# CRUDE OIL AND ECONOMIC GROWTH IN NIGERIA: A SIMPLIFIED PAIRWISE CAUSALITY TEST

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**Abstract**

This study examines how crude oil affects the economic growth of the Nigerian economy. Despite the early exploration of oil in Nigeria (since the 1950s),the Nigerian economy has been performing poorly in terms of growth and development in real terms, growth of sectoral output , diversification of the exports base, capital formation and accumulation, and labour development. Therefore, using some of the indicators of growth and development; this study re-examined how crude oil consumption has enhanced exports performance, capital accumulation and development of the Nigerian labour stock. The descriptive Statistics, correlation matrix, unit roots tests, cointegration and the Granger causal linkage tests were adopted as multivariate estimation techniques. The study observed and concludes that the crude oil consumed within the economy has no tangible impact on the Nigerian economy. Furthermore, the study also concludes that crude oil export is very significant to the utilization of labor, and has engendered economic growth in Nigeria. The study recommends that the revenue from oil should be invested in the productive sector and human capital development in the Nigerian economy.

**Keywords:** Crude Oil, Granger causality, Economic Growth, Nigeria

**JEL Classification:** Q43, Q32, Q35, P28

## 1. INTRODUCTION

Nigeria began oil production in 1956 when early discovery was made at *Oloibiri*, a remote town in the present day Bayelsa State in the Niger Delta. Since oil was discovered, the exploration and exploitation have covered almost all the areas of the Niger Delta Basin, expanding to nine states comprising of Rivers, Delta, Bayelsa, Akwa Ibom, Cross Rivers, Imo, Edo, Abia and Ondo States.

However, the rapid growth and unprecedented expansion of the oil industry and its dominance in the Nigerian economy started in the 1970s, though Scholars have argued that historically, actual exploration began by a German business organization in 1908 (.Anyanwu *et al*.,1997). The company's oil exploration activities halted at the outbreak of the First World War. In 1937 Shell D'Arcy Company re-activated the Nigerian Oil exploration operations and was

later sustained by Shell BP from 1938 to 1941 when large scale preliminary geological reconnaissance was initiated. By 1951, Shell had started the drilling her first wildcat well and made her first commercial discovery at *Oloibiri* in 1956.

This success story was complemented by the subsequent crude oil discoveries at *Afam* in 1957, *Ebubu* and *Bomu* in 1958. These discoveries boosted oil production between 1958 and 1964. At the end of the Nigerian civil war in 1970, oil production reached its peak of about 500,000 barrels per day. These developments in the Nigerian oil industry during the 1970s through the 2000s, transformed the economy from an agriculture-led economy to crude-petroleum-led and dominated economy; as the proceeds from oil accounted for more than 80 percent of the nation's total export earnings.

The unequivocal dominance of crude oil led to the displacement of agricultural products (the groundnut pyramids produced Northern Nigeria, the Palm Oil of the then Eastern region, the cocoa of the West and the high grade Rubber *latex* of Southern Nigeria) which accounted for over 66 percent of the nation's Gross Domestic Product (GDP) in the late 1950s and early 1960s; became less significant in national revenue generation and growth-led reliance and economic structural transformation. Since then, the role of oil on the performance of the economic growth of Nigeria has generated a lot of unanswered questions and unresolved issues.

Furthermore, the empirical investigation of the impact of crude oil consumption in Nigeria is a very important attempt because: first, crude oil is a strategic macroeconomic commodity and has been described as the mainstay of the Nigerian economy (being a highly oil-dependent economy),Ishioro (2019); second, global oil prices have displayed serious spiral oscillations and fluctuations either in an increasing or decreasing manner thereby causing instability in domestic crude oil energy consumption conservation policies. Oil is very fundamental and important to all the spheres of social, political, cultural and economic well-being of the Nigerian state. Furthermore, this study is necessary because since the 1950s, oil policies have been conducted in poor research and unpedantic intellectual context (Asiodu, 1979)

Based on this explanatory note, the focus of this study is to evaluate the impact of crude oil consumption on the growth and performance of the Nigerian economy. The rest of the paper is organized as follows: section two examines the trend in crude oil production, exports and domestic consumption; section three examines the theoretical framework of the analysis intertwined by literature review; and the next section focuses on the materials and methods, specification of models and estimation techniques. The last section concludes the study and presents recommendations.

## 2. THEORETICAL LITERATURE REVIEW

### 2.1 CRUDE OIL AND THE PERFORMANCE OF THE NIGERIAN ECONOMY

Different studies including Olukoshi (1993) have observed that the prolonged economic crisis of the Nigerian economy which has been characterized by far-reaching and unperturbedly enlarging consequences including large fiscal imbalances, expanded recurrent expenditure, poor sectoral growth performance, deepening poverty and exacerbated inequality, poor export performance, high levels of account deficits, mounting external debts, stagflation resulting into high level of unemployment is traceable to the huge oil revenue that accrued to the Nigerian State during the oil boom period of the 1970s.

Assuredly and in confirmation of Olukoshi (1993), Iwayemi (1983,1993,1998) noted that the current economic situation in Nigeria contrasts sharply with those of the oil boom era of the 1970s.The boom periods initiated a transiently high but not sustainable exceptionally robust macroeconomic performance. Since then, the Nigerian economy has been subjected to pervasive, largely negative whims and caprices of crude oil windfall era. The study further argued that there are enough evidences to suggest that the origin of the current deepening, widening and heightening crisis in the Nigerian economy can be traced to the impacts and consequences of deep-seated structural imbalances set in motion by the response of economic agents to the sudden and unprecedented monumental inflows of oil revenue in the 1970s,1980s and 1990s, and the attendant hasty inappropriate economic policies initiated by the oil boom era.

