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The Role of Natural Gas In Nigeria' Economic Development Calculus: Some Simple Empirics.

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***Abstract**: The fact that the Nigerian economy depends critically and precariously on hydrocarbon resources, therefore, makes imperative to illuminate and x-ray the importance of natural gas to the development of the Nigerian economy. Against this background, the study examines empirically the role of natural gas in the economic development calculus of Nigeria. The main objective of this study is to provide a framework for understanding the larger economic role of gas at a time when issues of employment and investment are so critical in a traumatized national economy in Nigeria. For us to achieve the above objective the following questions are germane: what is the impact of natural gas revenue on real GDP per capita in Nigeria? What is the relationship between natural gas revenue and economic development? What has been the impact of natural gas on electricity generation? What more is needed to be done for natural gas development to continue to be one of the key drivers in achieving sustained economic growth and inclusive development in Nigeria? The study adopted the political economy in the context of theoretical and descriptive analysis to x-ray the issues that are germane to the study. Findings revealed that the gas is very important to the Nigerian economy and that for strategic reasons Nigeria should continue to develop her gas resources. The study recommends further investments be made in the gas sector by funding trains 7 and 8 of the NLNG. Other gas projects should be embarked upon such as the Brass LNG and Olokola LNG. Policies that are environmental friendly should be enacted.*

Keywords: *Energy, natural gas, development, policy, Nigeria.*

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I Introduction

In all human existence, energy is of utmost importance. Without sufficient energy in place, life becomes a drag and burdensome. Energy has been a major means of wealth creation in all climes, Nigeria inclusive. It becomes imperative, therefore that the role of energy as economic driver cannot be over stated. The nature and mix of energy portfolio as well as energy demand and utilization in a nation' economy are major determinants of its level of economic development. Natural gas is not only a major component of energy configuration but also a strategic natural resource for those who are privileged to have it in their energy portfolio. Energy is the heart of the global economy; a strategic input in nearly all the goods and services of modern living. In fact without heat, light and power you cannot build or run the factories and the cities that provide goods, jobs and homes, nor enjoy the amenities that make life more comfortable and enjoyable.

Nigeria is abundantly endowed with energy resources. These include crude oil, hydro-power, coal, tar sand, natural gas, solar energy, nuclear and fuel wood. In recent years, global attention is shifting to gas as alternative source of energy within the context of safety, cleanliness, versatility and economy. Available data from EIA sources (2012) reveal that the recoverable gas reserves in Nigeria is 235 trillion cubic feet, but the proven gas reserve in Nigeria is 182 trillion cubic feet out of which 209 billion cubic feet is produced annually. About 44% of this figure produced is presently being flamed. Translating this to electricity generation, it can produce 69GW of electricity that is estimated at economic value of $5billion dollars.

Table 1.1: NIGERIAN ENERGY RESOURCES ARE SHOWN BELOW.

	Types of Resource	Reserves of unit of Measurement	Aver Energy content per unit in KJ	Total resources energy content KJ	Energy ratio of resources to oil %	Energy ratio of total resources
A	Coal & Lignite	650m shot tons	22.7×10^6	14.75×10^{15}	11.20	3.86%
B	Gas	$3.615 \times 10^{12} m^3$	38.556×10^6	139.4×10^5	105.9	36.49%
C	Crude oil	$3.42 \times 10^9 m^3$	38.48×10^6	131.6×10^{15}	100.00	34.45%
D	Hydro	31.5×10^{11} kWh-100y	3.6×10^3	11.34×10^{15}	8.6	2.95%
E	Solar	180×10^{11} kwhh	3.6×10^3	64.8×10^5	49.3	16.97%

