Power Supply Efficiency and Economic Growth in Nigeria

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Abstract **-This paper examines the causal relationship between power supply efficiency and economic growth in Nigeria. Granger causality and co-integration tests were employed using annual data from 1985 to 2015. The results show a bi-directional causality running from energy production to GDP and from GDP to energy production. The finding also shows a long run relationship between the selected variables. These results strongly contradict the neoclassical perspective that energy consumption is not a limiting factor in economic growth in Nigeria. The implication of the findings is that any policy to reduce energy production from oil, coal and gas aimed at reducing greenhouse gas emissions is likely to have a detrimental impact on the nations GDP because this source causes more growth to the GDP at the moment. Nonetheless, more investment on renewable sources should be encouraged since it also contributes positively to GDP. The study recommends the need for the deregulation of the downstream sector to attract more investments.**

Key words **- Power supply, efficiency, production, economic growth**

I. INTRODUCTION

Power supply is gradually becoming a major factor in the pursuit of economic development. The attainment of economic growth is a necessary but not a sufficient condition for nations to attain an improved social welfare for its citizens. As growth is achieved, more principal policies should be in place to translate this growth into the living standard of the citizens. A good electricity supply not only improves the quality of life of its users, but also has the potential to improve the industrial output of a country and therefore, can have positive impacts on a country's growth and development prospects.

Nigeria has the biggest gap in the world between electricity demand and supply, providing its population of over 160 million with less than 4000 megawatts of electricity. In contrast, South Africa with a population of less than 50 million people generates more than 40,000 megawatts while Brazil, an emerging economy like Nigeria, generates over 100,000 megawatts for its 201 million citizens. Indeed, the gap in the power sector has implications for improving the business climate, sustaining economic growth and the social wellbeing of Nigerians. About 45 percent of the population has access to electricity, with only about 30 percent of their demand for power being met.In this regard, adequate supply and distribution of electricity constitute a central development issue. It is also the nucleus of operations and subsequently the engine of growth for all sectors of the economy (Ayodele, 2011).

The relationship between energy supply and economic growth has remained an existing debate among scholars. Consequently, this study seeks to ascertain the possible effect of energy supply on economic growth in Nigeria. The specific objectives are to: (i) determine the causality that exist between economic growth and energy supply in Nigeria, (ii) investigate if there is existence of long-run relationship between energy supply and economic growth in Nigeria.

This study has much significance on prospective market operators, stakeholders and government. It would help Nigerian government and managers of both private and public institutions to fund energy infrastructural projects in Nigeria. It would also help to design more suitable economic development driven models applicable in Nigeria. Furthermore, it will serve as reference for other researchers who may carryout research in the related field.However this study covered the impact of power supply efficiency on the economic growth in Nigeria from 1985 to 2015.

II. LITERATURE REVIEW

Noko (2016) examined power supply failure on Nigeria economy and observed that erratic situation of power supply in Nigeria led many firms to shut down their plants due to high operating cost resulting from the use of generator to power their plant and offices. The resultant effect of this power failure is hazardous to human health. And many lives have been lost as a result of carbon-monoxide that erupts from the generator sets.

Menyah and Wolde-Rufael (2010) examined the relationship between energy consumption, pollutant emissions and economic growth in South Africa for the period 1965 to 2006. They found evidence of unidirectional causality running from energy consumption to economic growth, thus suggesting that an energy conservation policy is feasible..

Ozturk, Aslan and Kalyoncu(2010) employed the panel co-integration and causality analysis to investigate the relationship between energy consumption and economic growth among three groups of 51 countries classified as low income countries, lower middle income countries, and upper middle income countries for the 1971 to 2005 period. The results indicate that there exists co-integration between energy

consumption and real GDP for all three income groups. From the panel causality tests, they conclude that there is a uni-directional causality running from GDP to energy consumption for low income countries and bi-directional causality between these variables for the middle income countries.

Adeniran (2009) investigated the causal relationship between energy consumption and economic growth in Nigeria using systematic econometric techniques. The study found that there is a uni-directional causality runnning from GDP to electricity consumption.

HlalefangSanderson and Pierre (2016) examined the causal relationship between electricity supply and economic growth in South Africa. The study established a unidirectional causality flowing from electricity supply to economic growth. The result implies that electricity supply boosts economic growth in South Africa.

III. METHODOLOGY

Model Specification

A linear equation model is specified, and Ordinary Least Squares (OLS) technique is applied to ascertain the relationship which exists between the dependent variable and independent variables.

The functional form of the model is specified thus:

RGDP= f (EP).

