DIGITALES ARCHIV

ZBW – Leibniz-Informationszentrum Wirtschaft
ZBW – Leibniz Information Centre for Economics

Okoye, Lawrence Uchenna; Omankhanlen, Alex; Okoh, Johnson I. et al.

Article

Analyzing the energy consumption and economic growth nexus in Nigeria

Provided in Cooperation with:
International Journal of Energy Economics and Policy (IJEEP)

Reference: Okoye, Lawrence Uchenna/Omankhanlen, Alex et. al. (2021). Analyzing the energy consumption and economic growth nexus in Nigeria. In: International Journal of Energy Economics and Policy 11 (1), S. 378 - 387.
https://www.econjournals.com/index.php/ijeep/article/download/10768/5605.
doi:10.32479/ijeep.10768.

This Version is available at:
http://hdl.handle.net/11159/8132

Kontakt/Contact
ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics
Düsternbrooker Weg 120
24105 Kiel (Germany)
E-Mail: *rights[at]zbw.eu*
https://www.zbw.eu/econis-archiv/

Standard-Nutzungsbedingungen:
Dieses Dokument darf zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden. Sie dürfen dieses Dokument nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen. Sofern für das Dokument eine Open-Content-Lizenz verwendet wurde, so gelten abweichend von diesen Nutzungsbedingungen die in der Lizenz gewährten Nutzungsrechte.
https://zbw.eu/econis-archiv/termsofuse

Terms of use:
This document may be saved and copied for your personal and scholarly purposes. You are not to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public. If the document is made available under a Creative Commons Licence you may exercise further usage rights as specified in the licence.

ZBW Leibniz-Informationszentrum Wirtschaft
Leibniz Information Centre for Economics

Mitglied der Leibniz-Gemeinschaft

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2021, 11(1), 378-387.

Analyzing the Energy Consumption and Economic Growth Nexus in Nigeria

Lawrence U. Okoye[1]*, Alexander E. Omankhanlen[1], Johnson I. Okoh[2], Ngozi B. Adeleye[3], Felix N. Ezeji[4], Gideon K. Ezu[5], Benjamin I. Ehikioya[1]

[1]Department of Banking and Finance, Covenant University Ota, Nigeria, [2]Department of Financial Studies, National Open University of Nigeria, [3]Department of Economics and Development Studies, Covenant University Ota, Nigeria, [4]Department of Financial Standards and Statutory Compliance, Nigerian Maritime Administration and Safety Agency, Lagos, Nigeria, [5]Department of Banking and Finance, Nnamdi Azikiwe University, Awka, Nigeria. *Email: lawrence.okoye@covenantuniversity.edu.ng

Received: 04 September 2020 **Accepted:** 13 November 2020 **DOI:** https://doi.org/10.32479/ijeep.10768

ABSTRACT

Public and private sectors across the globe formulate and implement policies that target growth of their operations. It is of essence therefore that economic managers and other stakeholders identify and engage key factors that promote economic activities in policy formulation. The connection between economic performance and energy utilization is acknowledged in the literature, but empirics on the nature of this relationship produce mixed outcomes thereby suggesting the need for more research. Using the auto-regressive distributed lag method, this study estimates the effect of energy consumption on economic growth in Nigeria between 1981 and 2017, incorporating financial development, gross fixed capital formation and inflation for enhanced robustness. The results indicate that energy consumption and gross fixed capital formation (proxy for infrastructure) significantly determine growth of economic activities in Nigeria. The study also presents empirical support for delayed response of an endogenous variable to its own shocks as well as shocks to explanatory variables. It therefore asserts that energy consumption is a major determinant of economic growth in Nigeria, and aligns with the energy-led hypothesis. The observed positive impact electricity and capital consumption provides empirical support for the endogenous growth theory. Increased government and private sector investment in energy and infrastructural development is strongly advocated.

Keywords: Energy economics, economic growth, energy utilization, endogenous growth, infrastructure.
JEL Classifications: C22, O4, O47, Q43

1. INTRODUCTION

Demand and supply conditions in the energy sector have remained issues of global concern, particularly in this era of rising trends in population growth and advances in technology *vis-à-vis* low level of infrastructural development. Energy concerns present key issues confronting growth and development initiatives of governments and induce social challenges to human societies (Chen et al., 2019). A clean and reliable source of energy is critical to the attainment of improved living conditions and it is often considered a major driver of stable economic growth and development. There is hardly any sector of the economy that can function effectively without adequate and consistent supply of energy, particularly electricity. Electric energy, for instance, is critical to the operations of the transportation, agricultural, water resources sectors and indeed maintenance of economic stability. Being a major driver of electric power supply, oil is also critical for the survival of modern economies as they struggle to attain rapid industrialization (Basher and Sadorsky, 2006). As critical inputs in the production process, electricity supply and price of oil (proxies for energy consumption) can impinge on the competitiveness of the real sector, and hence overall economic performance.

This Journal is licensed under a Creative Commons Attribution 4.0 International License

Supply and pricing of electricity have remained contentious among the various stakeholders in the energy sector, partly due lack of capacity to meet consumer demand. Inability to match electricity demand with supply *vis-a-vis* rising population growth also places serious constraints on the operating efficiency of power generating systems which are often over-loaded leading to incessant episodes of forced outages. Resort to power rationing or load shedding by electricity distribution companies to mitigate the crisis has not been very effective. Arising from the supply gap also is the imbalance in electricity distribution between the industrialized commercial urban and the poor rural areas. While the urban areas receive more regular supply of electricity to power industrial and commercial activities as well as enhance their living conditions, the rural areas resort to crude methods with adverse implications for economic and social life of the people.

Broadly speaking, energy can be derived from renewable and non-renewable sources. Though renewable energy sources like solar, wind, geothermal, hydropower and biomass offer clean, environmentally-friendly, cheap, and sustainable energy, non-renewable sources such as fossil fuel are often the more exploited option in spite of their high carbon content, huge maintenance cost, high capital intensity, high rate of depletion, inadequacy and inconsistency of supply (Ajayi and Ajanaku, 2009). Undue reliance of the global population on alternative (non-renewable) sources of energy is attributed to inadequate supply of non-fossil energy (Egbichi et al., 2018). This practice renders the ecosystem vulnerable to enormous environmental challenges such as deforestation, pollution, ozone layer depletion, and so on. Alege et al. (2016) report that fossil fuels contribute significantly to carbon emissions whereas non-fossil fuels reduce the concentration of carbon-dioxide (CO_2) in the atmosphere.