F	Wood fuel	25 yrs availale KJ	2.2×10^{12}/day	20.075×10^{15}	15.2	5.26%

Source: International Energy Agency

Oil and gas discovery has had certain impacts on the Nigeria economy both positively and negatively. On the negative side are issues of environmental degradation, resource course, militancy, oil theft, pipeline feudalization, and Dutch disease (see for instance, Adelegan and Oriavwote (2014). On the positive side, the oil sector has contributed very significantly to the country's GDP since it dethroned agriculture as the main stay of the Nigerian economy in the 1960s, Okojie and Oaikhenan (2012). Also, it has helped in government revenue generation, export earnings, energy generation, industrialization, social and infrastructural development and employment generation, see for example (Odularu,2012, Okojie and Oaikhenan,2012). Ebeneche (2009) averred that the commercialization, of natural gas reserves took three decades to materialize in Nigeria in spite of socio, political, economic and technological obstacles. For the past sixteen years, Nigeria has become a global player in the LNG market as demands continue to be robust in the Atlantic and Pacific basins respectively. Again, Nigeria has also be dependent on crude oil revenue though its attendant variability notwithstanding. Recently, with the commencement of the liquefied Natural Gas Project, natural gas has become a flagship component of the Nigerian export and revenue profile. Okojie and Oikhenan (2012) asserted that when fully harnessed, Nigeria stands to generate more revenue from natural gas than crude oil. According to Shokoye and Iledare (2014), the NLNG project was embarked upon to diversity the revenue base of the country and to reduce associated gas flaring prevalent in the Niger Delta.

Spring from the issues raised above, and the fact that the Nigerian economy depends critically and precariously on hydrocarbon resources, it therefore makes sense to illuminate and x-ray the importance of natural gas to the development of the Nigerian economy. Against this background, the study examines empirically the role of natural gas in the economic development calculus of Nigeria. The main objective of this study is to provide a framework for understanding the larger economic role of gas at a time when issues of employment and investment are so critical in a traumatized national economy in Nigeria. For us to achieve the above objective the following questions are germane: what is the impact of natural gas revenue on real GDP per capita in Nigeria? What is the relationship between natural gas revenue and economic development? What has been the impact of natural gas on electricity generation? What more is needed to be done for natural gas development to continue to be one of the key drivers in achieving sustained economic growth and inclusive development in Nigeria? The impact of this study is anchored on the fact that given the abundance of gas reserves in Nigeria, the nation should leverage on this asset to attain the goal of social optimum bliss. This is the thesis of this paper. Consequently, section two examines the development of natural gas resources within a historical context and the role of natural gas in Nigeria's economic development calculus as well highlights the major challenges facing the gas sub-sector. While in section three, we present the research methodology and model specification. In section four, discussion of findings is presented while section five concludes the paper.

II Economic History Of Natural Gas Development In Nigeria.

In this section, a concise composition of natural gas will be given and the evolution of natural gas in the context of energy use globally also will be examined and finally, we shall attempt to dovetail it to the Nigerian context. Natural gas is a colourless, sharpeless and odourless in its purest form however it is combustible and when burned, it gives a great deal of energy, Ahaotu (2007). Natural gas is clean and environmentally friendly, when burned, it emits lower levels of potentially harmful by- products into the atmosphere.

Modern man of the 21st century has come to appreciate the utility of natural gas in improving everyday life. Natural gas provides us with energy to heat our homes, cook our food, generate our electricity and fire our industrial plants. Thus, it clear that natural gas has become a strategic component of modern man' energy portfolio and therefore occupies a place of importance in our lives. Natural gas is made of combustible hydrocarbon gases. It is primarily formed of methane, it can also include ethane, propane, butane and pentane. Looking at it from the view of chemistry, the kind of natural gas we use in our homes is almost pure methane.

Natural gas was first discovered in the United States of America and used as a source of energy. Although the Chinese were believed to have used natural gas around 500BC for salt water desalination. Natural gas seepages were discovered in the united states in the 17th century and first gas well was dug in 1821, Bhattacharyya (p.335, 2011). In the early days of natural gas exploration, gas flaring was common due to inadequate technology and skilled manpower. At the coming of steel pipes, the transportation of natural gas was no longer a major issue in the industry. By 1931, high pressure withstanding pipes were develop that can cope with varying operating conditions. Scientific discoveries and innovations in steel pipe design and fabrication, electrical welding, corrosion protection and mechanical pipelaying. Peter (1971) opines that the above factors led to the emergence of a dynamic natural gas industry.

