



ECONOMIC LINKAGES BETWEEN, ENERGY CONSUMPTION AND POVERTY REDUCTION: IMPLICATION ON SUSTAINABLE DEVELOPMENT IN NIGERIA

Innocent OKWANYA^{1*}, OGBU Moses² & Abdulkareem ALHASSAN³

¹ **Department of Economics, Federal University Lafia, Nassarawa State, Nigeria**

² **Department of Economics University of Jos, Plateau State, Nigeria**

³ **Department of Economics, Federal University Lafia, Nassarawa State, Nigeria.**

***Corresponding author**

ABSTRACT

The aim of this paper is to investigate the relationship between total energy consumption and poverty rate in Nigeria. To achieve this purpose the study employs ordinary least square regression analysis and the cointegration analysis to test for the long run relationship. The study also use the Granger Causality test to ascertain if energy consumption Granger cause poverty or otherwise. The empirical results show that a long run co-integrated relationship exists between total energy consumption and poverty rate in Nigeria. The long-run co-integrating regression result reveals that if total energy consumption is increased by one percent poverty rate will decrease by 0.33 percent. We also found a strong causal relation which runs from total energy consumption to poverty rate in Nigeria. These findings clearly indicate that energy consumption has a significant impact on poverty rate in Nigeria. The study recommends that there is need for the government to make energy available for the citizens so as to make them self-reliant-thus increasing employment opportunities, income level and reduce poverty rate in Nigeria.

Keywords: Energy; poverty; causality; sustainable development.

INTRODUCTION

It was Adams Smith (1776) who said “No society can surely be flourishing and happy, of which by far the greater part of the numbers are poor and miserable” (Todaro & Smith, 2010). Poverty in sub-Saharan Africa is increasing despite efforts by the government and private organisations to reduce poverty. According to the World Bank (2013) reports, approximately 1.2 billion persons are living under \$1.2 a day of which sub-Sahara Africa accounts for one-third of the world’s poor. This figure shows that poverty still pose a threat to a large population of human race and is a global phenomenon that should be top in the agenda of most countries in the world.

In Nigeria for instance, poverty rate kept increasing in the face of an average growth rate of 2.4 per cent over the past 20 years (World Bank, 2012). Unlike in other parts of the world, such as China and South Korea, most of these growths have not been translated into sustainable development. This is because economic growth cannot be sustained where there is no meaningful investment on the provision of workable energy that will power industrialisation and skill development especially in the grassroots. According to the World Commission on Environment and Development [WCED], 1987) there is sustainable development when a nation is able to meet the needs of the present generation without compromising the needs of future generation. This should include among other things improving the welfare of the poor. Unfortunately, about seventy per cent of people living in Nigeria especially in the rural areas are poor and have little or no access to infrastructure, experience low productivity and low incomes (World Bank, 2013).

In the early 1980s and 1990s the focus in most academic literatures has been on growth as a measure to reducing poverty. But the experience of most of the developing world has shown that growth is not a cure for poverty (Morduch & Sicular 2002). This is partly due to the fact that some sector of the economy may

not be incorporated in the growth process. In addition, there cannot be sustainable growth in an economy in whose manufacturing and grass root sector is not engaged in real production. For instance, almost all finished product are imported. This means a loss of jobs and income to the country.

Presently, given the importance of eradicating poverty it is not surprising that the government of Nigeria have adopted other measures of tackling poverty. One popular method used is the poverty reduction programs. Poverty reduction programmes are aimed at achieving the Millennium Development Goals (MDGs) objectives (MDGs, 2001). Key objectives of the MDGs among others include the eradication of extreme poverty and hunger, reduce inequality and illiteracy level and improvement of basic health. A major approach adopted by most poverty reduction programmes is the conditional cash disbursement. Unfortunately this approach has not helped in reducing poverty. Studies shows that five out of every ten Nigerians still live in abject poverty, the gap between the poor and the rich is increasing each year and there is no improvement in the quality of health facilities provided to Nigerians (National Bureau of Statistics [NBS], 2012). Ibbih (2010) observed that cash disbursement to the poor is just a temporary measure with no lasting impact in curbing poverty. This calls for a paradigm shift in the way of tackling poverty.

