government support for manufacturing is only in declarations (www.vanguardngr.com, 2009).

Economic growth is seen to be positive change in the level of production of goods and services by a country over a certain period of time. It occurs when a nation takes its resources and rearranges them in ways that make them more valuable. A useful metaphor for production in an economy comes from the kitchen. To prepare delicious soups, we mix inexpensive ingredients together according to a recipe. The cooking one can do is limited by the supply of ingredients, and most cooking in the economy produces undesirable side effects. If economic growth could be achieved only by doing more and more of the same kind of cooking, we would eventually run out of raw materials. Economic growth therefore springs from better recipes, not just from more cooking.

Economic growth rate in Nigeria has witnessed wide fluctuation over the years due to external and internal economic and political environment. Nigeria maintained an average growth of 6% during 1966 and 1975 period largely due to the Dutch oil disease effect before plummeting to a negative growth trajectory in the 1980s. By the end of 1990 and early 2000 decade, the Nigerian economy recovered and has sustained a growth rate of over and above 5.5% average between 2000 and 2008. This was as a result of the sectoral and structural economic reform and policies that have been vigorously pursued under the democratic government since 1999. The government has focused on the non-oil export expansion through the provision of infrastructure to boost external trade particularly the substantial investment in power and steel development (Harrison, 2008).

From table 2 below, the electricity plant site at Egbin is seen to have the highest installed capacity of 1,320MegaWatts (MW) with utilized capacity of 650MW which implies that there is an ungenerated capacity of 670MW. This is followed by Sapele site with installed capacity of 1,020MW and available capacity of 63MW and un-generated capacity of 957MW, Afam also follows with 980MW. The least available capacity is that of geometric with 140MW. In totality, Nigeria has installed capacity of 8,876MW and available capacity of 3,653MW that implies 5,223MW of ungenerated capacity. It is also evident that thermal form of electricity is what is mostly generated in Nigeria.

Table 2: Existing Power Generating Capacity in Nigeria

Site	Type	Installed capacity(MW)	Available capacity(MW)	Number of units
Egbin	Thermal	1,320	650	6
Shiroro	Hydro	600	450	6
Ughelli	Thermal	812	320	20
Kainji	Hydro	760	450	12
Sapele	Thermal	1020	63	10
Afam	Thermal	980	NA	20
Afam VI	Thermal	650	450	3
Jebba	Hydro	540	482	6
Geregu	Thermal	440	92	3
Omotosho	Thermal	304	35	NA
Olorunsogo	Thermal	304	NA	NA
AES	Thermal	270	NA	5
Okapi	Thermal	450	361	5
Omoku	Thermal	150	60	4
Tras Amadi	Thermal	136	NA	NA
Geometric	Thermal	140	140	NA
Total		8,876	3,653	

Source: Emovon, I. B Kareem and M.K Adeyeri. "'Power Generation in Nigeria; Problem and Solution.", 2011.

1.2 Problem Statement

Electric power is the engine that drives industrialization, stable Electric power supply for adequate consumption is the key for Nigeria to become one of the most 20 developed economy in the world. But it is very unfortunate that the biggest problem in Nigeria is electricity crisis, a crisis without an end. In a review (Emovon, *et al.*, 2011) on current power generation in Nigeria, it was revealed that the total grid capacity of 8,876 MW with only 3,653 MW available as at December 2012. Thus available power is less than 41% of the total installed capacity.

An analysis of Nigeria's electricity supply problems and prospects found that the electricity demand in Nigeria far outstrips the supply, which is epileptic in nature. The country is faced with acute electricity problems, which is hindering its development notwithstanding the availability of vast natural resources in the country. It is widely accepted that there is a strong correlation between socio-economic development and the availability of electricity. In view of the above, the research questions are, what is the trend of electricity consumption over the years under review, what is the impact of electricity sources on economic growth, what is the causality between economic growth, capacity utilization and electricity consumption sources.

1.3 Objectives

The general objective of this study is the econometric analysis of electricity consumption, capacity utilization and economic growth in Nigeria. The specific objectives are to: determine the impact of electricity sources on economic growth; determine the causality between economic growth, capacity utilization of the manufacturing industries and electricity consumption sources; proffer recommendations based on research findings with a view to increasing the electricity supply and consumption in Nigeria.

Based on the above therefore, the research hypotheses posited for this study in its null form are: Electricity power consumption does not exert significant influence on economic growth of Nigeria and that there is no causality between capacity utilization and electricity consumption sources.

