

MEASURING ENERGY EFFICIENCY IN NIGERIA: ENERGY INTENSITY AND ENERGY-GDP ELASTICITY APPROACH

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ABSTRACT

Energy intensity and Energy-GDP are both measure of efficiency in the use of energy in economy. Most studies as discussed in the literature only exposed the effect energy consumption on economic growth in Nigeria. However, there is need to measure the how efficient energy was consumed. This study employed secondary data on energy consumption and economic growth sourced from IEA of US. The study adopted a descriptive analysis in the form of trends and chats. The results show that energy efficiency in Nigeria has been on the decrease within the understudy period. Also, the major proportion of energy consumed in Nigeria is by household. By implication, most energy consumed are not on productive purpose therefore, economic growth be affected. The study finally recommend that, knowing the importance of industrial activities in economic growth, Policies that could make credit available for industrial activities should be formulated and implemented. Also, import substitution industrial policies and tax relieve could stimulate industrial activities and increase the demand for energy for productive activities. Feedback industrial policies can also be encouraged by promoting the agricultural sector with the aim of making raw materials available to the industrial sector.

KEYWORDS

Energy intensity, energy-GDP elasticity, energy consumption, economic growth Energy.

JEL Classification Code: Q43, C22, O43

INTRODUCTION

The significance of energy consumption has been an issue of concern by energy economist across the globe. It has been emphasized that energy consumption has been very imperative to economic growth as capital and labour are. As such, increased energy consumption is perceived to lead to economic growth. Going by EIA (2015), increase in energy consumption is expected to increase economic growth. This argument was supported by the early works of Kraft and Kraft (1978), Yu and Choi (1985). However, it is expected that the effect of energy consumption on economic should be reflected on the energy intensity of any country.

Energy intensity is an indicator to show how efficiently energy is used in the economy. It is defined as the ratio of energy consumption to another metric, typically Gross Domestic Product (GDP) in the case of a country's energy intensity. Sector-specific intensity may refer to energy consumption per sector; per household, per commercial sector, industry and transport (IES, 2015). In other words, energy intensity is the amount of energy used or consumed per work units (Shegene, 2007). However, since 1990, Nigeria energy intensity has been on the decrease. That is, it is below unity and is expected to continue to decrease given the prevailing situation in the world oil market and the domestic price of petroleum product. Going by the poor energy supply in the country, most industries may be discouraged by the high cost of production (IEA, 2015).

The indicator of Energy-GDP (Gross Domestic Product) elasticity, that is the ratio of growth rate of energy to the growth rate of GDP, captures both the structure of the economy as well as the efficiency (Santosh 2008). The energy-GDP elasticity in Nigeria has been less than unity (IEA, 2015). This could be attributed to several factors, some of them being demographic shifts from rural to urban areas, structural economic changes towards less energy industry or movement or close down of large industries as a result of high social overhead cost from electricity, impressive growth of service improvement in efficiency of energy use and inter fuels substitution.

The energy sector in Nigeria has been receiving high priority over the years. The government of Nigeria in 2003 recognized the fact that under-performance of the energy sector can be a major constraint in delivering a growth of 10% GDP during the year. It therefore, called for acceleration of the energy reforms process and adoption of an integrated energy policy in 2003. The comprehensive energy policy captures policies on oil, gas, electricity and coal. In addition to the specific objectives of the policy, it was aimed at increasing the energy intensity of the country. By so doing the Energy-GDP elasticity will improve.

A lot of studies have been conducted on energy consumption, but most has been on the relationship between energy consumption and economic growth of different countries (see Kraft and Kraft, 1978; Akarca and Long, 1980; Stern, 1999; Sari and Soytas, 2008; Altinay and Karagol, 2005; Shaari, Hussain and Ismail, 2012; Twerefou et al, 2007; Qazi, Ahmed and Mudassar, 2012 and Ziramba, 2009). Most studies did not recognize the importance of measuring the energy intensity of a country. These lapses were identified as contribution to existing knowledge on scholarly research on energy consumption of a country.