Onakoya, Olatunde, Adejuwon and Odediario (2013) evaluated the relationship between energy consumption and economic growth in Nigeria. They found out that in the long run there is a positive relationship between energy consumption and growth but what remain unclear in their study is whether energy consumption has impact on the level of poverty in Nigeria or whether economic growth for the period of their study has translated into poverty reduction. There is a need to examine the linkage between energy consumption and poverty reduction. This is because the level of energy consumption arguably is an indication of growth in production level but not all economic growths lead to sustainable economic development. No adequate study has been carried out to determine the linkages between energy and poverty rate in Nigeria.

This paper is an attempt to link poverty with energy consumption, it is inspired to promote local development through investment in energy that will lead to a grassroots growth; sustainable economic development that will ensure income generation by the citizens. This study is significant on two fronts: firstly, there is very little study carried out on the relationship between energy consumption and poverty rate in Nigeria and secondly, the study provides a new direction on solving the problem of poverty in Nigeria by showing that the reduction of poverty in most cases is a gradual process that comes from productive activities where the poor can generate income.

The following research questions are raised in the study: (1) what is the relationship between energy consumption and poverty rate in Nigeria? (2) What are the measures that can be adopted to reduce the high rate of poverty in Nigeria? The aim of the study is to address two main issues namely: (1) Analyse the relationship between the rate of poverty and energy consumption in Nigeria; (2) Identify measures aim at reducing the poverty rate in Nigeria.

To achieve the stated objectives, this paper is organized into six sections. Following the introduction is an overview of poverty rate in sub-Saharan Africa in section 2. Section 3 is the theoretical framework and review of relevant literatures. Next is the model formulation in section 4. In section 5 we present the main findings of the data. This is followed by a summary and conclusion in section 6.

Poverty rate in Nigeria

Researchers have disagreed on the parameters that should be used to measure poverty. However, one common ground in defining poverty is that, poverty is a condition of being. It is a state where people have no sufficient income; insufficient food; lack access to good health care services, live in indigent shelter and poor environment; lack access to basic education and skills, infrastructures and are ignorant of their fundamental human rights (Barnes, 2010).

The above description depicts the situation of about 70 per cent of people living in Nigeria (NBS, 2013). The causes of poverty in Nigeria are numerous, some of which include lack of individual responsibility, bad government policy, corruption (Kilishi, Mobolaji, Yaru & Yakubu, 2013), subsidy removal (Okwanya, Ogbu & Migap, 2015) increase emphasis on export of primary products, inefficient agricultural practices, drought and poor crop yields, large percentage of the population still depend on subsistence farming for

survival and still engage the use of traditional crude method of agriculture with little or no access to better farming method. Combination of these and other factors tends to deepen poverty in Nigeria. This explains why poverty level is still on the increase despite increase in economic growth rate as can be seen in the diagram below. Poverty rate was on the increase throughout period from 1990 to 1999. Poverty rose from 43 percent to about 80 percent. We experience a drastic fall in the early period of democracy after which the rate of poverty rate was still increasing.

