NON-RENEWABLE ENERGY, OIL PRICES AND ECONOMIC PERFORMANCE IN NIGERIA

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Abstract

This paper examines the long run relationship among non-renewable energy consumption, oil prices economic performance using annual time series data covering the period 1980-2013. The trend of production and consumption of non-renewable energy, oil prices and the real GDP over years was depicted: Augmented Dickey-Fuller Unit Root Method, Engel Granger Co-integration test and the OLS estimation technique were employed in the course of the study. The result indicates that there is long run relationship between the Real GDP and the consumption of the non-renewable energy (Coal, Oil and Natural gas) and the oil prices in Nigeria but in the short run, the consumption of coal and natural gas doesn't have significant effect on the real GDP. It was however recommended that the production of coal and crude oil should be increased so as to increase the Real GDP of Nigeria.

1.0 Introduction

For all countries whether developed or developing, energy is an essential production factor like capital and labour. Moreover, energy consumption is one of the basic indicators of economic development and growth. Energy is the mainstay of Nigeria's economic growth and development, it plays a significant role in the nation's international diplomacy and serves as a tradable commodity for earning the national income which is used to support government development programmes. It also serves as an input into the production of goods and services in the nation's industry, transport, agriculture, health and education sectors, as well as an instrument for politics, security and diplomacy (Youngho & Yanfei, 2014)

Energy, and in particular, oil and gas, has continued to contribute over 70% of Nigeria's Federal revenue. National developmental programmes, and security, depend largely on these revenue

earnings. Energy, especially crude oil, has over the past five years contributed an average of about 25% to Nigeria's Gross Domestic Product (GDP), representing the highest contributor after crop production. Crude oil (a non-renewable energy) is usually found in underground areas called reservoirs. It is liquid in nature and yellowish black in colour. They are composed mainly of hydrocarbons and organic compounds. They are usually discovered by oil prospecting scientists. Sometimes, petroleum and crude oil are used to mean the same thing, but petroleum itself is a broad range of petroleum products including crude oil itself. We use the term 'petroleum products after crude oil is refined in a factory. Crude oil exist either deep down in the earth's surface or deep below the ocean beds (Soheila, Bahman & Nikos 2013).

According to the 2012 oil market report1 published in the Organization for Economic Cooperation and Development (OECD) and the International Energy Agency (IEA, 2012), oil constitutes the more important source of energy and represents an essential factor which spurs the development in the economic sectors (such as electricity, transport, industry, agriculture) and the noneconomic sectors (such as the military service), too. Moreover, we notice that the oil price has increased significantly during the last decade which may affect the economic situations of the countries which based on the use of huge quantities of oil. This lead to an increase in the oil demand, a decrease in the oil supply which generates, an increase in extraction and refining costs and also an increase of oil importations (Farhani & Rejeb, 2012).

The aim of this paper is to analyze the long run relationship between non-renewable energy, oil prices and economic performance in Nigeria between 1980 and 2013 from the secondary data obtained from CBN and the WDI, using Augmented Dickey-Fuller test and Co-integration. It is believed that the outcome of this study will be of enormous benefit to students, academics, institutions, policy makers and individuals who may want to know about non-renewable energy, oil prices affects the real GDP in Nigeria.

The balance of paper is organized as follows. Section 2 provides an extensive review of the relevant literature on the link between non-renewable energy, oil prices and real GDP. Section 3 discusses the data, methodology, section four presents the empirical results, analysis and discussions. Finally, Section 4 provides concluding remarks and policy implications from the empirical findings.

2.0 Literature Review

Energy is fundamental to all human activities. It plays an important role in the economic growth of both developed and developing countries. The growth hypothesis suggests that energy consumption is an indispensable component in growth, directly or indirectly as a complement to capital and labour as an input in the production process (Mulegeta *et al*. 2010). Since production and consumption activities involve energy as an essential factor inputs, the relationship between

energy consumption and economic growth has been a subject of greater inquiry as energy is considered to be one of the important driving force of economic growth in all economies

Nigeria is an energy resource, rich country blessed with a lot of resources such as solar, wind, biomass, crude oil, natural gas and coal, yet an estimated number of 60-70% of Nigerians population does not have access to electricity. This simply means that Nigeria as the most populous country in sub- Saharan Africa nearly one quarter of sub- Saharan African‘s population despite their huge National Energy resources had not been able to harness them for proper development of the country.