Attempts by energy experts to give reasons to this problem in Nigeria, 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 importance of revealing the energy intensity to GDP of Nigeria and to establish the energy-GDP elasticity of Nigeria. This indicator captures the structure of the economy as well as the efficient use of energy. The study examined the trend of energy-GDP elasticity and Energy intensity of Nigeria.

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, exactly 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 et 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 cointegration 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 Soytaş 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 and the measurement of energy intensity in Nigeria.

METHODOLOGY

In this study, we have tried to find out the trend of total energy consumption in Nigeria from 1990 to 2013. This period is limited to the data on energy in Nigeria (see international Energy Statistics, 2015)

We have adopted the general trend analysis technique as used by Santosh (2008). The study also employed the use of charts to describe the distribution of energy consumption among various sectors. The least squares growth rate, r , was estimated by fitting a linear regression trend line to the logarithmic annual values of the variables in the relevant period. The regression equation takes the form

$$\ln X_t = a + bt \quad - \quad - \quad - \quad 3$$

which is equivalent to the logarithmic transformation of the compound growth equation;

$$X_t = X_0(1+r)^t \quad - \quad - \quad - \quad 4$$

In this equation, X is the variable, t is the time, and $a = \ln X_0$ and $b = \ln(1+r)$ are parameters to be estimated. The calculated growth rate is an average rate that is representative of the available observations over the entire time period. The study deals with secondary data. Data were collected from Energy Information Administration (EIA), International Energy statistics website which is the official website of the US Government and the official website of the Central Bank of Nigerian (CBN).

EMPIRICAL RESULT

Trend Analysis

Growth Rate of Energy Consumption

The growth rate of total energy consumption in Nigeria is given in figure 1. The consumption pattern was experiencing slight fluctuation between 1991 to 2000. The year 2001 started a

pickup of energy consumption to 2005. A record of a gradual growth rate was observed between 2001 and 2003 which continued to the year 2006 where a more rapid growth was experienced in Nigeria. This could be attributed to the implementation of the comprehensive energy policy of 2003. The year 2007 experienced a ridiculous fall in the growth of energy consumption in Nigeria. This was a period of transition in government which brought about political tension, fear of investors which led to fall in productivity. After 2007, the total energy consumption increased but at a decreasing rate. The increase could be attributed to the amnesty programme of the late President Yaradua's led administration. The growth rate in consumption for the period 1990 to 2013 in Nigeria was positive except the period 1994 and 2009. After the transition of 2009, there was an insignificant increase between 2010 and 2013. It can be said that the growth rate of energy consumption in Nigeria has been positive but not highly significant.