Though Nigeria is richly endowed with quite a good number of energy sources, majority of the citizens are without adequate and consistent supply. Majority of the rural dwellers are not served. The huge amount of solar radiation, abundant wind energy sources, large-scale deposits of fossil fuel, and hydro-power resources in the country which could be channeled to electricity generation are largely unexploited. With the appropriate policy mix, these resources could be harnessed and deployed to achieve stable, balanced and adequate supply of this vital resource. Today, the country is both a major exporter of crude petroleum and a major importer of refined petroleum products, notwithstanding the existence of five (5) refineries with grossly underutilized capacities. What a paradox! The refineries operate on imported technology which existing domestic technical infrastructure cannot support and thereby constitute channels for the outflow of foreign exchange. These systemic inefficiencies translate to inadequate power supply and high price for available energy.

Low level of local content in the sector impairs the capacity of the local refineries to operate at optimal levels of capacity utilization. Opportunities for optimization of indigenous technology in the oil sector have been serially missed. For instance, one of the positives of the Nigerian civil war (1967-1970) was the use of local technology to refine petroleum products. Even in the creeks of Niger Delta, local refining activities still exist, with the proceeds not accounting for the national income. With the right policy and attitude, these talents can be more profitably engaged to boost domestic supply of petroleum products thereby ensuring the supply of more energy at reduced price. As an essential component of industrial production, cheap energy can facilitate output growth through improved capacity utilization in domestic production facilities.

For oil exporting countries, high oil price can lead to improvement in balance of payment, enhance private disposable income, raise aggregate demand and corporate profitability, stimulate stock price, and appreciate domestic exchange rate (Abdelaziz et al., 2008). However, Omojolaibi (2014) contends that inefficient procurement practices in the public sector of oil exporting countries often deny them the opportunity of profitable engagement of oil resources. On the other hand, it is argued that high oil price distorts market stability, fuels inflationary pressure, thereby retarding the growth of economic activities (McKillop, 2004). This argument has empirical support in studies like Hamilton (1983). Rapid increase in oil price and exchange rate volatility are also identified as obstacles to growth (Jin, 2008).

Empirics on the connection between economic growth and energy consumption show mixed outcomes. While some studies show robust positive effect of energy consumption on economic activities (Omojolaibi, 2014; Akinlo and Apanisile, 2015, Ebele, 2015; Manasseh et al. (2019)), some other studies suggest negative impact of energy consumption (Hamilton, 1983; Aliyu, 2009; Qianqian, 2011; Dogah, 2015, etc.). Lack of consensus among scholars provides motivation for further studies on the subject. Also, dearth of empirical evidence on the response of real activities to changes in capital consumption and financial development, as observed in reviewed literature, informed their inclusion in this investigation. The rest of the paper is structured as follows: section 2 reviews the theoretical and empirical literature; section 3 outlines the methodology and data; section 4 analyses and discusses the results while section 5 concludes with policy recommendations.

2. REVIEW OF THEORETICAL AND EMPIRICAL LITERATURE

This study is premised on the endogenous growth theory which explains growth as the outcome of activities within the economy. As opposed to the Solow exogenous growth theory which assumes that improvements in technical knowledge derive from innovations and research outside the domestic economy, endogenous growth theorists, like Romer (1986) and Lucas (1988), posit that technical knowledge is acquired through repeated engagement in an activity (learning by doing). Endogenous growth economists contend that internally-driven growth can be achieved through increased savings rate, infrastructural and human capital development, increased investment in research and innovation, trade facilitation, among other initiatives. This suggests that economic growth can be achieved when government invests in human capital, innovation and research, infrastructure, healthcare, education, etc.

On the review of the empirical literature, the seminal work of Kraft and Kraft (1978) ignited considerable interest among researchers in energy economics. The study provides empirical foundation for the link between energy consumption and economic activities. It examined the causal relationship between energy consumption and economic growth in the USA and observes one-way causal flow from economic growth to energy consumption. Following the landmark work of Kraft and Kraft (1978), several studies have been conducted across different jurisdictions to deepen understanding of economic growth-energy consumption nexus based on a variety of analytical methods.

Balsalobre-Lorente et al. (2019) examined the correlation between consumption of natural gas and economic growth in Iran based on quarterly data for 1990(Q1)-2017(Q4). Gross fixed capital formation and oil revenue were incorporated in the model to enhance its robustness. They used Modified Wald test of Toda and Yamamoto (1995) to estimate the transmission of causality among the variables, and Fully Modified OLS (FMOLS), Dynamic OLS (DOLS) and Canonical Co-integration Regression (CCR) to estimate the long-run effect of the explanatory variables on GDP. The result indicates strong positive effect of natural gas consumption on output growth. It further shows one-way causality from gas consumption to output growth, thereby validating the hypothesis that economic growth is driven by energy consumption.

Using panel data obtained from 75 net energy importing countries from 1990 to 2012, Esen and Bayrak (2017) examined the connection between economic growth and energy consumption. The countries were first arranged into two groups according to level of import dependence (> or <50%). Each of the groups was further categorized according to income levels: low income, lower middle income, upper middle income and high income economies. The panel and country-level analyses show significant positive impact of energy consumption on economic growth, with stronger impact observed in less import-dependent countries. The study further shows negative influence of income level on energy consumption-induced growth, an indication that energy-led growth hypothesis is more robust as level of income decreases.

Tariq et al. (2018) investigated the energy consumption-economic growth nexus in Pakistan, Bangladesh, India and Sri Lanka over the period 1981-2015. Data analysis was based on the method of instrumental variable regression method. The result indicates robust positive effect of economic growth on energy consumption. It further shows that the countries investigated depend substantially on energy and are sensitive to its supply shocks. Finally, the study reveals that trade negatively affects energy consumption through inflow of energy-saving technology.

The work of Gozgor et al. (2018) examined the nexus between energy consumption and economic growth in a panel of 29 OECD countries using a modified growth model that incorporates economic complexity (proxy for productivity and economic structure). ARDL and panel quantile regression (PQR) methods were used to analyse data for 1990-2013. The study reveals that energy (renewable and non-renewable) and economic complexities have strong positive effect on economic growth.

Belke et al. (2011) investigated the link between energy consumption and economic growth based on data from 25 OECD countries between 1981 and 2007. The study used principal component analysis to show how country-specific factors and those common to all countries in the panel affect long-run interaction between the dependent and independent variables. The result not only indicates that international or common factors have stronger impact on the interaction between energy consumption and output growth but that energy consumption is price inelastic. The causality estimates show bi-directional causality between economic growth and energy consumption.

Muse (2004) used co-integration analysis, OLS regression method, error correction model (ECM) and Pairwise Granger causality methods to estimate the relationship between economic growth and energy consumption in Nigeria between 1980 and 2012. The result indicates robust positive effect of energy consumption on economic growth. It also shows bi-directional causal relationship between economic growth and energy consumption. Khobai et al. (2017) used ARDL method to investigate how electricity price, trade openness, capital, employment and electricity supply impact economic growth in South Africa based on data between 1985 and 2014. They observe that increase in energy price stifles growth while improvements in electricity supply, trade openness, employment and capital enhance economic growth.

