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Analysis of the Nexus between Natural Gas Consumption and Economic Growth in Nigeria (1981-2019)

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Abstract
The study examines the nexus between natural gas consumption and economic growth in Nigeria. The research is conducted using annual time series data running from 1981 to 2019. The paper employs autoregressive distributive lag model (ARDL) as the estimation technique. The variables studied are Real Gross Domestic Product (RGDP), Natural Gas Consumption (NGC) and Oil Price (OP).The results of the analysis shows that natural gas consumption had negative and significant relationship on RGDP on the long run and it is insignificant in the short run because it is a derived demand, while oil price had a positive and significant relationship on the dependent variable both on the short run and the long run. Based on the empirical outcomes of the result obtained, the following recommendations are offered: There is room for massive investment in the oil and gas sector especially in infrastructures with the aim of increasing natural gas consumption through its availability, accessibility and affordability most especially in the rural areas where it is less consumed and also urban areas.

Keywords: Gas, Consumption, Real Economic Growth, Oil Price, ARDL Model
JEL Classification: F43, L95

1. Introduction

The usefulness of energy in human lives cannot be overestimated, it is vital to all aspects of economic growth, progress and development as well as poverty eradication and security (Akinola, Rominiyi & Eiche 2017). Energy is of highest importance in all human existence. Without enough energy in place, life becomes a drag and burdensome. Energy has been a major means of wealth creation, Nigeria inclusive. It becomes imperative, therefore that the role of energy as economic driver especially the natural gas aspect of it be examined (Adelegan 2018). Natural gas is the leading natural resource in Nigeria with a proven gas reserves of 199.090 trillion cubic feet (tcf) of gas comprising of 96.36 trillion cubic feet (tcf) which occurs as Associated Gas (AG) and 102.730 trillion cubic feet (tcf) occurs as Non-Associated Gas (NAG) also, Nigeria is rank as the ninth (9th) largest gas reserve in the world and it is evident, that Nigeria has more gas reserve than oil (Department of Petroleum Resources 2017).There has always been a shortfall in meeting up with the domestic gas obligation in Nigeria and this has affected the economic activities that would have been triggered, in the form of gas based industrialization (DPR 2016). According to National Gas Policy (2017), Nigeria domestic natural gas performance is currently at 38.18% and the economic recovery and growth plan (2017 – 2020) developed by the federal government of Nigeria, that was framed to support the economy within the short term economic growth framework, did not capture gas exploitation, development and consumption as a means or driver for economic growth in the short term framework (Biose, 2019).

Oil price and natural gas prices are cointegrated as they affect energy consumers, producers and marketers. They are derived demand as both fuels can be substituted in uses. Ramberg and Parsons (2012) establish that the cointegration relationship between Oil price and natural gas prices were unstable base on their study. They estimated an ECM to explain short run dynamic adjustment of natural gas and crude oil prices using variables comparable to those introduced in Brown and Yücel (2008). They wrap up that even if the long run pricing relationship changes, a relationship should eventually re-establish as new technologies introduce new margins of substitution between the fuels.

Given the rising significance of natural gas, many distinctiveness of this precious resource have not been properly investigated in the economic literature. Very limited attempts have been made in the literature in this aspect and without a clear agreement among the researchers over the relationship between natural gas consumption and economic growth (Odhiambo (2009), Noor and Siddiqi (2010), Dantama, Abdullahi and Inuwa (2012), Adamu and Darma (2016)). Instead, significant part of the causality tests has focused on either aggregate energy consumption or electricity consumption with very important policy implications. Hence the burning desire or motivation that triggers this study is to further explore not only aggregate energy consumption or electricity consumption but to analyze the nexus between gas consumption and economic growth in Nigeria. The paper will also look at the relationship between oil price and natural gas consumption in Nigeria. This paper is divided into five sections. Following this introduction is section two which is empirical review. Section three is methodology while section four is data analysis and finally section five is conclusion and recommendation.