In Nigeria, various governments at one time or the other have attempted to diversify the structure of the Nigerian economy. The need for a complimentary source of revenue to crude oil has been a nagging issue to the managers of the Nigerian economy especially at a time when oil revenue has nosedived in recent times. In 1966, the earliest effort at a major LNG project was conceived when the British Gas Corperation signified its intention to buy LNG from Nigeria. Unfortunately for Nigeria, the discovery of natural gas in the North Sea disorganized the fate of that project initiative. At the onset of the 1973 energy crisis, the Americans came negotiating to buy LNG from Nigeria, however, another discovery of vast quantities of natural gas from nearby Mexico and Alaska together with policy change from the Canadian end to supply more gas to the United States than it had earlier done sealed the fate of that effort. After thirty years in the wilderness of hydrocarbon space, the nexus of growing demand with declining production of gas in the Atlantic Basin, technology advances, favourable potitical environment, and strong commitment from shareholders lifted Nigeria's dream of gas exports to the reality of NLNG as it is today, Ibeneche (2009). The NLG was specifically established in 1991, and the first export was recorded in 1999. It is remarkable to note that prior to 1999, there was not gas export market in Nigeria.

2.1 STATUS OF THE GLOBAL NATURAL GAS MARKET: DEMAND AND SUPPLY PROFILE

In this section, we shall clearly but briefly present the dynamic nature of the global gas industry by taking a look at the reserves, production and consumption patterns of the industry using available data and graphics. Gas data reserves are based on either proven reserves, probable reserves or possible reserves. Estimated proven gas reserves within a given period of survey may exhibit variability, that's the reason why various reserve terminologies are used. In spite of the variability, gas reserves estimates are indispensable in studying the roles of natural gas in the global economy. Available data from EIA sources reveal that world natural gas reserves stood at 95 billion M^3 while potential recoverable resources amounted to over 191,000 billion $M^{3.}$.

Natural gas caught international attention in the 1950s, since then the rate of increase in global natural gas demands has thus far exceeded that of other energy resource be it crude oil, hydro and nuclear power.

The first global LNG was sold commercially in 1964 in Australia. In the 90s global liquefaction capacity was 100MPTA and rose to about 140MPTA by the year 2000. Between 2000 and 2012, liquefaction capacity had grown by more than 100%.

This was primarily driven by substantial investment in Qatar and Australia. Projections from IEA sources reveal a growing role for natural gas in the world's energy mix, with natural gas growing from 21% in 2010 to 25% in 2035.

With the fukushima disaster in Japan and the closure of all other nuclear electricity generating plants, there is opportunity for gas as fuel for power generation. In addition, newer markets are springing up especially in China, India, the Middle East, Europe and South America. China five year gasification policy, it is expected to put and to notch up the market for LNG. In Europe, the North sea production capacity is fastly dwindling and commitment to environmental preferences and the Kyoto protocol mechanism is another consideration that could change the gas game.

For instance, see the table below.

Table 1.2: NATURAL GAS IN WORLD ENERGY CONSUMPTION

Years	Coal Lignite	%	Oil	%	Natural Gas	%	Hydro Elite	Nuclear	%	Total	%
1950-1960	1043	59.0	457	25.8	166	9.4	102		5.8	1768	100
1960-1970	1500	49.4	924	38.4	404	13.3	207		6.9	3035	100
1970-1980	1645	33.2	1997	40.4	931	18.8	374		7.6	4.947	100
1980-1990	1907	26.1	2793	40.3	1700	24.6	622		9.0	6922	100
1990-2000	2010	21.7	3893	42.0	2364	25.5	1012		10.9	9275	100
200-2010	2215	16.3	4961	36.5	5000	36.8	1421		10.5	13,597	100
2015	2637	14.5	6161	33.8	7210	39.6	2210		12.1	18,218	100

Source: UN World Energy Supplies 2016

We can see vividly that natural gas almost trip increased by 300% its share of world energy consumption within the period. The United States of America was originally associated with the consumption of natural gas between 1920 and 1950. Up till 1970s, the USA remained the only significant consumer of natural gas in the world. Over time, gas consumption assumed international dimension with the establishment of more gas powered industries in Western Europe, Soviet Union and Japan. Natural gas reserves have more than doubled between 1980 and 2009 (see the figure below).

