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Inland Natural Gas Consumption and Real Economic Growth in Nigeria: ARDL Cointegration Test

Ahmed Adamu[1]*, Muttaqah Rabe Darma[2]
[1]Department of Economics, Umaru Musa Yar'adua University, Katsina, Nigeria
[2] Pleasant Engineering and Technical Services

Abstract

Nigeria was ranked second worst country in terms of gas flaring, its domestic energy demands keep increasing in the wake of inadequate alternative cleaner (compare to oil) energy sources like natural gas. This is why Nigerian gas master plan was proposed to develop the natural gas for domestic utilization. Consequently, this research assessed the relationship between domestic gas consumption and real economic growth in the country to discover the resulting economic effect of the proposed gas development plans. To analyse the effect of gas development on the country's economy, an ARDL bound cointegration test was used, where oil production, gas consumption and real GDP were used in the model, cointegration was found, and positive and significant long run relationship was found between gas consumption and real economic growth, where a persistent 1% increase in domestic gas consumption in the long run causes 2.89% increase in real economic growth in the country. It was also found that the country is likely to be facing the economic problem of resource curse due to the potential adverse effect of crude oil production on real GDP, even though this is not statistically significantly justified. Therefore, if gas flaring is stopped, and more investment as well as further infrastructures are provided in the gas sector in the country, the gas sector can then start to feed in more to the economic productivity, and thereby making the economy dependent on the gas sector eventually due to continues increase in gas consumption, and then the significant link between gas consumption and economic growth can be actualised. In addition, direct investment in gas development can lead to high positive impact on the gas consumption as discovered in this research. Natural gas should be supplied to residential and commercial sectors to stimulate more domestic gas demand through gas pipelines, CCGT and GTL. The country's economy should be diversified to tackle the likely problem of resource curse. The findings of this research further justified the Nigeria gas master plan's objective and serves as an academic guide toward actualizing and extending the objective of the plan in the country.

Key words: Gas consumption, ARDL, real economic growth, natural gas, oil production, GDP

1. Introduction

The top two highest gas flaring nations in the world are Russia and Nigeria [2]. Nigeria flared natural gas equivalent to a quantity of about 10% of the global gas flaring in 2011 [3], and in 2013, Nigeria flared 12 bcm of natural gas, [2] [4]. However, Nigeria is more in a challenging position since Russia has more of gas reserves and has higher energy per-capita access than Nigeria [5]. Nigerian proven gas reserves are larger than those of crude oil are, yet oil receives attention that is more favourable. This is despite its environmental effects (oil spillages and higher CO_2 emission compare to natural gas), price volatility and relatively early possible depletion.

Nigeria has the largest natural gas reserves in Africa, contributing 2.5% to the global share of proven gas reserves and 1.2% of the global gas production in 2014 [6] [7]. However, due to lack of domestic gas demand, inadequate or vandalism of gas infrastructure and the absence of incentives for gas development in the country, gas has not been fully utilized [8]. Natural gas was first discovered unintentionally in Nigeria while searching for crude oil. As at 2013, the reserves estimate of the country's natural gas is around 5.1 trillion cubic metres [4], with about 50/50 distribution ratio between Associated Gas (AG) and Non Associated Gas [9].

Associated gas is the gas that is produced from oil producing wells; it is sometimes dissolved in the crude oil and sometimes separate from the oil. Non associated gas is produced in pure gas reservoirs [10]. Only a small fraction of the available gas reserves is currently being utilized, mostly for power generation and at levels that are insufficient to meet the rising electricity demand in the country. Similarly, zero level of gas consumption has been reported in transport, residential and commercial sectors of the economy [11].

Lack of development of gas reserves for primary consumption within the country makes the exports of the non-flared part of the produced gas as LNG to European countries the predominant option [12]. Nigeria imports petroleum products, especially petrol, which has been one of the major transport fuels in the country. However, the 2011 partial deregulation policy in the country has affected the nature of energy consumption in the country, where many people cannot afford to buy the petroleum products, especially petrol, due to its high price [13]. With the growing population indices and emergence of small and medium enterprises in the country, the in-country demand for energy continues to increase without a corresponding increase in the supply of energy, which restricts the economic growth of the country [13]. Therefore, in order to meet the latent energy demand, there is a case for developing natural gas for domestic consumption, so as to provide alternative energy products that people can substitute for petrol, enhance supply of electricity and provide sufficient industrial inputs.

Nigeria opted for gas export partly due to lack of visible demand for the gas within the country. Some portion of Nigerian population are not familiar with the potential of natural gas for meeting the country's energy demand. Few industrial and power companies utilize the gas, these being concentrated in the western part of the country. This is due in part to the fact that there is insufficient basic infrastructure (gas pipelines) to help move the gas to the areas of higher population or demand. Such infrastructures if provided may help stimulate private-sector investment in gas processing plants via Gas to Liquid (GTL) and Gas to Power (GTP) projects as a means of supplying transport fuels and electricity respectively, which will eventually stimulate high demand for natural gas in the country.

Subsequently, the Nigerian gas master plan proposed some set of infrastructures and some policy frameworks to help encourage investment and development of gas in the country. The Nigerian gas master plan is designed to improve gas utilization within the Nigerian territory, eliminate gas flaring and make it affordable to industrial, residential and commercial sectors of the economy. The plan also mandates gas producers to supply certain portion of gas produced to domestic market. The petroleum ministry will predetermine this portion, and penalties shall be placed for any default. The plan also proposed construction of three gas processing plants in the oil and gas production region. These plants will be located in West Delta (Warri area), Obiafu (North of Port-Harcourt) and Akwaibom/Calabar area. Investment for these projects will be open for private investors [14].

Therefore, this research tries to prove if the gas consumption that will eventuate after the intended investment in gas development sector has any relationship with the real economic growth in the country. This is to further justify the economic benefit of these capital investment in the gas sector. So, the research aims to find the dynamic linkage and relationships between domestic gas consumption and economic growth in Nigeria. It is the objective of this research to analyse the Cointegration between gas consumption and real economic growth as well as the dynamic long run and short run relationships between them in the country. This will help give up to date information about the resulting effects of the gas development on the overall economic performance in the country. An econometric model called Auto-regressive Distributed Lag Model (ARDL) will be used to study the long run Cointegration and multiplier effect of inland gas consumption on the real economic growth in the country.

As the proposed gas development projects are cost intensive, and the objective of the gas master plan is to use the gas to foster the economic growth in the country, this research asks: What is the Cointegration, long-run and short-run relationship between domestic gas utilization and the real economic growth in the country? The research also test the hypothesis that says crude oil production that has dominated the petroleum sector in the country may not have direct positive effect to the domestic productive output but natural gas consumption does. This is significant as it provides academic justification for the proposed gas investments for domestic utilization in the country, by assessing the effect of these investments on the real economic growth in the country, so that government and investors will understand the implication of their investment in domestic gas development.

The research is categorised in to five sections, after the introduction, there will be a review of some related literature in chapter two. Chapter three will explain the methodology and data used in the research, and chapter four will present the empirical results and their discussions. Chapter five is the conclusion.

2. Literature Review

Natural gas development is capital intensive, and investors especially government needs to understand the dynamic relationship between gas consumption and economic growth, and the resulting effect of investment and consumption of gas on the overall economy. Even though it is clear that natural gas is very useful to the sectors of the economy, one needs to have a clear estimate of how the aggregate gas consumption can affect the economic performance in a country.

Many literature have been written to improve understanding of the relationship between energy consumption and economic growth in many case studies using different methodologies and data range. Some of these studies are discussed here to understand the disparity in the findings and how this research can improve in understanding this dynamic relationship especially with gas consumption in Nigeria. Having discovered the use of traditional methodologies like the single equation ordinary least square, Engle and Granger (1987), Johansen (1988), and Johansen and Juselius (1990) cointegration procedures in analysing the nexus between energy consumption and economic growth in Nigeria and in some other case studies, which they are not without numerous limitations. For example, Johansen (1988) cointegration restricts to the use of I(1) variables in the specification and it is sensitive to sample size [15]. The ARDL bound cointegration test that this research will use, address some of these limitations and provides more robust and sufficient estimates of these relationships, and allows for multivariate framework in the model [16], hence it is used in this research. This will be further discussed in the econometric analysis.