Nigeria energy resources can be classified on the bases of their renewability as

- Renewable
- Non-renewable.

Renewable energy sources are sources that can be replenished or produced quickly through natural processes. The rate at which they are used does not affect their availability in future and as such cannot be exhausted. All the regions of the world have reasonable access to one or more forms of renewable energy supply because the resources are generally well distributed all over the world, even at wide spatial and temporal variations. Many of the renewable resources can be depleted by human use, but may also be replenished thus maintaining a flow.

The types of Renewable energy resources that occur are as follows:

- Wind Energy
- Solar Energy
- Hydro Energy
- Biomass Energy.

Non-renewable energy sources are those sources that drain fossil reserves deposited over centuries. This results in depletion of these energy reserves. There are many countries, which have recorded significant reduction of these sources and are currently suffering from the side effects of drilling these energy reserves from deep underground. Examples of these countries include China and India. The environmental impact is so great that just by travelling to these two countries, you can get a firsthand experience on the case studies that are there to be seen by the naked eyes. There are many places in the world that are experiencing fast degradation of non-renewable sources in terms of fossil fuels. Soon there will be none left is appropriate measures are not take into consideration. This is a trend that has to be reversed if the world is to survive the degradation process that is going or happening at a much rapid pace. The main non-renewable energy sources are:-

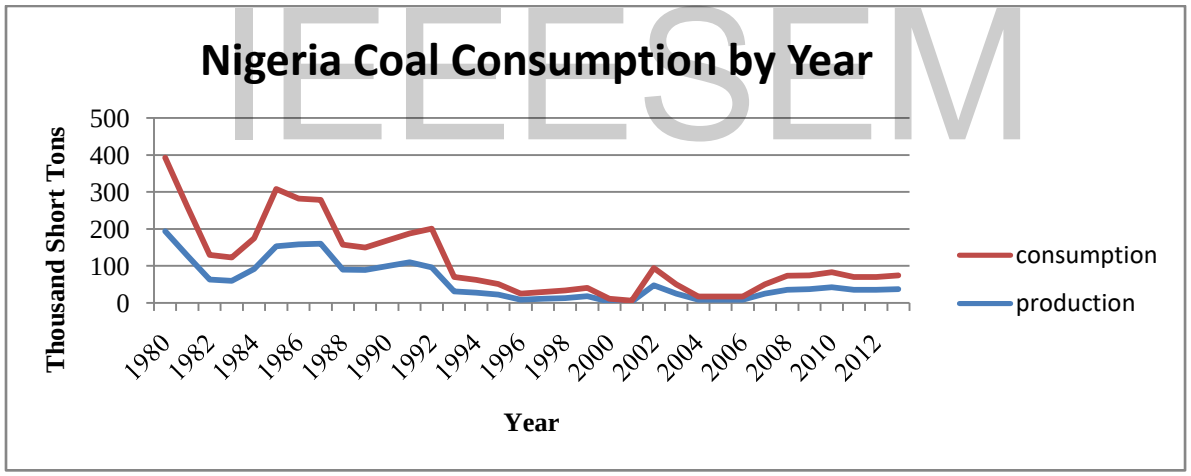
a. Coal

Coal is the most abundant form of fossil fuel available on earth. They were formed by the decay of old plants and animals several centuries ago. Coal is mostly found below the earth and is

major source of fuel for electricity generation as of today. Most power stations on earth require huge reserves of coal to produce electricity continuously without break. When coal is burnt, it produces heat that is used to convert the water into stream. The steam is then used to move the turbines which in turns activate generators which produces electricity. Coal contains excessive amount of carbon. When it is burnt to produce power, it mixes up with oxygen to produce carbon dioxide. Carbon dioxide is one the gas responsible for global warming.