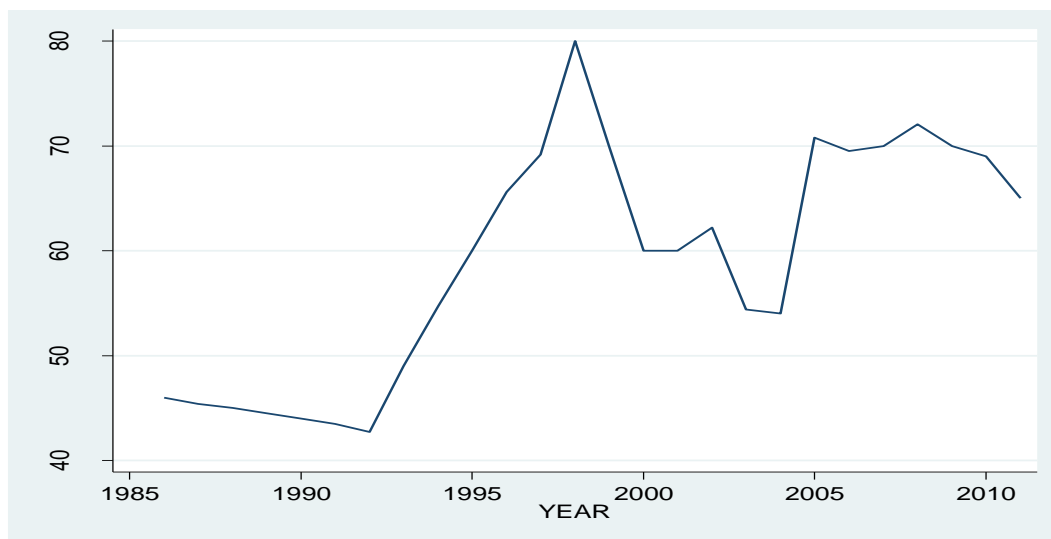


Fig 1. Trend in poverty rate

Source: National Bureau of Statistics (2013)

Poverty influences and determines the energy choices of people (Cecelski, 2000). In recent years developing nations have adopted the use of poverty reduction programs to address poverty. The poverty reduction program is part of the MDGs established through the United Nation Development Program (UNDP) with the aim of eradicating extreme poverty and hunger by 2015. Such programs include National Economic Empowerment Development Strategy (NEEDS) in Nigeria, Growth and Poverty Reduction Program (2006-2009) in Ghana. These programs are all geared at curbing poverty. The government of developing nations in collaboration with the UNDP has spent much money so as to achieve the objectives of the MDGs. Nigeria for instance, is still rated third on world poverty index with the largest number of poor (Omoh, 2014).

Despite money spent to reduce poverty through the various programs aimed at reaching the poor, one may wonder if these poverty reduction programmes are really ameliorating the state of the poor. Put differently, why is the poverty rate increasing in most sub-Saharan Africa countries? In Nigeria for instance, poverty reduction programs have not reduce poverty but rather have exacerbated poverty through inequality by making the rich richer (Ibbih, 2010). Clearly, most poverty reduction programs hardly reach a significant number of the poor because large number of the poor live in areas that are not accessible. In addition, it is quite difficult in real terms to identify the poor, because poverty is a relative term.

This is an indication that the problem of poverty cannot just be tackled by the transmission of funds to poor groups, but by providing enabling environment for innovation that is geared towards productivity and increase access to cheap energy. This research shows that the reduction of poverty in most cases is a gradual process that comes from empowering and building up a resource base where the poor can generate income. The study argued that poverty rate is reflected in the amount energy consumed. A nation with low energy consumption is an indication that a large percentage of the population are not productive

and/or earns little income such that they cannot afford the minimum amount of energy needed for survival.

Given the threat of global recession and the need to reduce dependence on government revenue, it is high time there is a change in the way governments of the sub-Saharan nations address the problem of poverty. Government should engage programs that will enable the people to empower themselves. The part to economic development means developing sufficient and efficient infrastructure that will support the citizens. This paper therefore attempts to address this issue by analysing whether there is a relationship between energy consumption and poverty in sub-Saharan Africa and if there is, propose an alternative measures to plummeting poverty rate in sub-Saharan Africa.

Theoretical Framework and Literature Review

This study adopts two theories to support its argument: the vicious circle of poverty and the optimal growth theory.

The vicious cycle of poverty theory maintained that individuals and societies are poor because they are trapped in a vicious cycle (Todaro & Smith, 2010). An individual is poor because he earns low income which leads to low consumption, which in turn leads to poor health and low productivity. The theory maintained that poverty is an endemic factor in a society that requires an external intervention for it to be eradicated. According to this theory, poverty is caused by failure in macroeconomic policies and misallocation of resources. People are poor because there is no incentive for economic growth, productivity and income generation. The theory states that to reduce poverty, macroeconomic policies geared towards growth, expanding employment, increase technology and improved institutional conditions should be imbibed in the economy.