It can be argued further, that the resultant oil shocks occasioned by the boom period of the 1970s and early 1980s linked the Nigerian economy to the negative impact of the over dependence on a resource export that is susceptible and vulnerable to sharp fluctuations both in price and in quantity. The revenue that accrued to the Nigerian economy aggravated fiscal imbalances; because the managers of the Nigerian economy were more eager to engage in unsustainable increases in spending including wages and salaries as experienced during the *Udoji* award, massive external borrowings and execution of growth-inhibiting projects.

In this regard, two effects of crude petroleum on the Nigerian economy have been identified in the literature: the movement and monetary effects. The oil movement effect has been explained based on the spending effect induced by the oil boom. As a result of the spending effect, the non-tradable goods sector is expected to expand while the non-booming commodities will experience a sharp contraction. This usually result in the movement of factors of production from the non-booming tradable goods to the production of non-tradable good. If all the factors of production except labour, are sector specific and if nominal wages are rigid downwards, the movement initiated by the expansion of the non-tradable goods sector and the contraction of the tradable goods sector will lead to a period of generalized rise in nominal wages in the economy.

Also, the monetary effect of crude oil and resource boom has been anchored on the argument that, oil booms are usually accompanied by balance of payment surpluses for the booming sector. If these surpluses are monetized by the economy, an increase in domestic money supply will result. However, if the demand for money fails to match the supply in the face of slowly clearing money markets, this will result in excess supply of money and hence an excess demand for both tradable and non-tradable goods. The excess demand for non-tradable goods arising from monetary disequilibrium will further reinforces the real appreciation of the domestic currency caused by the first phase of spending effects of the boom like those of the erstwhile *Udoji* award.

### 2.2 NATURE, DIRECTION AND POLICY IMPLICATIONS OF THE CAUSALITY BETWEEN CRUDE OIL AND GROWTH

Four different types of causal linkages and hypotheses have been established in the literature viz: conservation hypothesis, neutrality hypothesis, growth hypothesis, and the feedback hypothesis (Ozcan and Ozturk, 2019; Ozturk, 2010).

First, the conservation hypothesis posits that, there is a one-directional causal linkage flowing from economic growth (GDP) to crude oil energy consumption. The existence of this linkage connotes a weakly-crude-oil-dependent economy, implying that policies saving crude oil energy might cause little or no negative effect on economic growth;

Second, the neutrality hypothesis postulates that no causality exist between crude oil energy consumption and GDP. The proponents of this hypothesis affirmed that, crude oil consumption does not affect either economic growth or performance of GDP and vice versa. Akin to the conservation hypothesis, the causal relationship in this scenario suggests a more consolidated GDP and/or economic performance, in which case, energy conserving policies may be implemented without resounding negative impacts on the performance of GDP;

Third, the growth hypothesis confirms the existence of a one-way causality flowing from crude oil consumption to GDP and economic growth. The growth hypothesis holds the view that, crude oil consumption has either a direct or indirect impact on the performance of GDP and/or the growth of the economy because of its complementarity to the accumulation of labor and economy-wide capital. In the context of this hypothesis, crude oil conserving policies aimed at to reducing crude oil energy consumption may negatively affect the performance of economic growth by resulting to a decrease in national output and an increase in unemployment; and;

Fourth, the feedback hypothesis posits the existence of a two-way causal linkage between crude oil energy consumption and GDP, connoting that crude oil consumption and the performance of GDP are mutually inclusive and are complements.

The summary of these hypotheses in terms of their directions of causality, empirical connotations and policy implications are presented in table 1.

***Table 1.*** *Nature, Types and Direction of Causality in Crude Oil Energy- Economic Growth Nexus*

| S/N | Nature/ Type of Causality | Direction of Causality | Empirical Implications | Emerging Outcomes |
|---|---|---|---|---|
| 1) | Conservation Hypothesis: One-way causality exists | $GDP \Rightarrow CO$ Causality flows from GDP to Crude oil energy consumption | • changes in GDP will significantly affect the consumption of crude oil;<br>• consumption of crude oil will not affect the performance or growth of GDP. | • implementing crude oil energy conservation policies such as increasing crude oil energy consumption costs won't hamper economic growth. |
| 2) | Neutrality Hypothesis: | $GDP \neq CO$ consumption of crude oil and economic growth are mutually exclusive ( not linked) | • The implementation of crude oil energy consumption conservation policies won't adversely affect the performance of GDP neither will structural changes in GDP affect consumption of crude oil | • implementing crude oil energy conservation policies such as increasing or decreasing crude oil energy consumption costs will not affect economic growth; and the growth or retardation of GDP will not affect crude oil energy consumption. |
| 3) | Growth Hypothesis: Existence of One-way causality | $CO \Rightarrow GDP$ One-way causality flows from crude oil energy consumption to GDP | • The performance of GDP , sectors and economy are crude oil energy dependent. Therefore, the implementation of crude oil energy consumption conservation policies will | • implementing crude oil energy conservation policies such as increasing crude oil energy consumption costs will hamper the performance of GDP and economic growth;<br>• Policy makers and managers of the economy need to implement different policies to forestall the wasting of crude oil |