The use of coal and other fossil fuels have only increased since they were discovered. Their excessive extraction and use has resulted in degradation of environment and ecological imbalance. Though coal is still available in big quantity on this earth but it is predicted that it won't last for more than 40-50 years if switch is not made to green or clean energy. Nigeria is heavily endowed with 22 mines of coal resources which have a total proven capacity of 2 billion tonnes. Coal was the first energy resource to be exploited in Nigeria. It then immediately became the power of the country but its relevance began to drop immediately after oil was discovered. The level of significance attributed to coal by the nation began to drop very quickly and today it is insignificantly used as an energy resource.

The trend or Coal production and consumption in Nigeria between 1980 and 2013



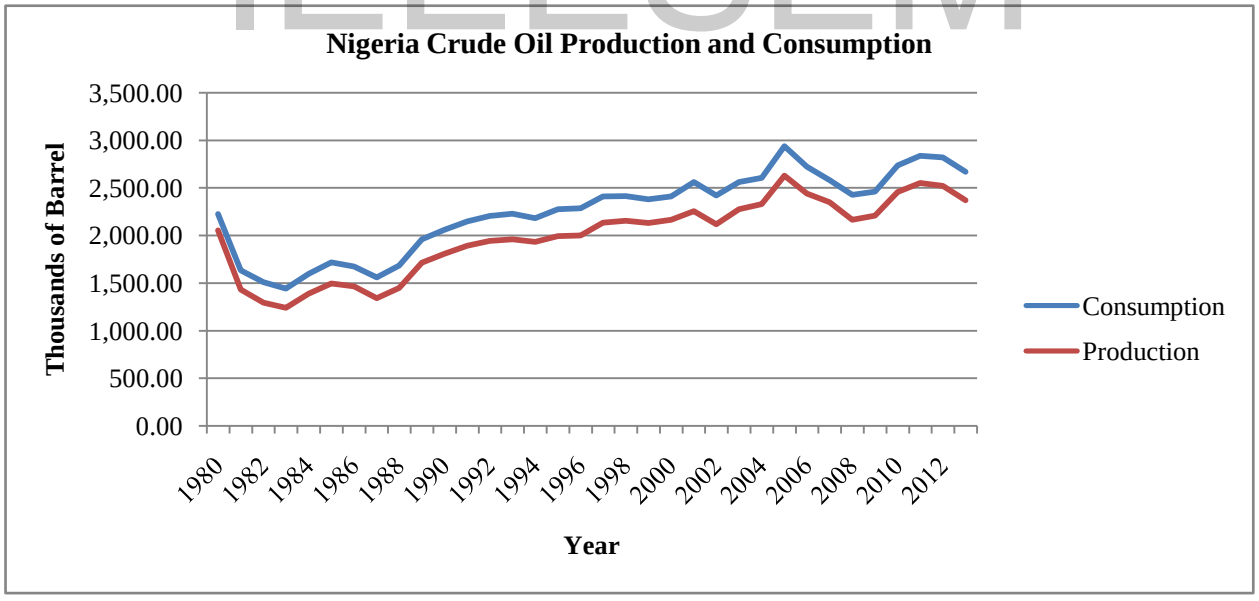
Source: Author's Computation.