Pirlogea and Cicea (2012) examined the link between energy consumption and economic growth in 27 member states of the European Union (EU) with Spain and Romania as two individual member states over the period 1990-2010. Components of energy consumption modeled in the study include natural gas, oil, coal, and renewable energy sources like hydropower, biomass, geothermal, solar and wind energy. Using GDP per capita as proxy for economic growth, they observe significant positive impact of: natural gas, petroleum products and renewable energy on long-run economic growth for Romania; natural gas and petroleum products on long-run economic growth for Spain; and renewable energy sources and petroleum products on long-run economic development for the EU countries.

Using the ARDL method, Madhavan et al. (2010) investigated the connection between economic growth and electricity consumption in Malaysia from 1971 to 2003, introducing electricity price as a moderating variable. They observe that electricity consumption greatly affects the performance of economic activities. An analysis of the relationship among electricity consumption, inflation, economic growth, and employment in India, China, Pakistan, Malaysia and South Africa between 1990 and 2012 conducted by Abbas et al. (2014) using generalized least squares (GLS) and Hausman test methods report that electricity consumption and employment strongly determine output performance, but did not show substantial effect of inflation on economic growth.

Manasseh et al. (2019) analyzed the response of the Nigerian economy to changes in oil price and exchange rate between 1970 and 2013. Employing GARCH, EGARCH and Granger causality tests, they discover strong positive effect of oil price, exchange rate and interest rate in addition to negative effect of external debt on economic performance. The authors further show that oil price dynamics significantly influence exchange rate volatility in Nigeria but did not establish causality between them. Using quarterly data between 1986(Q1) and 2007(Q4), Aliyu (2009) shows short-run negative impact of lagged oil price and exchange rate on the growth of economic activities. He also reports causal transmission from oil price shock to economic growth as well as bi-directional causality between exchange rate and output growth

Jin (2008) reports mixed results on the response of economic activities to oil price and exchange rate shocks in his study sample. While the study indicates negative effect of oil price on output growth in China and Japan, it reveals positive effect on the Russian economy. Growth-retarding effect of oil price increase on economic growth is also validated in the post-World War II study on the performance of the American economy conducted by Hamilton (1983). The work of Hondroyiannis et al. (2002) provides further empirical support for energy price and energy consumption effect on economic growth.

Okoye et al. (2019) investigated the causes of economic growth in Nigeria over the period 1981-2017, and discover significant positive effect of gross fixed capital and exchange rate on economic growth. They also observe that while financial sector activities retard economic activities in the country, oil price did not substantially affect it. Danmaraya and Hassan (2016) examined the relationship among manufacturing productivity, electricity consumption, capital and labour in Nigeria over the period 1980-2013. The ARDL estimates show robust short-run effect of the explanatory variables on manufacturing productivity. However, the long-run result indicates that current and lagged values (lag 1) of electricity and capital consumption demonstrate positive influence on manufacturing performance.

Iwayemi and Fawowe (2011) estimated the effect of oil price shocks on the economies of Nigeria, Egypt, Libya and Algeria, from 1970 to 2006, using the vector autoregressive (VAR) method. They adopted changes in nominal oil price (linear) as well as changes (positive and negative) in real oil price (non-linear) as proxies for oil price shocks, and observe from impulse response analysis that initial oil price shocks significantly induce macroeconomic volatility.

Based on quarterly data between 1970 and 2010, Oriakhi and Iyoha (2013) used vector auto-regression (VAR) method to examine the how Nigeria's economic performance is affected by volatile oil prices. They observe indirect effect of oil price volatility on growth. The authors specifically find that changes in oil price affect economic growth through government expenditure. This implies that oil price dynamics determine the level of government expenditure which thereby determines the growth potential of the economy. Maku et al. (2018), explored the nexus between pump price of major petroleum products (premium motor spirit [PMS], dual purpose kerosene [DPK] and automotive gas oil [AGO]), and human welfare in Nigeria based on data over the period 1990-2015. Using the ARDL method, the authors report robust negative impact of PMS and DPK on human welfare, both in the short and long-run periods.

The work of Anyalechi et al. (2018) used ARDL to estimate the response of stock market returns in Nigeria to movements in the price of oil based on monthly data between January 1994 and December 2016 and observe that oil price movements do not significantly drive stock market returns in Nigeria. It further shows that while inflation enhances short-run performance of market returns, its long-run impact is rather feeble. The study also produced evidence of long-run negative effect of real interest rate and foreign exchange rate on stock market returns.

Using the vector autoregressive (VAR) method, Gunu and Kilishi (2010) analyzed the dynamic interaction between Nigeria's economic performance and oil price shocks. Evidence from the study indicates robust effect of oil price on money supply, real GDP, and unemployment. Akpan (2012) also presents strong macroeconomic implication of oil price shock in Nigeria. The study specifically shows significant positive impact transmission of oil price shock on government expenditure, with rather marginal impact on industrial production. However, the work of Aremo et al. (2012) which used structural VAR (SVAR) to study the between link oil price shock and fiscal policy in Nigeria from 1980(Q1) to 2009(Q4) report that oil price shock affects government expenditure through revenue and output.

With the aid of quarterly data from 1985 to 2010, Omojolaibi (2014) analyzed the nexus between crude oil price and economic growth in Nigeria. Estimates from the structural vector auto-regression (SVAR) test show that oil price volatility correlates with higher level of economic activities. The result further reveals that oil price volatility is strongly linked to domestic shocks. The study of Balke et al. (2008) also reports that domestic variations in US output are largely traced to domestic shocks. It also reveals that oil price dynamics induce shocks to output demand and supply in the United States.

Akinlo and Apanisile (2015) explored the link between oil price volatility and economic growth with data from twenty sub-Saharan African countries for the period 1986 to 2012. The sample which is composed of a mix of oil and non-oil exporting countries, in equal proportions, reveal strong positive effect of oil price volatility on growth for oil exporting countries but weak and positive effect for non-exporting countries. The work of Dogah (2015), however, shows robust negative impact of oil price shock on the economy of Ghana. The author asserts that rising oil price raises Ghana's output prices thereby impairing its capacity to produce for both domestic consumption and export. Research by Qianqian (2011) also report substantial negative effect of oil price on output price for China.

Ogundipe et al. (2014) report that exchange rate volatility in Nigeria is highly driven by changes in oil price. This implies a close correlation between oil price and economic performance, since the Nigerian economy is highly susceptible to developments in the external sector. The work of Ebele (2015) presents further evidence of negative effect of oil price volatility on the growth of real activities in Nigeria, in addition to significant positive contribution of oil price itself on growth. Alhassan and Kilishi (2016) identify oil price volatility as a major factor in Nigeria's volatile macro-economy, and thereby present strong argument for economic diversification as panacea for unstable economic performance.

