Sectoral Consumption of Non-Renewable Energy and Economic Growth in Nigeria

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Abstract: *Most studies on energy consumption and economic growth are mostly on the relationship between aggregate energy consumption and economic in Nigeria. However, the results of few studies that disaggregate energy consumption could be misleading. They could have identified which sector's energy consumption contributes more to economic growth in the economy. This study therefore contributes to existing literatures by examining the impact of sectoral consumption of non-renewable energy on economic growth in Nigeria. Descriptive statistics in the form of pie chart and error correction mechanism were employed to analyse time series data on non-renewable energy in the form of oil, gas, electricity and coal consumed by industrial sector, agricultural sector, transport sector, commercial and residential sector in Nigeria. The study revealed that the residential sector consumed more energy in Nigeria than other sectors. The ECM results further revealed that all the variables contribute significantly to economic growth in Nigeria. But the residential sector was identified to contribute more to economic growth than other sectors. The study finally recommends that, to drive economic growth in Nigeria, policies aimed at encouraging the industrial sector should be formulated and implemented to encourage energy consumption by industrial sector in Nigeria.*

Keywords: *Energy consumption, Economic growth.*

JEL CODE: Q43, E21, O47

I.INTRODUCTION

Energy is widely regarded as a propeller of any economic activity and indeed industrial production. Therefore, high grade energy resources will intensify the impact of technology and create tremendous economic growth. Ojinnaka (1998) argued that the consumption of energy is proportional with the national product. Hence, the scale of energy consumption per capita is an important indicator of economic modernization. In general countries that have higher energy consumption are more developed than those with low level of consumption (IAE, 2015).

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. However, some energy economists contend that energy consumption cannot stimulate economic growth given that the small fraction of energy usage is used in the production process (Santosh, 2008).

Government of Nigeria has shown some efforts over the years to increase energy consumption by key sectors. The major objective is to improve the productive capacity of the sector to meet the expected economic growth of the country. Statistical evidence has shown that there is slight increase in the total energy consumption in Nigeria (see figure 1 below). The fitted regression line shows an increase with a positive slope of about 88%. However, despite government efforts to improve on the energy demand of the country over time, the growth rate of the country's GDP has shown continuous fall over the years. The fitted regression shows a negative slope and its contribution over time is highly insignificant (see figure 2 below).

From figure 1 and 2, it is clear that the growth rate of energy consumption is more than that of economic growth in Nigeria. Given the importance of energy to the economy, we expect that as energy consumption increases there should be a proportionate increase in economic growth over time.