In many countries which use coal as an energy resource, increased coal consumption reflects the increasing output of industry, transportation, and even agriculture. Coal resources are mainly located in Anambra State and it is sub bituminous with low sulphur and ash content. This makes it attractive to African countries like Ghana; Egypt as well as European countries which have began to show interest in Nigerian Coal. Underground and surface coal production potential is reported to be 200,000 -600,000 tonnes per year and 400,000 - 800,000 tonnes per year, respectively (World Bank, 1983). This potential still exists but the resource is not tapped.

b. Oil

Crude oil is the dominant source of commercial energy use, accounting for over 70% of national commercial energy consumption, of this, the transport sector accounts for about 70% of commercial energy consumption. In Nigeria, crude oil has been a major economic growth determinant. For the past three decades it has claimed the topmost position in the export list of the country (National Bureau of statistics, 2006). Presently, there are eleven huge Oil producing and exporting companies in the country. The share of oil in total exports is over 90%. Nigeria was one time the 6th largest oil producing country in the world but today it is presently 8th due to the unrest in the Niger Delta region of Nigeria which is under intense militant crises. However, as a member of the Organization of Petroleum Exporting Countries (OPEC), Nigerian oil attracts very huge buyers in the international market.

The major reason for this is because Nigerian oil is of high quality and most environmental friendly relative to oil from other countries. Nigeria's export blends are light, sweet crudes and have low sulphur contents of 0.05 - 0.2%. The local consumption of oil in the country is low. With The inability of our refineries to be at work in Nigeria there is inadequate capacity to meet the increasing demands for petroleum products. Nigeria's four refineries have a total capacity of 445,000 barrels of oil per day but these refineries are currently inactive to meet domestic demand of 300,000 barrels of oil per day. This is as a result of inadequate maintenance and a general declining technical inefficiency causing incessant shortages, hoarding and long queues at petrol filling stations.



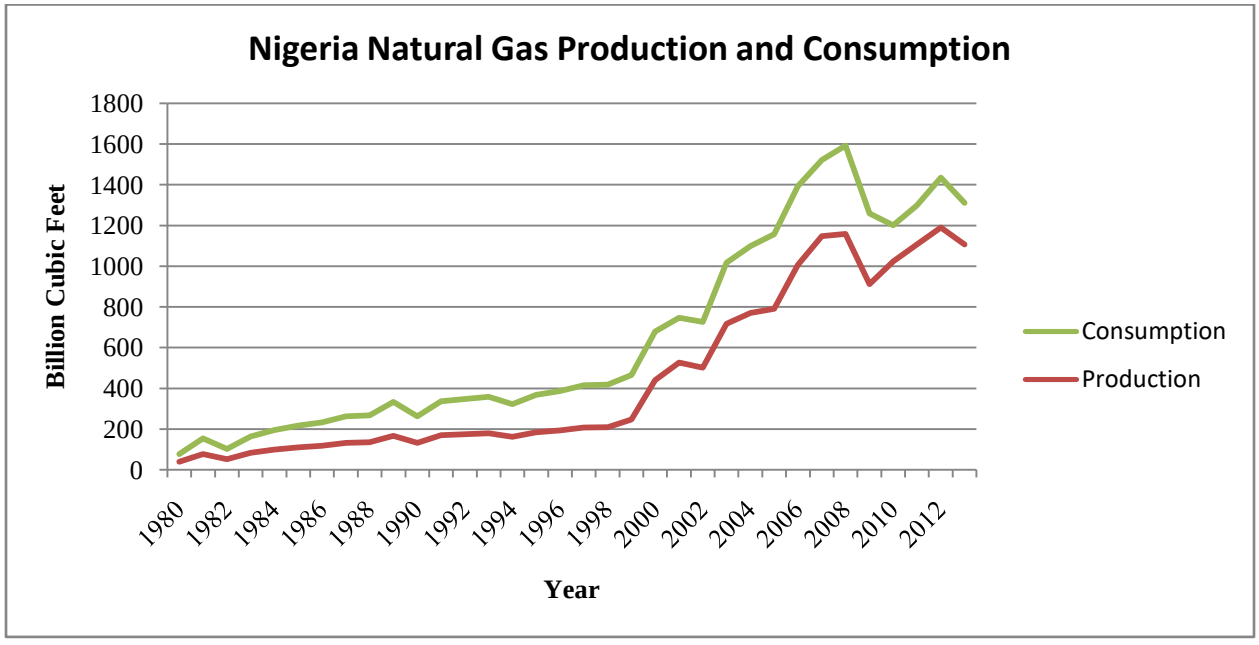
The trend of Crude Oil production and consumption in Nigeria between 1980 and 2013
Source: Author's Computation.