| | | | | |
|---|---|---|---|---|
| | | | severely and widely affect the performance of GDP and economic growth | energy (such as consistent investment in crude oil energy efficiency programs and energy saving techniques), improve industrial technologies or allocation of subsidies on clean energy generation and distribution alternatives |
| 4) | Feedback Hypothesis: Two-way causality exists | $CO \Leftrightarrow GDP$ Bidirectional/ Feedback Causality exists between Crude oil energy Consumption and GDP | • Any the reduction of crude oil energy consumption will still adversely affect the performance of GDP and economic growth but it is usually with complementarit y effect and the same policies as recommended and implemented for the case of growth hypothesis should be applied to avoid resounding negative impact on GDP and economic growth. | • implementing crude oil energy conservation policies such as increasing crude oil energy consumption costs do not hamper economic growth when GDP to Crude oil causality;<br>• implementing crude oil energy conservation policies such as increasing crude oil energy consumption costs will hamper the performance of GDP and economic growth when Crude oil to GDP causality exists;<br>• Policy makers and managers of the economy need to implement different policies to forestall the wasting of crude oil energy (such as consistent investment in crude oil energy efficiency programs and energy conserving techniques), improve industrial technologies or allocation of subsidies on clean energy generation and distribution alternatives when Crude oil to GDP causality is in force. |

*Source: (Author's Compilation, 2020).*

## 2.3 REVIEW OF RELATED LITERATURE

The impact of crude oil on the economic growth of Nigeria in particular and the global economy in general is well known, widely documented and has been exceptionally underscored in the literature (Iwayemi, 1983, 1993, 1998; and ADB, 1996). The major contributions of crude oil energy consumption to the growth process of the Nigerian economy are diverse and multi-faceted and have been well-accentuated by Asiodu (1979). The domestic consumption of crude oil is believed to have positive impact on economic growth ( Falegan and Okah,1976; Kraft and Kraft, 1978; Cheung and Lai, 1993; Chang,Fang and Wen, 2001; Soytas and Sari, 2003; Guttormsen, 2004 amongst others ).

Furthermore, the relationship between crude oil export and economic growth has raised more questions than answers in the literature. The role of export in economic growth has been a subject of interesting debate since the origin of the classical and neoclassical economists. The major proponents of these schools of thought include Adam Smith, John Stuart Mills and David Ricardo who argued that any nation that engages in international trade stands to gain through specialization and argues that production for exports (include crude oil exports) and international trade generally, facilitates more diffusion of knowledge and enhances the efficiency of inputs' usage (see also Blumenthal, 1972; Cipher and Dietz, 1997; and Belloumi, 2009 ).

Within the context of Keynesian macroeconomics, it is believed that exports foster economic growth through increased demand (see Palley, 2002 and 1999). However, the empirical results on this issue are mixed. For instance, Fajana (1979) concluded that there is an export-led growth in Nigerian; but Blumenthal (1972) did not confirm the export –led growth. For more details on this subject see Viovodas (1974), Maizels (1963), Abou-Stait (2005) amongst others. Surprisingly, none of these studies concentrated on the impact of crude oil export on economic growth for the Nigerian economy.

However, the conclusions reached by these studies are different. Kraft and kraft (1978) concluded that while the growth of the economy can cause the consumption of crude oil to increase; the consumption of crude oil does not cause the growth of the economy. This implies a unidirectional causal relationship that flows from economic growth to crude oil consumption (see Fatai *et al*., Ghali and El-Sakka 2004; 2004; Oh and Lee , 2004 ; Soytas and Sari , 2003; Chang *et al*., 2001; Yang , 2000 ; Erol and Yu, 1987; and Yu and Choi , 1985; Yu and Hwang , 1984; Glausure and Lee, 1977).

This portrays an unclear relationship between economic growth and crude oil consumption.

***Table 2.*** *Summary of Studies on the Crude Oil-Economic Growth Nexus*

| S/N | Study | Country | Estimation Technique | Direction of Causality |
|---|---|---|---|---|
| 1 | Yang (2000) | Taiwan | Engle-Granger ECM | GDP to Crude Oil (one-directional causality) |
| 2 | Aqeel and Butt (2001) | Pakistan | Engle-Granger VECM | GDP to Crude Oil (one-directional causality) |
| 3 | Wolde-Rufael (2004) | Shanghai | Toda-Yamamoto | GDP ≠ Crude oil consumption (Neutrality Hypothesis upheld) |
| 4 | Lee and Chang (2005) | Taiwan | Johansen-Juselius cointegration | Crude oil consumption to GDP (one-directional causality) |
| 5 | Zou and Chau (2006) | China | Johansen-Juselius cointegration | Crude oil consumption to GDP (one-directional causality) |
| 6 | Yoo (2006) | Korea | Johansen-Juselius cointegration | Crude oil consumption to GDP (one-directional causality) |
| 7 | Yuan *et al* (2007) | China | Johansen-Juselius cointegration | GDP to Crude Oil (Two-way directional causality) |
| 8 | Zamani (2007) | Iran | Engle-Granger VECM | GDP to Crude Oil (one-directional causality) |
| 9 | Fatai, Oxley and Scrimgeour (2004) | New Zealand | Bivariate Causality test | GDP ≠ Crude oil consumption (Neutrality Hypothesis upheld) |
| 10 | Al-Muliali (2011) | MENA Countries | Panel cointegration | Long-run relationship between crude oil consumption and economic growth; Bidirectional causality between crude oil energy consumption and economic growth (both Short and Long-run) |

*Source: (Author's Compilation, 2020).*

## 2.4 THEORETICAL FRAMEWORK

The theoretical foundation of this study derives its fundamental intuitions from the Solow (1956) growth model. Within the framework of the Solow growth model when augmented with crude oil variables; the growth of the economy is hypothesized to be a function of crude oil consumption. This is predicated on the fact that as the economy grows, saving per worker and output per worker even income per worker increases and the demand for and consumption of crude oil also increases (due to the expansion of economic activities), Ishioro (2015). Second, as the population grows; the consumption of crude oil also expands-but this

expansion in the consumption of crude oil may not be due to the expansion in economic activities. Hence, unidirectional relationship may be expected from economic growth to crude oil consumption.