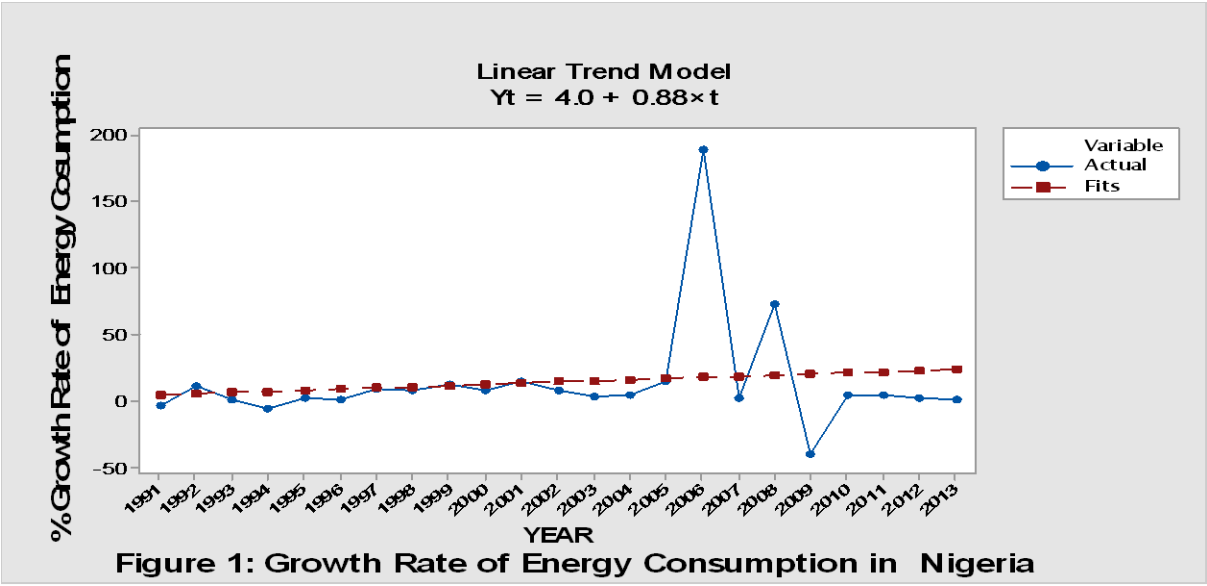


Figure 1: Growth Rate of Energy Consumption in Nigeria

Source: Authour's computation using Minitap 17.0

A contrary trend was observed on the growth rate of GDP over the years. Evidence has shown that there is a fall in the growth rate of GDP in Nigeria (see figure 2 below).

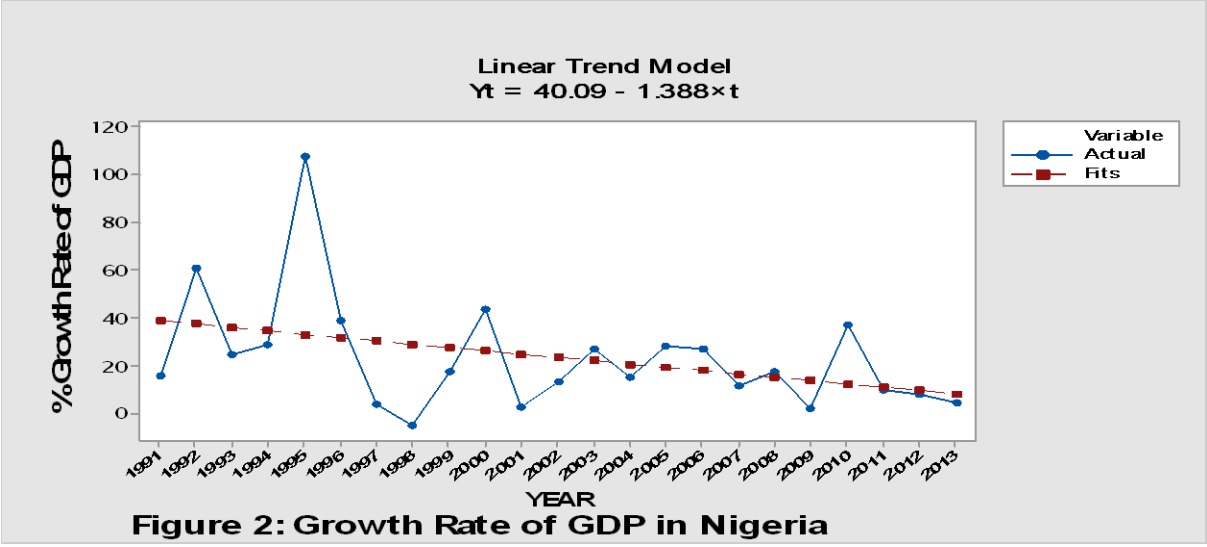


Figure 2: Growth Rate of GDP in Nigeria

Source: Authour's computation using Minitap 17.0

Attempts by energy experts to give reasons to this problem in Nigeria, Olusegun (2008), Gbadebo and Okonkwo (2009), Orhewere and Harry (2011), Akomolafe, Danladi and Babalola(2012), Olumyiwa(2013), Richard, Victoria and Olaoye(2013) studied energy consumption and economic growth in Nigeria. Their studies mostly focused on the relationship without identifying the consumption pattern and the contribution of energy consumption by different sector on economic growth (GDP) in Nigeria. Studying energy consumption on the aggregate may not tell which sector actual contribute more than the other. By implication their result may be misleading.