Natural Gas

Natural gas is a mixture of several gases including methane, ethane, propane and butane. It burns completely and leaves no ashes. It causes almost no pollution and is one the cleanest form of fossil fuel. Of these gases, methane is highly inflammable. It has no color, taste or odor. This is the reason that some chemicals are added to it before it can be supplied to individual homes so that a leakage can easily be detected.

Nigeria has abundant reserve of natural gas. In energy terms, the quantity of natural gas is at least twice as much as the oil, and the horizon for the availability of natural gas is definitely longer than that of oil. The known reserves of natural gas have been estimated at about 2.4 x 10^{12}cm3 and are expected to last for more than a century as a domestic fuel and a major export. Nigeria has the largest natural gas reserves in Africa and is among the top ten in the world. However, due to a lack of utilization infrastructure, Nigeria still flares about 40% of the natural gas it produces, accounts for about 20% of all gas flared worldwide.

In Nigeria, 75% of the associated gas was burnt off that is flared. This wastage was due to the inadequate infrastructure and the remedy is therefore to build suitable infrastructure to reduce this wastage which could have been used to boost supply and increase receipt from sellers of this energy product. Natural gas can be also converted into liquid state known as the Liquefied Natural Gas (LNG). This is a natural gas product whose market is also constantly increasing. Natural Gas has been affirmed to be the fastest growing source of primary energy according to EIA (2004).The beauty of this source of fuel is that it causes almost no pollution, it is cheap and environment friendly.



The trend of Natural Gas production and consumption between 1980 and 2013

Source: World Development Index

There are many arguments both for and against non-renewable energy. The advantages of Non-Renewable Energy include:

- One advantage of non-renewable energies is that right now, they seem widely available and affordable. Oil and diesel are still good choices for powering vehicles.
- They are cost effective and much easier to produce and use.
- Non-renewable energy also has market value where a supplier or manufacturer makes money and pays workers enhancing economies.
- Non-renewable energy source can be used as a bargaining tool to help their economy stay afloat.

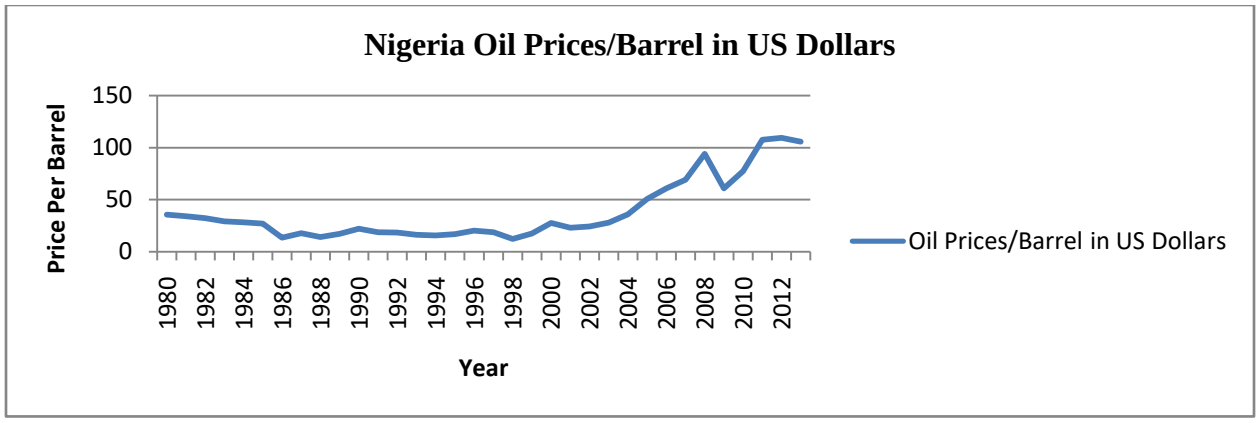
Disadvantages of Non-Renewable Energy

- Because non-renewable energies come from sources on our planet, once they are gone they can't be replaced or revitalized.
- Pollution grows greater through the by-products they leave behind and mining of non-renewable energy is causing damage to our environment.
- There is no doubt that fossil fuels contribute to global warming and to break humans of their habit to lean on non-renewable energy sources remains a challenge.