The Solow (1956) model assumes a Cobb-Douglas production function with constant returns to scale.

$$Y_t = K_t^{\gamma}, E_t^{\alpha}, Ex_t^{\beta}, L_t^{\delta} \quad (1a)$$

$$Y_t = f(K_t^{\gamma}, E_t^{\alpha}, Ex_t^{\beta}, L_t^{\delta}) \quad (1b)$$

Where $Y_t$ is current real output in Nigeria), $K_t$ is the stock of physical capital at current time t, $L_t$ is the stock of labour in Nigeria at current time t, $E_t$ is the vector for Energy consumption at the current period t; and $Ex_t$ represents exports in equation (1a) and (1b).

Linearising equation (1a), we obtain:

$$Y_t = \gamma K_t + \alpha E_t + \beta Ex_t + \delta L_t \quad (2)$$

Transforming equation (2) into an econometric model gives us:

$$Y_t = \Theta_0 + \gamma_1 K_t + \alpha_2 E_t + \beta_3 Ex_t + \delta_4 L_t + \varepsilon_t \quad (3)$$

In order to determine the impact of crude oil on economic growth, this study veered from the orthodox Solow model presented in equation (1),(2) and (3) ; and augmented after the framework of Mankiw *et al* (1992), and based on the assumption, that Nigerian economic growth is determined by the production function in equation (1) . We express series-definite equations as:

$$Y_t = CPL_t^{\gamma} COE_t^{\beta} DmC_t^{\alpha} LAB_t^{\delta} \quad (4)$$

Where $CPL$ represents physical capital accumulation
$COE$ represents Crude oil export
$DmC$ represents Domestic Consumption of crude oil
$LAB$ represents Labor.

Equation (2) implies that economic growth or the growth of national output depends on the contributions of physical capital, crude oil export, domestic consumption of crude oil and labor.

## 3. MATERIAL AND METHODS

### 3.1 NOMENCLATURE, DESCRIPTION AND SOURCES OF DATA

The data on the Crude Oil variables domestic consumption of crude oil (DmC) and crude oil exports (COE) were extracted from the World Bank, World Development Indicators (WDI) for various Years. The data on economic growth represented as real gross domestic product (RGDP), capital formation (CPL) and

labour (LAB) were also sourced from the World Bank, World Development Indicators (WDI) for various years (see Table 3).

***Table 3.*** *Theoretical Characteristics and Nomenclature of Our Series*

| No | Symbol | Nomenclature | Source |
|---|---|---|---|
| 1 | **RGDP** | Economic Growth represented by real Gross Domestic Product(GDP) | WDI (2018) |
| 2 | **CPL** | Capital Accumulation represented by Gross fixed capital formation defined as the expenditure on fixed assets for replacement or adding to stock. | WDI (2018) |
| 3 | **LAB** | Labour represented the proportion of the population that is 16 years and above | WDI (2018) |
| 4 | **COE** | Crude oil export represented by oil export | WDI (2018) |
| 5 | **DmC** | Domestic consumption of Crude oil | WDI (2018) |

*Source: (WDI 2019)*

### 3.2 ESTIMATION TECHNIQUES

For the estimation of the relationship among the variables used in this analysis (viz RGDP, CPL, DmC, LAB and COE) this study employed multivariate estimation techniques (the descriptive statistics, correlation matrix, unit root test, Johansen cointegration and the Granger causality tests).The estimation techniques adopted in this are explained and summarized below:

**The Correlation Matrix**: The correlation matrix serves two important purposes in the present study. First, it shows both degree and nature of correlation between two variables, that is, whether there is weak or strong and positive or negative correlation between the variables. Second, it also shows that possibility of the existence of multicollinearity or otherwise. The rule of thumb in this regard states that a correlation coefficient of 0.90 (-0.90) or more is likely to cause multicollinearity between the variables. To solve this problem, the Granger causality test is employed.

**The Descriptive Statistics**: Obtaining the descriptive statistics of the variables gives very important information about the mean, median, standard deviation, degree of skewness and Kurtosis, and the *Jacque Bera* test. From these components of the descriptive statistics, the nature, behavior in terms of the trend and performance of the observations can be understood.

**Granger Causality Test**: The Granger causality test as proposed by Granger (1969,1988) is useful in testing the direction and flow of causality between two variables, say X and Y in time series econometrics. Granger causality helps to eliminate any possibility of occurrence or presence of serial correlation because it adds lagged values of the dependent variable on the right hand side of the regression model. In line with Awe (2012), we identified certain conditions that must be satisfied for a successful implementation of the Granger causality test. These include: the variables must either be integrated of the same order (stationary) or non-stationary but cointegrated; hypotheses (null and alternative) must be stated

and tested; accurate determination and selection of the optimal lagged terms, and the error terms involved in the pair-wise causality test must be uncorrelated. Also, Awe (2012) presented 6 steps that can be adopted in the implementation of the Granger causality test. Therefore, we present a modified step-by-step implementation of the Granger causality test.