Natural gas reserves in 1980 stood at 81TCM while in 2009, it was almost 188 TCM. The OECD countries hold only less than 10% of the global reserves. The Russian Federation, Iran and Qatar held more than 50% of the global natural gas reserves in 2009. We also have 18 other countries with at least 1% of the global gas reserves or about 1.8TCM of gas reserves from production perspective, it is remarkable to note that natural gas production is skewed toward countries with small reserves are generally exploiting their resources more intensively than those with large reserves. Bhattachayya (2011) points that the reserve to production ratio varies widely for instance, from about 5 years for the United Kingdom in 2009 to close to 300 years for Qatar. At the present level of gas consumption, the available reserves will last for 63 years.

The demand for natural gas is skewed to developed countries. Available data from EIA (2010) source indicate that the OECD countries accounted for 75% of the global gas demand in 1965 and this declined to 49% in 2009. Three distinct markets are discernable in the gas industry. We have the North American market, the European market and the Asia-Pacific market. By virtue of supply-demand imbalances, there is the development of trade in natural gas. At present too modes of transportation are prevalent in the market. We have pipelines transportation and transportation upon liquefaction as liquefied natural gas. In 2009, 877 BCM volume of gas was traded, of which piped gas trade accounted for 72%.

The three gas markets identified earlier on accounted for more than 80% of global gas trade. Europe had a 45% share in the gas trade in 2009, followed by Asia-Pacific and North America. LNG is the dominant means of supply in Asia Pacific where 89% of the import takes place in the form of LNG, however in the rest of the world; piped gas transport is the common means of supply. Sterns (2007) surmised that almost one half of the gas supply in Europe comes from other European countries, the maturity of European supply and the growing demand in the region is making Europe heavily dependent on foreign gas supply.

In the Asia-Pacific market, the major players are Japan, South Korea, India, Taiwan and China. The Japanese promoted the policy of using natural gas for electricity after the first oil crisis. Prior to the first oil crisis the country was vulnerable due to excessive dependence on imported fuel oil for electricity generation. The major suppliers of gas include Indonesia, Malaysia and Brunei. Qatar and Australia have also acquired a significant market share in the LNG sales in this region. For now, in the absence of viable alternatives and with the versatility of fossil fuels, fossil fuels are expected to be dominant in world energy consumption through to 2030 based on projections from available data sources from IEA. Policy changes with respect to climate change and reduction of carbon dioxide and other emissions will go a long way to determine fossil fuel consumption. By reason of its environmental friendliness, natural gas will continue to be a dominant fuel of choice for power generation which will increase the demand for natural gas. LNG is perceived by gas consumer as providing diversity and security of supply. In the Asia Pacific markets where Indonesia's supply is in decline in her Arum and Botang plants, demand for LNG in the region is expected to be robust.

From IEA reference scenario, demand for natural gas grows by 2.1% per year from 2,854 Bcm in 2005 to 4,779 Bcm in 2030. It is expected that gas demand will increase the most in developing countries. It is also expected that the biggest regional increase will occur in the Middle East. Furthermore, the United States of America and Europe will continue to remain leading consumers of gas by 2030. China and India are strongly showing promises of being emerging consumers. Gas reserves are declining in the major consuming nations and demand is growing, this will lead to increase in gas needs over time. Under this market scenario, LNG is expected to play an increasing significant role. We can discern from the analysis so far that natural gas has come to be a preferred fuel in the development world and in emerging developing countries by because of threat of climate change and consequent search for low-carbon fuels.

2.3 GAS DEMAND AND SUPPLY IN NIGERIA

The inadequacy and inefficiency associated with development and management of energy sector has been responsible for supply-demand gap in spite of abundance of energy resources in Nigeria. The gas industry is not well developed in Nigeria despite its huge potential CBN (2003) surmised that the major reason for this is the high cost of requirements for installation facilities and distribution network. Others include poor incentives for potential investors, poor infrastructure facilities, lack of investment in information, and undeveloped export markets.