1.4. Justification

Electric power supply has always being the most important commodity for national development. The low distribution voltages and disruptions, due to frequent switching off and on are deleterious to sensitive equipment and national development. Today, many developing countries are facing power shortage problems. An adequate and regular power supply may be one of the most crucial factors which support economic growth in developing countries. According to a study on the relationship between electricity use and economic development conducted by (Ferguson et al, 2000), they posited that there was a strong correlation between electricity use and economic development. The Nigerian power sector has persistently been erratic and running with a shortfall, in spite of heavy funding and the availability of abundant coal, natural gas, hydropower and inexhaustible solar power. This remains not only a challenge but inimical to the growth of Nigerian economy. Thus, this study is important because it serves as a means to improve the Nigerian economy. So, Nigeria can be one of the top industrialized

Nations in the world. Also, the findings of this study will also contribute to knowledge in the area of energy sector of the economy as well as serving as a policy framework for the government in general. More importantly, the study tries to fill a gap with its current data spanning between 1976 to 2011 as against the research conducted by Akinlo (2009) which spanned between 1980 to 2006.

1.5. Empirical Review

Whether or not electricity consumption positively affects and causes GDP, the relationship is crucial for electricity conservation policies (Narayan and Smyth, 2005) (Ghosh, 2002). Also, Iwayemi (1988) posited the importance of energy sector in the socio-economic development of Nigeria. He therefore submitted that strong demand and increased supply would stimulate increased income and higher living standards. Okafor (2008) used descriptive analysis to corroborate the views of these authors by arguing that poor and inefficient electricity supply has adverse implication for industrial development in Nigeria. Akinlo (2009) conducted a study in Nigeria to investigate relationship between economic growth and electricity consumption during the period 1980 to 2006. The result exhibits that there is unidirectional Granger causality running from electricity consumption to real GDP and suggested use of electricity could stimulate the Nigerian economy.

The positive relationship between electricity consumption and economic growth has been justified by some Authors as being consistent. Many economists agreed that there is a strong correlation between electricity use and economic development. Balat (2007) shed light on the importance of energy consumption. He viewed that in developing countries, energy consumption has been on the increase. However, Turkish government is encouraging national and international investors to invest in energy projects. He says energy sector needs more investment for the progress of the country. He suggested wind and solar energy as alternative sources. Moreso, Gbadebo and Okonkwo (2009) also found positive relationship between energy consumption and economic growth in Nigeria. Greater energy consumption means more economic activity of the nation and as a result higher economic growth. He suggests this sector should be given attention for the development of the country. Galip (2005) analyzed the relationship between electricity consumption and real GDP of Turkey for the period of 1950-2000. The author found uni-directional causality running from electricity consumption to income. He posited that electric supply is necessary for economic growth. According to a study on the relationship between electricity use and economic development conducted by Ferguson *et. al.* (2000), there was a strong correlation between electricity use and economic development. Yang (2000) found a bidirectional causal relationship between gross domestic product (GDP) and electricity consumption in Taiwan for the period 1954 – 1997.

Kamal (2008) finds the relationship between energy consumption and economic growth in Nepal. He finds uni-directional causality running from GDP to electric consumption. He says energy consumption stimulates economic growth. He says increase in income will raise energy consumption as people spend more proportion of their income on goods and services that consumes energy like cars, tractors, water pumps at farms etc. Higher growth needs energy infrastructure and this growth will increase energy consumption at commercial level. Baek (2011) examined the relationship between trade, income growth and energy consumption. He viewed energy consumption has been positively related with economic growth.

3.0 Research methodology

3.1 Area of Study: Nigeria

The area of study is the Federal Republic of Nigeria. Nigeria is located on the west coast of Africa, bordered on the north by the Niger and Chad; on the east by Cameroon; on the west by the Benin; and is bounded on the south by the Gulf of Guinea and Equatorial Guinea. It has a total area of 923,766 square kilometers of which the land area consists of 910,768 square kilometers, while the balance of 13,000 square kilometers is water, with a total coastline of 853 kilometers. Temperatures across the country are relatively high with a very narrow variation in seasonal and diurnal ranges (22-38 degrees Celsius). There are two basic seasons: wet season which lasts from April to October; and the dry season which lasts from November till March. Nigeria, with a population of more than 150 million, is a highly populated country with a wide diversity of peoples. The population is made up of about 374 distinct ethnic groups.