Taking congnisance of the implication of studying relationship between consumption and economic growth as suggested by Kraft and Kraft (1978), Akarca and Long (1980), Stern (`1999), Sari and Soytas (2008) Altinay and Karagol (2005), Shaari and Hussain and Ismail (2012). Twerefou, et'al (2007), Qazi, Ahmed and Mudassar (2012), Ziramba (2009) and Philip (2013), one could conclude that little or no studies has been conducted on energy consumption pattern and contribution of energy consumption by different sector on economic growth in Nigeria.

As part of contribution to existing knowledge, this study examined energy consumption pattern and contribution of energy consumption by different sector on economic growth in Nigeria. This will reveal which sector contributes

more. It finally analyses the contribution of energy consumption by individual sector on economic growth in Nigeria.

II. LITERATURE REVIEW

Even though the relationship between energy consumption and output growth has been a well-studied topic over the past three decades, the evidence is still controversial. The literature has extensively evaluated the nature of temporal causality between energy consumption and economic growth or employment. However, empirical evidence of these studies is mixed, ranging from bi-directional or unidirectional causality to no causality. These studies in the literature generally have no consensus judgment due to different countries or different time within the same country.

The pioneering study of Kraft and Kraft (1978) provides evidence in support of unidirectional causality running from gross national product (GNP) to energy consumption for the case of the U.S. over the period 1947-1974. The results imply that energy conservation policies might be enforced without affecting GNP growth. Nevertheless, Akarca and Long (1980) failed to obtain causality between energy consumption and GDP when the period is shortened. They argued that Kraft and Kraft's study could suffer from temporal time period instability.

Masih and Masih (1996) in a multivariate framework examined the relationship between total energy consumption and real income of Asian economies such as India; Pakistan; Malaysia; Singapore; Indonesia; Philippines; Korea; and Taiwan. Energy consumption was found to be neutral with respect to income for Malaysia, Singapore and Philippines, unidirectional causality existed from energy consumption to GNP for India, e xactly the reverse for Indonesia and mutual causality was present for Pakistan.

Erbaykal (2008) examined the relationship between disaggregated energy consumption and economic growth with evidence from Turkey. A time series data on energy consumption and economic growth was analysed using the Auto Regressive Distributed Lag (ARDL) Bounds test developed by Pesaran at'al (2001). The bounds test revealed the existence of cointegration relationship between the variables. Cheng (1995) had established a unidirectional influence from economic growth to energy consumption but Asafu-Adjaye (2000) found causality in the reverse direction.

Ghosh (2006) using cointegratioin and error correction modeling approach found the existence of a long-run equilibrium relationship between total petroleum products consumption and economic growth in India for the period of 1970-71 to 2001-02.

Several researchers have since joined the debate, with some who have either confirmed or contradicted Kraft-Kraft's results. There are cases where unidirectional Granger causality was found to be running from energy use to economic growth. These studies include the Philippines (Yu and Choi, 1985), India (Masih and Masih, 1996), Singapore (Glasure and Lee, 1997), Indonesia (Asafu-Adjaye, 2000), and in the cases of France, West Germany, Japan, and Turkey by Soytas and Sari (2003). In some other works, an opposite unidirectional causality running from economic growth to energy use was found by Cheng and Lai (1993) for Taiwan.

Time series data between 1971-2010 on GDP per capita, electricity consumption, per capita foreign direct investment and total energy in Nigeria was employed to examine the relationship electricity consumption and economic growth. The result of the granger causality test shows two ways causality between electricity consumption and GDP, a one way causality running from foreign direct investment to GDP, electricity consumption to foreign direct investment and energy used to foreign direct investment (Akomolafe, Danladi and Babalola, 2012).