**Step One**: **Determine the order of integration of the Series involved in the Granger Causality Regression Model**.

A pre-condition for the implementation of the Granger causality regression depends on a well-defined knowledge of the unit root test (Ishioro, 2018 and 2019). Granger (1969) posited that the definition of causality is only applicable to stationary series. Therefore, to test the stationarity and unit root of our series, we have applied the ADF unit root test (Dickey and Fuller,1979). Three cases of the Augmented Dickey Fuller (ADF) test can be specified as follows:

Case 1: has no time trend or intercept;

$$\Delta Y_t = \gamma Y_{t-1} + \alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + ... + \alpha_p \Delta Y_{t-p} + \alpha_t \quad (5a)$$

Case 2: has an intercept term but has no time trend;

$$\Delta Y_t = \alpha_0 + \gamma Y_{t-1} + \alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + ... + \alpha_p \Delta Y_{t-p} + \alpha_t \quad (5b)$$

Case 3 : has an intercept term and a time trend

$$\Delta Y_t = \alpha_0 + \gamma Y_{t-1} + Z_t + \alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + ... + \alpha_p \Delta Y_{t-p} + \alpha_t \quad (5c)$$

In cases one, two and three; the subscript (p) represents the number of optimal lag lengths. *P* is determined by either Schwartz Bayesian Criteria (SBC) or Akaike Information Criteria (AIC). where $v_t$ is a white noise *(i.i.d)* error process $v_t \sim N(0, \sigma^2)$ and *t* serves as a representative variable for time ( time operator). $\delta$ is introduced into the above model because it helps to test the hypothesis relating to stationarity or otherwise.

Null hypothesis: $H_0$: $\delta = 0$ : There is a unit root.

Alternative hypothesis: $H_A : \delta \neq 0$ : There is no unit root. If $\delta = 0$, it implies non-stationarity but if $\delta \neq 0$, then the series is stationary ( has no unit root).

**Step Two: Test the Long-run Cointegrating Relation Among the Variables**

The next step is to test for the existence or otherwise of a cointegrating relationship among our variables of interest. The Johansen and Juselius cointegrating technique was adopted. This cointegration test is designed to investigate the existence or otherwise of long run equilibrium relationships (that links the series). If a cointegrating relationship is established; it implies that series

tend to move together towards a common equilibrium position over a certain period of time. The multi-variate cointegrating regression model is specified as:

$$Y_t = \varpi + \beta X_t + \theta Z_t + \varepsilon_t \quad (6)$$

The Johansen cointegration test proposed by Johansen (1991) and, by both Johansen and Juselius (1990) and applied by Ghosh (2002);Yoo (2005,2006); Zou and Chau (2006) ;Yuan *et al*., (2007, 2008); Jobert and Karanfil (2007) to determine the number of equilibrium relationships among crude oil export, domestic consumption of crude petroleum oil, labour, capital accumulation and economic growth has two different components of the maximum likelihood ratios (LR) :the trace statistics and the maximum Eigen value test. The presence of cointegration implies the existence of causality among the variables. However, the test does not determine in definite terms the direction and flow of causality.

**Step Three: Specify the Null hypothesis of the Granger causality Test.**

Generally, the null hypothesis is stated as $H_0 : \phi_i = 0 \forall i = 1, 2, 3, ..., n$ : The null hypothesis posits that lagged terms of the regressors do not belong to the regression model. This connotes that the lagged values of both *RGDP* and X represented as *DmC*, *COE*, *CPL* , and *LAB* do not belong to the regression.

**Step Four: Determine the Appropriate / Optimal Lag Lengths of Granger Regression Series.**

Granger(1969) defined the appropriate causality lag length *k* to be the assumed minimal value of *n* given that, knowing the values of $RGDP_{t-j}$ with $j = 0, 1, ..., k-1$ will definitely not significantly enhance the predictability of either $CPL_t$ , $COE_t$ , $DmC_t$ or $LAB_t$ in the Granger regression model.

**Step Five: Evaluate the Correlation between the Stochastic Terms and Specify the Bivariate or Bilateral Granger Causality Regression Models.**

The first sub-step in step 4 is to ensure that the stochastic terms are not correlated.

It is assumed that the disturbance terms $e_{1t,...,}e_{12t}$ are $e_{it} \sim N(0, \sigma^2)$ and K represents maximum number of lag lengths.

**Step Six: Perform the Regression of the Granger Test.**

Regress the current value of economic growth ( $RGDP_t$ ) on the past values of RGDP ( $RGDP_{t-i}$ ) and domestic consumption of crude oil ( $DmC_t$ ).In the first regression, do not include the lagged values of DmC (i.e. $DmC_{t-i}$ ).This is done with a view to obtaining the residual sum of squares (RSS).The next sub-step in step 6 is to perform the above regression again but with the lagged values of the domestic consumption of crude oil ( $DmC_{t-i}$ ) included in the regression. This

second sub-step of the regression is to enable us obtain the unrestricted residual sum of squares (URSS).Step 6 can be repeated for the series $RGDP_t$ and $COE_t$ respectively.

**Step Seven: Test the Null Hypothesis.**

The hypothesis stated in step 2 above is tested. The F-test statistic is applied in testing the null hypothesis.

**Evaluation of Hypothesis criteria***:* If the value of the F-statistic of the Granger regression > the critical value of F at a specified and preferred significance level [1 percent(0.01), 5 percent(0.05) and 10 percent(0.10)] then , the null hypothesis is rejected; implying that the lagged values of the regressand belong to the regression. Otherwise, if the P-value are significant at either 1,5 or 10 percent level of significance; we reject the null(we fail to or do not reject the alternative hypothesis).