2. Literature Review

Empirical Review

Odhiambo (2009) use autoregressive distributed lag (ARDL) bound test and granger causality test to investigate the relationship between energy consumption and economic growth in Tanzania from 1971 to 2006. The result shows a long run relationship between energy consumption and economic growth which the granger causality reveals a unidirectional causality running from energy consumption to economic growth. The outcome implies that energy conservation policies would have damaging repercussions on economic growth for Tanzania. Noor and Siddiqi (2010) employ ordinary least square techniques to analyse the relationship between per capita energy consumption and per capita gross domestic product (GDP) in Nigeria (1971-2006). The OLS result reveals a strong long run relationship between variables in the model. The long run estimated equation show a negative relationship between the per capita energy consumption and per capita GDP, while the causality test reveal a unidirectional causality running from GDP to EC in the short run. Dantama, Abdullahi & Inuwa (2012) look at the impact of energy consumption on economic growth in Nigeria over the period of 30 years and they use ARDL cointegration technique. Findings reveal a long run relationship exist between energy consumption and economic growth. Also, the speed of adjustment in the model estimated is associated with its expected sign and level of significance.

Abalaba and Dada (2013) in addition investigate the relationship between energy consumption and economic growth in Nigeria, and establish weak evidence to support the presence of relationship between them in the long run, they also found no causal effect in both ways between energy consumption and economic growth in Nigeria, but establish a short-run relationship. Their finding is in line with Aliero and Ibrahim (2012) who found absence of causality between total energy consumption and economic growth in Nigeria using data from 1970 to 2009. Their result on the contrary, contradicts the findings of Olusegun (2008) and Ighodaro and Ovenseri (2008). They used aggregate energy consumption, without considering the natural gas consumption as a separate variable in their Johansen cointegration test. Agbonifo (2015) used literatures to review the contributions of the oil and gas to the Nigerian economy as well as its obstacles to sustainable development. The study reveal that obstacle are deeply rooted in dearth of natural gas gathering and distribution infrastructure, fiscal and regulatory policy, funding, and more importantly, the prevailing security situation in the main gas supply source, the Niger Delta region. It conclude that the absence of enabling environment for private participation on natural gas development, lack of energy intensive plants across Nigeria to utilise vast proportion of natural gas and the imposition of price control mechanism are serious threat to natural gas development. Adamu and Darma (2016) establish cointegration between natural gas consumption and economic growth in Nigeria (1981-2013), and the result shows positive and significant long run relationship between the two variables. However, they did not look at the sensitivity between economic growth and gas consumption in the country. This will be useful in identifying the vulnerability of the economic growth to a shock in natural gas consumption in the country, and vice versa. This is useful for policy making and investment priority to identify the resultant effects of investment or growth in one variable on the other, in this case gas consumption and economic growth. The paper uses oil production, natural gas consumption and real GDP while this paper takes into congnisance oil price as its variable and the scope of study is 1981 to 2019.

Theoretical Framework

For the purpose of this paper, the theoretical framework adopted is Energy Ladder model. The energy ladder model was the famous model of explaining household energy choice in developing countries (Hosier 1987; Leach1992) until a decade ago (Elias 2005). The energy ladder describes a pattern of fuel replacement as a household's economic situation changes. The model was developed based on the relationship between income and uptake of modern fuels (e.g. electricity). The energy preference ladder position fuels modern fuels like electricity and LPG are considered superior fuels thanks to their high efficiency, cleanliness and convenience of storage and usage and are located higher up the ladder than traditional fuels, or lower fuels (Leach 1992). According to this model, households switch from traditional energy systems to modern energy systems up the ladder at the speed and extent acceptable by factors such as household income, fuel and equipment costs, availability and accessibility of fuels, reliability of recent fuel distribution, and, to a lesser extent, relative fuel prices (Masera 2000). The energy ladder model relies on the microeconomic theory of rational choice. Adam Smith, who proposed the idea of "invisible hand" moving free-market economies within the mid 1770s, is more often than not credited as the father of rational choice theory. Rational choice theory states that individuals use their self-interests to make choices that will provide them with the greatest benefit.