The impact of petroleum on economic growth in Nigeria using time series data between 1981 to 2011 was examined by Baghedo and Atima (2013). The variables employed were GDP, oil revenue, corruption perception index and foreign direct investment in Nigeria. The error correction result revealed that all the explanatory variables contributes significantly to GDP in Nigeria.

Olumuyiwa (2013) examined the interaction between economic growth, domestic energy consumption and energy prices in Nigeria. The error correction method was employed to measure the interaction between per capita energy consumption, per capita real Gross Domestic Product and domestic energy prices. The three variables were specified as endogenous variables. The models were specified having each variable influencing the other in a system of equations. The result revealed strong interactions between variables.

Richard, Victoria and Olaoye (2013) examined the relationship between electricity consumption and economic growth in Nigeria. The Granger causality in quartiles test was used as the estimation technique. It was discovered that causality runs from electricity consumption to economic growth in Nigeria.

Further examination of the nexus between energy consumption and economic growth nexus with evidence from Nigeria was conducted by Aguegboh and Madueme (2013). The vector auto regression model and the co-integration technique were adopted. Their study contradicts other studies on energy consumption and economic

growth in Nigeria. A unidirectional causality was observed between petroleum consumption to GDP, gas consumption to GDP and capital to GDP. Also, the impulse response result shows that energy consumption does not contribute to economic growth in Nigeria. On the contrary, capital formation contributes to economic growth as opposed to labour force that does not contribute to GDP in Nigeria.

Bamidele and Mathew (2013), examine energy consumption and economic growth nexus in Nigeria. The error correction mechanism was used to analyse the influence of total energy consumption, consumer price index, monetary policy rate, credit available to private sector on economic growth in Nigeria. The result of the study revealed that all the explanatory variables significantly influence output growth in the short-run.

To sum up the reviewed research papers, it gives different direction and casual relationship between energy consumption and GDP. Little or no study exists on the trend and pattern of energy consumption in Nigeria. Also, no study has attempted to examine the contribution of energy consumed by various sector on economic growth in Nigeria.

III. METHODOLOGY

In this study, we have tried to find out energy consumption pattern and the contribution of energy consumption by different sector on economic growth in Nigeria using data from 1990 to 2013. The employed the use of charts to describe the distribution of energy consumption among various sectors. We have used Error Correction Mechanism (ECM) to find out the contribution of each sector energy consumption on economic growth in Nigeria. The variables were estimated in their log form. The double log was used to examine the degree of response or the elasticity of the variables. Most variables were tested against unit root using the Augmented Dickey Fuller statistic. A multiple regression model was formulated and the Error Correction Mechanism as used by Bamidele and Mathew (2013) was applied to the regression model below:

$$\ln GDP_t = \alpha + \beta_1 \ln ENCI_t + \beta_2 \ln ENCA_t + \beta_3 \ln ENCT_t + \beta_4 \ln ENCC_t + \beta_5 \ln ENCR_t + \beta_6 \ln INV_t + U_{it} \quad - - 5$$

GDP= Gross Domestic Product it is used as proxy for economic growth, ENCI = energy consumption by industrial sectors over time, ENCA = energy consumption by agricultural sectors over time, ENCT = energy consumption by transport sector over time, ENCC = energy consumption by commercial sectors over time, ENCI = energy consumption by industrial sectors over time, INV = Investment, U_{it} are the error term over time. α and βs are the intercept and slope coefficients and t is the time periods.

The study employed secondary data. Data were collected from 'Energy Information Administration (EIA)' and International Energy statistics website which is the official website of the US Government. As well as many secondary data are collected from the official website of the Central Bank of Nigerian (CBN).

IV. EMPIRICAL RESULT

Sector Energy Consumption

Figure 2 shows the distribution of energy consumption by various sectors in Nigeria. It was estimated that residential sector accounted for about 76.9% of the energy consumed in Nigeria while the industrial, transport sectors, Agric and Commercial accounted for 12.1%, 10.6%, 0.1% and 0.3% respectively.