Gas demand is expected to grow as a result of improvement in the operations of major consumers of gas. Also, there is a growing consciousness towards increased natural gas consumption in the country. Gas is consumed in commercial quantities by fertilizer companies and power generating companies. Since the adoption of the Associated Gas Framework Agreement (AGFA), domestic gas users were classified into commercial, parastatals and quasi-parastatals the commercial users include cement factories and 18 industrial users in Lagos, Ota, Ikorodu and Port-Harcourt.

Most of natural gas extraction and processing facilities are owned by multinational oil companies while the distribution and marketing of gas is carried out by private companies.

The power sector consumes the highest volume of gas in Nigeria in line with what' obtainable in continental Europe, America and Japan. Costing gas infrastructural facilities in Nigeria are mostly owned by the Nigerian Gas Company. It maintains about 1,158TCM of gas transmission pipelines through the Eastern and Western pipelines system.

POWER SITUATION IN NIGERIA

A major obstacle to economic growth and human development in Sub-Saharan Africa is chronic power generation deficit across the continent. Installed power generation capacity in the 48 countries in the Sub-Saharan Africa totals just 80GW- about the same as the Republic of Korea. South Africa accounts for more than half of that capacity. The continent not only suffers from acute shortage of power but even when power is grudgingly. There are opportunities for gas pipeline infrastructure development in Nigeria taking into consideration the huge population in Kano, Kaduna, Abuja and other inland cities. Potential gas supplies to these cities could spark off the possibilities of industrial demand. The major challenge is volume aggregation.

The West Africa Gas Programme is another avenue but the issue with this programme is that it has a history of unreliability but has potential of being expanded and extended to Ghana and Cote d' Ivorie with huge returns. With appropriate pricing of about $2.50 per MMBTU as against the present & 0.50, there is huge market for domestic gas supply. But as at now there is a need to incentivize gas investment in Nigeria.

The creation of gas based industries that use energy as fuel and feed stock. The idea is to produce semi-finished and finished goods domestically while emphasizing the role of small – to – medium sized firms. This could spark off the needed industrial parks in Nigeria. The greater the positive impact of money spent in terms of creating additional jobs across the larger economy. Available it is very costly. Available data from EIA sources indicate that Nigeria alone has enough discovered gas to generate over SOGW of power for 30 years. Consequent upon this abundance of gas in Nigeria, the country should leverage on it and break the yoke of power outages. The sufficiency of gas resources together with strategic investments in the sector, the barrier of darkness will certainly be shattered. The use of gas as power generation fuel has a number of advantages. For instance, modern combined-cycle gas turbine (CCGT) generators operate at very high thermal efficiencies can be constructed more quickly and for lower unit cost than coal or hydropower plants. Burning gas emits 30% less than oil. This simply means that gas is environment friendly when compared with oil and coal as fuel. Still on the use of gas for electricity, gas supplied to the domestic power sector can bring benefits to the economy in the contest of reduced cost and increased supply of electricity. Also, for an economy like Nigeria's that has an acute generation deficit, cost reduction can come from lower consumption of diesel in stand-by generators. The benefits of natural gas exploitation is discussed in the following section.

2.4 THE CONTRIBUTION OF NATURAL GAS IN NIGERIA'S ECONOMIC DEVELOPMENT CALCULUS.

Generally, the gas sector contributes to economic growth in two ways. First, the gas sub-sector being a strategic part of the energy sector create jobs and value by attracting, transforming and distributing energy goods throughout the economy. Also, the availability of gas underpins the rest of the economy. In the same vein, economists group gas related jobs into three categories; direct jobs held by individuals who are employed by firms in the sector to produce and deliver energy products; indirect jobs represent positions created in industries that supply the gas sector with goods and services; Induced jobs result from salaries paid workers in the first two groups. These workers spend their incomes and create demand for goods and services, thereby increasing aggregate demand and employment in unrelated industries. The gas sector has deep supply chains and high pay, indirect and induced jobs represent an imported part of its overall economics contribution. The employment multiplier effect measures the contribution that the sector makes to the economy through the indirect and induced jobs it creates. The larger this, the greater the positive impact of money spent in terms of creating additional jobs across the larger economy.