Okoye et al. (2019) examined the influence of financial development (with focus on the intermediation activities of microfinance banks) on the performance of the Nigerian economy over the period 1992-2016 using the estimation method of ARDL. The authors observe significant positive effect of lagged GDP on current rate of economic performance, as well as robust positive effect of inflation on the real economy. In another study, Okoye et al. (2018) demonstrate that inflation substantially reduced GDP per capita in Nigeria between 1970 and 2016 while domestic interest rate induced significant output improvement.

Adeleye et al. (2017) used the ARDL and ECM techniques to analyze the connection between credit growth and financial reforms using data for 1980-2016, and observe strong positive effect of interest rate reform on economic performance. The result of the study suggests positive spill-over effect of reformed interest rate on the real sector, a validation of the McKinnon (1973) and Shaw (1973) hypothesis.

Okoye et al. (2019) used the method of ordinary least squares (OLS) to investigate factors that determine output growth on Nigeria between 1981 and 2017, and discover that exchange rate dynamics and capital consumption promote economic growth while financial development has an opposite effect. The study further reveals non-significant capacity of oil price to raise economic activities in the country. Also, the work of Adeleye et al. (2020) reveal significant asymmetric effect of finance on agro-industrialization between 1981 and 2015. However, Ehikioya (2019) presents robust positive effect of oil price and financial development on Nigeria's economic growth. The study also provides empirical validation of negative effect of exchange rate volatility and inflation rate on real sector performance.

3. SCOPE AND METHODOLOGY

The research used ex-post facto design to investigate the response of economic activities to energy consumption, incorporating financial development, infrastructure, and inflation to minimize possible estimation error arising from variable omission. Electricity consumption and oil price are used as proxies for energy consumption. Based on availability of data sourced from the Central Bank of Nigeria Statistical Bulletin (2018) and BP Statistical Review of World Energy (2018), the research covers the period 1981 to 2017. Preliminary examination of the dataset was conducted with the Augmented Dickey-Fuller (ADF) test to ascertain its time series properties and given the outcome of the ADF test, the autoregressive distributed lag (ARDL) model was used to analyze the data. The ARDL model developed by Pesaran and Shin (1999) and reinforced in Pesaran et al. (2001) simultaneously estimates short and long-run parameters of a model, unlike the traditional approaches to co-integration like Engle and Granger (1987) and Johansen and Juselius (1990). It can also be applied regardless of whether the variables are integrated of order zero [$I(0)$], one [$I(1)$] or fractionally integrated. To ascertain the inferential significance of our findings, the empirical model is subjected to diagnostics which tested for serial correlation, normality, heteroskedasticity, and structural stability.

3.1. Model Specification

The functional form of our model is a modification of the model used in Solarin and Ozturk (2016) which explains economic growth as determined by individual and joint effect of natural gas consumption (NGC), gross fixed capital formation (GFCF), and oil revenue (OR). The model is specified as:

$$GDP_t = f(NGC_t, GFCF_t, OR_t) \tag{1}$$

This study modifies equation (i) introducing electricity consumption in place of natural gas consumption, oil price in place of oil revenue, and incorporating additional variables for enhanced robustness. The implicit form of the modified model is presented as:

$$GDPR_t = f(ELCON_t, OPR_t, FDPT_t, GFCF_t, INF_t) \tag{2}$$

Where, GDPR = GDP growth; ELCON = Electricity consumption; OPR = Oil price, FDPT = Financial development (proxied as private sector credit as percentage of GDP), GFCF = Gross fixed capital formation (proxy for infrastructure), and INF = Inflation.

Since the model contains a mix of variables in relative (rate, percentage) and absolute values, the semi-log (linear-log) functional form of the model is specified in Equation (3) as:

$$GDPR_t = \beta_0 + \beta_1 \ln ELCON_t + \beta_2 \ln OPR_t + \beta_3 FDPT_t + \beta_4 GFCF_t + \beta_5 INF_t + \varepsilon_t \tag{3}$$

Where: β_0 = Intercept; $\beta_{1,\ldots,}\beta_6$ = Parameters to be estimated; ε_t = Error term or stochastic variable.

3.2. A Priori Expectations

$\beta_1 > 0$; $\beta_2 > 0$ or < 0; $\beta_3 > 0$; $\beta_4 > 0$; $\beta_5 < 0$

The ARDL technique takes account of the autoregressive character of time series model, which indicates that previous values of a variable partly determine its present value. The adoption of this technique aligns with similar studies (Adeleye et al., 2018; Adeleye et al., 2020) on single-equation models with a view to analysing long- and short-run impacts The model estimates the short and long-run impact of the explanatory variables (electricity consumption, oil price, financial development, gross fixed capital formation, and inflation) on economic growth and the expanded form is expressed in Equation [4] as:

$$\Delta GDPR_t = \alpha_0 + \beta_1 GDPR_{t-1} + \beta_2 \mathrm{In}ELCON_{t-1} + \beta_3 \mathrm{In}OPR_{t-1} + \beta_4 FDPT_{t-1} + \beta_5 GFCF_{t-1} + \beta_6 INF_{t-1} + \varepsilon_t + \sum_{i=1}^{p} \beta_7 \Delta GDPR_{t-1} + \sum_{i=1}^{q} \beta_8 \Delta \mathrm{In}ELCON_{t-1} + \sum_{i=1}^{r} \beta_9 \Delta \mathrm{In}OPR_{t-1} + \sum_{i=1}^{s} \beta_{10} XFDPT_{t-1} + \sum_{i=1}^{t} \beta_{11} \Delta GFCF_{t-1} + \sum_{i=1}^{u} \beta_{12} \Delta INF_{t-1} \tag{4}$$

Where: Δ=First difference operator; α=Drift parameter; ε_t=White noise residual

The ARDL short-run equation estimates the error correction term (ECT), which the speed of adjustment of the model to long-run equilibrium convergence. Equation [4] is an amalgam of short and long-run equations. The long- run component is expressed as:

$$\Delta GDPR_t = \lambda_0 + \lambda_1 GDPR_{t-1} + \lambda_2 \text{In}ELCON_{t-1} + \lambda_3 \text{In}OPR_{t-1} + \lambda_4 FDPT_{t-1} + \lambda_5 GFCF_{t-1} + \lambda_6 INF_{t-1} + \varepsilon_t \quad (5)$$

The short-run component of Equation [4] is expressed as:

$$\Delta GDPR_t = \gamma_0 + \sum_{i=1}^{p} \gamma_1 \Delta GDPR_{t-1} + \sum_{i=1}^{q} \gamma_2 \Delta \text{In}ELCON_{t-1} + \sum_{i=1}^{r} \gamma_3 \Delta \text{In}OPR_{t-1} + \sum_{i=1}^{s} \gamma_4 \text{X}FDPT_{t-1} + \sum_{i=1}^{t} \gamma_5 \Delta GFCF_{t-1} + \sum_{i=1}^{u} \gamma_6 \Delta INF_{t-1} + \partial ECT + \varepsilon_t \quad (6)$$

4. PRESENTATION AND DISCUSSION OF RESULTS

4.1. Unit Root Test

The results of the unit root test, as presented in Table 1, indicate a mixed order of integration. It specifically shows that four of the variables (GDPR, GFCF, INF, OPR) are integrated of order zero [$I(0)$] while two (ELCON and FDPT) are integrated of order 1 [$I(1)$]. The variables exhibit stationary trend since they demonstrate a tendency for their values to revert to long-run constant mean and variance at level and first difference. Therefore, the ARDL is the appropriate estimation technique to analyze the data.

