Energy Supply Shortage and Economic Growth in Nigeria: 1970-2011

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Abstract: *The study examines the impact of energy (electricity and petroleum) consumption on economic growth, exports and foreign direct investment in Nigeria using time series data for the period 1970-2011. We employed Augmented Dickety Fuller (ADF) and Phillip-Perron (PP) technique to test for unit root, and the ARDL bounds to examine the presence of cointegrating relationship. Granger causality test was applied to verify the direction of causality between electricity consumption, petroleum consumption, foreign direct investment, and export in Nigeria. From the cointegration test results, we establish the existence of a long run relationship between electricity consumption, economic growth, and petroleum consumption. Moreover, the result of vector error correction coefficients, which determine the speed of adjustment, had an expected and highly negative sign. The study therefore, recommends that government should strengthen the on-going transformation agenda particularly on energy infrastructure to create sufficient energy (electricity and petroleum) supply. The Nigerian government should encourage research and development on technological innovation for energy savings in addition to encouraging the use of alternative energies such as solar power, hydro power, and wind power.*

Keywords: *Consumption, Economic Growth, Energy, Exports, FDI.*

1. Introduction

Economic growth is critical in reducing poverty, increasing self-sufficiency and achieving prosperity. Trade and investment accelerate growth, stimulate income and wealth creation. Virtually all economic activities depend on energy whether in urban, peri-urban or rural areas. Electricity and modern fuels are integral to economic development and trade and underpin agriculture, industry, transportation and commercial enterprises. Stern (2004) observed that though energy is not sufficient on its own to achieve economic growth, it is a necessary pre-requisite. Energy plays a critical role in the economic growth and development of both developed and developing countries. Energy consumption directly or indirectly complements capital and labour as an input in the production process (Yusuf, et al, 2012). Since production and consumption activities involve energy as an essential factor input, the relationship between energy consumption and economic growth has been a subject of greater inquiry as energy is considered to be one of the important driving force of economic growth in all economies (Gerogre and Nickoloas, 2011).

Insufficient supply of energy affects all aspects of development, more specifically social, economic, environment, and the overall quality of life of the people (Moses et al, 2003). Improvements in standard of living are manifested in increased agricultural output, increased industrial output, the provision of efficient transportation, adequate shelter, healthcare and other human services and these will holistically require increase in energy consumption. Thus, energy is considered an important requirement for economic growth and is potentially an inhibiting factor to economic and social development. Nigeria is highly endowed with abundant natural resources including renewable and non-renewable potential energy resources. However, increasing access to energy has proved to be not only a continuous challenge but also a pressing economic and social issue as the country seeks to integrate into the global world (Ma et al, 2011). The gloomy energy services provision in Nigeria have adversely affected living standards of the population and aggravated energy poverty in the economy, the energy consumption mix of the country in 2010 was dominated by oil (56 percent), natural gas (31 percent) and hydroelectricity (10 percent). The proportion of oil in Nigeria's energy mix between 1990 and 2011 decreased from 73 to 61 percent (National Energy Commission, 2012). Though, some studies have investigated the nexus between energy (electricity and petroleum) consumption and economic growth in Nigeria (Yusuf et al, 2012; Olaniyan, 2010; Odularo and Okwonkwo, 2009), the studies did not examine the impact of energy consumption on exports and foreign direct investment. Therefore, this study intends to fill this gap in the literature.

Therefore, the major objectives of this study is to examine the impact of energy (electricity and petroleum) consumption on economic growth, foreign direct investment and exports in Nigeria. In order to achieve this, the paper is organized into five sections including this introduction. The rest of the paper is organized as follows: Section 2 presents the empirical review. In section 3, the methodology of the study is presented. Presentation and discussion of results with policy implications is done in section 4. Conclusion and recommendations are drawn in section 5.

2. Literature Review

There are studies that have examined the impact of Energy (electricity) consumption on growth and trade, some focused on the direction of causal relationship between electricity consumption and economic growth. While some strand of empirical literature focused on multi-countries studies, other literature focused on single-country studies. A review of previous empirical studies is presented below.