Oil price ebb and flow has foremost consequence on economic growth. These consequences are projected to be diverse in oil importing and in oil exporting countries. Raise in oil price is considered excellent news for oil exporting countries and bad news in oil importing countries, the overturn should be expected when the oil price decreases, accordingly, an increase of crude oil price will affect positively the real gross domestic product (GDP). Crude oil is a basic input to production, the theory usually forecast that supply side consequences of oil price while addition, aggregate demand is expected to fall in oil importing countries, and go up in oil exporting countries. Economists are trying to investigate the relationship between oil prices volatility and economic growth and noted that increase in oil prices is regarded as a positive signal for the oil exporting countries and positive reception in exchange rate will have a important positive impact on economic growth. So, for those countries oil prices and appreciation in exchange rate are positively correlated with gross domestic product.

The rise in oil prices is due to increase in demand not by supply side effects. Oil prices are more worthwhile than monetary contraction. Increase in oil prices is affecting the oil producing countries in two contexts. First is positive effect that is income and wealth increases in oil producing countries, because importing countries pays more and if the exporting countries utilize income in home country then investment will be more in countries and increase employment in the society. It increase money supply in the society and currency appreciates in this regard. Second effect is negative because increase in oil prices will decrease demand for oil in oil

importing countries and worsens balance of trade position in oil exporting country (Rahul, Hassan, Sahar; 2014)



Above is the trend of oil price increase for the period of 1980 and 2013 in Nigeria.
Source: Author's Computation.

Several studies have been done on renewable energy, oil prices and real GDP. Hsiao-Tien (2011) employed Error Correction Mechanism (ECM) to explore the causal relationship between real GDP and the types of energy consumption from 1980-2010. The study found out that there is a common trend in the long run between real output, capital formation, labour force and four types of energy consumption.

Amaira (2012) adopted ADF, Granger Causality and Vector Error Correlation Model to examine the impacts of oil price fluctuation on the level of real economic activity in Tunisia from 1960-2009 and found out that international oil price is a key variable that influence economic growth in Tunisia within the study period.

Soheila et al (2013) used ADRL approach to examine renewable, non-renewable energy consumption, economic growth and co_2 emission in Iran. The study found out that non-renewable energy consumption and economic growth has unidirectional relationship.

Rahul (2014) conducted a study to investigate the dynamic relationship between renewable, non-renewable energy consumption, industrial output, GDP growth in OECD from 1980-2011 where panel co-integration techniques was employed. It was observed that OECD economies still remains energy dependent for their industrial output as well as overall economic growth. it was recommended that substitution renewable to non-renewable energy sources could enhance a sustainable energy economy.

Sahib (2012) employed Simple Linear Regression Model (SLRM) and Dynamic Regression Model (DRM) to investigate the impact of oil price increase in the US economy. The study

realized that the use of SLRM and DRM can present a non-significant coefficient or a bad adjustment in the direct relationship and they present a weakening effect in the direct relationship.

3.1 Theoretical Framework

Taking inference from the empirical findings and theories which have been derived from the theoretical exposition of the exogenous growth theories which makes energy central to the equation,

$Y=F(A, K, L)$

Where;

Y = aggregate real output.

K = stock of capital.

L = stock of labour.

A = Technology (or technological advancement).

It is worthy to note that A (technological advancement) is based on the investment on research technology. Technology is seen as an endogenous factor which could be related to energy. Most technology as given per time is dependent on the availability of useful energy to power it. The technology referred to here is that such as plants, machinery and the likes. Without adequate energy supply (in this case electricity or petroleum) then these technology are practically useless. Hence, a model will be drawn up to determine economic growth in Nigeria context.