Another relevance of the reported literature is that, it made us to understand four contradicting findings relating to the relationship between gas consumption and economic growth; One, those literature that found that energy consumption relates and granger-causes economic growth, and concluded that the economic growth is dependent on energy consumption, and a decrease in the energy consumption can slack economic growth as stated in the work of Narayan and Smyth (2008) [17], and Olusegun (2008) and Ighodaro and Ovenseri (2008) in Nigeria. The second finding was that economic growth drives energy consumption, which indicates a country is not dependent on energy consumption for its economic growth, and this was concluded in many case studies that the economies of countries with this kind of relationship are not absolutely dependent on energy for their economic growth like in the work Kraft and Kraft (1987) in USA[18]. The third and fourth set of the findings were the ones that found causal and no causal relationship for both directions between energy consumption and economic growth respectively [19] [20] [21]. These findings are both found in similar case studies in different researches using different methods and data. Therefore, there is the need to use more sufficient techniques and updated data to verify the exact relationship between the disaggregated energy consumption and economic growth in specific case studies, which this research aim to achieve in Nigeria.

Apergis and James (2010) attempted to study 67 random countries to observe the relationship between gas consumption and economic development in these countries. Using the time series data between 1992 and 2005, they used GDP as the proxy for the economic development and they found that gas consumption has long run equilibrium cointegration with GDP, and using panel Vector Error Correction model, they found that both gas consumption and economic development cause each other. That is increase in gas consumption can also cause increase in economic development and vice versa. They concluded that 1% increase in gas consumption leads to 0.65% increase in GDP in these countries [22].

However, it may be inconsistent to have this level of relationship exactly in each of these countries. A country specific analysis of this relationship needs to be carried out, which Sahbi et al (2014) did for Tunisia, where they looked at the relationship between gas consumption and GDP (proxy for economic development) in Tunisia. They used other variables like trade and real gross fixed capital formation as additional independent variables in their Auto-Regressive Distributed Lag (ARDL) regression. Using the data between 1980 and 2010, they found long run cointegration between these variables, and using Toda-Yamamoto approach, they found bidirectional relationship between GDP and these variables in Tunisia. Precisely they found positive short run and long run relationship between gas consumption and GDP in Tunisia. They found that, 1% increase in gas consumption causes 0.028% and 0.04% increase in GDP in long run and short run respectively with high level of significance (5% level of significance).

The use of additional variables in observing this relationship differs, as some use traditional production theory using capital and labour as in Apergis N. and James E.P. (2010) and Kum H. et al (2012), while others use combination of other energy products or indicators like in Khan and Ahmad (2009). Kum et al (2012) tried to disaggregate the country causality, where they studied G-7 countries, and found variance in terms of causality between these countries. They found that in Italy, there is unidirectional causality running from gas consumption to economic growth, and another causality running from economic growth to gas consumption in UK. They found bidirectional causality between gas consumption and economic growth in France, Germany and United States [23]. Their approach to identifying country specific relationship is an improvement on the work of Apergis and James (2010).

Isik (2010) looked at the cointegration between gas consumption and GDP in Turkey using the data between 1977 and 2008, and also found long term stable and positive cointegration between the two variables [24], however, using a bivariate framework may omit some vital variables in the long run relationships, as omission of relevant variables may lead to biased long run estimates [25]. Similar result was found in Korea as studied by Lim and Yoo (2012) who found bidirectional causality between natural gas consumption and economic growth in Korea [26].

Exports and CO_2 emissions were included in the work of Shahbaz et al (2013) when observing the effect of gas consumption on economic growth in Indonesia. They found cointegration between these variables using ARDL bound test model, and found that gas consumption granger causes economic growth. However, Yang (2000) found no cointegration between gas consumption and economic growth in Taiwan, but still found one-way causality from natural gas consumption to economic growth in the country. He found bidirectional relationship between the aggregate energy consumption and economic growth [19], and this was done by using the Granger causality test and data from 1954 to 1997[27].

In India, Aqeel and Butt (2001) found no cointegration and no causality between natural gas and economic growth (GDP) using the data for the period 1955 to 1996 [28]. However, Muhammad et al (2014) studied that of Pakistan using ARDL bound test approach and found high multiplier effect of gas consumption on the country's GDP, they found that 1% increase in natural gas consumption will cause GDP to increase by 0.3526% in the country using the data between 1972 to 2011[29]. Many studies were conducted on the cointegration and causality between gas consumption and economic growth in so many countries as highlighted in table 1.

Some few researches were conducted on the relationship between Nigerian energy consumption and economic growth. Ighodaro (2010) have used Johansen cointegration test to find the cointegration and causality between Nigerian disaggregated energy consumption using the data between 1970 and 2005 [30]. Though, Hjalmarsson and Osterholm (2010) questioned the use of Johansen test alone to verify whether there is presence of cointegration or not, apart from it being an outdated method [31].

Nevertheless, Ighodaro (2010) found unidirectional relationship from gas utilization to economic growth in Nigeria. He used health expenditure, money in supply and electricity consumption, which was not proper combination of variables given the main aim of the research. Combining electricity consumption and gas consumption on right side of the equation may cause biased estimates [32], as gas consumption can be used to predict electricity consumption as more than 50% of the country's gas consumption is used for electricity production [33]. He should have included capital formation as in Apergis (2010) [22], and exports would have been an appropriate variable in place of health expenditure, as Nigerian economy is largely reliant on the exports earnings especially from the oil and gas resources [34]. He also failed to estimate the multiplier effect of natural gas consumption on the economy.

In his earlier research, Ighodaro and Ovenseri (2008) using the data from 1970 to 2003, he still found unidirectional causality running from energy consumption to economic growth, but this time using electricity consumption as the proxy for energy consumption against GDP [35]. Coal and electricity consumptions were also paired to find their causality relationship with GDP in Nigeria, and it was found to have bidirectional causality [36] [37]. Olusegun (2008) used ARDL bound test cointegration approach to study the relationship between aggregate energy consumption and economic growth in Nigeria, which is the approach that this research will adopt. However, he used bivariate framework in his cointegration test, and also used the data up to 2005, which might be outdated due to the significant shifts and antecedents that happened post 2005, which caused changes to price and consumption of energy resources, which might change the earlier findings [38], and this necessitate updated research like this one [37].

Abalaba and Dada (2013) also attempted to study the relationship between energy consumption and economic growth in Nigeria, and found 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 found evidence of short-run relationships. Their finding is consistent 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 [39]. Their findings also went contrary to the findings of Olusegun (2008) and Ighodaro and Ovenseri (2008) in Nigeria. They also used aggregated energy consumption, without considering the natural gas consumption as a standalone variable in their Johansen cointegration test [21].

This finding is also contrary to the findings of Ebohon (1996) who reported bidirectional causality between energy consumption and economic growth in Nigeria. Dantama et al (2012) [40] used the ARDL approach and found long run cointegration on disaggregated energy consumption using petrol, coal and electricity consumption with real GDP in Nigeria, and found their coefficients to be positive and significant in relation with the GDP except for the coal consumption coefficient, which is negative though statistically insignificant. Mustapha and Fagge (2015) stated that there has not been consensus on the dynamic nexus between energy consumption and economic growth in Nigeria [41], and as Ozturk (2010) mentioned, this could be as a result of difference in time periods used, unique features of the country, mix of variables and different econometric methods used.

Muhammad et al (2013) presented the following table (table 1) summarising some of the researches and findings on the topic of cointegration and causality between gas consumption and economic growth from different countries and period of observations [1]. Different results can be derived depending on the country, methodology, period of observation and variable mix. However, the ARDL bound test model is the most recent and preferred due its efficiency and ability to accept variables even at different order of integration and using any size of a data. It can also be used to determine the short run and long run multiplier effects of gas consumption on economic growth simultaneously [42] [43]. None of the studied literature have applied this method to study the cointegration and long run and short run relationship between gas consumption and economic growth in Nigeria in recent years. That is why this research will employ the use of the model and using appropriate variables in multivariate framework and recent data to analyse the dynamic relationship between gas consumption and economic growth in Nigeria.