Nurul and Hassanuzzaman (2013) examined the long run cointegrating relation and short-run dynamics among carbon emissions, energy consumption, economic growth, urbanization, financial development and openness to trade in Bangladesh by using autoregressive distributed lag (ARDL) bounds testing approach of cointegration over the period 1975-2010. The results suggested evidence of a long-run relationship between the variables at 1 percent significance level. The estimated coefficient of energy consumption and urbanization are positive and highly significant indicating that increasing level of urbanization and energy consumption are responsible for CO2 emission. It was also found that an increase in the real GDP per capita tend to reduce carbon emissions per capita. On the other hand, there was no evidence of a causal relationship between carbon emission, financial development and trade openness.

Shunyun and Donghua (2011) examined the causality between energy consumption and economic growth for the period 1985-2007 in China, within a multivariate framework by apply fully modified OLS (FMOLS). The results indicated the presence of bidirectional relationship between energy consumption and economic growth. Similarly, Ansgar et al, (2010) apply the technique of error correction model (ECM) to investigate the role of energy consumption in economic growth from Croatia for the period 1993-2006, their results support unidirectional hypothesis. Sinha (2009) using panel data from 88 countries Model (VECM) and causality tests, the results showed that per capita GDP and per capita energy are cointegrated. The findings also suggested bidirectional short run, long run and strong causality between the growth of GDP and growth of energy consumption.

Mallick (2007) used time series data for the period 1970-71 to 2004-5 and employed Granger causality test and variance decomposition analysis of autoregression (VAR) method to examine the relationship between energy consumption and growth, the result from the application of Grander causality test suggested that it is the economic growth which leads to demand for the natural gas and electricity and the overall energy consumption, and it is only coal consumption which has positive influence on growth. But variance decomposition analysis suggested that there could be bidirectional causality between electricity consumption and economic growth in the future and unidirectional relationship as observed in Granger causality test for natural gas and coal on India.

Mazazzino (2011) examined the causal relationship between energy (electricity, gas and coal) on growth, using time series data for the peiod 1970-2009 and technique of Vector Autoregressive (VAR) and Vector Error Correction Model (VECM). The results showed the existence of a long-run bidirectional relationship between energy consumption and economic growth in Italy. Similarly, using time series data from Malaysia for the period 1971-2008 and applying ARDL bounds testing approach to cointegration, Lean et al, (2010) discovers long run bidirectional causality amount all series. This implies that GDP and energy consumption causes each other in both short and long run. Using a sample of 18 EU countries for three years (1980, 1990 and 2000) and applying non-parametric regressions, George and Nickoloas (2011) examined the impact of energy consumption on growth. The results justified the neutrality of energy consumption on growth. Acaravci (2010) using time series data for the period 1960-2003 and employing the notion of Granger causality and the notion of instantaneous causality, find no evidence of long run relationship between energy consumption and economic growth which is neutral with each other. The analysis also shows strong evidence of instantaneous causality between these variables.

Chien-Chiang and Chun-Ping (2005) examined the possibility of both a linear effect and nonlinear effect of energy consumption on economic growth, using data for the period 1955-2003 in Taiwan. They found evidence of a level-dependent effect between the two variables. They provided evidence that the relationship between energy consumption and economic growth is characterized by an inverse U-shape. Their empirical findings indicated that the relationship exists only where there is a low level of energy consumption. They showed that a threshold regression provides a better empirical model than the standard linear model and that policy- makers should seek to capture economic structures associated with different stages of economic growth. Some studies investigated the impact of energy on growth in Africa region. For instance, Mulegeta et al, (2010) using a panel of 40 Sub-Saharan Africa (SSA) countries for the period 1980-2007 and a panel cointegration approach to test the causal relationship between energy consumption and GDP. They found support for the neutrality hypothesis in the short run, except for middle income countries and a strong causation running in both directions is found in the long run. The different results for low and middle income countries provided evidence for the importance of income in the causal relationship.