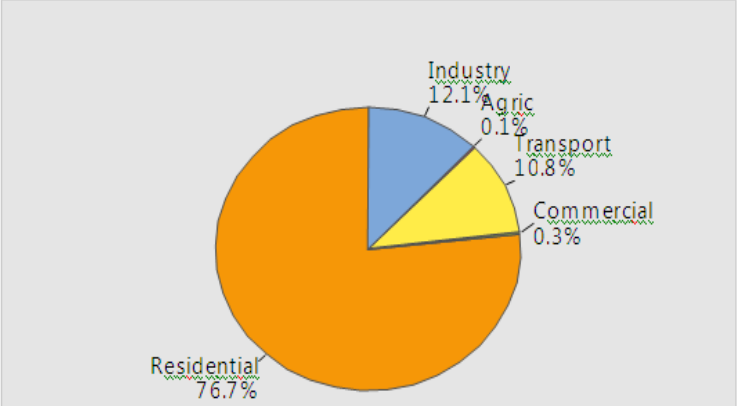


Figure 2: Total Energy Consumption by Sector in Nigeria

Source: Author's computation using Minitap 17.0

As the economy of the country grows, and the economy gets more industrialized, it is expected that the industrial sector will account for a larger percentage of the energy consumption. The percentage of energy consumption by industrial sector is not significant to drive economic growth in Nigeria.

Relating Energy Consumption and GDP in Nigeria

From different studies it has been found that many developed as well as developing countries have consumed higher energy resources while achieving rapid growth in GDP. In the case of Nigeria, the trend analysis has shown that the growth in GDP is not proportionate with the growth in energy consumption. That is when the growth rate of energy consumption is rising, GDP growth rate is falling.

In order to find out the relationship between energy consumption and GDP, this study examined the contributions of energy consumption by sectors on economic growth in Nigeria. Also, analysis was made on the relationship between total energy consumption and economic growth in Nigeria. The results are presented below:

Table 1: Unit Root Test Result

Variable	ADF Statistic	Critical value at 5 Percent	Prob.	Remarks
GDP	-4.061022	-3.020686	0.0015	I(1)
ENCI	-5.141767	-3.004861	0.0005	I(1)
ENCA	-8.033752	-3.004861	0.0000	I(1)
ENCT	-5.369840	-3.004861	0.0003	I(1)
ENCC	-6.053868	-3.004861	0.0001	I(1)
ENCR	-4.566606	-3.004861	0.0017	I(1)
INV	-5.365478	-3.012363	0.0003	I(1)

Source: Author's computation using Eviews7.0

The result in table 1 above provides evidence that all the variables employed in this study are stationary in their first difference.

Using differenced variables for the estimation of regression would suggest a loss of valuable information about the long-run equilibrium between variables. Therefore there is need to integrate the short-run dynamics with the long-run equilibrium using the error correction mechanism (ECM). The ECM reveals the ability of the model to restore or not restore to equilibrium path. In doing this, a co-integration test was conducted using the Johansen co-integration test.

In the Johansen co-integration test results in table 2 below, the Trace test indicates 6 co-integrating equations at 5 percent critical level, while the Max-Eigen value test indicates 5 co-integrating equations at the 5 percent critical level.