Since the first shipment of LNG in 1999, the gas sector has made sustainable impacts on the Nigeria economy. These impacts are in the area of employment opportunities, industrialization, contributions to government revenues, Gross Domestic Product, foreign exchange reserves, supply of energy to industry, agriculture and social welfare in terms of home use for example cooling and heating.

Employment opportunities through Industrialization

The gas sector has helped in sustaining jobs in the petrochemical industries both directly and indirectly. The major component of this sustainability of the industry is the availability natural gas to power the industry and serves as feed stocks to the production of industrial petrochemicals. Presently, about 82% of organic chemicals are supplied by natural gas and crude oil. Through the process of industrial thermal and catalytic dehydrogenation and polymerization, industrial petrochemicals like ammonia, ethylene and methanol are

obtained from natural gas. The petrochemical industries have done well in Nigeria, and have enhanced industrial development especially in manufacturing and communication sectors

Improved agricultural productivity

A major essential input into agricultural productivity is the application of fertilizers to the soil to enhance crop growth and yield. The use of Nitrogenous fertilizers, herbicides and fungicides, irrigational piping, mulching with plastic films, packaging and storage of food items are basically from the rise of natural gas in fertilizers producing films. Ammonia, urea and nitrate fertilizers are all products from the fertilizers producing industries which have helped in no small measure in improving agricultural productivity as well as helped in creating new jobs and sustaining existing jobs in the agricultural sector. Available estimate on the Benue basin scheme would require additional 26,000 metric tons of polyvinyl chloride (PVC). The flour mills and noodles producing firms consume several millions of plastic and polyethylene films annually to deliver their products to consumers.

Power generation

The gas sector has contributed immensely to electricity generation in Nigeria. Natural gas is used in driving steam and gas turbines as a fuel for power generation. The power sector stands out as the largest consumer of natural gas. The sector accounts for about 72% of gas consumed in Nigeria. Some power stations use gas to fire their steam and gas turbines such as Ijora, Afam, Egbin, Ughelli and Sapele power stations. The uses of gas for electricity generation hold the ace for uninterrupted power supply in Nigeria, given the abundance of gas.

Contribution to GDP, export earnings and government revenue.

The gas sector has contributed 4% to Nigeria's GDP and has earned substantial revenue to the government. Omotowa (2013) stated that the NLNG has generated over US $60 billion revenue in its 13 years of existence. Again, the NLNG is fulfilling its mandate of diversifying the revenue base of the economy as well as helping to reduce gas flaring, in short it accounts for 50% flare reduction in Nigerian. Furthermore, NLNG contributes 7% to the global LNG and produces 65% liquefied petroleum Gas (LPG) in the Nigerian market.

CHALLENGES IN THE GAS SECTOR

The gas sector has been plagued by myriads of challenges which undermined its optimal development over the years. The Nigerian gas sector is facing some of the following problems:

1. **Poor funding of investments**

The Federal Government's delays in responding to funding issues have impaired the development of gas sector. Delays in the payment of cash calls to the joint venture operators have a discouraging effect on the go operators. Poor funding is responsible for the abandonment of the Olokola LNG project and the Trans-Sahara gas pipeline project.

2. **Communal and Environmental Issues**

Frequent communal disturbances have taken their tolls on the oil and gas industry as oil and gas bearing communities clamour for higher stake in oil operations.

3. **Technological Innovations**

The development of high technology to explore unconventional gas resources which were uneconomical to produce in the past is now in place. The potential of natural gas supplies from shale gas, tar sands and coral bed methane could transform the world's energy markets and shrink the NLNG gas market.

4. **Competition in the global LNG market.**

Qatar has been a phenomenal growth in her LNG drive. Between 2006 and 2011, its output jumped from 20MTPA to 80MPTA and has capacity to do more. Australia has 20 trains of LNG facilities, in spite of the fact that she has about 60% of Nigeria' gas reserves. For NLNG, it is struggling with producing 22MPTA, to drive it up to 30MPTA has been very challenging. Some countries in the East African region notably Mozambique and Tanzaria will join the tray in 2018 thereby shrinking further the NLNG market.