Chandran et al, (2010) applied panel unit root tests, panel cointegration and panel error correction model to estimate the causal relationship between energy consumption and economic growth for 19 sub-Saharan African countries for the period 1980-2005. Their analyses revealed that causation run from energy consumption to economic growth for low income countries. Esso (2010) examined the long-run causality relationship between energy and economic growth for 7 sub- Saharan countries over the period 1970-2007 and applied bounds testing approach to cointegration. The findings suggested unidirectional relationship between GOP and energy consumption for all countries, while the result of causality indicates bidirectional relationship between energy consumption and real GDP in the case of Coted'lvoire and unidirectional causality from real GDP to Congo.

Moreover, Tsani (2010) on the basis of time series data examines the causal relationship between energy consumption (both at aggregated and disaggregated levels) and economic growth for Greece for the period 1960-2006 and applying Toda and Yamamoto technique, the findings suggest unidirectional relationship between energy consumption and real GDP at aggregate levels and bidirectional relationship with exception of transport energy consumption at disaggregated levels. Another study conducted in India using time series data for the period 1971-2006 through the application of ARDL model and Toda and Yamamoto multivariate model, indicated the evidence of bidirectional Granger causality between energy consumption and 002 emissions in the long run but neutral relationship between energy consumption and economic growth which invariably implying that India could pursue conservation policies with harming economic growth.

Yoo and Kwak (2010) employed the cointeqration and the Hsiao's (1981) Granger causality techniques to analyze the association between economic growth and electricity consumption in seven South American economies. Interestingly, they found that most of the selected countries support uni-directional causality running from electricity consumption to economic growth (i.e. Argentina, Brazil, Chile, Colombia, and Ecuador), while the rest of the two countries such as Venezuela support conservation hypothesis and Peru supports the feedback hypothesis.

Odhiambo (2009) used autoregressive distributed lag (ARDL) bounds test approach and Granger non-causality test for Tanzania for the 1971-2006 period. The results of the bounds test revealed a stable long-run relationship between energy consumption and economic growth, while, the results of Granger non-causality showed the evidence of unidirectional causality running from energy consumption to economic growth as well as from electricity consumption to economic growth. The results imply that energy conservation policies have damaging repercussions on economic growth for Tanzania. Olaniyan (2010) observed that on the basis of panel data of 5 West African countries (including Nigeria) for the period 1970-2005 and employing Granger causality tests and cointegration analysis, the results showed that energy consumption did not cause economic growth suggesting that individual efforts may be inadequate; rather, regional cooperation to lower oil prices, increase access to cheaper renewable energy sources as well as increased intra-region energy trade should be encouraged.

Yusuf et al, (2012) examined the impact of energy consumption on economic growth in Nigeria over the period 1980-2010. The short-run and long-run relationship between energy consumption variables and economic growth were estimated using Autoregressive Distributed Lag (ARDL) approach to cointegration analysis. The results indicated a long-run relationship between economic growth and energy consumption variables. Though, the coefficient of coal consumption is positive but is statistically insignificant, while petroleum consumption and electricity consumption were positive and statistically significant on economic growth. Moreover, the coefficient of error correction model suggested that the speed of adjustment in the estimated model is relatively high and had the expected significant and negative. The findings of the existing empirical studies indicate lack of consensus evidence of the impact or causal relationship between energy (electricity) consumption and economic growth for country-specific (Nurul and Hasanuzzaman, 2013; Yusuf etal, 2012; Mallick, 2010, Odhiambo, 2009), multi-countries (Chadran et al, 2010; Yoo and Kwak, 2010; Tsani, 2010) as well as regional studies (George and Nickoloas, 2011; Mulegeti et al, 2010; Esso, 2010; Olaniyan, 2009).

3. Methodology

3.1 Source and Description of Data

This study uses annual data (time series) of real gross domestic product (RGDP) per capita (1990 = 100), electricity consumption (EC) per capita (in million kwh), exports (TR) is measured by the ratio of total trade (export plus import) to GDP and Petroleum consumption (POP). This study covers the sample period from 1970 - 2011. The data were collected from Central Bank of Nigeria (CBN) and Energy Commission of Nigeria (ECN).