The statistical form of the model is specified thus:

$$RGDP_t = \beta_0 + \beta_1 EP + \beta_2 REP$$

The econometric form of the model is specified thus:

$$RGDP_t = \beta_0 + \beta_1 EP + \beta_2 REP + \mu_t$$

Where:

RGDP = Real Gross Domestic Income

EP =Electricity production from oil, gas and coal sources (% of total)

REP= renewable electricity production

β_0 is the intercept term

β_1 is the parameter of the independent variable EP

β2 is the parameter of the independent variable REP

μ is the stochastic error term

IV. DATA ANALYSIS AND RESULTS

Unit Root/Stationarity Test Result

Table 1: Unit Root Test at Level

variable	None. ADF test statistic (test critical value at 5%)	Intercept ADF test statistic (test critical value at 5%)	Trend and intercept ADF test statistic (test critical value at 5%)	Lag
EP	0.831863 (-1.952910) 0.8857	-0.132006 (-2.967767) 0.9790	-1.806789 (-3.574244) 0.6762	4
L RGDP	2.249035 (-1.952473) 0.9925	-0.512897 (-2.963972) 0.8748	-2.078810 (-3.568379) 0.5355	4
REP	-0.469456(-1.952473) 0.5036	-0.719127(-2.963972) 0.8269	-1.749762(-3.568379) 0.7034	4

Note: the figure below in each series is the probability value

Ho: there is unit root problem

Decision rule: reject Ho if p-value is less than 0.05 and accept if otherwise.

Conclusion: from table 1a, observing their p-values we conclude that the variable LRGDP, EP and REP are not stationary at their levels.

Table 1b: Unit Root Test for Stationarity at first difference

variable	None ADF test statistic (test critical value at 5%)	Intercept ADF test statistic (test critical value at 5%)	Trend and intercept ADF test statistic (test critical value at 5%)	Lag
L rgdp	-3.000607(-1.952910) 0.0041	-3.930263(-2.967767) 0.0054	-3.737077(-3.574244) 0.0356	4
Ep	-6.179015(-1.952910) 0.0000	-6.341765(-2.967767) 0.0000	-6.893291(-3.574244) 0.0000	4
Rep	-4.738499(-1.952910) 0.0000	-4.678005(-2.967767) 0.0008	-5.102423(-3.574244) 0.0015	4

Note: the figure below in each series is the probability value

Ho: there is unit root problem

Decision rule: reject Ho if p-value is less than 0.05 and accept if otherwise.

Conclusion: from table 1b, observing their p-values we conclude that the variable LRGDP, EP and REP are stationary at their first differences.

Co-integration test result

Table 2

Variable	ADF statistics	5% critical value	lag
Residual	-5.346420	-1.953381	I~(0)

From the table above, considering the values obtained from the unit root test conducted on the residual at levels. The ADF statistic is greater than the test critical value at 5%.

Note: where EP~I(1) ,REP~I(1) ,LRGDP~I(1) and the residual E~I(0) then EP ,REP and LRGDP are said to be cointegrated.

Pairwise Granger Causality Tests

Table 3

Null Hypothesis:	Obs	F-Statistic	Prob.
LRGDP does not Granger Cause EP	30	9.56828	0.0046
EP does not Granger Cause LRGDP		3.91453	0.0582
REP does not Granger Cause EP	30	0.01975	0.8893
EP does not Granger Cause REP		82.2156	1.E-09
REP does not Granger Cause LRGDP	30	5.84985	0.0226
LRGDP does not Granger Cause REP		8.87843	0.0060
LRGDP does not Granger Cause EP	30	9.56828	0.0046
EP does not Granger Cause LRGDP		3.91453	0.0582
REP does not Granger Cause EP	30	0.01975	0.8893
EP does not Granger Cause REP		82.2156	1.E-09

From the table above, the Granger-causality is found to run from LRGDP to EP and from EP to LRGDP. The null hypothesis of LRGDP does not Granger-cause EP is rejected at the 5 percent level of significance where the value of F statistic is 9.56828 with probability 0.0046. Also, the null hypothesis of EP does not Granger-cause LRGDP is rejected at the 5 percent level of significance where the value of F statistic is 3.91453 with probability 0.0582. The Granger-causality is not found to run from REP to EP. The null hypothesis of REP does not Granger-cause EP is accepted at the 5 percent level of significance where the value of F statistic is 0.01975 with probability 0.8893. The null hypothesis of EP does not Granger-cause REP is accepted at the 5 percent level of significance where the value of F statistic is 82.2156 with probability 1.0000. The Granger-causality is found to run from REP to LRGDP. The null hypothesis of REP does not Granger-cause LRGDP is rejected at the 5 percent level of significance where the value of F statistic is 5.84985 with probability 0.0226. In terms of LRGDP, the Granger-causality is found to run from LRGDP to REP. The null hypothesis of LRGDP does not Granger-cause REP is rejected at the 5 percent level of significance where the value of F statistic is 8.87843 with probability 0.0060. Thus, between LRGDP and EP there is a bi-directional causality. LRGDP impacts on EP just as EP impacts on LRGDP although at different rates. Noteworthy is the bidirectional relationship that also exist between REP and LRGDP. They both have impacts on each other at different rates. There is no causal relationship between REP and EP.