5. **Logistics Issues**

The logistics of gas exploitation and transportation facilities is a major issue due to paucity of huge investments required for the realization of the domestic gas sub-sector. The costs of setting up LNG facilities have been raising, as a result increased costs of sourcing strategic material such as steel and nikel. Costs are expected to escalate by 9.5% annually. The issue of gas transportation in the domestic market is still a nagging problem. As at now, we do have enough pipeline system to help in supplying gas to homes, offices, schools, hotels and hospitals.

6. **Skill gaps issues**
Insufficient manpower and lack of experience on the part of contractors and sub-contractors. The industry is basically knowledge and technology based, hence the absence of sufficient manpower is a major challenge to the industry.

III Method Of Study

Data Sources and Method of Analysis
The study employed data that are secondary in nature. The annual time series data was obtained from the World Bank Indicators and International Energy Agency sources.. We employed co-integration and error correction mechanism (ECM) and OLS as our estimation technique.

Model Specification
In modeling the roles of natural gas in the economic development scenario of Nigeria, we specify two models to capture the impact of natural gas on real GDP per capita in Nigeria.
Following earlier works such Odularu (2005) and Interri (2009), we specify a mathematical functional relationship:

Model. RGDPC=f(NGR, OR) …….(1)

Where RGDPC = Real GDP per Capita
NGR = Natural Gas Rent (revenue from natural gas)
GOR = Grude Oil Rent (Revenue from crude oil sale)
μ = Error Term
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The econometric equation becomes;
[
$RGDPPC = \beta_0 + \beta_1 NGR + \beta_{2G} OR + \mu$…….(2)
[
Where β_0 = Intercept and
β_1, β_2 are coefficient of parameters' estimate
Apriori, $\beta_1, \beta_2 > 0$ and $E(\mu) = 0$.

ADF UNIT ROOT TEST RESULT
It is a common knowledge in economic literature that most time series variables are non-stationary and using non-stationary variables to run regression might lead to spurious results, Granger and Newbold (1974), Chibber and Wingnbergan (1988) that will yield only meaningless results thereby rendering any forecast and any policy recommendation based on such result as untenable. We avoided this pitfall by conducting the Augmented Dickey Fuller test of unit roots.

ADF UNIT ROOTS RESULT

Table 4.1

Variable	**Level**			
	ADF Value	5% Critical Value	Prob.	Remark
RGDPPC	3.717	-2.936	1.000	I(0)
NGR	-3.185	-2.936	1.000	I(0)
GOR	3.183	-2.936	1.000	I(0)
ΔRDPPC	-4.184	-2.938	0.002	I(1)
ΔNGR	-4.877	-2.938	0.000	I(1)
ΔGOR	-4.877	-2.938	0.000	I(1)

Source: Authors computation from E-View
From the ADF Augmented Dickey Filler test, the three variables were non-stationary at levels but become stationary upon first differencing. This therefore motivates us to conduct the Johansen co-integration test to confirm the existence of a long run relationship.

Johansen-Jeliseus Test

TABLE 4.2: Trace statistic

Hypothesized	**Trace**	**5%**	
No. of CE(S)	Statistic	Critical Value	Prob.
None	34.517	29.797	0.710
At most 1	5.872	15.494	0.710

Source: Authors computation from E-View

TABLE 4. 3: Maximum Eigen Value

Hypothesized	**Trace**	**5%**	
No. of CE(S)	Statistic	Critical Value	Prob.
None	28.644	21.131	0.0036
At most 1	5.766	14.264	0.643

Source: Authors computation from E-View

Given that the probability values of the hypotheses at most 1 equation is co-integrated at 5% level of significance in both Trace and Maximum Eigen value, both statistic indicate one co-integrating equation.

$RGDP= \beta_0 + \beta_1 NGR + \beta_2 OR + \mu$, we estimate an error correction model. This is consequent upon the fact that, RGDPPC, NGR and OR are integrated of order one 1(0) and their residuals stationary after differencing. The combination of the 1(1) variable is a long run relationship between the variables while a relationship between the first difference of RGDPPC, NGR and GOR becomes the short run relationship.