3.2 Unit Root Test and Cointegration Tests

Unit root test or confirmation of the order of integration is a pre-requisite for time series analysis. In this study, we applied the Augmented Dickey-Fuller (ADF) and Philhps-Perron (PP). Since the ADF test is low-power in small sample (Cheung and Lai, 1995), we also applied the PP root tests to check the robustness of the estimation results. After determining the order of integration, we employ the bounds testing approach to cointegration within the autoregressive distributed lag (ARDL) framework to investigate the existence of a long-run equilibrium relationship between electricity consumption, Petroleum consumption, economic growth, foreign direct investment and exports (Pesaran et al., 2001). Unlike the conventional cointegration techniques, the bounds testing approach can be applied to the model irrespective of whether the variable are purely I(0) or purely I(1). In addition to that, the Monte Carlo analysis exhibits that the ARDL cointegration approach has superior properties in small sample (Pesaran and Shin, 1999). The ARDL model for bounds testing approach to cointegration can be formulated as follows:

$$\Delta InEC_t = a_0 + \pi_1 \, InEC_{t-1} + \pi_2 InY_{t-1} + \pi_3 In\,POP_{t-1} + \pi_4 In\,FD_{t-1} + \pi_5 InTR_{t-1} + \sum_{j=1}^{k} b_{1j}\Delta InEC_{t-j}$$
$$\sum_{j=0}^{k} b_{2j}\Delta InY_{t-1} + \sum_{j=0}^{k} b_{3j}\Delta InPOP_{t-j} + \sum_{j=0}^{k} b_{4j}\Delta InFD_{t-j} + \sum_{j=0}^{k} b_{5j}\Delta InTR_{t-j} + e_{1t} \quad (1)$$

$$\Delta InEC_{,} = a_2 + \pi_1 \, InEC_{t-1} + \pi_2 InY_{t-1} + \pi_3 In\,POP_{t-1} + \pi_4 In\,FD_{t-1} + \pi_5 InTR_{t-1} + \sum_{j=0}^{k} b_{1j}\Delta InEC_{t-j}$$
$$\sum_{j=0}^{k} b_{2j}\Delta InY_{t-1} + \sum_{j=0}^{k} b_{3j}\Delta InPOP_{t-j} + \sum_{j=0}^{k} b_{4j}\Delta InFD_{t-j} + \sum_{j=0}^{k} b_{5j}\Delta InTR_{t-j} + e_{2t} \quad (2)$$

$$\Delta InEC_1 = a_3 + \pi_1 InEC_{t-1} + \pi_2 InY_{t-1} + \pi_3 In\,POP_{t-1} + \pi_4 In\,FD_{t-1} + \pi_5 InTR_{t-1} + \sum_{j=0}^{k} b_{1j}\Delta InEC_{t-1}$$

$$\sum_{j=0}^{k} b_{2j}\Delta InY_{t-1} + \sum_{j=0}^{k} b_{3j}\Delta InPOP_{t-j} + \sum_{j=0}^{k} b_{4j}\Delta InFD_{t-j} + \sum_{j=0}^{k} b_{5j}\Delta InTR_{t-j} + \mathrm{e}_{3t} \quad (3)$$

$$\Delta InEC_1 = a_4 + \pi_1 InEC_{t-1} + \pi_2 InY_{t-1} + \pi_3 In\,POP_{t-1} + \pi_4 In\,FD_{t-1} + \pi_5 InTR_{t-1} + \sum_{j=0}^{k} b_{1j}\Delta InEC_{t-1}$$

$$\sum_{j=0}^{k} b_{2j}\Delta InY_{t-j} + \sum_{j=0}^{k} b_{3j}\Delta InPOP_{t-j} + \sum_{j=0}^{k} b_{4j}\Delta InFD_{t-j} + \sum_{j=0}^{k} b_{5j}\Delta InTR_{i-j} + \mathrm{e}_{4t} \quad (4)$$