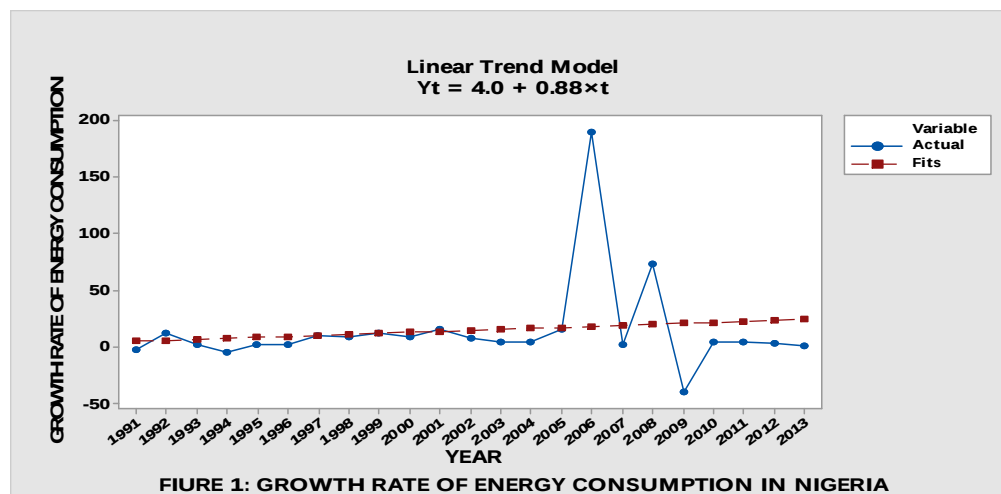


FIGURE 1: GROWTH RATE OF ENERGY CONSUMPTION IN NIGERIA

Source: Author's computation using Minitap 17.0

Sector Energy Consumption

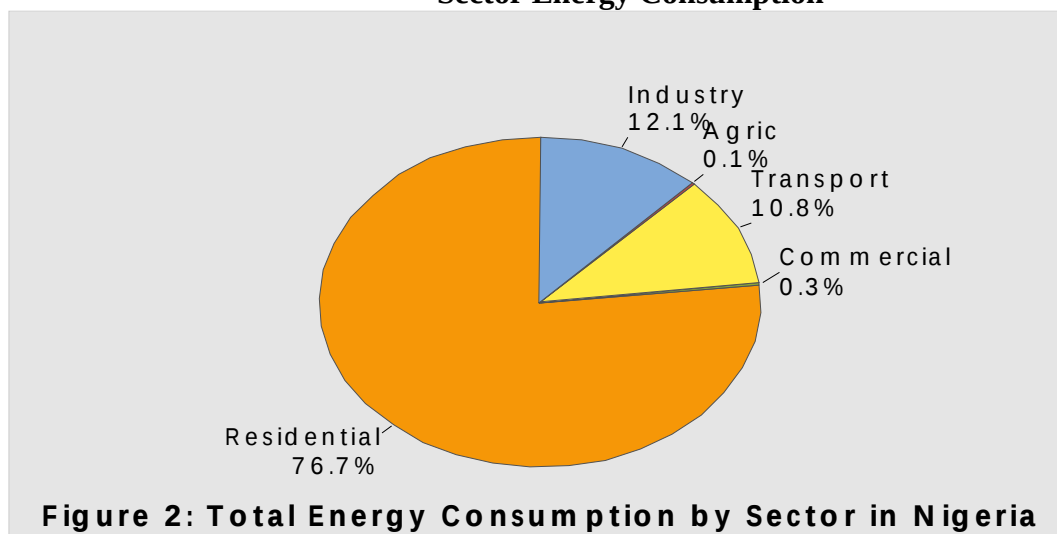
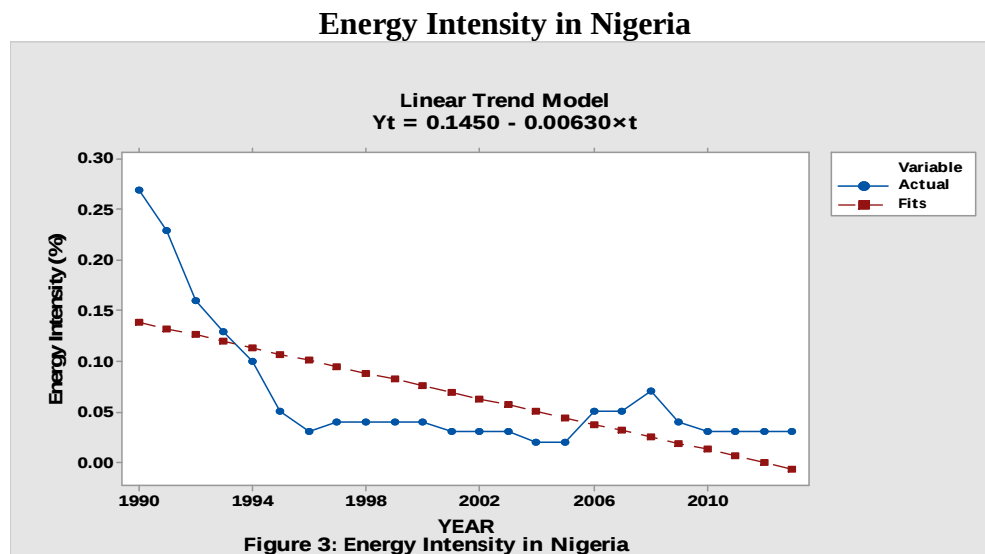