Table 4.4 : ECM Result. Dependent Variable: LRGDPPC

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
L(RGDPPC(-1))	0.322804	0.419113	1.016821	0.3227
L(RGDPPC (-2))	0.419966	0.520246	1.352745	0.1635
LNGR	1.256669	0.073112	3.691559	0.0013
LNGR (-2)	0.121032	0.066433	2.244717	0.0411
LGOR	-2.296704	0.055131	2.242736	0.3413
LGOR(-1)	-0.100791	0.083014	1.183607	0.22881
ECM(-1)	-0.614083	0.175355	-3.729063	0.0012
C	3.116282	0.856424	3.943407	0.0007

R-squared	0.580528	Mean dependent var	0.102500
Adjusted R-squared	0.225909	S.D. dependent var	4.065866
S.E. of regression	3.777249	Akaike info criterion	5.786701
Sum squared resid	230.3407	Schwarz criterion	6.327960
Log likelihood	-76.98721	Hannan-Quinn criter.	5.799260
F-statistic	1.695920	Durbin-Watson stat	2.123114
Prob(F-statistic)	0.157752		

Source: Author's computation, 2017.

From the estimate, it is shown that the coefficient for the error term ECM has the right sign and is statistically significant. That is, natural gas rents have impacted on economic development in Nigeria in the period under consideration but reverse is the case for oil rents. This is the reality of economic outcomes in Nigeria, although the government has received huge revenues from the sales of crude oil but this has not impacted on the wellbeing of the people. The issues of systemic corruption, skewed fiscal federalism and gross underdevelopment of oil and gas bearing communities are still endemic in the Nigerian economy.

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POLICY IMPLICATION OF FINDINGS

The sign on the coefficient of crude oil rent did not conform to a priori expectation, the sign is negative and not significant. This has implications for the national economy. It simply means that the oil sector with its high revenues to the economy has not translated to economic development in the country as majority of the people are plagued with underdevelopment issues of poverty, unemployment, infrastructural deficits, insecurity, low level of life expectancy and general low standard of living. In addition to the above, the parsimonious ECM result indicates that gas rent both at the current and lag levels conformed to a priori expectation and significantly influence economic development in Nigeria.

From the estimate, it is shown that the coefficient for the error term ECM has the right sign and is statistically significant. The ECM coefficient is high at 61% indicating that the speed of adjustment to long run equilibrium is fairly high. That is, natural gas rents have impacted on economic development in Nigeria in the period under consideration but reverse is the case for oil rents. This is the reality of economic outcomes in

Nigeria, although the government has received huge revenues from the sales of crude oil but this has not impacted on the wellbeing of the people. The issues of systemic corruption, skewed fiscal federalism and gross underdevelopment of oil and gas bearing communities are still endemic in the Nigerian economy.

IV Conclusion

In this research work, we have empirically ascertained and discussed the role of natural gas in Nigeria's economic development calculus. The main objective of this paper was to examine the contributions of natural gas to economic development in Nigeria. Gas development in Nigeria took many years before it eventually took off. The government has put in place a plethora of legislations in order to get the best from the sector. The laws governing the oil and gas sector is undergoing various reforms just to ensure that optimal impact on the economy is actualized. It is glaring that the economy critically depends on the sector for export earnings, infrastructural development, industrialization and revenue. The major challenge is how to ensure that the revenue and earnings from the sub-sector impacts on the people within the context of economic development paradigm.

V. Recommendations

On the basis of the above analyses, the following recommendations are made.

1. Further investments be made in the gas sector by funding trains 7 and 8 of the NLNG.
2. Other gas projects should be embarked upon such as the Brass LNG and Olokola LNG.
3. Policies that are environmental friendly should be enacted.
4. The major challenges and the attendant problems in the oil sector be avoided to enable the sector moved forward. Benchmarking countries that have achieved ample success in the oil and gas sector and learning from their experiences is way of moving the sector forward.

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