Authors	Countries	Sample Period	Variables	Cointegration	Causation
Yang (2000b)	Taiwan	1954-1997	Real GDP, Natural Gas Consumption	No	$G \rightarrow Y^{a}$
Aqeel and Butt (2001)	Pakistan	1955-1996	Real GDP, Natural Gas Consumption	No	$Y \times G^{c}$
Siddiqui (2004)	Pakistan	1970-2003	Real GDP, Natural Gas Consumption	-	$Y \times G^{c}$
Lee and Chang (2005)	Taiwan	1954-2003	Real GDP per Capita, Natural Gas Consumption	Yes	$G \rightarrow Y^{a}$
Ewing et al. (2007)	US	2001:1–2005:6	Industrial Production, Natural Gas Consumption	-	$G \rightarrow Y^{a}$
Zamani (2007)	Iran	1967-2003	Real GDP, Natural Gas Consumption	Yes	$G \leftrightarrow Y^{d}$
Sari et al. (2008)	US	2001:1–2005:6	Industrial Production, Natural Gas Consumption	Yes	$G \leftarrow Y^{b}$
Hu and Lin (2008)	Taiwan	1982:1 to 2006:4	Real GDP, Natural Gas Consumption	Yes	$G \leftrightarrow Y^{d}$
Reynolds and Kolodziej (2008)	Soviet Union	1928–1987,1988–1991, 1992–2003	Real GNP, Natural Gas Consumption	-	$G \rightarrow Y^{a}$
Adeniran (2009)	Nigeria	1980-2006	Rea GDP, Natural Gas Consumption	Yes	$G \leftarrow Y^{b}$
Amadeh et al (2009)	Iran	1973-2003	Real GDP, Natural Gas Consumption	Yes	$G \leftarrow Y^{b}$
Clement (2010)	Nigeria	1970-2005	Real GDP, Natural Gas Consumption	Yes	$G \rightarrow Y^{a}$
Yu and Choi (1985)	UK	-	Real GNP, Natural Gas Consumption	-	$G \leftarrow Y^{b}$
	US			-	$Y \times G^{c}$
	Poland			-	$Y \times G^{c}$
Fatai et al. (2004)	New Zealand	1960-1999	Real GDP, Natural Gas Consumption	No	$Y \times G^{c}$
	Australia			Yes	$Y \times G^{c}$
Zahid (2008)	Pakistan	1971-2003	Real GDP per Capita, Gas Consumption	Yes	$Y \times G^{c}$
	Bangladesh			No	$G \rightarrow Y^{a}$
	Indiça			No	$Y \times G^{c}$
	Nepal			No	$Y \times G^{c}$
	Sri Lanka			No	$Y \times G^{c}$
Apergis and Payne (2010)[e]	67 Countries	1992-2005	Real GDP, Natural Gas Consumption, Labor, Real capital	Yes	$G \leftrightarrow Y^{d}$
Shahbaz et al. (2013)	Pakistan	1972-2010	Real GDP, Natural Gas Consumption, Employment, Real capital	Yes	$G \rightarrow Y^{a}$

[a] Unidirectional causality running from natural gas consumption to economic growth.
[b] Unidirectional causality running from economic growth to natural gas consumption.
[c] No causal relationship.
[d] Bidirectional causality.

Table 7: Summary of past literature on cointegration and causality between gas consumption and economic growth [1]

3. Econometric Analysis of Domestic Gas Consumption and Real Economic Growth in Nigeria

3.1. Introduction

This research hypothesised that once the proposed gas development projects are implemented in the country, the demand for natural gas will emerge, and that will positively affect the economy depending on the outcome of the following cointegration test. Investing huge amount of resources on natural gas development infrastructure requires a compelling multiplier effect on the economy, so that government and investors will really know the value they are adding to the economy. If gas development for domestic use has no positive multiplier effect or has no cointegration with the economic development, then perhaps there may not be a serious need for such investment. Now, there is a need to analyse the effect of gas development or consumption on the economy.

This research will assess the cointegration, long run and short run relationship between the inland gas demand and the overall economic performance in Nigeria using a multiple regression model called Autoregressive Distributed Lag (ARDL) bound test as developed by Pesaran et al.(2001) [16]. This model has been used for many years, and it is becoming more favourable among econometricians in estimating relationships, which will be discussed in this chapter [42]. However, despite some of the reported advantages of the model it has some limitations. One of the limitation of the ARDL model is that, it does not provide robust results in the presence of variables that are integrated of order two, that is I(2). If any of the underlying variable is I(2), such variable cannot be used in the ARDL model, therefore, it restricts the use of only variables that are of I(0) or I(1) or combination of them.

3.2. Choice of variables

As one of the main target of the research is to identify the cointegration and relationship between gas consumption and economic growth in the country, which is in line with the research question of using the natural gas to foster national development. This examination is significant in proving the exact impact of natural gas consumption on the real economic growth in the country.

Therefore, the primary variable of consideration is the domestic gas consumption (GC), and the objective is to assess how it relates to the real GDP as the proxy for real economic growth, hence the inclusion of gas consumption among the explanatory variables. The relationship between these two variables will be examined in the presence of a variable for crude oil production, so as to observe the relationship of oil production and gas consumption to the real GDP. This is to test research hypothesis that says crude oil production that has dominated the petroleum sector in the country may not have direct positive effect to the domestic productive output but natural gas consumption does, and may likely not lead to economic growth as the revenue from exporting crude oil may not necessarily be translated in to improved economic productivity in the country. Similarly, among the country's petroleum resources, crude oil is produced more than the other resources, and that lead to more foreign direct investment in the oil upstream sector, which relatively lead to low investment in the inrfastructures of other energy resource sectors especially natural gas, which could be responsible for lower domestic gas consumption. Therefore, the second model specification will observe the impact the oil production and gas consumption on the real GDP.

Similarly, the choice of these variables was also informed by the theory of endogenous growth, which claimed that economic development of a country is geared by the internal factors [44] [45]. This may include domestic production, labour efficiency, economic policies etc. We could potentially consider other variables like national expenditure, population, interest rate, security and political stability, renewable energies, etc, but in order to avoid over parameterisation in the model which could lead to higher standard errors and large number of insignificant coefficients in the estimate, we stick to the explanatory variables above, and the influence of other non-considered variables can be explained in the residual or error term. Some important diagnostic tests like the serial correlation and stability tests will be run to check for the efficiency of the ARDL models. Once it is efficient, the problem of partial multicollinearity or presence of endogenous regressors will not affect the model, as the ARDL model test for the cointegration will provide unbiased estimates of the long-run model and valid t-statistics even in the presence of endogenous regressors [15].

The coefficients of theses variables will be presented in log form, the sign "l" will be attached to each variable, which represents the natural logarithm of the variables both regressand and regressors. This will make the respective coefficients of the explanatory variables in form of elasticity. The use of percentage changes is useful as it is an easy way of understanding the strength of the relationships.

3.3. Data descriptions:

The data used in this research covers the period of 1981 to 2013 and they are for Nigeria particularly. The gas consumption, which is in million cubic metres (mcm) and crude oil production in ktoe were sourced from the IEA database as produced by the UK data service [46] [47]. The nominal gross domestic product (GDP) and capital formation were sourced from World Bank as produced by UK data service, and they were both in current US dollars, but converted to 2005 constant dollars [48]. In order to convert the data to real values, a CPI index for US dollars was used using 2005 as base year. Therefore, all the data that are in monetary value, were converted to 2005 constant dollars. The CPI index was sourced from the UNCTAD database [49]. The nominal values of the data are presented in appendix A, the gas consumption and crude oil price are in volume.

Let lgdp, lgc, and lop represent the logarithm of real GDP, gas consumption and oil production. The descriptive statistics of these variables are presented in table 2 and figure 1 below.

Table 2: Statistical description of the data

	LGDP	LGC	LOP
Mean	25.02118	8.747270	11.47514
Median	24.68610	8.728750	11.55839
Maximum	26.80420	9.645105	11.73655
Minimum	23.78408	7.729296	11.03981
Std. Dev.	0.821099	0.538684	0.209667
Skewness	0.791068	-0.050826	-0.679415
Kurtosis	2.612504	1.892040	2.175874
Jarque-Bera	3.648301	1.702124	3.472706
Probability	0.161355	0.426961	0.176162
Sum	825.6991	288.6599	378.6796
Sum Sq. Dev.	21.57451	9.285771	1.406733
Observations	33	33	33