The main idea of Granger causality is that if regressand (RGDP, DmC, COE, CPL and LAB) causes the regressors, then changes in the regressand should precede changes in the regressors. This is a major characteristic of the Granger causality test that makes it very useful in the test of endogeneity and causation.

## 4. EMPIRICAL RESULTS

### 4.1 RESULTS OF DESCRIPTIVE STATISTICS

***Table 4.*** *Results of Descriptive Statistics*

| | $DmC_t$ | *COE* | *CPL* | *LAB* | *RGDP* |
|---|---|---|---|---|---|
| **Mean** | 79671.17 | 595781.7 | 43109.17 | 33.5261 | 471793.9 |
| **Median** | 87495.00 | 610600.0 | 38045.50 | 31.84000 | 411818.5 |
| **Maximum** | 164250.0 | 846179.7 | 134164.0 | 51.20000 | 848219.0 |
| **Minimum** | 12234.00 | 383455.0 | 17126.00 | 20.39000 | 250604.0 |
| **Std. Dev.** | 44338.74 | 124629.0 | 24506.00 | 9.53121 | 148344.5 |
| **Skewness** | 0.194618 | -0.03488 | 1.879920 | 0.379914 | 0.817735 |
| **Kurtosis** | 2.175967 | 2.152062 | 7.190389 | 1.927112 | 2.956184 |
| **Jarque Bera** | 1.245826 | 1.085798 | 47.54365 | 2.59264 | 4.01502 |
| **Probability** | 0.536380 | 0.581061 | 0.0000 | 0.27353 | 0.13432 |

*Source: (Author's Compilation, 2020)*.

The results of the descriptive statistics presented in Table 4 show that the mean of domestic consumption of crude oil for the period under consideration stands at 79671.17 while crude oil export is 5695781.7; capital accumulation stand at 43109.17; labour is 33.52 and economic growth is 471793.9. The maximum value attained by domestic consumption of crude oil during the period is 164250.0 while that of crude oil export is 846179.7, capital accumulation is 134164, labour reached 51.20 and economic growth is 848219.0 respectively.

The magnitude of the standard deviation implies that the observations are scattered away from the mean. The implication of this is that the means of the variables are not reliable for policy purposes.

The skewness statistic indicated that all the variables except COE are positively skewed.. The characteristics of the Kurtosis of our series show that domestic consumption of crude oil, crude oil export, labour accumulation and economic growth had values of 0.19, 2.15, 1.93 and 2.95 respectively. This means that their curves can be described as *platykurtic* ( that is having a curve that is less peaked than normal curve). However, the value of the kurtosis of capital accumulation is 7.190 which indicates that it has a *leptokurtic curve* (a curve that is more peaked than the normal curve).

The capital accumulation variable did not satisfy the normality test having obtained a *Jarque Bera* statistic of 47.54 far exceeding the rule of thumb value of 5.00. This means that the capital accumulation variable to susceptible to generating large residuals and as such might become an outlier.

Therefore, considering the high tendency of the capital accumulation variable to be collinear with RGPC; and its failure to satisfy the normality assumption test, the application of Ordinary Least Squares (OLS) discouraged while the Granger causality test is justified and hence adopted.

## 4.2 EMPIRICAL RESULTS OF CORRELATION MATRIX

***Table 5.*** *Results of Correlation Matrix of Selected variables*

| Variable | COE | CPL | DmC | LAB | RGDP | Possibility of Multicollinearity |
|---|---|---|---|---|---|---|
| **COE** | 1.000 | 0.439 | -0.078 | 0.167 | 0.332 | No possibility of multicollinearity of COE with any of the series. |
| **CPL** | 0.439 | 1.000 | 0.265 | 0.449 | 0.619 | No possibility of multicollinearity of CPL with any of the series. |
| **DmC** | -0.078 | 0.265 | 1.000 | 0.847 | 0.790 | Weak possibility of multicollinearity between DmC and each of LAB and RGDP |
| **LAB** | 0.167 | 0.449 | 0.847 | 1.000 | 0.965 | High possibility of multicollinearity between LAB and RGDP suspected |
| **RGDP** | 0.332 | 0.619 | 0.790 | 0.965 | 1.000 | High possibility of multicollinearity between RGDP and LAB suspected |

*Source: (Author's Compilation, 2020).*

The results of the correlation matrix presented in table 5 are useful for two purposes in this analysis. First, it shows the nature of the correlation between the variables. As indicated above, labour (LAB) has the strongest correlation with

economic growth (RGDP) 0.965.The positive sign indicates the direct relationship between labour and economic growth. This sign agrees with our expectation and also implies that the impact of labour on economic growth is very high in the Nigerian economy.

Also, the domestic consumption of crude has a stronger correlation with economic growth having a value of 0.796. It has a positive sign as we expected indicating a direct relationship with economic growth. The capital variable (CPL) has a strong correlation of 0.619 with economic growth. It has the expected positive sign indicating a direct correlation between RGDP and CPL. This also confirms the growth theory explanation of the role of capital accumulation in the growth and performance of the economy.

However, of the four independent variables, COE has the weakest correlation with RGDP, 0.33267. As we expected, the correlation between COE and RGDP is positive signifying a direct correlation between them.