4.2. ARDL Bounds Cointegration Test

The bounds cointegration test was conducted to determine the cointegrating properties of the variables. It estimates tendency of the variables to move together over the long-run. The null hypothesis of absence of cointegrating relationship is specified as $\propto_1 = \propto_2 = \propto_3 = \propto_4 = \propto_5 = \propto_6$ against the alternate of existence of cointegrating relationship, which is specified as $\propto_1 \neq \propto_2 \neq \propto_3 \neq \propto_4 \neq \propto_5 \neq \propto_6$ Cointegration is assumed (rejection of null hypothesis) if the observed F-statistic is greater than the critical values of the lower [$I(0)$] and upper $I(1)$ bounds. The results show that at the stated degrees of freedom (K = 5), the F-statistic of 4.066174 from the bounds test exceeds critical values of $I(0)$ and $I(1)$ regressors at 5% level of significance (Table 2), thereby establishing robust evidence of long-run cointegration.

4.3. Long-run Regression Results

The results presented in Table 3 indicate that economic growth responds to changes in current and lagged values of the explanatory variables, inclusive of its own lagged values. The findings reveal robust third order autoregressive (lag) effect of GDPR [GDP (−3)], which implies that the current growth rate of GDP (GDPR) is strongly determined by its third preceding periods. The negative value suggests that economic performance during the period strongly retards present performance of the economy. It contradicts the result of Okoye et al. (2019) which presents positive effect of lagged GDP on current rate of economic performance.

Similarly, GDPR is strongly affected by both present and first lag values of electricity consumption (ELCON). The strong negative effect of lagged ELCON suggests that immediate past period value of electric energy consumption reduces the capacity of the economy to grow in the present period. The growth-retarding impact of lagged ELCON contradicts the positive result documented in Danmaraya and Hassan (2016). On the other hand, there is substantial evidence that GDPR is enhanced by current level of electric energy consumption. The positive effect of energy consumption on economic growth aligns with Muse (2004), Pirlogea and Cicea (2012), Khobai et al. (2017), Balsalobre-Lorente et al. (2017), and Gozgor et al. (2018).

With regard to oil price dynamics, the study shows strong influence of the oil market on Nigeria's economy. It specifically shows strong positive effect of current oil price on economic growth. The result implies that the huge inflow of foreign exchange arising from high price of oil exports enables procurement of production inputs, leading to higher level of productivity. This is consistent with the outcomes of Jin (2008), Omojolaibi (2014), Akinlo and Apanisile (2015), Ebele (2015) and Ehikioya (2019). However, lagged oil price [OPR (−1)] proves a substantial impediment to output growth. The negative result aligns with Hamilton (1983), Jin (2008), Aliyu (2009), Qianqian (2011) and Dogah (2015). This result is very germane for countries like Nigeria that depend largely on the performance of the energy sector to drive domestic economic activities.

The study further shows that economic performance is strongly linked to present and previous levels of infrastructure (proxied as GFCF). The result indicates that at 10% level of significance, current value of GFCF (gross fixed capital formation) boosts economic growth but past values have mixed effects on growth. For instance, while first period lagged value of GFCF retards present growth performance of the economy, its second period lagged value leads to improved performance. The study of Danmaraya and

Table 1: Unit root test

Variables	ADF at levels	5% critical value	ADF at 1st diff	5% critical value	Remarks
GDP Growth, GDPR	−3.064	−2.951	N/A	N/A	I(0)
Elect. Consumption, ELCON	0.469	−2.948	−8.657	−2.948	I (1)
Financial Devt., FDPT	−0.816	−2.946	−6.337	−2.948	I (1)
Capital Formation, GFCF	−4.704	−2.946	N/A	N/A	I (0)
Inflation, INF	−2.984	−2.946	N/A	N/A	I (0)
Oil Price, OPR	−3.559	−2.972	N/A	N/A	I (0)

Source: Authors' Computation with EViews (2020). N/A: Not applicable

Hassan (2016) validates the observed positive lag effect of capital on economic growth. In addition, the observation that current level of capital consumption facilitates growth aligns with Okoye et al. (2019). However, empirical evidence, from reviewed literature, on the link between GFCF and economic growth is quite scant.

Though there is evidence that FDPT (financial development) facilitates growth of economic activities, but the degree of impact is not statistically significant. The observed positive effect of FDPT on economic growth provides weak support for finance-leading hypothesis, an indication that the banking sector is not significantly supporting the growth of real activities in the country. The positive result is at variance with the report of Okoye et al. (2019) which suggests that financial sector activities in Nigeria retard economic activities but aligns with Ehikioya (2019) and Adeleye et al. (2020) which posit that finance is a positive contributor to real sector activities.

Finally, the coefficients of the current and lagged values of inflation, though negative, are statistically not significant in influencing growth. These outcomes contradict Abbas et al. (2014), Okoye et al. (2018) and Ehikioya (2019) that inflation is a negative predictor of economic growth but align with the positive outcome documented in Okoye et al. (2019). The model diagnostics reveal that the R-squared value of 0.812 indicate that 81.2% variation in growth is explained by the regressors, the F-statistic (4.033608) also indicates that the regressors are jointly significant in explaining economic growth while the Durbin-Watson (D-W) statistic of 2.224311 indicates existence of no serial correlation. Overall, the model demonstrates robust capacity to support policy decisions.

4.4. Error Correction Model (ECM) Results

The short-run estimates presented in Table 4 show that all the explanatory variables substantially affect economic growth. The results reveal robust positive effect of current values of electricity consumption (ELCON), oil price (OPR), and gross fixed capital formation (GFCF) on economic growth. Similarly, the second lag of GDPR (economic growth rate) contributes significantly to the growth of economic activities in the present period while the first lag of GFCF retards current growth. The results further reveal that current inflation does not substantially raise the growth of economic activities but its lagged values (lags 1 and 2) greatly enhance economic performance which aligns with Adeleye et al. (2018) on the growth-enhancing role of the inflation rate.

The error correction coefficient of −1.032, which is the speed of adjustment, shows the rate at which the variables adjust to or converge towards long-run equilibrium. This indicates that past deviations are corrected within one year (Olczyk and Kordalska, 2017; Adeleye et al., 2020). The observed magnitude of the error correction coefficient (>100%) aligns with the extant studies of Rao and Singh (2005), Muse and Usman (2013), Adeleye et al. (2018), Eke (2018), which report adjustment rates of −1.114, −1.107, −1.043 and −1.009 respectively.