Optimal growth theory is a neoclassical growth model popularised by (Solow, 1974). The optimal growth theory shows how effective combination of energy and other factors of production leads to economic growth and social welfare. The theory shows that capital, land labour as well as energy (resource endowment) play a vital role in economic growth. Thus, energy should be considered among other primary factors of production (Stern, 1997 and Spreng, 1993). Energy is the driver of growth in any economy (Kaufmann, 1994). The theory argued that energy is an indispensable factor of production because energy consumption increases with increase in production.

Several authors have used granger causality test to test whether energy consumption causes economic growth or the reverse, but they have provided diverging views on the matter. For instance, Erol and Yu (1987), Beenstock and Willcocks (1981), Hunt, Judge and Ninomiya (2003) observed that causality runs from GDP to energy consumption in most developed nations. On the contrary Pathan and Abbasi (2014) observed that in Pakistan electricity consumption granger causes GDP growth. Also, Yu and Choi (1985) found that in Japan and Philippine causality runs from energy to GDP. Yu and Jin (1992) test whether energy and GDP are cointegrated. They found that there is no relation between energy consumption and GDP.

Adhikari and Chen (2013) studied energy consumption and economic growth in 80 developing countries from 1990 to 2009. They used the panel cointegration and panel dynamic ordinary least square in their studies. They found out that causality runs from energy consumption to economic growth for high and middle income countries. While causality runs from energy growth to energy consumption in low income countries.

Onokoya, et al (2013) studied energy consumption and Nigerian economic growth for the period of 1975 to 2010. Using cointegration and ordinary least square techniques, they found out that with the exception of coal, there exist a positive relationship between total energy consumption and economic growth in Nigeria. They call for the government to diversify its source of energy for there to be meaning economic growth.

Nwosa and Akinbobola (2012) examined the nexus between energy consumption and sectorial output in Nigeria for the period of 1980 to 2010. They employ a bivariate vector auto-regressive (VAR) method in their analysis. The outcome of their study shows that while there is bi-directional causality between total

energy consumption and agricultural output, the causality between total energy consumption and service output is unidirectional. They recommended a sector specific energy policy that will ensure growth. The question that still remain unanswered is that why is poverty not reducing despite positive energy consumption and growth. By implication, it means that some sector(s) which arguably does not include majority of citizens is experiencing growth while sectors that employ majority of citizens remain stunted. Recent studies dealt elaborately on the relationship between GDP and energy consumption but no study have been carried out on energy consumption and poverty level especially as it relates Nigeria.

METHODOLOGY

The main objective of this research is to ascertain whether energy consumption affects poverty rate in Nigeria. The study employed yearly data of total energy consumption and poverty rate in Nigeria for the period of 1990 to 2011. The data for total energy consumption and poverty rate were obtained from the Central Bank of Nigeria (CBN) and the Nigeria Bureau of Statistics (NBS) respectively.

The study adopts the granger causality approach to test if there is any meaningful causal relationship between poverty rate and total energy consumption and if there is to determine the direction of the relationship (Engle & Granger, 1987). The granger causality is done by testing whether the lagged values of one variables significantly add to the explanatory power of a model which already includes lagged values of the dependent variables (Gujariti and Porter, 2009). All the variables are in logarithm form. The granger causality between energy consumption and poverty rate can be stated thus:

$$LPR_t = \alpha + \beta_1 LPR_{t-1} + \dots + \beta_n LPR_{t-n} + \phi_1 LTEC_{t-1} + \dots + \phi_n LTEC_{t-n} + \varepsilon_t$$

Or To test if PR Granger cause LTEC we have

$$LTEC_t = \alpha + \beta_1 LTEC_{t-1} + \dots + \beta_n LTEC_{t-n} + \phi_1 LPR_{t-1} + \dots + \phi_n LPR_{t-n} + \varepsilon_t$$

Where $LTEC_t$ is the logarithm of the total energy consumption for the period, LPR_t is the log of poverty rate for the period and ε_t is the error term

We test for Granger causality in both directions by testing the null hypothesis that the coefficients of ϕ s jointly equal zero. That is LTEC does not Granger cause LPR or otherwise. The F-test is use to ascertain whether causality exist between the two variables. For instance, if the F-statistics is significant for both equation it means causality runs from LTEC to LPR and from LPR to LTEC. If F-statistics is significant in the first equation but not in the second equation we can conclude that LTEC granger cause LPR. Or if F-statistics is not significant in both equation it means there is no causality between the two variables.