$$\Delta InEC_1 = a_5 + \pi_1 InEC_{t-1} + \pi_2 InY_{t-1} + \pi_3 In\,POP_{t-1} + \pi_4 In\,FD_{t-1} + \pi_5 InTR_{i-1} + \sum_{j=0}^{k} b_{1j}\Delta InEC_{t-1}$$

$$\sum_{j=0}^{k} b_{2j}\Delta InY_{t-j} + \sum_{j=0}^{k} b_{3j}\Delta InPOP_{t-j} + \sum_{j=0}^{k} b_{4j}\Delta InFD_{t-j} + \sum_{j=0}^{k} b_{5j}\Delta InTR_{t-j} + \mathrm{e}_{5t} \quad (5)$$

Where: ? is the first difference operator, denotes the natural logarithm and ? is the lag order s elected by Akaike's Information Criterion (AIC). Note that, In EC_t, $InGDP_t$, $InFD_t$, $InPOP_t$, and $InTR_t$ are the electricity consumption per capita, real DGP per capita, foreign Direct Investment, petroleum consumption and exports respectively. The residuals $?_{it}$ are assumed to be normally distributed and white noise. According to Pesaran et al, (2001), we ca n use the F -test to determine the presence of a long -run relationship by restricting the coefficients of the lagged level $?_0 : ?_1 = ?_2 = ?_3 = ?_4 = ?_5 = 0$ from equaitions (1) to (5). Pesaran et al. (2001) computed two set of asymptotic critical values for ARDL cointegration test that is lower bounds critical values 1(0) and upper bounds critical values 1(1). However, Narayan (2005) provided a new set of critical values for small sample. [1] We employ the critical values suggested by Narayan. If the calculated F-statistics exceeds the upper bound critical value, we conclude in favour of a long -run relationship regardless of the order of integration. If the calculated F -statistics falls below the lower critical values, we cannot reject the null hypothesis of no cointegr ation. However, if the calculated F-statistic falls between the two critical bounds, inference would be inconclusive.

3.3 Granger Causality Test

According to the concept of Granger causality, ' *X* causes *Y*' if and only if the past values of *X* help to predict the changes of *Y*', While, *Y* causes *X'* if and only if the past values of *Y* help to predict the changes of *X*'. The vector autoregression (VAR) model is likely to be used for this purpose. However, Granger (1988) noted that if a set of variab les are cointegrated, there must be short - and long-run causality which cannot be captured by the standard first difference VAR model. In this case, we must implement the Granger causality test with the VECM framework as follows:

$$\Delta In\, EC_t = a_1 + \sum_{i=1}^{p} \beta_i \Delta InEC_{t-i} + \sum_{i=1}^{p} \vartheta_i \Delta InGDP_{t-i} + \sum_{i=1}^{p} \kappa_i \Delta InFD_{t-i} + \sum_{i=1}^{p} \theta_i \Delta InPOP_{t-i} + \sum_{i=1}^{p} \emptyset_i \Delta InTR_{t-i} + \psi_1 \mathrm{ECT}_{t-1} + \upsilon_{1t} \quad (6)$$

$$\Delta In\, EC_t = a_2 + \sum_{i=1}^{p} \vartheta_i \Delta InGDP_{t-i} + \sum_{i=1}^{p} \beta_i \Delta InEC_{t-i} + \sum_{i=1}^{p} \kappa_i \Delta InFD_{t-i} + \sum_{i=1}^{p} \theta_i \Delta InPOP_{t-i} + \sum_{i=1}^{p} \emptyset_i \Delta InTR_{t-i} + \psi_2 \mathrm{ECT}_{t-1} + \upsilon_{2t} \quad (7)$$

$$\Delta In\, EC_t = a_3 + \sum_{i=1}^{p} \kappa_i \Delta InFD_{t-i} + \sum_{i=1}^{p} \beta_i \Delta InEC_{t-i} + + \sum_{i=1}^{p} \vartheta_i \Delta InGDP_{t-i} \sum_{i=1}^{p} \theta_i \Delta InPOP_{t-i} + \sum_{i=1}^{p} \emptyset_i \Delta InTR_{t-i} + \psi_3 \mathrm{ECT}_{t-1} + \upsilon_{3t} \quad (8)$$