3.2 Model specification

However, in Nigeria context, 3 main non-renewable energy types are considered and they include Oil, Coal, and Natural gas. If non-renewable energy is taken as an independent variable then the model can be stated as:

RGDP = f (CCON, NGCON, COCON, PROIL)

Where;

RGDP = Output,

NGCON= Natural Gas consumption,

COCON = Crude Oil consumption,

CCON = Coal consumption.

PROIL= Price of oil.

Rewriting the model above in a linear form, we obtain:

$RGDP = a_0 + a_1CCON + a_2NGCON + a_3COCON + a_4PROIL + U$

3.2.1 Apriori Definition

Apriori expectations: $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, $a_4 > 0$, a_5

Where; a_1 to a_4 represents the slope coefficients, a_0 is the intercept, U is the stochastic term or the error term at time t.

3.3 Estimation Techniques

Augmented Dickey-Fuller Unit Root Test, Engle and Granger (1988) and Ordinary Least Square technique were employed.

4.0 Analysis of Results

4.1 Tests for Stationarity: Unit Root Tests

The use of non-stationary data in causality tests may lead to spurious regressions (Stock and Watson, 1989). The assumption of stationarity is necessary for econometric estimators to have standard distributions. Most economic time-series do not satisfy the stationarity condition, and such series need to be identified using unit root tests to subsequently make them stationary. Therefore, a stationarity test is mandatory when dealing with time-series data, and is necessary to determine the order of integration of the time-series. Two types of unit root tests are conducted: the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979, 1981) and the Phillip-Perron (PP) test (Phillips and Perron, 1988), on 4 variables: Real GDP, Coal consumption., Crude oil Consumption and Natural Gas Consumption. These tests were selected because of their simplicity and robustness in correcting for the serial correlation between the error terms. The ADF Test estimates the following regression, when testing for the stationarity of an individual time-series *Y*t For the purpose of this study, Augmented Dickey Fuller (ADF) was employed to know the stationary and significance level.

Table 2

Augmented Dickey-Fuller Unit Root Test (Trend and Intercept)

Variables	ADF statistics	Critical Value	Level of Significance	Order of Integration
CCON	-3.661960	-3.552973	5%	I(0)
COCON	-6.583536	-4.273277	1%	I(1)
NGCON	-5.647803	-4.284580	1%	I(1)
PROIL	-7.019464	-4.284580	1%	I(1)
RGDP	-6.011358	-4.273277	1%	I(1)

Source: Author's own estimate

The above is the ADF unit root test for the variable are all stationary at different significance level and order of integration COCON, NGCON, PROIL and RGDP were stationary at first difference, CCON is stationary at level. Furthermore, COCON, NGCON, PROIL and RGDP are at 1% significance level while CCON is stationary at 5% significance level.

4.3 Co-integration.

The concept of co-integration can be described as a systematic co-movement among the selected time series over the long-run. If two or more series are each non-stationary, but a linear combination of them is stationary then it can be said that the series are co-integrated. It is necessary to test for co-integration if we want to provide robust and meaningful results.

The main objective of this paper is to assess not only the pair-wise nature of causality among the variables, but, also the short run and long run dynamic impact as well, we tested for Co-integration using two well known approaches: the one developed by Engle and Granger (1987). This test is a procedure that involves an OLS estimation of a pre-specified co-integrating regression between the variables. This was followed by a unit root test performed on the regression residuals previously identified.

4.3.1 Engel Granger Co-integration test

Series: RGDP PROIL NGCON COCON CCON
Sample: 1980 2013
Included observations: 34
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C
Automatic lags specification based on Schwarz criterion (maxlag=2)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
RGDP	-4.937144	0.0427	-29.05987	0.0315
PROIL	-4.997689	0.0381	-28.95971	0.0325
NGCON	-2.973195	0.6316	-20.83768	0.2328
COCON	-4.583903	0.0810	-26.23987	0.0703
CCON	-5.064184	0.0346	-50.86077	0.0000

*MacKinnon (1996) p-values.