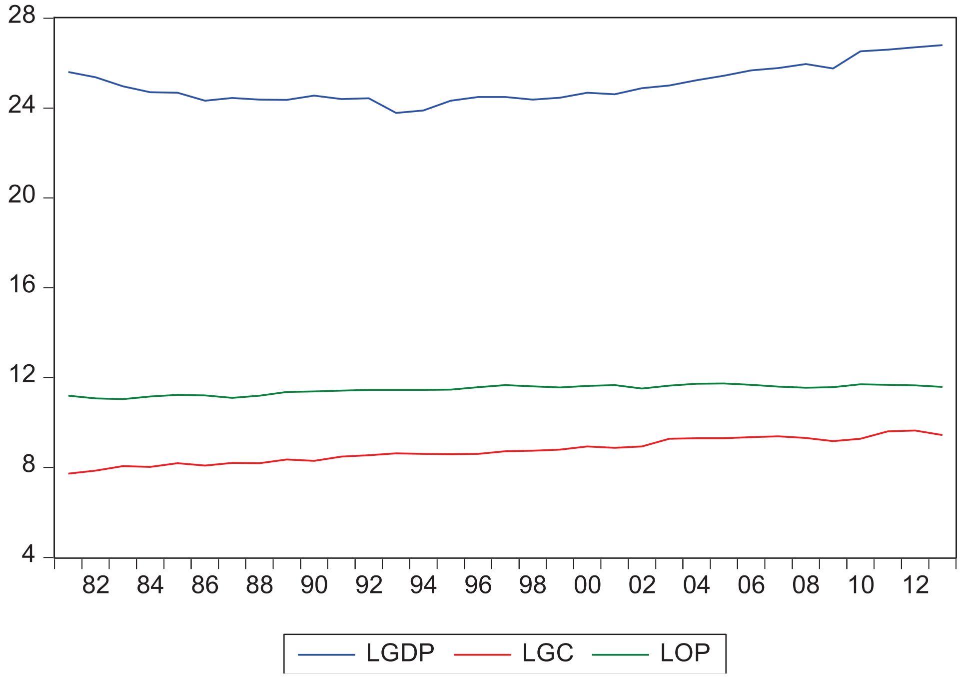

Figure 1: Graphical presentation of the trend of the data

3.4. Models Choice Justifications and Specifications

In order to examine the long run cointegration between the economic growth, natural gas consumption and oil production, the Autoregressive Distributed Lag (ARDL) bound testing method will be used, which "is a general dynamic specification, which uses the lags of the dependent variable and the lagged and contemporaneous values of the independent variables, through which the short-run effect can be directly estimated, and the long run equilibrium relationship can also be estimated" [50]. As developed by Pesaran et al (1999) [51] and subsequently elaborated by Peseran et al (2001)[16], this cointegration examination method has added advantage over other methods like Engle & Granger and Johansen cointegration test because of the following reasons [15] [52] [53] [50]: Its limitation were earlier explained.

1. It ruled out the indecision about the selection of order of the integration among the underlying variables. The model can be efficient even if the variables under consideration are of different order of integration, which is to say even if they are stationary at different order of integration, but not up to two. The model does not put restrictions that all of the variables must be of the same order of integration. It therefore permits for having different optimal lags among variables. Even if the variables are of the same order of integration, the model is still sufficient.
2. The model is not sensitive to the choice of deterministic components in the specification.
3. The model is suitable for simultaneously estimating the long run and short run components within a particular VECM.
4. The model cannot be distorted by the diversity of the variables, and some challenges involved in testing unit root test can be avoided. Stationarity exists when the distribution (mean,

variance and covariance) of a variable is independent of time. Unit root exists when these distributions changes with time, making the variable non-stationary, which is not desirable.

5. The model is also convenient because it allows us to apply on whatever size of the data, either big or small. It does not have restrictions, unlike other cointegration tests like, Engle Granger test and Johansen Vector Error Correction Models, which are sensitive to the sample size for their efficiency. It is ideal to use ARDL model for use of a small sample size like in the case of this research.
6. The model use a single reduced-form equation unlike other techniques where they estimate within system equations.
7. The model provides unbiased estimates of the long run relationship even if there are presence of endogenous regressors in the specification [43] [54].

3.4.1 Model specification and procedure:

The relationship between domestic gas consumption and economic growth is studied, while incorporating the effects of oil production in the following model specification. The ARDL model includes estimating an unrestricted error correction model as follows, following the work of [51] [16, 55].

$$\Delta lgdp_t = b_0 + \sum_{i=1}^{p} b_{1i}\Delta lgdp_{t-i} + \sum_{i=0}^{q1} b_{2i}\Delta lgc_{t-i} + \sum_{i=0}^{q2} b_{3i}\Delta lop_{t-i} + \delta_1 lgdp_{t-1} + \delta_2 lgc_{t-1} + \delta_3 lop_{t-1} + \varepsilon_t. \quad (1)$$

Where Δ stands as the first difference operator. Where b_0 are the constants, other b_i are the coefficients of the differenced variables, and δ_i are the coefficients of the lagged variables, which are significant in testing for the long run cointegration. The dependent variable is lagged up to p times (the maximum time lag of the dependent variable), and qs are the optimal number of lags for the respective independent variables. These are called the "autoregressive terms and distributed lag terms" respectively. Therefore, we have ARDL (p, qs). The ε_t is the error term at the current period t.

The procedure will have equations 1 estimated using the ARDL approach by using f-statistics to test for the joint significance of the derived coefficients of the specified lagged variables so as to establish the presence of long run relationship between the set of variables in each of the above models. We will be testing for the following null hypotheses that suggest that there is no cointegration among these variables in equation 1.

$$H_0 : \delta_1 = \delta_2 = \delta_3 = 0$$

The alternative hypothesis H_1 suggests that the δ_i are not equal to zero, and if that is the case, we can conclude at least a long-run relationship among these variables. F-test will be applied to determine the presence of cointegration between these variables. The F-test do not have a standard distribution under the identified null hypothesis as it depends on the order of integration of the variables, the number of the explanatory variables, presence of intercept and/or trend as well as the size of the sample. This is why Peseran et al (1999) and Peseran et al (2001) developed two different set of critical F values for different set of specifications. One of the F critical value assuming that all the underlying vaiables are integrated of order zero (I(0)), and the other critical value assuming them to be of order one (I(1)). These are called lower bound and upper bound respectively and they are provided at both levels of significance. The decision rule is when the computed F statistic is higher than the upper bound, the null hypothesis can be rejected and we can conclude there is presence of the cointegration withiout concern whether the variables are I(0) or I(1). The decision will be inconclusive if the computed F-statistic falls within the specified F critical values and if it falls below the lower bound, then the null hypothesis of no cointegration will be accepted [16].

If long run cointegration is found, then the following long run and short run coefficients will be estimated, but if there is no cointegration, we can either conclude inconclusive about the presence of cointegration or report absence of the cointegration, depending on where the F value falls. Alternatively, we can further run VAR to analyse the impulse response and variance decomposition among the variables [55].

$$lgdp_t = e_0 + \sum_{i=1}^{p} e_{1i} lgdp_{t-i} + \sum_{i=0}^{q1} e_{2i} lgc_{t-i} + \sum_{i=0}^{q2} e_{3i} lop_{t-i} + \varepsilon_t. \quad (2)$$

The long run coefficients e_i will be estimated from equation 2. The shortrun coefficients will be estimated using the following equation:

$$\Delta lgdp_t = g_0 + \sum_{i=1}^{p} g_{1i} \Delta lgdp_{t-i} + \sum_{i=0}^{q1} g_{2i} \Delta lgc_{t-i} + \sum_{i=0}^{q2} g_{3i} \Delta lop_{t-i} + \emptyset ect_{t-1} + \varepsilon_t. \quad (3)$$

From equation 3, Where

$$ect_{t-1} = lgdp_{t-1} - i_0 - i_1 lgc_t - i_2 lop_t \quad (4)$$

The coefficient $\emptyset$ will confirm the presence of the short run relationships and other short run coefficients can be determined accordingly. If coefficients of any of the variables in both long run and shortrun equations is significant, then the particular variable can be said to have strong relationship with the dependent variable. The coefficient of the error correction term (ect), needs to be negative and statistically significant to confirm the short run relationships, which also signifies the speed of adjustment toward equilibrium.

3.4.2 Stationarity test

It is significant to first identify if the variables under consideration are stationary or not, and to find out if they are stationary at zero order or first order. This is because the ARDL model cannot accept variables that are stationary at second order, i.e I(2), we have to confirm if none of the variables is stationary at I(2) [16].

In order to investigate the order of integration of these variables, the research will employ the use of Kwiatkowski-Phillips-Schmidt-Shin (KPSS) and Augmented Dickey-Fuller (ADF) unit root tests. The ADF is testing the null hypothesis that says the variables have unit root against an alternative that says all the variables have no unit root, while KPSS is testing the null hypothesis that says the variables are stationary against an alternative that says there is presence of a unit root. ADF test is formulated as follows:

$H_0: \delta = 0$ (*stochastic trend*), $H_1: \delta < 0$ (*deterministic trend*)

The ADF test is implemented by F-test or by the t-test on the δ. Using the two tests is to have a robust results [56] [32]. The unit root tests involve three procedures to arrive at a decision. Using these types of tests, we cannot be satisfied that a particular variable is stationary at any level unless it is confirmed to be so in three different circumstances. That is testing the stationarity of the variable when the variable is just a random walk, then when it becomes a random walk with drift, and then when it is random walk with drift and a deterministic trend [56].