Second, the correlation matrix is used to check multicollinearity as suggested in the econometric literature. This implies that the correlation matrix can also be used to ascertain the degree of interaction among the variables; as correlation among the variables is indicative of multicollinearity. It should be noted that multicollinearity can distort the standard error of estimate and may, therefore, lead to incorrect conclusions as to which variables are statistically significant.

Furthermore, the correlation matrix indicates that there is a negative but very weak correlation between domestic consumption of crude and crude oil export. It is in consonance with economic theory that the domestic consumption of a commodity is inversely related to its export. The weak correlation seems to be in agreement with the fact that what is consumed domestically has negligible impact on what is exported because for over a *quinquennium* and above, what is consumed domestically in the Nigerian economy has been imported.

### 4.3 RESULTS OF AUGMENTED DICKEY FULLER UNIT ROOT TEST

The results of the Augmented Dickey-Fuller unit root tests are presented for all the series (crude oil export, domestic consumption of crude petroleum oil, labour, capital accumulation and economic growth) used in this study.

***Table 6.*** *Results of the Augmented Dickey-Fuller Unit Root Tests*

| | LEVEL | | | FIRST DIFFERENCE | | | Order of Integration |
|---|---|---|---|---|---|---|---|
| **Name of Variable** | **Intercept** | **Trend and Intercept** | **None** | **Intercept** | **Trend and Intercept** | **None** | |
| **COE** | -0.705 | -1.364 | 1.352 | -4.337* | -4.507** | -4.382* | I(1) |
| **CPL** | -1.204 | -0.901 | 1.725 | -2.830*** | -3.319** | -3.698* | I(1) |
| **DmC** | -1.814 | -2.070 | -0.431 | -5.989* | -5.216* | -5.012* | I(1) |
| **LAB** | -3.056 | 1.012 | -1.814 | -1.294 | -4.401** | 2.017 | I(1) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **RGDP** | 0.263 | 2.044 | -2.571 | -3.708* | -4.612* | -3.495** | I(1) |

*Source: (Author's Compilation, 2020).*

The results of the ADF unit root test shown in table 6 indicated that all the series are not stationary at levels but became stationary after first differencing. This implies that at levels, we do not fail to reject the null hypothesis of the presence of unit root. At the first difference, the series were stationary or integrated of order one (I (1)) using both intercept (except for LAB), intercept with trend and, without intercept and trend (except for LAB); therefore, we rejected the null hypothesis of the presence of unit root or non-stationarity. Thus, the series satisfied one of the conditions for the implementation of the Granger causality test (Harris and Sollis, 2003).

## 4.4 RESULTS OF JOHANSEN COINTEGRATION TESTS

***Table 7.*** *Results of Johansen Co-Integration* Test

| | | **Trace Statistics** | | | **Maximum Eigen Statistic** | | |
|---|---|---|---|---|---|---|---|
| **Hypothesized No of CE(s)** | **Eigen Value** | **Trace Statistic** | **0.05 Critical Value** | **Prob.** | **Maximal Eigen Statistic** | **0.05 Critical Value** | **Prob** |
| None* | 0.897 | 202.291 | 139.530 | 0.000 | 128.221 | 62.363 | 0.000 |
| At Most* 1 | 0.783 | 159.270 | 115.615 | 0.000 | 68.628 | 46.231 | 0.002 |
| At Most* 2 | 0.672 | 127.652 | 85.754 | 0.000 | 52.087 | 40.078 | 0.029 |
| At Most* 3 | 0.566 | 88.515 | 69.819 | 0.009 | 30.904 | 23.877 | 0.028 |
| At Most 4 | 0.349 | 32.581 | 47.856 | 0.143 | 12.260 | 17.584 | 0.207 |
| At Most 5 | 0.237 | 24.331 | 29.797 | 0.401 | 10.221 | 11.124 | 0.255 |

*Source: (Author's Compilation, 2020).*

The results of the Johansen cointegration test presented in table 5 show that there are four (4) cointegrating equations; which implies that there is evidence and confirmation of cointegration among the variables. The existence of cointegration is the establishment of long-run relationship either between or among the variables. The econometric or empirical connotation of the results is that, in the long-run, the variables tend towards a common equilibrium implying that any policy the adversely affects the performance of any of these variables have long-run implications for some or all of the other variables. Furthermore, the existence of a long-run relationship among the variables is an affirmation of the existence of at least a one-way causal linkage. This is another confirmation of the satisfaction of one of the conditions for the implementation of the Granger causality test (Harris and Sollis, 2003).

### 4.5 EMPIRICAL RESULTS OF THE GRANGER

The results of the Granger causality test of the bivariate regression of the relationship between economic growth and the domestic consumption of crude oil indicated that there exist no causal linkages between them. It means that no growth-inducing benefit is realised from the consumption of crude oil in Nigeria. This suggests that, the consumption of crude oil in Nigeria is for other non-productive and non-growth-enhancing purposes (such as hoarding for the *shadow market,* unproductive household consumption, etc) and not for industrial/productive capacity utilisation.