The assumption of rational choice theory is that all actions are rational and are made due to considering costs and rewards. Also, the reward of a relationship or action must outweigh the cost for the action to be completed, when the value of the reward diminishes below the value of the costs incurred, the person will stop the action or end the relationship and finally individuals will use the resources at their disposal to optimize their rewards. Rational choice theory shows that individuals are in control of their decisions. They don't make choices because of unconscious drives, tradition or environmental influences; finally consumer uses rational considerations to weigh consequences and potential benefits. However, energy ladder model assumes that all forms of fuel (traditional and modern) are available, that there is a universal set of fuel preferences, and that households will decide to move up the ladder as soon as they can meet the expense to do so. The major success of the energy ladder is its ability to capture the strong income dependency of energy choice in households, particularly in urban areas.

3. Methodology

This paper utilizes ex-post facto research design, which uses secondary data to establish the relationship between the dependent variable and independent variables. The ex-post facto research design is suitable for this paper because of the nature of the study, which shows the following characteristics of the research covering more than one-year period, also the data used are already in existence and cannot be manipulated. This study is fundamentally analytical and it embraces the use of secondary data in examining the Nexus between Natural Gas Consumption and Economic Growth in Nigeria. Descriptive analysis is used to capture the nature and structure of the data, correlation analysis is also carried out to examine the mutual connection between each of the variables and the other, while an Autoregressive Distributed Lag model (ARDL) is employed to show the relationship that exist between dependent and independent variables.

To critically analyse the nexus between Natural Gas Consumption and Economic Growth in Nigeria, this paper adapts the model of Solarin and Shahbaz (2015) which examined Natural Gas Consumption and Economic Growth: The Role of Foreign Direct Investment, Capital Formation and Trade Openness in Malaysia. The model specified in the paper is as follows;

Y_t= F (G_t,F_t,K_t,O_t) ……………………………………………………………… 1

Where; Y is real GDP per capita, G is natural gas consumption (in cubic metres) per capita, K is real capital formation (proxies by real gross fixed capital formation) per capita, F is real foreign direct investment per capita and O is real trade openness (real exports of goods and services plus real imports of goods and services) per capita. Sakiru and Muhammad (2015) model is therefore, modified in this paper by replacing all the independent variables with gas consumption and oil price. For the Analysis of the Nexus between Natural Gas Consumption and Economic Growth in Nigeria, the model is therefore specified as;

$RGDP = \alpha + \beta_1 NGC + \beta_2 OP + \varepsilon_t$ …………………………………………... 2

Where; RGDP is Real Gross Domestic product per capital, NGC is Natural Gas Consumption, OP is Oil Price and ε_tDenotes stochastic disturbance term. The *a priori* expectations of the behavior of the independent variables in term of their parameters to be estimated are; $\beta_1 > 0$; $\beta_2 > 0$; $\beta_3 > 0$.

Natural Gas is measured by volume and is stated in cubic feet. A cubic foot of gas is the quantity of gas needed to fill a volume of one cubic foot under set conditions of pressure and temperature. To measure larger quantity of natural gas, a "therm" is use to denote 100 cubic feet, and "mcf" is use to denote 1,000 cubic feet. To provide greater accuracy in comparing fuels, energy content is measure in terms of British Thermal Units (BTU's). A BTU is the quantity of heat required to raise one pound of water (approximately a pint), one degree Farenheit at or close to its point of maximum density. The energy content of natural gas differs in various locations throughout the country. For the sake of comparison, one average cubic foot of natural gas is about 1,000 BTU's of heat energy.

Oil Price is the spot price of one barrel of the benchmark crude oil. The price is a function of its grade, location and the content of sulfur present in it. Oil price is determined with the help of balance between its demand and supply.

Gross domestic product (GDP) is the monetary measure of the market value of all the final goods and services produced in a specific period of time. Also, Gross domestic product is an aggregate measure of production equal to the sum of the gross values added of all resident and institutional units engaged in production and services (plus any taxes, and minus any subsidies, on products not included in the value of their outputs).