The optimum number of lags used in determining the stationarity is allowed to be determined by AIC and SIC, but the maximum lag was chosen for the criteria, which is 2 as our series are annual time series [57]. The t-statistic is used to test for the hypothesis. In ADF test, if the t-statistic is higher than the critical value of t-statistic, then the null hypothesis of a presence of unit root will be rejected. For the KPSS test, if the computed t-statistic is lower than the critical value of t-statistic, then the null hypothesis that says the series are stationary will be accepted. The computed t-statistics are presented in tables 3 -7, each of the reported t-statistic was compared with the critical t-statistic at 5% level of significance, and decision about the stationary was made accordingly as shown in the last columns of the tables. The critical t-statistics using the degree of freedom of 33-1 (32) and 5% level of significance is 1.6939.

Table **3**:ADF stationarity test including intercept and trend using t-statistics

Results of Unit Root Test

1. Intercept and trend included

ADF	AIC		SIC		Stationarity Status
Variables	Level	First Difference	Level	First Difference	
LGC	-3.773	-4.852	-3.773	-5.804	I(0)
LGDP	-2.138	-6.732	-2.138	-6.732	I(0)
LOP	-1.031	-5.016	-1.854	-6.635	I(1)I(0)

Null hypotheses are rejected at 5% level of significance

Table 4: ADF stationarity test including intercept only using t-statistics

Results of Unit Root Test

2. Intercept

ADF	AIC		SIC		Stationarity Status
Variables	Level	First Difference	Level	First Difference	
LGC	-1.451	-4.852	-1.451	-5.836	I(1)
LGDP	0.368	-5.079	0.368	-5.079	I(1)
LOP	-2.179	-6.141	-1.431	-6.141	I(0)I(1)

Null hypothesis are rejected at 5% level of significance

Table **5**: ADF stationarity test not including intercept and trend using t-statistics

Results of Unit Root Test					
3. without Intercept and trend					
ADF	AIC		SIC		Stationarity Status
Variables	Level	First Difference	Level	First Difference	
LGC	2.417	-4.955	2.417	-4.955	I(0)
LGDP	0.829	-5.015	0.829	-5.015	I(1)
LOP	-1.808	-5.618	1.808	-5.618	I(0)

Null hypothesis are rejected at 5% level of significance

Table 6: KPSS stationarity test including intercept and trend using t-statistics

Results of Unit Root Test			
1. Intercept and trend included,			
	KPSS		Stationarity Status
Variables	Level	First Difference	
LGC	0.062	0.038	I(0)
LGDP	0.15	0.071	I(0)
LOP	0.140	0.051	I(0)

Null hypothesis are acceped at 5% level of significance

Table 7: KPSS stationarity test including intercept and trend using t-statistics

Results of Unit Root Test			
2. Intercept			
	KPSS		Stationarity Status
Variables	Level	First Difference	
LGC	0.39	0.101	I(0)
LGDP	0.803	0.728	I(0)
LOP	0.349	0.110	I(0)

Null hypothesis are accepted at 5% level of significance

Tables 3 to 7 show results of different procedures used in determining the order of integration for each of the variables. The decisions of rejecting or accepting the null hypothesis were made using 5% level of significance while comparing the computed t-statistic with the asymptotic critical value for the t-statistic as stated above. ADF and KPSS tests were applied, for the ADF test, AIC and SIC were both used in choosing the optimum lag for each procedure. Similarly, the stationarity test was conducted while including intercept and trend, and then including intercept alone and then without including both intercept and trend. When trend was included, all variables became integrated of order zero, and when trend was not included, the variables became integrated of order one. The inclusion of trend produced contrary outcome, where variables integrated of order zero when trend was included became integrated of order one when trend was not included in the ADF test, as shown in table 3 and 4. The two lag selection criteria were consistent with each other in table 3 and 4 except for oil production (OP) variable. When trend was included, OP variable was integrated of order one as judged by AIC, and it was integrated of order zero by SIC in table 3. The discripancy was the other way round when including only the intercept in table 4 for OP variable. When intercept and trend were not included, combination of orders of integration between zero and one were found as shown in table 5.When no intercept and trend were included, the decisions about the order of integration of the variables under ADF were consistent for both the lag selection creteria. The decision rules was already presented earlier. Based on this rule, combinations of order of integration not up to order two were found, which satisfies the condition for using the ARDL model. Similarly, using the KPSS test, all variables were integrated of order zero.

Therefore, we can confirm that none of the variables is I(2), and we can conclude the presence of combination of I(0) and I(1) variables in the above scnearios, which further justifies the use of the ARDL model for the long run cointegration examination.

4. Empirical results and Discussion

4.1. Cointegration test

In order to examine the long run cointegration between these variables, there is need to identify the order of lags that will be applied in the first differenced variables as in equation 1 and 2, and same way, the SIC and AIC will be used to determine the optimum lag selection for the ARDL model as suggested by Peseran et al (2001). This will also be examined in the presence of the trend and without the trend.

Table 8: ARDL lag order selection and diagnostic tests

ARDL distributed lag selection					
With trend and intercept	*Lag length based on AIC*	*Lag length based on SIC*	**With intercept**	*Lag length based on AIC*	*Lag length based on SIC*
Variables			Variables		
LGDP	1	1	LGDP	1	1
LGC	0	0	LGC	0	0
LOP	2	0	LOP	0	0

The model specification (equation 1) will have an ARDL order of selection as ARDL (1, 0, 2) suggested by AIC or ARDL (1, 0, 0) as suggested by SIC when trend is included. When trend is not included as in equation 1, the SIC's order of lag selection was maintained that is ARDL (1, 0, 0) as suggested by both AIC and SIC.

These orders of lag length are applied to the ARDL model (equations 1) using the AIC and SIC order of lag selection. After running the ARDL model using these lag selection orders, the bound test will be applied, from which the calculated f-statistic will be used to test for the joint significance of the derived coefficients of the specified lagged variables, and this is done by comparing it with the upper and lower bound asymptotic critical value of f-statistic as provided by Peseran et al (2001) as earlier explained, and presented in table 9.

Table 9: Bound test critical values for cointegration for ARDL equation 1

Asymptotic critical values: intercept and trend			
5%		10%	
I(0)	I(1)	I(0)	I(1)
3.88	4.61	2.38	4.02

Asymptotic critical values: intercept and no trend			
5%		10%	
I(0)	I(1)	I(0)	I(1)
3.10	3.87	2.63	3.35

***Asymptotic critical value bounds acquired from table F-statistic in appendix CI(ii) and CI(iv), for k=2 (Peseran et al (2001)p.300).**

Peseran et al (1999) and Peseran et al (2001) developed the above sets of critical F values for different set of specifications. One of the F critical values, the lower bound assuming that all the underlying vaiables are integrated of order zero (I(0)), and the other critical value, the upper bound assuming them to be of order one (I(1)). These values are provided for when including and when not including the trend. The above bound F-critical values for the ARDL estimation were provided for comparison with the computed F-statistic. These bound values will be used in the ARDL bound test to decide about the presence of cointegration in the model specification, whose calculated F-statistics testing for the joint significance of the derived coefficients of the specified lagged variables are presented in table 10.

Table 10: ARDL bound test results

1. $F_{lgdp}(lgdp\|lgc, lop)$			Cointegration?
With trend			
AIC	2.83	[0.0647]	No*
SIC	2.07	[0.1326]	No*
Without trend			
AIC	4.73	[0.0098]	Yes(at 5% and 10% level of significance)
SIC	4.73	[0.0098]	Yes(at 5% and 10% level of significance)

*means it falls below the threshold.

From table 10, presence of cointegration was found among the variables under study, since the calculated F-statistic of 4.73 has exceeded the threshold of the critical values at both levels of significance with reference to table 9. This is so for both AIC and SIC. This means that $H_0 : \delta_1 = \delta_2 = \delta_3 = 0$ can be rejected, and we can confirm that there is cointegrating relationship between the variables (LGP, LGC and LOP). In the event of adding trend to the equation, cointegration was not found, where the F-statistic of 2.83 and 2.07 was found for AIC and SIC respectively, which are below the threshold at both levels of significance, and as such we have to accept the null hypothesis at this scenario.

We can now conclude there is cointegration in equation 1. Therefore, we will now examine the long run and short run estimations of these variables. Having found cointegration in ARDL equation 1, a serial correlation and stability tests were applied on the overall ARDL model specification that the long-run and short-run coefficients will be derived, and the result of the test for this particular model is summarised in table 11.