Figure 2: Total Energy Consumption by Sector in Nigeria

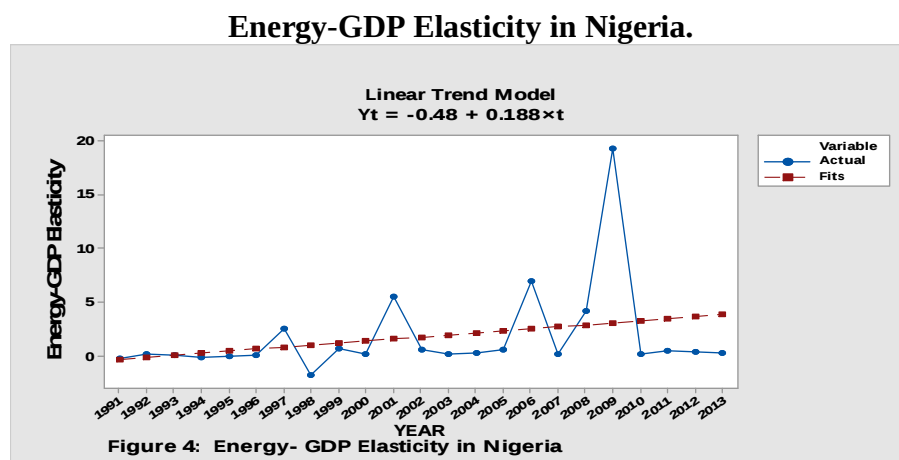
Source: Author's computation using Minitap 17.0

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. 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.



Source: Author's computation using Minitap 17.0

In figure 3, it is shown that Energy intensity in Nigeria has experienced a continuous decline over the years. This evidence shows that energy has not been efficiently used in Nigeria to promote growth in economic activities. This result is in line with the result in figure 2 which shows that energy is more consumed by residential sector than the industrial sector in Nigeria. The activities of industrial sector could drive economic growth than house hold consumption.



Source: Author's computation using Minitap 17.0

Figure 4 above shows the growth of Energy-GDP elasticity in Nigeria. The fitted regression line expresses a positive trend, indicating a slight growth over time. The actual growth rate was constant from 1991 to 1996 but started fluctuating from 1997 to 2009. The year 2009 experienced a more rapid growth rate in Nigeria. The drastic fall from 2009 could be as a result of uncertainty initiated by Petroleum Industry Bill (PIB) of July, 2009. Most multinational Final Investment Decision (FID) was put on hold. This fear continues till date. However, the fitted slope coefficient of about 19% shows that the growth rate is positive but insignificant to conclude that energy has been efficiently used in driving economic growth in Nigeria.

Conclusion and Recommendations

From the result of the study, we therefore conclude that energy has not been efficiently used in Nigeria. This is evidenced from the downward trend of energy intensity in Nigeria and the insignificant growth in the Energy-GDP elasticity. (see figure 3 and 4 above). For a more rapid economic growth and to improve on the energy intensity of the country, the government of Nigeria should encourage the activities of the manufacturing industries in Nigeria. Manufacturing industries are the prime movers of most economy in the world and the largest consumer of energy therefore the more the industrial activities the more efficient energy intensity will be. Policies that could make credit available for industrial activities, import substitution industrial policies and tax relieve could stimulate industrial activities and increase the demand for energy for productive activities. Feedback industrial policies can also be encouraged by promoting the agricultural sector with the aim of making raw materials available to the industrial sector.

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