ARDL Cointegration Approach

To test the long run relationship among the variables, this paper deviates from the well-known Engle and Granger (1987) and Johansen and Juselius (1990) approaches of cointegration and make use of new and advanced approach known as autoregressive distributive lag model (ARDL) bounds testing approach developed by Pesaran, Shin & Smith (2001) to test whether long run relationship exist between the variables or not. This method is recently embraced because it is valid if the variables of interest have vague order of integration i.e. purely I(0), purely I(1) or I(0) / I(1) which is not acceptable in previous approaches. Also, as maintain by Haug (2002), ARDL bounds testing approach is more suitable and gives better results for small sample size while the short and long-run parameters can be estimated simultaneously. Hence, the ARDL representation of equation iii can be presented as thus;

$$\Delta RGDP_t = \alpha_0 + \alpha_1 RGDP_{t-1} + \alpha_2 NGC_{t-1} + \alpha_3 OP_{t-1} + \sum_{i=1}^{k} \beta_1 \Delta RGDP_{t-i} + \sum_{j=1}^{l} \theta_1 \Delta NGC_{t-j} + \sum_{j=1}^{m} \gamma_1 \Delta OP_{t-j} + \varepsilon_t \ldots\ldots 3$$

While for the equation iii, the ARDL representation is presented as; where; Δ is the first-difference operator, and β's and α's shows the long run coefficients and short run coefficients. Hence, the null hypothesis (H_0) of no cointegration states that, H_0: $\alpha_1 = \alpha_2 = \alpha_3 = \beta_1 = \theta_1 = \gamma_1 = 0$ and the alternative hypothesis of existence of cointegration state that; $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \beta_1 \neq \theta_1 \neq \gamma_1 \neq 0$ respectively.

The above hypotheses are tested by comparing the calculated F-statistic with critical values from Narayan (2005) which were produced for small sample sizes of between 30 and 80 observations on the assumption that all variables in the model are I(0) in one side and that all the variables are I(1) on the other side. Following the norms of hypothesis testing, if the calculated F-statistic exceeds the upper critical bounds value, then the H_0 is rejected and we accept H_1, but if the F-statistic falls within the bounds then the test is inconclusive and lastly if the F-statistic falls below the lower critical bounds value, it implies that there is no co-integration.

ARDL Error-Correction Model (ARDL-ECM) Approach

With cointegrated variables, causal relations among variables can be examine within the framework of ECM (Granger, 1988). This present both the short run and long run relationship among the variables. The individual coefficients of the lagged terms explain the short run dynamics in the model, while the error correction term (ECT) presents the information of long run relationship. In the same vein, the significance of lagged explanatory variable depicts short run causality while a negative and statistically significant ECT is assumed to signify long run causality.

$$\Delta RGDP_t = \beta_0 + \beta_1 \Delta RGDP_{t-i} + \beta_2 \Delta NGC_{t-i} + \beta_3 \Delta OP_{t-i} + \mu_t \ldots\ldots 4$$

While that of the ARDL model in equation iv is presented in equation v;

$$\Delta RGDP_t = \beta_0 + \beta_1 \Delta RGDP_{t-i} + \beta_2 \Delta NGC_{t-i} + \beta_3 \Delta OP_{t-i} + \rho ECM_{t-1} + \mu_t \ldots 5$$

Where, Δ is the difference operator, ECM represent the Error Correction Term (ECT) derived from the long-run co-integrating relation from specified ARDL models equation iv. Equation v, ρ should exhibit a negative and significant sign for causality to exist in the long run.

Lastly, the stability of the model is tested using the cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ) tests. This is based on the assertion of Narayan and Smyth (2005) who maintained that, after the error correction models have been estimated, Pesaran(1997) suggest applying the cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ) tests to assess the parameter constancy.

4. Result

Table 1: Descriptive Statistics

Statistics	GDP	NGC	OP
Mean	30559.51	11.83144	42.47884
Median	6897.482	10.70900	28.89890
Maximum	144210.5	26.42849	105.0096
Minimum	144.8312	1.447166	13.06444
Std. Dev.	41655.36	5.923969	29.10352
Skewness	1.292604	0.219625	0.971070
Kurtosis	3.429122	2.489378	2.661252
Jarque-Bera	11.15960	0.737223	6.315821
Probability	0.003773	0.691694	0.042514
Sum	1191821.	461.4263	1656.675
Sum Sq. Dev.	6.59E+10	1333.550	32186.57
Observations	39	39	39

Source: Author's own computation

Table 1 shows the descriptive statistics of RGDP, NGC and OP. It is shown that all the variables under consideration contained 39 observations. It can be observed from the table that RGDP, and OP have the highest mean value while NGC has the lowest mean value. In terms of standard deviation, the most volatile series are gross domestic product and OP whereas the least volatile series is NGC. Also, in terms of Jarque-Bera statistic, only NGC follows normal distribution while other variables are not normally distributed because of their low probability value.