Table11: Serial correlation test for equation 1 ARDL model

Null Hupothesis: no serial correlation			
BG LM statistics	2.102947	Prob. Chi-Square(2)	0.3494
F-statistic	0.800508	Prob. F(2,22)	0.4618
Critical Chi-square (2,5%)	5.991	Prob. RESID(-1)	0.8554
Critical F-statisitc	3.4434	Prob. RESID(-2)	0.4163

From table 11, it shows the serial correlation test result for equation 1, and from the results we cannot reject the null hypothesis, which signifies absence of serial correlation in the model. The BG-LM test of 2.102947 does not exceed the critical chi-square value of 5.991 at degree of freedom of 2 (the number of lags of the error term) and 5% level of significance, and as such we accept the null hypothesis, and conclude no autocorrelation of any order. Looking at the Chi-square's p-value of 0.3494, which is above 5% and even 10% level of significance, which signifies that the chi-square value is not significant, as such we can confirm acceptance of the null hypothesis. Similar decision is made using F-statistic. The coefficients of the lagged error terms are also not significant as their p-values are both above 5% level of significance, which further justifies the absence of serial correlation. So the ARDL model are efficient and fit.. The CUSUM test was also applied to test for the stability of the model as follows:

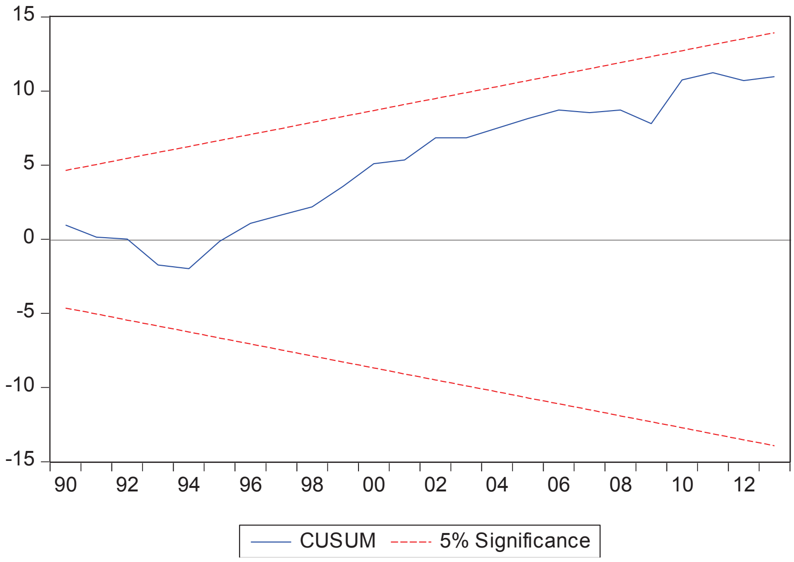

Figure 2: CUSUM stability test for equation 1 ARDL result

From figure 2, the CUSUM stability test results to the residual of equation 1 fell within critical boundaries at 5% level of significance, which confirms that all the coefficients of the ARDL model are stable. After observation $i = 96$ the recursive residuals were mostly positive, which indicates that the predicted GDPs are smaller than the actual GDPs, but still within the acceptable range at 5% confidence bounds, the null hypothesis of parameter constancy will not be rejected here.

4.2. Long-run impact

The subsequent empirical result for long run impact of gas consumption and crude oil production on real GDP in Nigeria from the ARDL model are presented in table 12, where it showed that gas consumption has positive and statistically significant effect on the real economic growth in the country in the long run. It shows that if there is persistent 1% increase in domestic gas consumption, there will be around 2.89% increase in real economic growth in the long run, and this is true at 5% and 10% level of significance. This means that real economic growth is relatively elastic to changes in gas consumption in the long run as continues percentage increase in gas consumption causes higher percentage increase in real economic growth. This result is consistent with some theoretical point of views, like the Keynesian economic school of thoughts who argue that economic growth is demand driven. The domestic gas consumption can stimulates demand for many industrial and energy products, it can help boost capital investment as factors of production will be cheaper to due to improved access to energy resulting from more gas consumption. This can make the general price level to go down, and trigger more demand, which will make businesses and markets to flourish in the country. The endogenous growth theory that holds that economic growth comes as a result of factors within an internal system, which beliefs that new technology and effective as well as efficient factors of production can be achieved with improvement of human capital, which boost the economy. Gas consumption can facilitate new technology as a result of more access to energy and adequate supply of industrial inputs, which could enhance efficiency of the economy and provide effective factors of production.

Looking at the pragmatic point of view of this result, this shows that low domestic gas consumption could potentially cost the country more economic growth, and if more investment are provided to create more demand for natural gas in the country, the economy will grow faster. Despite the fact that during the period under analysis, the domestic gas consumption was relatively below the potential level due to lack of infrastructures, but it still shows a very potential significant link with real economic growth in the event of persistent improvement in gas consumption. Similar positive and statistically significant linkage was found in the work of Apergis and James [22], where they found positive and significant relationship between gas consumption and GDP in some selected 67 countries. Muhammad S. et al (2013) also found positive and strong conneection between gas consumption and economic growth in Pakistan [1]. In Tunisia, similar relationship was found in the work of Sahbi F. et al (2014) [58]. The effect of gas consumption on real economic growth is likely to be statistically significant and visible in countries that have low industrial growth, or reliant on oil products. This is because the relative cleaness of the natural gas and its ability to fulfil many industrial and commercial energy demand will serve as an alternative energy fuel, which will precipitate increased productivity due to the resulting cheaper and efficient factors of production [58]. The long run coefficients are presented in table 12.

Table 12: Estimated long run coefficients using the ARDL model eq. 1

ARDL(1,0,0) selected based on SIC&AIC, dependent variable is lgdp

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LGC	2.8864	1.1052	2.6118[.015]
LOP	-.77797	3.4559	-.22512[.824]
C	8.7596	35.9721	.24351[.809]

The positive and statistically significant relationship between gas consumption and economic growth is shown in table 12 due to positive sign of the gas consumption coefficient and its low probability value as explained above. However, the oil production has statistically insignificant negative impact on the real economic growth. According to the estimate persistent 1% increase in oil production can cause 0.78% decrease in GDP everything being equal, this is a sign of likely presence of resource curse in Nigeria, as more crude oil production could potential hinders economic productivity. If this is statistically significant, it could have been in line with theoretical point of view of resource curse theory which postulates that countries with abundance of non-renewable energies and relying largely on them at the cost of other industries are likely to have a stagnant growth or economic contraction. The Nigerian economy being so much dependent on the crude oil production, from which revenue is supposed to be used to finance some development projects and provide capital formation, but it is likely to be negatively affected due to the volatility of the oil markets and mismanagement of the revenue [59]. Producing oil alone may not necessarily precipitate increased economic output especially in other sectors of the economy like the manufacturing sector. The effect of increased crude oil production may not impact of the economic growth as the revenue may not necessarily be translated in to improved access and affordable factors of production, as the country was accused of huge corruption and misappropriation of the oil revenue [59]. Similarly, the revenue received from oil exports is used to fund importation of petroleum products, and this is exacerbated by the expensive funding of government petroleum subsidy, which makes the export revenue less than the liabilities. However, this negative relationship between real economic growth and oil production is not statistically significant in the long run.

This finding confirms the early findings of Galbraith (1962) , who found inverse relationship between real economic growth and resource abundance. He raised the simple questions of many resource poor countries performing well economically and some resource rich countries are not. This idea was termed "resource curse" by Auty (1993) [60], and many researches like that of Boulhol et al (2008) [61] and Robinson et al (2006) [62] confirm negative relationship between oil resource abundance and economic growth in some economies. This means increasing oil production may likely impact little on the economy compare to what continues increase in natural gas production meant for domestic consumption may likely to impact if fully developed in Nigeria.

4.3. Short-run impact

Looking at the short run estimates in table 13, the important coefficient is that of the error correction model (ecm), which is -0.16 approximately, the sign is negative, but it is not statistically significant even at 10% level of significance. The negative coefficient of the ecm indicates the speed of adjustment from any disequilibrium in the previous year toward the long run equilibrium, the speed is slow as it is just 16%, and it is also statistically insignificant. In other word, 16% of any disequilibrium in the previous year is corrected in the current year, though statistically insignificant. The statistical insignificance of the ecm also shows that the relationship between these variables is not statistically significant in the short-run, this is so looking at the probability values of the short-run coefficients, which are all statistically insignificant.