3.2 Source of Data: This study investigated the relationship between economic growth and electricity consumption, using annual time series data from 1976 to 2011. It was observed that electricity consumed in Nigeria is generated from five different sources, namely: coal, hydroelectric, natural gas, oil and renewable. Hence, this prompted this study into disaggregating the different sources of energy consumed in Nigeria in order to determine the particular source that has impact on the economic growth. The data used for this study for electricity generation outputs and consumption was measured in *kilo watts per hour* and were obtained from the Central Bank of Nigeria statistical bulletin 2011.

3.3 Analytical Technique

In order to investigate the relationship that exists between the dependent variable and explanatory variables, this paper adopts the following procedures.

First, the time series characteristics of the variables were investigated. The purpose is to determine the order of integration. The paper conducted unit root test on the variables included in the regression by employing the Augmented Dickey-Fuller (ADF) Unit Root tests. The objective is to determine the underlying properties of the process that generate the present result.

Secondly, the paper examined the causal relationship between the dependent and explanatory variables by employing the Granger causality tests. Such an exercise provided an understanding of the interactions among the variables in the system and shed light on the directions of the causality.

Thirdly, the study used regression analysis (ordinary least square) model to examine the impact of electricity consumption variables on both economic growth and capacity utilization. The models which determined how electricity consumption variables affect capacity utilization and economic growth are as stated below:

3.4 Model Specification

3.4.1 Model 1.

Determination of electricity consumption sources factors influencing economic growth of Nigeria:

$Y=f(X_{1,}\ X_{2,}\ X_3\ X_{4,}\ X_5) \rightarrow$ implicit function

$Y = \varphi_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + U_t \rightarrow$ explicit function

Where;
Y= Real Gross Domestic Product (proxy for economic growth)
X_1= Electricity production from coal sources (kWh)
X_2 = Electricity production from hydroelectric sources (kWh)
X_3= Electricity production from natural gas sources (kWh)
X_4= Electricity production from oil sources (kWh)
X_5= Electricity production from renewable sources (kWh)

Where;
Y = dependent variable
φ_0=estimated constant term
$x_1,\ldots, x_5$= independent variables
β_1- β_5= estimated coefficients
U_t = the stochastic term

3.4.2 Model 2

Causality between capacity utilization and electricity consumption sources:

$Y=f(_{,}X_{1,}\ X_{2,}\ X_3\ X_{4,}\ X_5) \rightarrow$ implicit function

$Y = \varphi_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + U_t \rightarrow$ explicit function

Where;
Y = capacity utilization
X_1= Electricity production from coal sources (kWh)
X_2 = Electricity production from hydroelectric sources (kWh)
X_3= Electricity production from natural gas sources (kWh)
X_4= Electricity production from oil sources (kWh)
X_5= Electricity production from renewable sources (kWh)

3.4 *Apriori expectation*

The *apriori* expectation is that $\beta_1 \rangle 0,\ \beta_2 \rangle 0,\ \beta_3 \rangle 0,\ \beta_4 \rangle 0,\ \beta_5 \rangle 0$ which implies that it is expected from this study that the coefficients of the variables after the regression analysis will have positive values that would bring about increase in economic growth.

4.0 Results and Discussions

4.1 Augmented Dickey-Fuller Unit Root Tests

The results of Augmented Dickey-Fuller Unit Root test is presented below. The variables under consideration namely electricity production from coal, hydroelectric, natural gas, oil, renewable sources.

Table 3: Result of Unit Root Tests

Variables	ADF test statistic	Critical Values			Test for Unit Root	Decision
		1%	5%	10%		
Coal sources	-11.25017	-3.6353	-2.9499	-2.6133	At level	I(0)
Hydroelectric sources	-3.088926	-3.6422	-2.9527	-2.6148	1st difference	I(1)
Natural gas sources	-3.244261	-3.6422	-2.9527	-2.6148	1st difference	I(1)
Oil sources	-6.000919	-3.6422	-2.9527	-2.6148	1st difference	I(1)
GDP	-3.577023	-3.6422	-2.9527	-2.6148	1st difference	I(1)

Source: Computed from data analysis (2013)

Augmented Dickey Fuller (ADF) was used here instead of Dickey Fuller (DF) because the ADF is more sophisticated in testing for stationary of variables. The Augmented Dickey Fuller (ADF) test was used to determine the time series characteristics of variables used in the regression. The results of the unit root test showed that most variables were significant (stationary) at their first difference except coal sources which was stationary at levels. Hence, they are integrated of order I(1) and coal source variables are integrated of order I(0).

4.1 Granger Causality

The Granger causality test statistics was used to estimate the causal relationship between economic growth and electricity consumption in Nigeria between 1976-2011. The Granger statistics summarized by the F-statistics at 5per cent probability level.