Trend Analysis

Graphically, the trend analysis shows that the variables fluctuate at one point or the other during the period under review. This was attributed to the effects of natural gas consumption and economic conditions that would have had attendant effects on some of the variables. These are presented graphically in fig.4.1 to 4.3

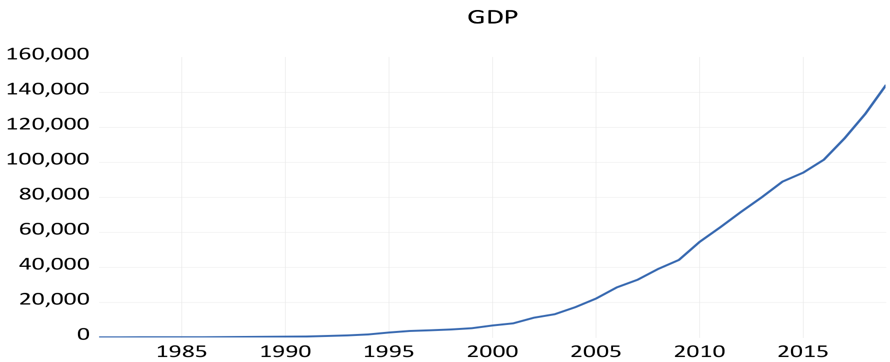

Figure 1: Gross Domestic Product

From figure 4.1, the variable shows a relatively upward trend over the period under study (1981-2019). This can be attributed to the fact that NGC and OP generate revenue for Nigeria and thus boost economic growth. The minimum was recorded in 1981 and the peak was recorded in 2019.

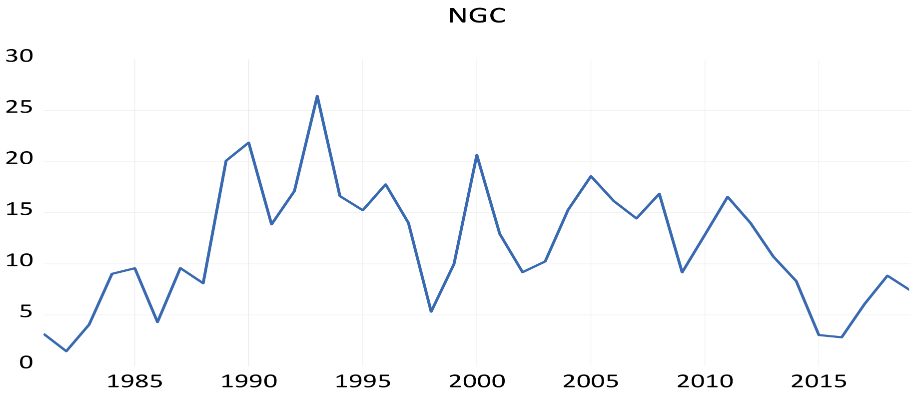

Figure 2: Natural Gas Consumption

Natural Gas Consumption within the period under investigation shows a relatively unstable trend for the period 1986-2019, it recorded its peak in 1993 and lowest in 1982. One of the reasons for the fluctuations on natural gas consumption is that there is seasonal change in demand and consumers are extremely limited in their ability to substitute other fuels when the price of natural gas fluctuates.

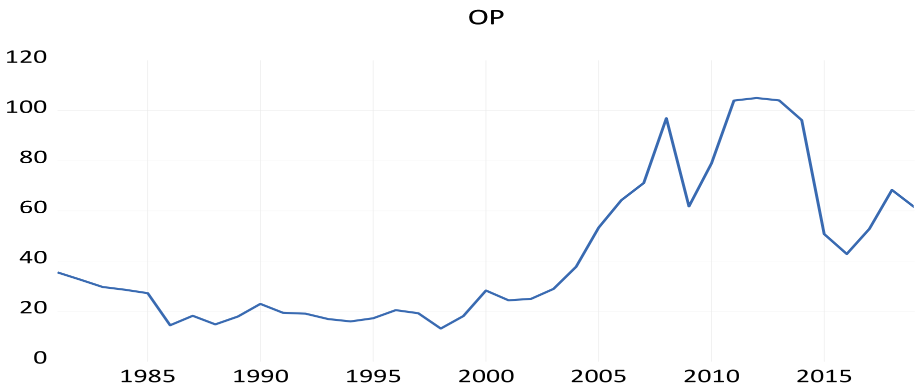

Figure 3: Oil Price

Oil price shows an unstable trend from 1981 to 2019, Nigeria being a net oil-exporting country makes it particularly vulnerable to oil price fluctuations, having its trough in 1986, but moved unexpectedly upwards and its peak around 2012.