4.5. Diagnostic Tests

Existence of autocorrelation or serial correlation in the model was examined with the Breusch–Godfrey test (Table 5). The test which is based on Lagrange Multiplier (LM) testing method investigates whether errors associated with one period carry over into future periods. Owing to lag effect of GDP growth, the Breusch–Godfrey test supersedes the Durbin-Watson test as the preferred method of testing for autocorrelation in the model.

Table 2: Bound test result

***F*-bounds test**		**Null hypothesis: No levels relationship**		
Test statistic	**Value**	**Significance level**	**I(0)**	**I(1)**
F-statistic	4.066174	10%	2.08	3.00
K	5	5%	2.39	3.38
		2.5%	2.70	3.73
		1%	3.06	4.15

Source: Authors' computation with EViews (2020)

Table 3: Long-run results

Variable	Coefficient	Std. error	t-statistic	Prob.*
GDP Growth, GDPR (–1)	0.156592	0.185320	0.844981	0.4123
GDP Growth, GDPR (−2)	0.291724	0.169262	1.723508	0.1068
GDP Growth, GDPR (−3)**	–0.480325	0.168977	–2.842555	0.0130
Elect. Consumption, ELCON*	1.177023	0.372188	3.162433	0.0069
Elect. Consumption, ELCON (–1)***	–0.802794	0.384513	–2.087819	0.0556
Oil Price, OPR**	0.000625	0.000277	2.252970	0.0408
Oil Price, OPR (−1)*	–0.001007	0.000312	–3.232990	0.0060
Capital Formation, GFCF***	0.614248	0.307738	1.996010	0.0658
Capital Formation, GFCF (−1)*	−1.805744	0.504295	−3.580733	0.0030
Capital Formation, GFCF (−2)**	1.086375	0.426740	2.545756	0.0233
Financial Devt., FDPT	0.089580	0.239816	0.373537	0.7143
Inflation, INF	−0.012754	0.045420	−0.280801	0.7830
Inflation, INF (−1)	−0.007195	0.048548	−0.148210	0.8843
Inflation, INF (−2)	−0.023344	0.046401	−0.503097	0.6227
Inflation, INF (−3)	−0.066239	0.038220	−1.733097	0.1050
C	4.449252	3.329617	1.336265	0.2028
R-squared	0.812019			
Adjusted R-squared	0.610760			
F-statistic	4.033608		Durbin-Watson stat	2.224311
Prob (F-statistic)	0.006375			

Source: Authors' computation with EViews (2020). *, **, *** 1%, 5%, 10% significance level

Table 4: Short-run estimates

Variable	Coefficient	Std. error	t-statistic	Prob.
Adjustment (−1)*	−1.032010	0.147406	1.279467	0.2215
GDP Growth, D[GDPR (–1)]	0.188602	0.130822	3.671587	0.0025
GDP Growth, D[GDPR (–2)]*	0.480325	0.130822	3.671587	0.0025
Elect. Consumption, D[ELCON]*	1.177023	0.246789	4.769348	0.0003
Oil Price, D[OPR]*	0.000625	0.000189	3.312839	0.0051
Capital Formation, D[GFCF]**	0.614248	0.211807	2.900032	0.0116
Capital Formation, D[GFCF (−1)]*	−0.086375	0.262612	−4.136812	0.0010
Inflation, D[INF]	−0.012754	0.028585	−0.446186	0.6623
Inflation, D[INF (−1)]*	0.089583	0.025542	3.507328	0.0035
Inflation, D[INF (−2)]**	0.066239	0.027929	2.371679	0.0326
R-squared	0.827994			
Adjusted R-squared	0.750591			

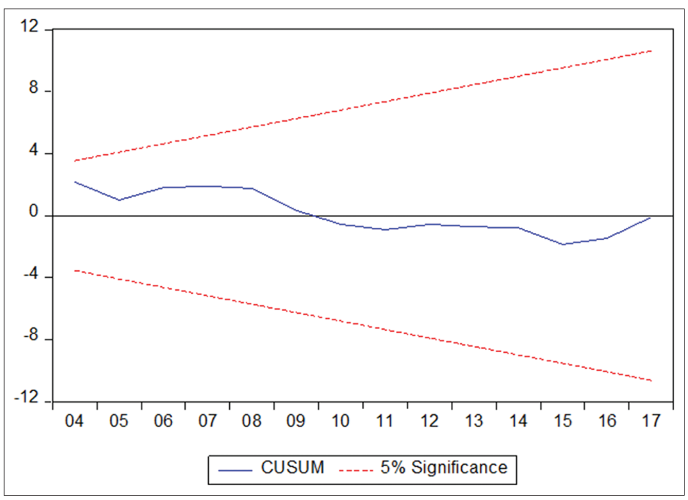
Source: Authors' computation with EViews (2020). *, **, *** 1%, 5%, 10% significance level

Table 5: Diagnostic tests

Test	F-statistic	P-value	Chi(χ^2)/T-statistic	P-value
Breusch-Godfrey serial correlation LM test	0.938019	0.4183	4.055994	0.1316
Heteroskedasticity test: Breusch-Pagan-Godfrey	1.263112	0.3337	17.25213	0.3040
Jarque-Bera	–	–	1.070765	0.585445

Source: Authors' computation with EViews (2020)

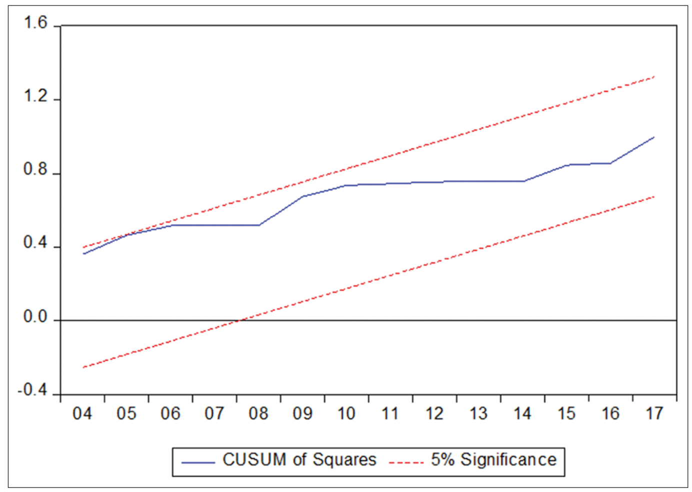
Figure 1: Cumulative sum (CUSUM) test of residuals



With the Prob. (F-statistic) and Prob. (Chi-square) greater than 5% (0.05), the Breusch–Godfrey test indicates non-rejection of the null hypothesis of no higher-order serial correlation among the residuals. This implies non-existence of serial correlation in the model up to order or lag two.