Table 2. Cointegration Test Result

Unrestricted Cointegration Rank Test (when GDP is used)

Null Hypothesis	Trace Statistic	Critical Value At 5 Percent	Null Hypothesis	Maximum-Eigen Statistic	Critical Value at 5 Percent
$r = 0^*$	256.0037	125.6154	$r = 0^*$	84.90877	46.23142
$r \leq 1^*$	171.0949	95.75366	$r \leq 1^*$	72.30423	40.07757
$r \leq 2^*$	98.79066	69.81889	$r \leq 2^*$	37.13822	33.87687
$r \leq 3^*$	61.65244	47.85613	$r \leq 3^*$	28.78819	27.58434
$r \leq 4^*$	32.86425	29.79707	$r \leq 4$	16.82816	21.13162
$r \leq 5^*$	16.03609	15.49471	$r \leq 5^*$	15.36795	14.26460
$r \leq 6$	0.668132	3.841466	$r \leq 6$	0.668132	3.841466

Note: r represent number of cointegrating vectors. Trace test indicates 6 cointegrating equations at the 0.05 level while max-eigenvalue test indicates 5 cointegrating equations. *Denotes rejection of the null hypothesis at the 0.05 level. Source: Author's computation using Eviews 7.0

Table 3: Parsimonious Error Correction Model

Dependent Variable: D(LNGDP)
Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.245552	0.117818	2.084158	0.0055
D(LNENCI)	0.204187	0.088392	2.310017	0.0051
D(LNENCA)	0.071064	0.023142	3.070780	0.0138
D(LNENCT)	0.389757	0.133720	2.914725	0.0061

D(LNENCC)	0.014250	0.004131	3.449528	0.0018
D(LNENCR)	0.431956	0.195777	2.206367	0.0023
D(LNINV)	0.259895	0.105762	2.457357	0.0026
D(LNENCA(-2))	0.260120	0.118130	2.201980	0.0083
D(LNENCC(-2))	0.012130	0.002130	5.694836	0.0001
D(LNENCR(-2))	0.416545	0.182046	2.288130	0.0320
D(LNINV(-2))	-0.645702	0.596622	-1.082263	0.4749
ECM	-0.628912	0.172091	-2.492356	0.0028
R-squared	0.878073	F-statistic		61.80040
Adjusted R-squared	0.390364	Prob(F-statistic)		0.000003
		Durbin-Watson stat		2.162712

Source: Author's computation using Eviews 7.0

From table 3 above, the t values of the independent variables (ENCI, ENCA, ENCT, ENCC, and ENCR) in the parsimonious error correction model has turned out to be significant at 5% level and the variables are positively signed. Hence we observed that, a 1% increase in ENCI on the average will bring about 20% increase in economic growth in Nigeria, a 1% increase in ENCA on the average will bring about 7% increase in economic growth in Nigeria, a 1% increase in ENCT on the average will bring about 39% increase in economic growth in Nigeria. Also, a 1% increase in ENCC on the average will bring about 1% increase in economic growth in Nigeria and a 1% increase in ENCR on the average will bring about 43% increase in economic growth in Nigeria. it finally revealed that investment contributes about 26% to GDP in Nigeria. This study has shown that residential and transport sector contribute more to economic growth in Nigeria.

The regression result in table 4 below

Table 4: Relationship Between Total Energy Consumption and Economic Growth in Nigeria

Dependent Variable (LNGDP)