Stationarity Test

The Augmented Dickey-Fuller test is use to test for unit root status of the variables. All the variables are regressed on trend and intercept to determine if they have trend, it was discovered that the three variables have trend and intercept, hence the unit root test involve trend and intercept. The result is presented below:

Table 2: Unit Root Stationarity Result

Variables	ADF Statistics	Critical Value	Stationary Status
GDP	-7.115934	-3.626784 (1%) -2.945842 (5%) -2.611531(10%)	I(1)
NGC	-7.447995	-3.626784 (1%) -2.945842 (5%) -2.611531(10%)	I(1)
OP	-5.759321	-3.629031 (1%) -2.943427 (5%) -2.610263 (10%)	I(1)

Source: Author's computation

Table 2 presents the result of the Augmented Dickey-Fuller unit root test. It can be observed that all the variables were stationary at the 1st difference. Hence, they are said to be integrated of order one, that is I(1). Theoretically, when all variables are integrated of order one, it is expected to conduct cointegration test. However, given the ARDL approach adopted by this research, the validity of this theoretical expectation is validated by conducting a cointegration test in what follows:

ARDL Bounds Test Approach to Cointegration

Table 3: Result of Bounds Cointegration Test

F-statistic	243.2683	
Critical Values		
Significance levels	I0 Bound	I1 Bound
10%	2.63	3.35
5%	3.1	3.87
2.5%	2.55	4.38
1%	4.13	5

Source: Author's Computation

The result of Bounds cointegration test is reported in Table 3. Since the F-statistic is greater than the I1 critical bound at 1%, 2.5%, 5% and 10% level of significance, the null hypothesis of no cointegration is rejected. The conclusion can therefore be made that there is long-run relationship between all the variables.

Lag Length Selection Criteria

The information criterion presented in the figure above showed that ARDL (1, 0, 3) is appropriate for the model in this paper. This explains the advantage of ARDL methodology as it is not necessary for all the variables to have the same lag(s).(See appendix 1)

Normality Test

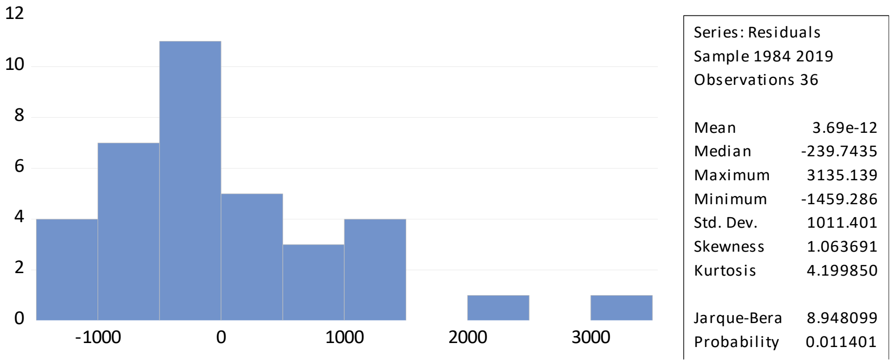

Figure 4: Normality Test
Source: Author's Computation

The Figure 4 shows normality of the model. The probability value of Jarque-Bera (0.01401) indicates that the model is abnormally distributed.