V. SUMMARY AND CONCLUSION

The causal relationship between energy production and economic growth in Nigeria was carried out by including renewable electricity production in the causality analysis in accordance with the neutrality hypothesis of energy and growth. Tests of causality were systematically performed using recently developed econometric techniques. Unlike the normal thoughts existing among people prior to a statistical and econometric analysis that energy production causes growth in the economy, the results infers not only that energy production cause growth but also that economic growth cause total energy production. In terms of energy production from oil, coal, gas and real GDP, the results of the analysis show that both electricity production and renewable electricity production causes real GDP to some extent. Noteworthy is that real GDP causes electricity production and renewable electricity production to some extent. Thus, this is a case of bi-directional causality that runs from energy production to economic growth and economic growth to energy production as well. This therefore supports the conclusion ofHwang and Gum (1992) who used the co-integration and error correction model, and a bi-directional causal relationship between energy consumption and economic growth was observed.

More so, it was discovered that there exist a long run relationship between the variables of the study which are RGDP, energy production (decomposed into electricity production and renewable electricity production).From the regression test carried out, it suffices to mention that energy is a contributing factor to economic growth. While electricity production causes on the average a 7% increase in RGDP as it is increased by a unit, the renewable electricity production causes a 3% increase in the RGDP as it is increased by a unit. This research thus encourages more private and public investment in researches and increasing the output base of renewable electricity production.

From the previous chapters, it was gathered that a consensus had emerged in theoretical literature that energy

production play a critical role as a driver of economic growth. This study subjected this consensus to empirical analysis using Nigerian data from 1985 to 2015. Since this study supports the conclusion of Hwang and Gum (1992) that there exists a bi-directional causal relationship between energy production and economic growth .This result indicates that the effect of energy conservation policies to help stem global warming will not have detrimental effect on the economic growth of Nigeria. Nonetheless, more investment should be made in renewable energy so that energy demand can be met. From the result, we can also put that reducing energy production could guide to a drop in economic growth.

The research contradicts the neoclassical view that energy is a limiting factor for economic growth. This in turn implies that energy can lead to an increase in rate at which an economy grows overtime. The positive coefficient of the REP is a call to the Nigerian government to go green just like other industrialized nations.

Due to the role that energy plays in determining economic growth, it is reasonable to conclude that the neutrality hypothesis growth theory which posits that energy inputs is a major determinant of economic growth is not out of place. This is true just as we see from the regression result. It has been argued that the possible impact of energy consumption on growth will depend on the structure of the economy and the level of economic growth of the country concerned. As the economy grows, its production structure is likely to shift towards service sectors, which are not much dependent on energy (Solow, 1974; and Cheng, 1995). Thus, as Nigeria advance, the relevance of energy in growth models will be less significant. Nonetheless, energy is still a necessary condition to achieve that desired growth considering the current structure of the Nigerian economy.

VI. POLICY RECOMMENDATIONS AND SUGGESTIONS

Since this study supports the conclusion of Hwang and Gum (1992) that there exist a bi-directional causal relationship between energy production and economic growth, it is suggested that the government of Nigeria should make a rigorous effort to encourage investment in energy generation as well as seeking out other measures to grow the RGDP since it also has an impact on energy. To this end, the deregulation of the downstream sector to attract investment is a policy in the right direction despite the fact that in the short run, it leads to increase in the price of electricity cost of firms and household. The policy if rightly implemented promises to increase investment in the energy industry and this will translate into increase in economic growth. Furthermore, the growth in the RGDP will also cause a further rise in the renewable and non-renewable energy production. These results further suggests that Nigeria should be brought into future climate change agreements, which can be achieved through increase in energy substitute such as wind, solar, geothermal etc., but not through reduction in energy consumption as this might be detrimental to overall economic growth. Obviously, the policy of the deregulation of the downstream industry will attract heavy investors which might foster the development of the relevant infrastructure desired by this sector of the economy.

As earlier mentioned, this work will serve as a reference point for further research work. This is because other than the gap filled by the researcher; there are still exigency gaps, which could not be filled due to the scope and context of this research work. To this end, suggestions made for further research work relating energy consumption and economic growth is as follows:-

- Electricity Consumption and Economic Growth in Nigeria: A Causality Analysis (Using Capital and Labour as Control Variables)
- The causality between Energy Consumption and Economic Growth in Nigeria: A Multi-Sectorial Analysis using Non-stationary Cointegrated Panel Data
- Dynamic Cointegration Link between Energy Consumption and Economic Performance in Nigeria
- Determinants of Nigeria's Energy Imports: An Empirical Analysis

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