This paper assumes that total energy consumption affects the level of poverty in Nigeria. To achieve this objective, we employ the ordinary least square analysis and the long run cointegration regression. For the ordinary least square regression, we ascertain the impact of total energy consumption on poverty rate. We also run a regression of the impact of other major factors that tend to affect poverty rate in Nigeria such as gross domestic product and adult literacy rate.

The long run cointegration regression is us to determine the long-run relationship between the total energy consumption and poverty rate in Nigeria. According to Engel and Granger (1987), although the individual variables may not be stationary, it is possible that their linear combination may be stationary. Thus, reducing the tendency to have a spurious regression result. The model for this study is specified thus:

$$LPR_t = \alpha + \beta LTEC_t + \varepsilon_t$$

Where ε is the classical error term. If LPR and LTEC are cointegrated it means that both PR and LTEC share some stochastic trend and a linear combination of them is assumed to be stationary and therefore ε_t will be stationary.

The study conducted a unit root test for the stationarity of the variables and order of integration using the Augmented Dickey Fuller (ADF) and the Phillips-Perron tests. The unit roots equation for trend and intercept for PR and LTEC are stated thus:

$$\Delta LPR_t = \alpha + \psi_t + \gamma \Delta LPR_{t-1} + \varepsilon_t$$

$$\Delta LTEC_t = \alpha + \psi_t + \gamma \Delta LTEC_{t-1} + \varepsilon_t$$

Where α and ψ_t are the intercept and trend components of the data respectively. ε_t is the stochastic component that is independently and identically distributed as a normal distribution with zero mean and

constant variance. The null hypothesis of the unit root test is that both LPR and LTEC follow a random walk process. Thus, we expect $\gamma = 0$. If we fail to reject the null hypothesis in any of the time series it means that particular time series is not stationary and we need to difference the series until stationarity is achieved.

DATA ANALYSIS AND RESULT

The study employed both Augmented Dickey-Fuller (ADF) and the Phillips Perron (PP) unit root test to assess the stationarity of the variables and to determine the order of their co-integration. The unit root test is shown thus in Table 1.

Table 1. Unit root test

Variables	Levels				First Difference			
	Intercept		Intercept and Trend		Intercept		Intercept and Trend	
	ADF	PP	ADF	PP	ADF	PP	ADF	PP
LPR	-1.45	-1.18	-2.79	-2.12	-3.47	-4.38	-3.35	-3.79
LTEC	-1.79	-4.62	-4.26	-4.38	-5.51	-8.53	-5.34	-12.25
LGDP	-0.34	-1.11	-2.56	-2.49	-4.11	-4.22	-3.97	-4.07
LLITR	-1.42	-2.53	-1.34	-0.68	-2.67	-2.69	-3.63	-3.89

The MacKinnon critical values of intercept and trend are -5.29 (1%) -4.01 (5%) -3.4 (10%); intercept are -4.42 (1%), -3.25 (5%) and -2.77 (10%).

The result shows that the intercept of both poverty rate and total energy consumption are not stationary at level but the first difference of the variables are stationary. Which means that LPR and LTEC are integrated to the order 1. This suggests that there is a long run co-integrating relationship between poverty rate and total energy consumption in Nigeria.

The Pairwise Granger causality test is shown thus in Table 2.