CUSUM and CUSUMSQ Stability Test

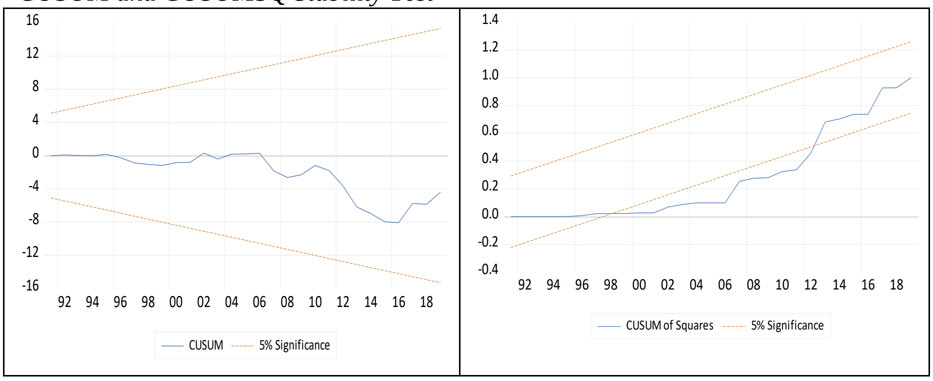

Figure 5: CUSUM and CUSUMSQ Stability test graphs

The Figure 5 indicates the cusum and the cusumq test graph that helps in tracing out the stability of error and it square during the period under study. The null hypothesis is that the regression model fit the data well versus its alternative hypothesis of invalid regression model. The smooth blue lines show the cumulative sum of recursive residual errors and the cumulative sum of square of recursive residual errors and the dotted lines indicated 5% Bartlett standard error bound.

Estimated ARDL Long Run and Short Run Model

The ARDL short run and long run estimation of the nexus between NGC and economic growth is presented in Table 4 using the ARDL (1, 0, 3) Selected based on Akaike info criterion (AIC). Those lags that are mostly statistically significant are reported in this table (See Appendix 1)

Table 4: Error Correction and Short-Run Analysis (Dependent variable: GDP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(OP)	99.66766	13.38624	7.445530	0.0000
D(OP(-1))	35.31930	13.32466	2.650673	0.0129
D(OP(-2))	43.47052	13.69810	3.173470	0.0036
CointEq(-1)*	-0.111601	0.003406	-32.76791	0.0000
R Squared	0.949607			
Adjusted R-Squared	0.944882			
S.E. of Regression	1057.548			
Diagnostic Tests	DW=1.728249			

Source: Author's Computation

Table 4 shows the short-run relationship among the variables and the error correction mechanism. From the analysis, it is observe that all of the variables were significant at their conventional levels. The Error Correction parameter is negative and significant indicating that short-run disequilibrium in the previous period is corrected to restore equilibrium in the subsequent period. The value of -0.111601implies that about 11% of the disequilibria in GDP of the previous year's shocks adjust back to the long-run equilibrium in the current period.

Table 5: Long -Run Analysis (Dependent variable is GDP)

Regressor	Coefficient	Std. Error	t-Statistic	Prob.*
GDP(-1)	1.111601	0.008771	126.7322	0.0000
NGC	-98.24412	46.86735	-2.096213	0.0375
OP	99.66766	16.73737	5.954798	0.0000
OP(-1)	-62.09078	20.56335	-3.019488	0.0052
OP(-2)	8.151217	20.84147	0.391106	0.6986
OP(-3)	-43.47052	16.57500	-2.622656	0.0138
C	882.8220	745.1038	1.184831	0.2457
R Squared = 0.999431	Adjusted R-Squared = 0.999313	S.E. of Regression = 1111.113	F-statistic (Prob.) = 8490.940 (0.00000)	
Diagnostic Tests		DW=1.728249		

Source: Author's computation

Note: Estimated Long Run Coefficients Using the ARDL Approach ARDL (1, 0, 3) Selected based on Akaike info criterion (AIC)

Table 5 displays the estimated long-run relationship of the nexus between natural gas consumption and economic growth. The results reveal that NGC have negative and significant relationship on GDP, OP had positive and significant relationship on GDP in the long-run

Interpretation of Results

Table 4 and 5 present both short-run and long-run autoregressive distributed lag model (ARDL) estimates of the nexus between natural gas consumption and economic growth in Nigeria. In line with the literatures reviewed above, table 4.4 presents the estimated short-run relationship among Gross Domestic Product (GDP), Natural Gas Consumption (NGC) and Oil Price (OP). The results reveal that all the variables have positive and significant relationship on GDP at conventional level in the short run. The Error Correction parameter is negative and statistically significant at 1% confidence level indicating that short-run disequilibrium in the previous period is corrected to restore equilibrium in the subsequent period. The value of -0.111601implies that about 11% of the disequilibrium in GDP of the previous year's shocks adjust back to the long-run equilibrium in the current period.