Table 13: Error Correction Representation for the selected RDL model eq 1.

ARDL(1,0,0) selected based on SIC&AIC, dependent variable is Δlgdp

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
ΔLGC	.45249	.30838	1.4673[.154]
ΔLOP	-.12196	.59717	-.20423[.840]
ΔC	1.3732	6.3761	.21537[.831]
ecm(-1)	-.15677	.10596	-1.4794[.151]

The long-run and short-run estimations reveal that, the cointegration exists in the long-run, but not in the short-run. The coefficient of gas consumption is still positive in the short-run even though statistically insignificant. The statistically insignificant connection between these variables in the short-run is not quite surprising due to the low level of gas consumption under the period under study and lack of direct economic impact of oil production on the economy as already perceived and explained under the long-run coefficients explanations. In addition, the gas sector development would require resources and time to develop, and the linkage or impact can take place in the long-run. This also indicates that both in the short-run and long-run, the oil production does not impact the economy positively, and is a further indication of a possibility of resource curse in the country, though this cannot be statistically significantly justified. This is manifested in the low growth of the manufacturing sectors and overcrowding of human and capital investment in the oil sector in the country, which makes the manufacturing sector less attractive and less productive.

5. Conclusion

Natural gas is one of the most promising energy resources that give hope for the future; it is favoured due to possible depletion of oil reserves (oil being the leading global energy resource), relative immaturity of many renewable energy technologies, and concerns about the security of nuclear energy. In addition, emissions of carbon dioxide (per unit of energy delivered) from natural gas are much lower than coal, which makes natural gas environmentally friendly compare to other fossil fuels. However, natural gas faces some challenges that threaten its potential of becoming the leading energy resource globally. One of the major challenges of developing gas is capital intensiveness of its projects and geographical concentration of its reserves. There is also a huge capital requirement for gas transporting systems. LNG and international pipelines have been the two major options for transporting gas to distant locations globally at large scale. Therefore, countries with these important reserves stand an economic opportunity of meeting its domestic energy demand and even exporting it outside to increase their hard currency earnings.

Some developing countries endowed with this energy resource do not utilize it to the fullest; rather the gas is flared in the process of producing the associated oil. This is why the demand for gas in these countries is latent and huge economic benefit is wasted. Nigeria has the largest gas reserve in Africa (which represents 2.5% of the global share of gas reserves), yet it is the second worst country in terms of gas flaring. Since 1999, Nigeria has been exporting its natural gas to European countries as LNG and until recently through gas pipelines to some African countries. However, despite the Nigerian reputation for gas reserves and gas production, there have been reports of wide gap between energy demand and supply in the country. This is because the gas produced is exported and the remaining portion of the gas is flared. The Nigerian Government is committed to developing its vast gas reserves, and has developed gas master plan that proposed some capital investment in the gas development sector in the country.

Consequently, this research studied the Cointegration between real economic growth gas consumption and oil production in Nigeria. The ARDL model specification was used in the Cointegration test, where these variables were included. As a result, Cointegration was found between these variables, and positive and significant long run relationship was found between gas consumption and real economic growth, where a persistent 1% increase in gas consumption in the long run can cause 2.89% increase in real GDP. The oil production was found to have negative relationship with real economic growth though not statistically significant. Therefore, it can be concluded that the country could likely be facing the economic problem of a resource curse due to adverse effect of crude oil production on real GDP even though not statistically significant. Therefore, the country's economy needs to be diversified to avoid any likely problem of resource curse. Similarly, short run relationship between gas consumption and economic growth is statistically insignificant. We concluded that, despite the fact that during the period under analysis, the domestic gas consumption was relatively below the potential level due to lack of infrastructures, but it still shows a very potential significant link with real economic growth in the event of persistent improvement in gas consumption in the long-run. Therefore, the research recommends deliberate and significant investment in the domestic gas development sector in the country. The hypothesis that says oil production may not directly impact positively on the real economic growth in the country could not be statistically significantly justified.

If more investment and further infrastructures are provided in the gas sector in the country, the gas consumption can then start to feed in more to the economic productivity, and thereby making the economy dependent on the gas sector eventually, due to continues increase in gas consumption, and then the significant link between gas consumption and real economic growth can be created. Flaring gas should be stopped so as to channel the produced gas to improve power supply and provide inputs to industries and manufacturing sector, and then the strong positive impact can be eventually created. Deliberate policies should be in place to enhance gas development and consumption within the country in order to sustain the increase in gas consumption, so that the significant positive connections discovered in this research between gas consumption and real economic growth can be actualised. In addition, direct investment in gas development can lead to high positive impact on the gas consumption as discovered in this research. Natural gas should be supplied to residential and commercial sectors to stimulate more domestic gas demand through gas pipelines, power plants and other gas developement projects. The findings of this research further justified the Nigeria gas master plan's objective and serves as an academic guide toward actualizing and extending the objective of the plan in the country.

References

1. Muhammad, S., H.L. Hooi, and F. Abdul, *Natural gas consumption and economic growth in Pakistan.* RenewableandSustainableEnergyReviews, 2013. **Vol 18**(2013): p. 87-94.
2. World Bank, *Gas Flaring Reduction*, in *Global Gas Flaring Reduction Press Release*. 2013.
3. EIA. *Nigeria*. Background 2015 [cited 2015 8th April]; Available from: http://www.eia.gov/countries/cab.cfm?fips=ni.
4. BP, *Statistical Review of World Energy*, British Petroleum, Editor. 2014.
5. Naidoo, P. and P.A. Bacela, *A wealth of possibilities: Power and energy in Africa.* IEEE Power and Energy Magazine, 2012. **10**(3): p. 67-70.
6. British Petroleum, *Statistical Review of World Energy June 2014.* 2014.
7. British Petroleum, *Statistical Review of world energy.* 2012, BP.
8. Udofia, O.O. and O.F. Joel. *Pipeline vandalism in Nigeria: Recommended best practice of checking the menace* in *36th Nigeria Annual International Conference and Exhibition 2012*. 2012. Lagos; Nigeria.
9. International Energy Agency, *Energy Balances of Non-OECD Countries (Edition: 2012)*, in *ESDS International,*. 2012, Economic and social data services: UK data service.
10. Economides, M.J., et al., *The optimization of natural gas transportation*, in *SPE Hydrocarbon Economics and Evaluation Symposium*, SPE, Editor. 2012: Canada. p. 143-153.
11. International Energy Agency, *Natural Gas Information* 2012: ESDS International, .
12. Nwaoha, C. and D.A. Wood, *A review of the utilization and monetization of Nigeria's natural gas resources: Current realities.* Journal of Natural Gas Science and Engineering, 2014. **18**: p. 4120-4432.
13. Eggoh, J.C., C. Bangake, and C. Rault, *Energy consumption and economic growth revisited in African countries.* Energy Policy, 2011. **39**(11): p. 7408-7421
14. Alokolaro, O. and F. Alghali. *Gas Utilization in Nigerian Gas Master Plan (NGMP)*. Energy and Natural Resources Group 2015 [cited 2015 14th January]; Available from: http://www.advocaat-law.com/userfilesadvocaat/file/Advocaat-Gas%20Masterplan.pdf.
15. Harris, R. and R. Sollis, *Applied Time Series Modelling and Forecasting*. 2003: Wiley, West Sussex,.
16. Pesaran, M.H., Y. Shin, and R.J. Smith, *Bounds testing approaches to the analysis of level relationships.* Journal of Applied Econometrics, 2001. **vol. 16**(no 3): p. 289-326.
17. Narayan, P.K. and R. Smyth, *The energy consumption and real GDP in G-7 countries: New evidence from panel cointegration with structural breaks.* Energy Economics, 2008. **Vol. 30**: p. 2331-2341.
18. Kraft, J. and A. Kraft, *On the relationship between energy and GNP.* Journal of Energy Development, 1978. **Vol. 3**: p. 401-403.
19. Yang, H.Y., *A note on the causal relationship between energy and GDP in Taiwan.* Energy Economics, 2000. **22**(3): p. 309-317.
20. Erol, U. and E.S.H. Yu, *Time series analysis of the causal relationships between U.S. energy and employment.* Resources and Energy, 1987. **Vol. 9**(1): p. 75-89.
21. Abalaba, B.P. and M.A. Dada, *Energy consumption and economic growth nexus: New empirical evidence from Nigeria.* International Journal of Energy Economics and Policy, 2013. **Vol. 3**(4): p. 412-423.
22. Apergis, N. and E.P. James, *Natural gas consumption and economic growth: A panel investigation of 67 countries.* Applied Energy, 2010. **Vol 87**(2010): p. 2759-2763.
23. Kum, H., O. Ocal, and A. Aslan, *The relationship among natural gas, energy consumption,capital and economicgrowth: boots trap-corrected causality tests from G-7countries.* . Renewable Sustainable Energy 2012. **Rev.16**: p. 2361–2365.
24. Işik, C., *Natural gas consumption and economic growth in Turkey: abound test approach.* Energy Syst., 2010. **Vol. 1**: p. 441–456.
25. Lutkepohl, H., *Non-causality due to ommited variables.* Journal of Economics, 1982. **Vol. 19**: p. 367-378.
26. Lim, H.J. and S.H. Yoo, *Natural gas consumption and economic growth in Korea: a causality analysis.* EnergySources, 2012. **Part B7,**: p. 169–176.
27. Granger, C.W.J., *Investigating Causal Relations by Econometric Models and Cross-Spectral Methods.* Econometrica, 1969. **vol 37**(3): p. 424-438.
28. Aqeel, A. and M.S. Butt, *The relationship between energy consumption and economic growth in Pakistan.* Asia-Pac.Dev., 2001. **J.8**: p. 101–110.
29. Muhammad, S., A. Mohamed, and T. Frédéric, *Short- and Long-Run Relationships between Natural Gas Consumption and Economic Growth: Evidence from Pakistan.* IPAG Business School, 2014. **2014-289**.
30. Ighodaro, C.A.U., *Co-integration and causality relationship between energy consumption and economic growth: Further empirical evidence for nigeria.* Journal of Business Economics and Management, 2010. **11**(1): p. 97-111.
31. Hjalmarsson, E. and P. Österholm, *Testing for cointegration using the Johansen methodology when variables are near-integrated: Size distortions and partial remedies.* Empirical Economics, 2010. **39**(1): p. 51-76.
32. Gujarati, N.D., *Basic Econometrics*. fourth edition ed. 2003, United States Military Academy, West Point: McGrwa-Hill/Irwin.
33. International Energy Agency, *World Energy Balances* in *ESDS International,*. 2012, UK data service.
34. United Nation Economic Commision for Africa and African Union, *Economic Report on Africa 2013*. 2013: Nigeria: Country Case Study.