$$\Delta In\, EC_t = a_4 + \sum_{i=1}^{p} \theta_i \Delta InPOP_{t-i} + \sum_{i=1}^{p} \beta_i \Delta InEC_{t-i} + \sum_{i=1}^{p} \vartheta_i \Delta InGDP_{t-i} + \sum_{i=1}^{p} \kappa_i \Delta InFD_{t-i} + \sum_{i=1}^{p} \emptyset_i \Delta InTR_{t-i} + \psi_4 \mathrm{ECT}_{t-1} + \upsilon_{4t} \quad (9)$$

$$\Delta In\, EC_t = a_5 + \sum_{i=1}^{p} \theta_i \Delta InTR_{t-i} + \sum_{i=1}^{p} \beta_i \Delta InEC_{t-i} + \sum_{i=1}^{p} \vartheta_i \Delta InGDP_{t-i} + \sum_{i=1}^{p} \kappa_i \Delta InFD_{t-i} + \sum_{i=1}^{p} \emptyset_i \Delta InTR_{t-i} + \psi_5 \mathrm{ECT}_{t-1} + \upsilon_{5t} \quad (10)$$

[2]Yoo (2006) also suggested a surface response procedure to compute the small sample critical values. Unfortunately, this procedure is limited to four variables cases only.

Where ? the first is difference operator and in is the natural logarithm. The residuals u is assumed to be normally distributed and white noise. The ECT_{t-1} is the one period lagged error-correction term derived from the cointegration equation. The ECT_{t-1}variable will be excluded from that model if the variables are not cointegrated. The optimal lag length p is determined by the Akaike's Information Criterion (AIC) because of its superior performance in small sample (Toda and Yamamotor, 1995). Next, we apply the Likelihood Ratio (LR) statistics to ascertain the direction of Granger causality between the variables of interest.

4. Results and Discussions of Findings

In this section, we present the results of unit root test, ARDL cointegration test and granger causality test and further discuss the results.

4.1. Unit Root Test

It is always necessary to test the order of integration using the Augmented Dickey Fuller (ADF) and Phillip-Perron (PP) unit root tests. The results of the two unit root tests are presented in Table 1. At the 1 per cent significant level, the results of ADE unit root test suggest that all variables are integrated of order one, /(1) process, except for petroleum consumption is found to be 1(0) process. However, the PP unit root tests show that all variables included except petroleum consumption are stationary at the first difference. As noted in the earlier section, the ADF test often has weak power when the sample size of a study is small, so we preferred to use the results provided by PP unit root tests in which all the variables are stationary in their first difference that is /(1). For this reason, we surmised that the variables can be well characterised as /(1) process.

Table 1: Unit Root Test

Variables	ADF	PP
InEC_t	-3.276	-2.943*
ΔInEC_t	-4.407 ***	-8.232***
InGDP_t	-2.116 *	2.576
ΔInGDP_t	-4.759 ***	3.997**
InFD_t	-2.633*	-2.199
ΔInFD_t	-4.410 ***	-4.455***
InPOP_t	-6.721 **	-1.837
ΔInPOP_t	-4.361 ***	-6.263***
InTR_t	-3.234	-2.698
ΔInTR_t	-3.596 ***	-5.422

*Note: ***, ** and * denote the significant at the 1, 5 and 10 percent level, respectively. The optimal lag order for ADF test is determined by AIC.*