The Breusch-Pagan-Godfrey heteroskedsticity test investigates whether the variance of errors in the model depends on the values of the explanatory variables. It shows how errors behave (increase or decrease) across the independent variables. Since the Prob. (F-statistic) and Prob. (Chi-square) >0.05 (Table 5), the null hypothesis that no heteroskedasticity is present in the model is not rejected. This implies existence of homoscedasticity (constant variance) among the model residuals.

Figure 2: Cumulative sum of squares (CUSUM of squares+) test of residuals



The result of the Jarque-Bera test (Prob. [Jarque-Bera statistic] >0.05), shown in Table 5, indicates non-rejection of the null hypothesis that series are normally distributed. This suggests reliability of the inferential statistics.

The cumulative sum (CUSUM) and cumulative sum of squares (CUSUM of Squares) of residuals results at 5% level of significance (Figures 1 and 2 respectively) show that the stability lines lie within the upper and lower bounds (threshold interval). This indicates that the model is structurally stable.

5. CONCLUSION AND RECOMMENDATIONS

The study estimates the extent to which energy consumption affects the growth of economic activities in Nigeria, taking into consideration the influence of additional variables like financial development, gross fixed capital and inflation. Electricity consumption and oil price were used as proxies for energy consumption. From the result of the ARDL estimation, it was observed that electricity consumption and oil price (proxies for energy consumption) and gross fixed capital formation (proxy for infrastructure) significantly determine growth of economic activities in Nigeria. The study presents empirical support for delayed response of an endogenous variable to its own shocks as well as shocks to explanatory variables (lagged effect). It further suggests that the financial system is not adequately supporting economic activities in Nigeria, an indication of lack of required depth or capacity to finance the real economy. Finally, there is no evidence that inflation is a major factor in Nigeria's economic growth.

Following from the above observations, the research concludes that energy consumption is a major determinant of economic growth in Nigeria, and thereby aligns with the energy-led hypothesis. In addition, the observed positive impact electricity and capital consumption provides empirical support for the endogenous growth theory.

Based on the findings outlined above, the study recommends increased government and private sector investment in energy and infrastructural development. As a country that is hugely dependent on the export of petroleum products, it is advised that revenue from oil exports be prudently channeled towards building a robust infrastructure base, as well as development of other sectors of the economy to immune the economy from the volatility of the international oil market.

6. ACKNOWLEDGEMENT

The authors acknowledge the support of Covenant University towards the publication of this manuscript.

REFERENCES

Abbas, N., Saeed, S., Manzoor, S., Arshad, M.U., Bilal, U. (2014), The relationship between electricity consumption, employment rate, inflation and economic growth in five developing countries. British Journal of Economics, Management and Trade, 5(2), 164-171.

Abdelaziz, M., Chortareas, G., Upollinni, A. (2008), Stock Price Exchange Rates and Oil: Evidence from Middle-East oil Exporting Countries. Available from: http://www.iiste.org/journals/index.php/ejbm.

Adeleye, N., Osabuohien, E., Asongu, S. (2020), Agro-industrialisation and financial intermediation in Nigeria. African Journal of Economic and Management Studies, 11, 443-456.

Adeleye, N., Osabuohien, E., Bowale, E., Matthew, O., Oduntan, E. (2018), Financial reforms and credit growth in Nigeria: Empirical insights from ARDL and ECM techniques. International Review of Applied Economics, 32(6), 807-820.

Ajayi, O.O., Ajanaku, K.O. (2009), Nigeria's energy challenge and power development: The way forward. Energy and Environment, 20(3), 411-413.

Akinlo, T., Apanisile, O.T. (2015), The impact of volatility of oil price on the economic growth in Sub-Saharan Africa. British Journal of Economics, Management and Trade, 5(3), 338-349.

Akpan, E. (2012), Oil price shocks and Nigeria's macro economy. Journal of Economics Ibadan, 4(2), 12-19.

Alege, P.O., Oluwasogo, S.A., Ogundipe, A.A. (2016), Pollutant emissions, energy consumption and economic growth. International Journal of Energy Economics and Policy, 6(2), 202-207.

Alhassan, A., Kilishi, A.A. (2016), Analysing oil price-macroeconomic volatility in Nigeria. CBN Journal of Applied Statistics, 7, 1-22.

Aliyu, S.U.R. (2009), Impact of oil price shock and exchange volatility on economic growth in Nigeria: An empirical investigation. Research Journal of International Studies, 11, 4-15.

Anyalechi, K.C., Ezeaku, H.C., Onwumere, J.U.J., Okereke, E.J. (2019), Does oil price fluctuation affect stock market returns in Nigeria? International Journal of Energy Economics and Policy, 9(1), 194-199.

Aremo, A.G., Orisadare, M.A., Ekperiware, M.C. (2012), Oil price shocks and fiscal policy management: Implications for Nigerian economic planning (1980-2009). International Journal of Development and Sustainability, 1(3), 1121-1139.

Balke, N.S., Brown, S.P.A., Yücel, M.K. (2008), An International Perspective on Oil Price Shocks an US Economic Activity, Federal Reserve Bank of Dallas (Globalization and Monetary Policy Institute). Available from: http://www.dallasfed.org/assets/documents/institute/wpapers/2008/0020.pdf.

Balsalobre-Lorente, D., Bekun, F.V., Etokakpan, M.U., Driha, O.M. (2019), A road to enhancements in natural gas use in Iran: A multivariate modeling approach. Resources Policy, 64, 1-15.

Basher, S.A., Sadorsky, P. (2006), Oil price risk and emerging stock markets. Global Finance Journal, 17, 224-251.

Belke, A., Dobnik, F., Dreger, C. (2011), Energy consumption and economic growth: New insights into the cointegration relationship. Energy Economics, 33, 782-789.

BP Statistical Review of World Energy. (2018), Available from: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf.

Central Bank of Nigeria Statistical Bulletin. (2018). Statistical Bulletin. Abuja: Central Bank of Nigeria. Available from: https://www.cbn.gov.ng/documents/statbulletin.asp.

Chen, J., Wu, Y., Xu, C., Song, M., Liu, X. (2019), Global non-fossil fuel consumption: Driving factors, disparities, and trends. Management Decision, 57(4), 791-810.

Danmaraya, I.A., Hassan, S. (2016), Electricity consumption and manufacturing sector productivity in Nigeria: An autoregressive distributed lag-bounds testing approach. International Journal of Energy Economics and Policy, 6(2), 195-201.

Dogah, K.E. (2015), The impact of oil price shocks on the macroeconomy of Ghana. Journal of Poverty Investment and Development, 9, 37-54.

Ebele, E. (2015), Oil price volatility and economic growth in Nigeria: An empirical investigation. European Journal of Humanities and Social Sciences, 34, 1900-1918.

Egbichi, C., Abuh, O., Okafor, V., Godwin, A., Adedoyin, O. (2018), Dynamic impact of energy consumption on the growth of the Nigerian economy (1986-2016): Evidence from symmetrical ARDL model. International Journal of Energy Economics and Policy, 8(2), 188-195.