Table 4: Results of Granger Causality Test

Null Hypothesis	F statistics	Probability	Decision	Causality
CL does not Granger Cause GDP	2.53365	0.15829	Reject	No-causality
GDP does not Granger Cause CL	0.57431	0.78709	Reject	
HYD does not Granger Cause GDP	0.89723	0.58843	Reject	No-causality
GDP does not Granger Cause HYD	2.48667	0.16327	Reject	
NAG does not Granger Cause GDP	2.08722	0.21561	Reject	No-causality
GDP does not Granger Cause NAG	0.88796	0.59352	Reject	
OIL does not Granger Cause GDP	6.50893	0.02591	Accept	Unidirectional
GDP does not Granger Cause OIL	1.47675	0.34931	Reject	
RNW does not Granger Cause GDP	0.89723	0.58843	Reject	No-causality
GDP does not Granger Cause RNW	2.48667	0.16327	Reject	
NAG does not Granger Cause CL	1.03409	0.51828	Reject	No-causality
CL does not Granger Cause NAG	3.18442	0.10652	Reject	

The null hypothesis which states that oil does not granger cause GDP was accepted at 5% level of significance while the hypothesis which states GDP does granger cause oil was rejected. This implies that it is GDP that leads to the consumption of oil as source of electricity. Also, the null hypothesis which states that coal does not granger cause GDP was rejected, so also no causality existed between hydroelectricity, natural gas, renewable resources of energy and GDP.

4.2 Regression Analysis

Table 5: The Results of Regression Analysis

Variable	Coefficient	Std. Error	t-statistic	Prob
C	-12.17784	1.660538	-7.333672	0.0002
LOG(CL)	-0.163069	0.074048	-2.202215	0.0635
LOG (HYD)	0.388114	0.137505	2.822534	0.0257
LOG(NAG)	0.856334	0.093184	9.189754	0.0000
LOG(OIL)	-0.033812	0.096377	-0.350835	0.7360
R-squared	0.994979		Mean dependent var	11.97828
Adjusted R-squared	0.0992110		S.D dependent var	0.786839
S.E of regression	0.069893		Akaike info criterion	-2.189352
Sum squared resid	0.034196		Schwarz criterion	-1.987308
Log Likelihood	18.13611		F-statistic	346.7726
Durbin-Watson stat	3.396146		Prob(F-statistic)	0.000000

4.2.1 Coefficient of Determination

The result of the regression analysis (table 4) shows that R^2 of 99 per cent is an indication of fitness of the regression line. This means that 99.4% variation in the dependent variable is explained by the independent variables which are coal, hydroelectric, natural gas and oil sources of electricity.

4.2.2 Coefficient of Variables

The coefficients of hydroelectricity and natural gas are 0.38 and 0.85. This means that 1 percent increase in hydroelectric and natural gas sources of energy consumption will raise gross domestic product (GDP) by 0.38 and 0.86 percent respectively. This implies that the consumption of hydroelectric and natural gas sources of electricity are positively related to gross domestic product (GDP). Also, the coefficient of coal and oil are -0.16 and -0.03 that means 1 percent increase in coal and oil sources of energy consumption will decrease Gross Domestic Product (GDP) by 0.16 and 0.86 percent respectively.

Data gotten for hydroelectric sources for this study is similar to that of renewable sources. To avoid perfect multi co-linearity problem, one of the variables (hydroelectric sources) was used to run the regression. Also, the reason we log values is to give the variables similar/scale values.

4.2.3 Significance of Variables

Table 4 also shows the estimated results of the ordinary least square (OLS) regression analysis. The significant variables in this analysis are hydroelectricity and natural gas with t-statistic values of 2.8 and 9.1 and probability values of 0.0257 and 0.0000 respectively. Using probability; the variables LOG(CL), LOG(HYD), LOG(NAG) were all significant at 10%,5%, and 1% respectively. This implies that coal, hydroelectric, natural gas and oil source of electricity were variables that contribute to the growth of the Nigerian economy.

4.2.4 Durbin Watson (DW)

The DW measures for the presence of autocorrelation in the model. However, it was noticed that there exists a negative serial correlation since the DW Statistic observed in the model is approximately 3.4.

4.2.5 F Statistics

The F-value calculated is 346.7 with a probability of 0.00002. This shows that it is statistically significant at 1 per cent level. This basically means that the model simultaneously explains the variations in the dependent variable. Thus, the model has a good fit.