35. Ighodaro, C.A.U. and O.F. Ovenseri, *Causality relationship between energy demand and eocnomic growth* The Indian Journal of Economics, 2008. **Vol. 89**(353): p. 99-111.
36. Omoto, D.G., *Causality between energy consumption and economic growth in Nigeria.* Pakistan Journal of Social Science, 2008. **5**(8): p. 827-835.
37. Olusegun, O.A., *Energy Consumption and Economic Growth in Nigeria: A bound testing cointegration approach.* Journal of Economic Theory, 2008. **2**(4): p. 118-123.
38. Franklin, A. and G. Giorgia, *The effects of the financial crisis on Sub-Saharan Africa.* Review of Development Finance, 2011. **Vol. 1**(1): p. 1–27.
39. Aliero, H. and S. Ibrahim, *The relationship between energy consumption and economic growth in Nigeria: A causality Analysis.* International Journal of Marketing and Technology, 2012. **Vol. 2**(3).
40. Dantama, Y.U., Y.Z. Abdullahi, and M. Inuwa, *Energy Consumption-economic growth nexus in Nigeria: An empirical assessment based on ARDL bound test approach.* European Scientific Journal, 2012. **Vol. 8**(12).
41. Mustapha, A.M. and A.M. Fagge, *Energy Consumption and Economic Growth in Nigeria: A Causality Analysis* Journal of Economics and Sustainable Development 2015. **Vol. 6**(13): p. 42-53.
42. Jean-Marie, D. and F.K. Jan, *Exact Inference Methods for First-Order Autoregressive Distributed Lag Models*, ed. T.E. Society. Vol. 66. 1998: Econometrica.
43. Hung-Pin, L., *Renewable energy consumption and economic growth in nine OECD countries: Bounds test approach and causality analysis.* The Scientific World Journal 2014. **vol.2014**.
44. Arrow, K.J., *Economic welfare and the allocation of resources to invention*. The Rate and Direction of Economic Activity, ed. R.R. Nelson. 1962, NY: Princeton University Press,.
45. Grossman, G.M. and E. Helpman, *Endogenous innovation in the theory of growth.* Journal of Economic Perspectives, 1991. **vol. 8**(1): p. 23-44.
46. International Energy Agency, *World Natural Gas Statistic*, UK Data Service, Editor. 2014.
47. International Energy Agency, *World Oil Statistic*, UK Data Service, Editor. 2014.
48. World Bank, *World Development indicators*, UK Data Service, Editor. 2015.
49. United Nations Conference on Trade and Development, *Terms of trade and purchasing power indices of exports, annual, 1980-2013* UNCTADSTAT, Editor. 2014.
50. Kakali, K. and G. Sajal, *Income and Price elasticity of gold import demand in India: Empirical Evidence from threshold and ARDL bounds test cointegration.* Resources Policy, 2014. **Vol. 41**(2014): p. 135-142.
51. Pesaran, M.H. and Y. Shin, *An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis*, in *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, S. Strom, Editor. 1999: Cambridge University Press, Cambridge.
52. Odhiambo, N.M., *Energy Consumption and Economic Growth Nexus in Tanzania: An ARDL bounds testing approach.* Energy Policy, 2009. **Vol. 37**(2009): p. 617-622.
53. Melike, E.B. and B. Tahsin, *The relationship among oil, natural gas and coal consumption and economic growth in BRICTS countries.* Energy, 2014. **Vol. 65**(2014): p. 134-144.
54. Steinar, S., *Econometrics and Economic Theory in the 20th Century*, ed. E.s. mongraphs. Vol. Press syndicate of University of Cambridge. 1998.
55. Khan, M.A., A. Qayyum, and A.S. Saeed, *Financial Development Development and Economic Growth: The case of Pakistan.* The Pakistan Development Review, 2005. **Vol. 44**(4): p. 89-110.
56. Dickey, D.A. and W.A. Fuller, *Distribution of the estimators for Autogregressive Time Series with a unit root.* journal of American Statistical Association, 1979. **74**(1979): p. 427-431.
57. Gujarati, N.D. and C.D. Porter, *Basic Econometrics*. 2008: McGraw Hill Higher Education.
58. Sahbi, F., et al., *The role of natural gas consumption and trade in Tunisia's output.* Energy Policy, 2014. **vol 66**(2014): p. 677–684.
59. BBC News. *Nigeria: 'Oil-gas sector mismanagement costs billions'*. Africa 2012 [cited 2015 5th August]; Available from: http://www.bbc.co.uk/news/world-africa-20081268.
60. Auty, R.M., *Sustaining Development in Mineral Economies: The Resource Curse* 1993. , London: Routledge. .
61. Boulhol, H., d.S. Alain, and M. Margit, *The Contribution of Economic Geography to GDP per Capita.* OECD Journal: Economic Studies, 2008. **Vol.** (2008): p. 1995-2848.
62. Robinson, J.A., T. Ragnar, and V. Thierry, *Political Foundations of the Resource Curse.* Journal of Economic Development. , 2006. **Vol. 79**: p. 447-468.

Appendix A: Data for the Econometric Analysis

Year	GC	OP	GDP
1981	2274	72603	131182075183.70
1982	2605	65029	104015498407.07
1983	3179	62306	69512001324

1984	3075	70184	53579062324
1985	3630	75585	52421880172
1986	3267	73956	36919968874
1987	3668	66716	41409915446
1988	3635	73169	38431619201
1989	4250	86550	38172722715
1990	4000	88249	45971811980
1991	4878	91829	39279955280
1992	5132	95166	40780798759
1993	5605	94905	21344984322
1994	5493	94407	23829471000
1995	5385	95998	36585254274
1996	5457	106632	43562990622
1997	6178	116493	43583043119
1998	6269	109783	38343035425
1999	6640	105323	42054730934
2000	7646	112792	52606261962
2001	7202	117778	48681022464
2002	7644	100831	64183636838
2003	10694	114916	71823989286
2004	11027	123902	90825775240
2005	11036	125060	112248324603.24
2006	11564	118326	140884928512.88
2007	11894	109315	156777048575.37
2008	11077	104651	188726596938.21
2009	9658	106230	154277720912.66
2010	10786	121980	330534252904.27
2011	15008	117924	357475043166.18
2012	15446	116091	393808303877.13
2013	12636	108016	437436058005.74

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