Ehikioya, B.I. (2019), The impact of exchange rate volatility on the Nigerian economic growth: An empirical investigation. Journal of Economics and Management, 37(3), 45-68.

Eke, O.P. (2018), Interest Rate Macrostructure, Corporate Bond Market Development and Industrial Output in Selected African Economies, A Thesis Submitted to the Postgraduate School, Covenant University, Ota, Nigeria, for the Award of Doctor of Philosophy Degree, Ph.D., in Finance.

Engle, R.F., Granger, C.J. (1987), Co-integration and error correction: Representation, estimation and testing. Econometrica, 55, 251-278.

Esen, O., Bayrak, M. (2017), Does more energy consumption support economic growth in net energy-importing countries? Journal of Economics Finance and Administrative Science, 22(42), 75-98.

Gozgor, G., Lau, C.K.M., Lu, Z. (2018), Energy consumption and economic growth: New evidence from the OECD countries. Energy, 153, 27-34.

Gunu, U., Kilishi, A.A. (2010), Oil price shocks and the Nigerian economy: A variance autoregressive (VAR) model. International Journal of Business and Management, 5(8), 39-49.

Hamilton, J.D. (1983), Oil and the macroeconomy since World War II. Journal of Political Economy, 91, 228-248.

Hondroyiannis, G., Lolos, S., Papapetrou, E. (2002), Energy consumption and economic growth: Assessing the evidence from Greece. Journal of Energy Economics, 24(4), 319-336.

Iwayemi, A., Fowowe, J. (2011), Oil and the macroeconomy: Empirical evidence from oil-exporting African countries. OPEC Energy Review, 35(3), 227-269.

Jin, G. (2008), The impact of oil price shock and exchange rate volatility on economic growth: A comparative analysis for Russia Japan and China. Research Journal of International Studies, 8, 98-111.

Johansen, S., Juselius, K. (1990), Maximum likelihood estimation and inference on cointegration-with application to the demand for money. Oxford Bulletin of Economics and Statistics, 52, 169-210.

Khobai, H., Mugano, G., Le Roux, P. (2017), The impact of electricity price on economic growth in South Africa. International Journal of Energy Economics and Policy, 7(1), 108-116.

Kraft, J., Kraft, A. (1978), On the relationship between energy and GNP. The Journal of Energy and Development, 3(2), 401-403.

Lucas, R.E. (1988), On the mechanics of economic development. Journal of Monetary Economics, 22(1), 3-42.

Madhavan, K., Sharma, S., Karunagaran, M. (2010), Electricity consumption-growth nexus: The case of Malaysia. Energy Policy, 38, 606-612.

Maku, O.E., Adetowubo-King, S.A., Oyelade, A.O. (2018), Impact of petroleum product price on human welfare in Nigeria. Periodyk Naukowy Akademii Polonijnej, 29(4), 27-42.

Manasseh, C.O., Ogbuabor, J.E., Abada, F.C., Okoro, E.U.O., Egele, A.E., Onwumere, J.U. (2019), Analysis of oil price oscillations, exchange rate dynamics and economic performance. International Journal of Energy Economics and Policy, 9(1), 95-106.

McKillop, A. (2004), Oil prices, economic growth and world oil demand. Middle East Economic Survey, 47(35), 1-10.

McKinnon, R.I. (1973), Money and Capital in Economic Development. Washington, DC: Brookings Institution.

Muse, B.O. (2014), Energy consumption and economic growth in Nigeria: Correlation or causality. Journal of Empirical Economics Research Academy of Social Sciences, 3(3), 108-120.

Nasiru, I., Usman, H.M. (2013), The relationship between domestic savings and investment: The Feldstein-Horioka test using Nigerian data. CBN Journal of Applied Statistics, 4(1), 75-88.

Ogundipe, O.M., Ojeaga, P., Ogundipe, A.A. (2014), Oil price and exchange rate volatility in Nigeria. Journal of Economics and Finance, 5(4), 1-9.

Okoye, L.U., Evbuomwan, G.O., Ezeji, F.N., Erin, O.A. (2018), Does exchange rate regime affect economic development? Evidence from Nigeria. Journal of Applied Economic Sciences, 8(62), 2459-2467.

Okoye, L.U., Omankhanlen, A.E., Ahmed, A., Ezeji, F.N., Ojo, A. (2019), Technological advances in microfinance banks and economic growth in Nigeria. International Journal of Civil Engineering and Technology, 10(3), 60-71.

Okoye, L.U., Omankhanlen, A.E., Okoh, J.I., Ehikioya, B.I., Ezeji, F.N., Okoye, H.C. (2019), Examining Economic Growth Drivers in Nigeria, Proceedings of the 34th International Business Information Management (IBIMA) Conference.

Olczyk, M., Kordalska, A. (2017), International competitiveness of Czech manufacturing-a sectoral approach with error correction model. Prague Economic Papers, 26(2), 213-226.

Omojolaibi, J.A. (2014), Crude oil price dynamics and transmission mechanism of the macroeconomic indicators in Nigeria. OPEC Energy Review, 38, 341-355.

Oriakhi, D.E., Iyoha, D.O. (2013), Oil price volatility and its consequences on the growth of the Nigerian economy: An examination (1970-2010). Asian Economic and Financial Review, 3(5), 683-702.

Pesaran, M., Shin, Y. (1999), An autoregressive distributed lag modeling approach to cointegration analysis. In: Strom, S., editor. Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium. Cambridge: Cambridge University Press.

Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationship. Journal of Applied Economics, 16, 289-326.

Pirlogea, C., Cicea, C. (2012), Econometric perspective of the energy consumption and economic growth relation in European Union. Renewable and Sustainable Energy Reviews, 16, 5718-5726.

Qianqian, Z. (2011), The impact of international oil price fluctuation on China's economy. Energy Procedia, 5, 1360-1364.

Rao, B., Singh, R. (2005), A cointegration and error correction approach to demand for money in Fiji: 1971-2002. Pacific Economic Bulletin, 20, 72-86.

Romer, P.M. (1986), Increasing returns and long run growth. Journal of Political Economy, 94(5), 1002-1038.

Shaw, E.S. (1973), Financial Deepening in Economic Development. New York: Oxford University Press.

Solarin, S.A., Ozturk, I. (2016), The relationship between NG consumption and economic growth in OPEC members. Renewable and Sustainable Energy Reviews, 58, 1348-1356.

Tariq, G., Sun, H., Haris, M., Javaid, H.M., Kong, Y. (2018), Energy consumption and economic growth: Evidence from four developing countries. American Journal of Multidisciplinary Research, 7(1), 100-107.

Toda, H.Y., Yamamoto, T. (1995), Statistical inference in vector auto-regressions with possibly integrated processes. Journal of Econometrics, 66(1-2), 225-250.