4.3 CAPACITY UTILIZATION

Table 6: Result of Granger Causality Test

Null Hypothesis	F statistics	Probability	Decision	Causality
CL does not Granger Cause CU	0.25235	0.97225	Reject	No causality
CU does not Granger Cause CL	1.24040	0.38597	Reject	
HYD does not Granger Cause CU	7.73080	0.00421	Accept	Bi-directional
CU does not Granger Cause HYD	4.77838	0.01910	Accept	
NAG does not Granger Cause CU	2.13262	0.14984	Reject	Unidirectional
CU does not Granger Cause NAG	9.07655	0.00246	Accept	
OIL does not Granger Cause CU	20.1380	0.00014	Accept	Unidirectional
CU does not Granger Cause OIL	1.23503	0.38830	Reject	

Source: Computed from data analysis (2013)

This study found no causal link between Coal sources and capacity utilization, (thereby rejecting the null hypothesis), due to the probability values of 0.97 and 0.38. There is a bi-directional causal relationship between Capacity utilization and hydroelectric sources (i.e accepting the null hypotheses at 1% and 5%) as probability values are is 0.00421 and 0.01910. This implies that consumption of hydroelectric source of electricity leads to capacity utilization. There exists a unidirectional relationship between natural gas sources and capacity utilization. The null hypothesis is accepted at 1% (as prob is 0.00246). The null hypothesis which states that oil sources does not granger-cause capacity utilization is accepted at 1% (i.e probability value of 0.00014). This implies that capacity utilization is the one that granger cause oil sources i.e capacity utilization will enhance the use of oil sources. Hydroelectric sources have the same data as renewable sources therefore there exist a bi-directional relationship renewable sources and capacity utilization at 1% and 5% (as probability is 0.00421 and 0.01910).

4.4 Summary

This study investigated the econometric analysis of electricity consumption, capacity utilization and Nigeria's economic performance. Augmented Dickey Fuller (ADF) test was conducted to determine the properties of variables used in the study and also to test the stationarity. The result of the unit root test showed that the variables were either stationary at levels or at first difference. The paper also adopted the Granger causality test to establish the causal link between RGDP and coal, hydroelectric, natural gas and oil sources. The results of Granger Causality test showed a uni-directional relationship between oil source of electricity consumption and RGDP, no causality was found between GDP and other variables.

The significant variables in ordinary least square analysis (OLS) are coal, hydroelectricity and natural gas at 10%, 5% and 1% respectively. The R^2 of 99 per cent shows the total variation in regressand being explained by regressors. The Durbin Watson statistics of 3.4 implies a negative serial correlation.
The results of ordinary least squares technique show positive relation between RGDP hydroelectricity and natural gas. This means that one per cent increase in both hydroelectricity and natural gas will raise GDP by 0.38 and 0.86 percent respectively. The study also found that that hydroelectricity and natural gas are those sources of electricity consumption in Nigeria.

5.0 Conclusion and Recommendations

5.1 Conclusion

This study investigated the econometric analysis of electricity consumption, capacity utilization and economic growth in Nigeria from 1976 to 2011. The study concluded that hydroelectricity and natural gas were those sources that contributed to electricity consumption in Nigeria. Moreso, the causality results revealed a unidirectional relationship existed between oil sources and RGDP.

For capacity utilization, the results found a bi-directional relationship between capacity utilization and hydroelectric sources, capacity utilization and oil sources, capacity utilization and renewable resources, uni-directional relationship between capacity utilization and natural gas.

5.2 Recommendations

Based on the findings of this study, the followings are therefore recommended:

- The findings of this study emphasized the consumption of electricity as a prerequisite for
- achieving higher economic growth in Nigeria.

- The causality results for capacity utilization imply that the Nigerian industries should engage more in the consumption of hydroelectric, natural gas and oil sources of electricity to bring about increased efficiency in production activities, capacity utilization and growth. Also, abundant energy generated from biomass and solar can be meaningfully introduced into the nation's energy mix through the development of comprehensive program.

- Ministry of power and energy of Nigeria may continue to exploit the possibilities of renewable energy and more use of coal for electricity generation as it can reduce reliance on hydroelectric sources of electricity. Renewable energy source and alternative source of electricity generation may change the power structure of Nigeria. Renewable energy technology has an enormous potential to solve electricity problem in Nigeria. The energy provided by the sun (solar energy) is many times greater than the current electricity demand. The wind, waves and tides have a large potential as well. It is to be understood that renewable energy may be the one of the vital source of future electricity supply.

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