4.2 ARDL Cointegration Test

Given that all variables are integrated of order one, we proceed to examine whether electricity consumption, economic growth, foreign direct investment, petroleum consumption, and exports are cointegrated using the bounds testing approach to cointegration. An important issue in applying bounds testing approach to cointegration is the selection of the optimal lag length. We set the maximum lag length at 3 years which is sufficiently long for annual data study to capture the dynamic relationship, and then the AIC statistic is used to choose the best ARDL models. In addition, a set of diagnostic tests are conducted on the selected ARDL models. Overall, the selected ARDL models passed a number of diagnostic tests. The Jarque-Bera normality tests indicate that the residuals are normally distributed. The Ramsey RESET and the autoregressive conditional heteroskedasticity (ARCH) tests show that the selected models are free from the general specification error and also ARCH problems and the models are absence of serial correction problem. From the analysis, the calculated F-statistics are greater than the 1 per cent upper bound critical values provided by Narayan (2005). Therefore, the null hypothesis of no cointegration can be rejected, implying that a long-run equilibrium relationship exists between electricity consumption, economic growth, foreign direct investment, population and foreign trade in Nigeria.

4.3 Granger Causality Test

After determining the presence of cointegration, it is also interesting to perform the Granger causality test. As the variables are cointegrated, we employed the Granger causality in the VECM framework to determine the direction of causality between the variables. Since the variables are cointegrated, the direction of causality can be divided into short- and long-run causation. The t-significance of the one period lagged error. Correction term EC71 represents the long-run causality, while the joint significance LR tests of the lagged, explanatory variables represents the short-run causality.

Begin with the long-run causality, our empirical results suggest that the EC1 coefficients are negative signed and statistically significant in all VECMs, implying that there is bi-directional causality between the variables of interest in the long-run. In addition to that, the significance of ECT, also exhibits that if the system is exposed to shock it will convergence to the long-run equilibrium at a relatively slow speed for foreign direct investment (—0.116) and petroleum consumption (—0.258) VECMs compared to the convergence speed of electricity consumption (—0.750), economic growth (—0.777), and exports (—0.772) VECMs. Contrary with the findings of long-run causality, we find that the short-run causality vary among VECMs.

In summary, our empirical evidence shows that at the 1 per cent level, there is Granger causality runs from economic growth, foreign direct investment, and petroleum consumption to electricity consumption. However, at the same level of significance, the results show Granger causality runs from electricity consumption to economic growth, petroleum consumption and exports. With respect to these findings, we affirmed that electricity consumption, economic growth, and petroleum consumption are bi-directional causality which is in line with the findings of Yusuf et al, (2012) and Shahbaz etal, (2011). Apart from that, at the 5 per cent level, we also find evidence of Granger causality runs from electricity consumption, foreign direct investment, and petroleum consumption, to economic growth. As a result, the Nigeria dataset support the energy-led growth and finance-led growth hypotheses. These evidences strongly indicate that the variables in the system are dynamicaHy interacted. Moreover, electricity consumption, foreign direct investment and exports are important catalysts of growth for Nigeria's economic growth.

5. Conclusion and Recommendations

The study examines the impact of energy (electricity and petroleum) consumption on economic growth in Nigeria during the period 1970-2011. We employed the ARDL bounds testing approach to cointegration to examine the presence of cointegrating relationship. For policymaking, we applied the Granger causality test within the VECM framework to verify the direction of causality between electricity consumption, economic growth, petroleum consumption, foreign direct investment, and exports in Nigeria. From the cointegration test results, the study found that electricity consumption, foreign direct investment, petroleum consumption, and exports have a long run relationship with economic growth. Moreover, the results of vector error correction coefficients, which determine the speed of adjustment, had an expected and highly negative sign. The study therefore recommends that government should strengthen the ongoing transformation agenda particularly on energy infrastructure to create sufficient energy (electricity and petroleum) supply. It is also necessary for the government to have an integrated energy policy, which will guide future energy related sub- sectoral policy developments, in order to avoid policy conflicts. This can be done through service availability, affordability, and accessibility. The Nigerian government should encourage research and development on technological innovation for energy savings to ensure stable supply and attract foreign direct investment. In addition to that, alternative energies such as solar power, hydro power, and wind power should be considered because these alternative energies are more environmental friendly compared to fossil fuel.

Shahbaz et a!, (2011) asserts that stable and reliable energy leads to expanded and diversified industrial, commercial and agricultural output and improve infrastructure, trade and GOP per capita.

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