The results in Table 5 reveal that NGC shows negative and significant relationship on the dependent variable (RGDP) in line with Adamu and Darma (2016). This can be attributed to the pattern of consumption of Natural gas which differs between the rural and the urban dwellers. The consumption of Natural gas is high in the urban areas when compared to the rural areas. OP shows positive and significant relationship on GDP, this is because it is a close substitute to Natural gas. The high adjusted R^2 (0.999431) testify to the high explanatory power and overall significance of the estimated model. In addition, the result of post-estimation tests showed that the outcome of this result was tested using some diagnostic tests such Breusch-Godfrey Serial Correlation LM Test, and Normality Test. The result of these tests as presented in the same Table 5 shows that, the model passes all the diagnostic tests.

Policy Implication of Findings

From the empirical researches conducted, the major findings of the research includes: NGC has a great influence on RGDP and it is highly responsive to its own innovation, which means direct investment in the sector can result to improvement in NGC and thus translate to economic growth. Also, government should help to improve infrastructure and supply of natural gas in the rural areas which will also help to boost the economy. More so, oil price positively impact RGDP in Nigeria indicating the need to invest more in the oil sector as it contributes a large part of Nigeria RGDP and the funds realized from the investments can be used for productive purposes that can lead to economic growth.

5. Conclusion and Recommendations

This paper examined the nexus between natural gas consumption and economic growth in Nigeria. Natural Gas consumption and oil price have a great influence on real economic growth as proven by this research. Also, oil price is one of the greatest catalysts of economic growth. The research shows that natural gas is beneficial and remains an essential tool of economic growth in Nigeria. Augmented Dickey-Fuller (ADF) was employed to test for the stationarity of the variables under study. The result of the unit root test revealed that all the variables were stationary at first difference. Based on this, the long run and short run relationships among the variables were tested using the ARDL model. The following major findings were observed from this study:

NGC has negative and significant relationship on economic growth on the long run, it is insignificant in the short run because energy consumption is a derived demand which is used for further production. Also, this can be attributed to the pattern of consumption and standard of living in the rural and urban areas of the country. There is more infrastructure which aids NGC in urban areas when compared to rural areas. OP has a positive and significant relationship on economic growth both on the short run and long run. This is because, it is a close substitute to natural gas and it has general acceptability.

Based on the findings, the following recommendations are made: There is room for massive investment in the oil and gas sector especially in infrastructures with the aim of increasing natural gas consumption through its availability, accessibility and affordability most especially in the rural areas and also urban areas. Government should ensure adequate supply of natural gas to stimulate economic growth, they should also create awareness and enlightenment campaign on prudent use of natural gas to avoid wastage, and unproductive consumption should be checked, most especially from the demand side both in the rural and urban areas. The private sectors should also tap in to opportunities that are available in the oil and gas sector. The involvement of the private sector will also help to boost the economic growth and development of the country. Government should create awareness on the need to encourage the use of natural gas over other fossil fuel energy to reduce carbon emission into the atmosphere which in turns causes global warming and climate change.

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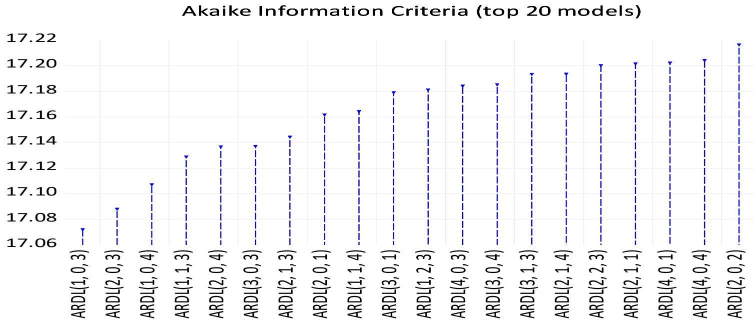
Appendix 1



Source: Author's Computation