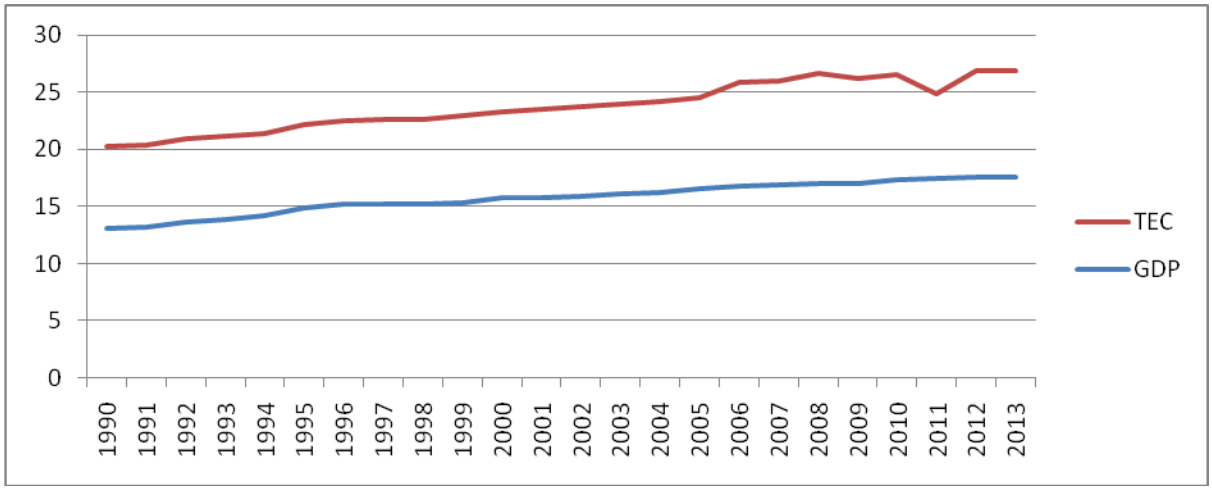
Variable	Coefficient	Standard Error	t value	Prob	R^2	Adjusted R
Constant	0.575697	0.162192	3.549478	0.0018	0.634951	0.618358
LNTEC	0.124673	0.020154	6.186018	0.0000		

Source: Author's computation using Eviews 7.0

Table 4 presents the double log regression result between total energy consumption (TEC) and economic growth in Nigeria. We can observe that there is a moderate R^2. This shows evidence that relationship exists between GDP and TEC. The t value of the dependent variable has turned out to be positive and significant at 5% percent level. Hence we can assume that economic growth increases with increase in energy consumption in Nigeria. In other words, a one percent increase in total energy consumption leads to about 12 percent increase in economic growth in Nigeria. Here we can conclude that economic growth in Nigeria can be determined by energy consumption in Nigeria.

The trend analysis in figure 9 (shows a proportionate increase between GDP and TEC) as well as the regression result shows that there is a positive relationship between economic growth and total energy consumption in Nigeria.

Figure 3: Total Energy Consumption and GDP in Nigeria



Source: Author's computation using Eviews 7.0

Table 5: Causality test result between GDP and Energy consumption

Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
LNTEC does not Granger Cause LNGDP	22	6.86761	0.0077
LNGDP does not Granger Cause LNTEC		4.42835	0.0181

Source: Author's computation using Eviews 7.0

Figure 4 above present the causality test result between GDP and total energy consumption in Nigeria. The result revealed bidirectional causality between GDP and energy consumption in Nigeria. It is evidenced that both variables cause the behavior of each other. Therefore, energy consumption should be considered important in driving economic growth in Nigeria.

V. CONCLUSION AND RECOMMENDATIONS

Conclusion

From the chat analysis as well as the error correction mechanism and the regression result, it is clear that there is a positive relationship between energy consumption and economic growth in Nigeria. The study also identifies investment as another contributor of economic growth in Nigeria. Further analysis on the contribution of sectors energy consumption on economic growth revealed residential sector as the major consumer of energy in Nigeria. Industrial sector contribution was second followed by transport sector.

This study supports the Keynesian view that increase in aggregate demand will increase economic growth of a country. Also, in addition to other studies on energy economics that only looked at aggregate energy consumption and economic growth, this study has succeeded in determining the contributions of each sector's energy consumption on economic growth in Nigeria. As evidence from other developing and developed countries, the more the demand for energy, the more the country's economy developed.

Recommendations

For a more rapid economic growth and to improve on the energy intensity of the country, the government of Nigeria should develop policies in the form of tax relieve or tax reduction that will create an enabling environment for industrial activities. This may increase the demand for energy for productive activities that could stimulate economic growth. Agricultural sector can still maintain the mainstay of the Nigerian economy if energy can be made available to improve agricultural activities. Energy such as natural gas are major input for the production of farm inputs such as fertilizer, insecticides, preservatives etc. improvement in this sector could feed the industrial sector for better productivity and to bring about economic growth and development in Nigeria.

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