Table 2. Granger causality test

Null Hypothesis	Obs	F-stat.	Prob.
LTEC does not Granger cause LPR	19	17.61	0.01
LPR does not Granger cause LTEC		1.75	0.29

The pairwise granger causality test reveals that causality flows from LTEC to LPR with an F-value of 17.61 and a probability value of 0.01. However, causality does not flow from LPR to LTEC with F-value of 1.75 and a probability value of 0.29. The result shows that total energy consumption granger causes poverty. This suggests that total energy consumption directly affect the rate of poverty in Nigeria. This result is not surprising because the demand for energy is derived. That is demand for energy is determine by the level of production. Increasing the level of production, means increasing level of employment and income thus reduction in the level of poverty.

The analysis of results are presented in equation (1) to (4). Equation (1) is the relationship between poverty rate (LPR) and total energy consumption (LTEC). Equation (2) shows the relationship between LPR and gross domestic product (LGDP). The relationship between LPR and adult literacy rate (LLITR) age 15 and above is revealed in equation (3).

Ordinary least square regressions are specified thus:

$$LPR_t = 7.2 - 0.18 LTEC_t \dots\dots\dots eqn. 1$$

(4.96) (-2.09) $R^2 = 0.33$ D-W = 1.53 F = 4.38

$$LPR_t = 1.32 + 0.09 LGDP_t \dots\dots\dots eqn. 2$$

(1.30) (2.79) $R^2 = 0.47$ D-W = 1.5 F = 7.8

$$LPR_t = -0.79 + 1.19 LLITR_t \dots\dots\dots eqn. 3$$

(-42) (2.66) $R^2 = 0.44$ D-W = 1.7 F = 7.1

The co-integrating regression for PR and TEC is shown thus:

$$LPR_t = 9.8 - 0.33LTEC_t \quad \dots\dots\dots \text{eqn. 4}$$

(3.91) (-2.23) D-W = 1.3

Equation (1) is the ordinary least square estimate of poverty rate and total energy consumption in Nigeria. The estimate meets the a priori expectation. The estimate shows that if energy consumption is increased by 1 percent poverty rate will decrease by 0.18 percent. The t value of the coefficient of LTEC is significant at 10 percent level of significance. The R^2 of 0.47 means that only 47 percent of the variation in LPR is explained by the change in LTEC. This may have aroused due to the fact that other factors affecting poverty rate in Nigeria are not included. We also assess the impact of other variables on poverty rate in equation 2 and 3. The results show that although the estimated coefficients are significant but they do not meet our a priori expectation. Equation 2 states that if GDP is increased by 1 percent poverty rate will increase by 0.09 percent. Also, equation 3 reveals that increasing adult literacy rate by 1 percent poverty rate will increase by 1.19 percent.

Equation 4 is the result of the long run cointegration using the Fully Modified Least Squares (FMOLS) regression analysis. The result shows that the estimates constant and coefficient are significant at 5 percent and 10 percent level respectively. The result of the regression meets the a priori expectation. The coefficient 0.33 shows that if total energy consumption increase by one percent poverty rate will decrease by 0.33 percent in Nigeria. This research is mainly concerned on whether energy consumption explain poverty rate in Nigeria. Thus, other factor such as institutional factors (Kilishi et al 2013), expenditure on poverty alleviation program and GDP growth rate (Onakoya, 2013) were not included in this research work.

SUMMARY AND CONCLUSION

This study is an attempt to analyse the relationship between total energy consumption and poverty rate in Nigeria. Instead of looking at the level of economic activity, we show that level of total energy consumed affects poverty rate in Nigeria. The study finds out that the level of total energy consumed significantly affect poverty rate in Nigeria since increasing total energy consumption by 1 percent reduces poverty by 0.33 percent. The study also shows that increase in GDP and adult literacy does not reduce poverty in Nigeria. This may be due to high level of unemployment prevailing in the country. We also show that bi-directional causality runs from total energy consumption to poverty rate in Nigeria. This means energy consumption plays a critical role in empowering people towards achieving financial independence that will pool them out of the shackles of poverty.

This paper concludes that poverty can be reduced if government engage in development programmes aim equipping people to be productive that will ensure a viable living. This can be done if the citizen has access to cheap and quality energy. Access to quality and cheap energy will make people to be self-reliant, improve employment, increase standard of living and welfare both for the rural and urban poor rather than just providing education or health facilities.

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