Intermediate Results:

	RGDP	PROIL	NGCON	COCON	CCON
Rho – 1	-0.880602	-0.877567	-0.410594	-0.795147	-0.891257
Rho S.E.	0.178363	0.175595	0.138099	0.173465	0.175992
Residual variance	8.71E+12	50.77656	2200.146	390.8589	473.0872
Long-run residual variance	8.71E+12	50.77656	5533.816	390.8589	1504.531
Number of lags	0	0	1	0	1
Number of observations	33	33	32	33	32
Number of stochastic trends**	5	5	5	5	5

**Number of stochastic trends in asymptotic distribution

Source: Author's own estimate

The result of the co-integration test shows that, with a trend and intercept, there is long run relationship among Coal Consumption (CCON), Oil Prices (PROIL) and the Real GDP (RGDP). At 5% significance level, while Crude Oil Consumption (COCON), Natural Gas Consumption (NGCON) doesn't have long un relationship with Real GDP (RGDP)

4.4 Regression Results

Dependent Variable: RGDP
Method: Least Squares
Sample: 1980 2013
Included observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-22078456	6924672.	-3.188376	0.0034
PROIL	397636.0	21133.57	18.81538	0.0000
NGCON	-3489.668	8097.285	-0.430968	0.6697
COCON	68464.48	24167.25	2.832944	0.0083
CCON	-15630.30	20156.44	-0.775449	0.4444

R-squared	0.950336	Mean dependent var	9128391.
Adjusted R-squared	0.943486	S.D. dependent var	13134566
S.E. of regression	3122448.	Akaike info criterion	32.88119
Sum squared resid	2.83E+14	Schwarz criterion	33.10565
Log likelihood	-553.9802	Hannan-Quinn criter.	32.95773
F-statistic	138.7306	Durbin-Watson stat	1.736410
Prob(F-statistic)	0.000000		

Source: Author's own estimate

The above OLS result presents the effects of non-renewable energy (coal, crude oil and natural gas) consumption on economic growth shows that Natural Gas Consumption (NGCON) and Coal Consumption (CCON) has negative relationship with the Real GDP which implies that Natural Gas Consumption, Coal Consumption does not have any effect on the economy while Oil Price (PROIL) and Crude Oil Consumption (COCON) has a positive relationship with the Real GDP.

Oil Price (PROIL) and Crude oil Consumption (COCON) has a significant relationship with Real GDP with Prob values of 0.0000 and 0.0083 respectively while Natural Gas Consumption (NGCON) and Coal Consumption (CCON) are not significantly related to Real GDP in the long run with Prob values of 0.6697 and 0.4444.

The coefficient of determination of the multiple regression (Adjusted R-squared) is 94.3%, this indicates that the explanatory power of the model (PROIL, NGCON, COCON, CCON) explains 94.3% of the total variation in the dependent variable. This shows that the model has high goodness of fit. However, the Durbin-Watson statistics being less than 2 (1.736410) suggests that there is no auto-correlation among residuals.

T-Statistics measures the significant effect on each independent variable on the dependent variable. This implies that consumption of coal and consumption of natural gas does not have significant effect on the real GDP, while oil price and consumption of oil has significant effect on GDP.

5.0 Conclusion and Recommendation

The main result of this paper is that long-run relationship between the consumption of non-renewable energy; oil prices and the performance of Nigeria economy for the period of 33 years (1980-2013) exist between the variables. The implication of the co-integration among the variables studied would imply that all series in the model move together in the long run. This co-integration relationship provides information about the long run relationship. It is however observed that the price of oil and the consumption of oil is the main determinant of the growth in GDP while the consumption of coal and consumption of natural gas doesn't have significant effect on the real GDP.

However it is recommended that in order to enhance sustained economic growth over years, government must encourage the production and consumption of coal and natural gas in Nigeria.

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