***Table 8.*** *Results of the Granger Causality Tests*

| Null Hypothesis | F-Statistic | Direction of Causality | Decision |
|---|---|---|---|
| **Economic Growth Versus Crude Oil Variables** | | | |
| RGDP does not Granger cause $DmC$<br>$DmC$ does not Granger cause RGDP | 0.317<br>0.046 | $RGDP \neq DmC$<br>$DmC \neq RGDP$ | No Causality<br>No Causality |
| RGDP does not Granger cause COE<br>COE does not Granger cause RGDP | 0.686<br>2.547 | $RGDP \neq COE$<br>$COE \Rightarrow RGDP$ | No Causality<br>Unidirectional causality |
| **Crude Oil Export Versus Domestic Consumption of Crude Oil** | | | |
| $DmC$ does not Granger cause COE<br>COE does not Granger cause $DmC$ | 1.054<br>0.125 | $DmC \neq COE$<br>$COE \neq DmC$ | No Causality<br>No Causality |
| **Crude Oil Export Versus Growth Variables** | | | |
| LAB does not Granger cause COE<br>COE does not Granger cause LAB | 0.358<br>3.613** | $LAB \neq COE$<br>$COE \Rightarrow LAB$ | No Causality<br>Unidirectional causality |
| CPL does not Granger cause COE<br>COE does not Granger cause CPL | 2.295<br>1,018 | $CPL \neq COE$<br>$COE \neq CPL$ | No Causality<br>No Causality |
| **Domestic Consumption of Crude Oil Versus Growth Variables** | | | |
| $DmC$ does not Granger cause CPL<br>CPL does not Granger cause $DmC$ | 2.920***<br>3.451** | $DmC \Rightarrow CPL$<br>$CPL \Rightarrow DmC$ | Bidirectional causality<br>Bidirectional causality |
| LAB does not Granger cause $DmC$<br>$DmC$ does not Granger cause LAB | 1.870<br>0.186 | $LAB \neq DmC$<br>$DmC \neq LAB$ | No Causality<br>No Causality |

*Source: (Author's Compilation, 2020).*

**NOTE**:* *means significance at 1% probability level; ** means significance at 5% probability level *** means significance at 10% probability level*

Furthermore, the results seem to suggest that, crude oil and its allied products meant to be consumed in Nigeria are principally imported. Therefore, the results can be seen as typically portraying the persistent and age-long unscathed petroleum products importation syndrome. Hence, we do not reject the null

hypothesis that domestic consumption of crude oil and economic growth do not belong to the regression model of the Granger causality test.

The results of the causal linkage between crude oil export and economic growth show the existence of unidirectional causality from crude oil export to economic growth implying that crude oil exports are economically significant. In Nigeria, crude oil export has exhibited and exerted both positive and negative impacts on economic growth and development. Also; the effects of crude oil export on the Nigerian economy are displayed through the direct and indirect channels as identified by Falegan and Okah(1976). Our results for crude oil export versus economic growth; crude oil export versus labour re-affirmed similarity to the conservation hypothesis established by Kraft and Kraft (1978), Stern (1993); Lotfalipour, Falahi and Ashena (2010); Lai,To,Lo,Choy and Lam (2011); Jinke, Hauling and Diaming (2008); Sabori and Sulaiman (2013); Murray and Nan (1996); Chontanawat, Hunt and Pierse (2008); Mahadevan and Asafu-Adjaye (2007); Constantini and Martini (2010), Ishioro (2015, 2018, 2019) amongst others.

The Pair-wise Granger Causality results shown above indicated that COE "Granger causes" LAB at the conventional 5 percent level of significance without feedback causal linkage from LAB to COE. This confirms the theoretical expectation that as the demand for oil exports increases and the volume of crude oil export expands, more labour will be employed to meet up with the increase in the demand for oil export. However, drawing inference from the results of the correlation matrix above on the relationship between COE and LAB, it shows a very weak correlation. This means that in the Nigerian context, the proportion of labour employed in the crude oil sector is very small due to the following arguments. First, the oil sector is highly capital intensive with only a handful of specialised labour required for its operations. Second, the oil sector employs only specialized labour such as gas engineers, pipeline engineers, corrosion engineers etc which are not currently trained in the Nigerian university system. The weakness of the Nigerian educational system arising from consistently inadequate funding has deprived it from training these specialized labour and manpower needed in the oil sector. This has resulted into very few employable Nigerian-trained graduates being absorbed in the sector. Third, the results suggest that more expatriates are employed in the Nigerian oil sector than home-grown professionals. This is a pointer to the violation of the local content Act by the operators of the oil sector especially the multinational corporations.

There is bidirectional causal linkage between DmC and CPL. This connotes that the two series Granger cause each other. Theoretically speaking, the results imply that as the domestic consumption of crude oil increases, more capital is accumulated and/or formed and; as more capital is accumulated for productive purposes, more crude oil is consumed in the economy. Therefore, we reject the null hypothesis that domestic consumption of crude oil and capital formation do not *Granger cause* each other.

## 5. CONCLUSION

The main objective of this study is to assess the impact of crude oil (represented by crude oil export and the domestic consumption of crude oil) on the economic growth, labour and capital accumulation in Nigeria. Also, this study presented a step-by-step implementation of the Granger causality test. In terms of the empirical implementation of the Granger causality test, it was re-affirmed that four conditions (test for the order of integration, statement and testing of the Granger hypothesis, accurate selection of the optimal lag lengths and the assessment of the nature of correlation between the stochastic terms of the regression) must be satisfied. The paper concludes that labour has not been fully utilised in the oil sector in Nigeria. Furthermore, it was established that the domestic consumption of crude oil has no significant impact on economic growth in Nigeria. However, crude oil export has very significant impact on economic growth in Nigeria. Also, the study further established that crude oil export has a very significant impact on labour but the domestic consumption of crude oil has no impact on the employment of labour in Nigeria within the period under consideration.

The study recommends that the domestic consumption of crude oil should be encouraged essentially for industrial purposes (the production of intermediate goods and services) and not for household consumption. In this way, it will facilitate growth-inducing productive activities in the Nigerian economy. Emanating from crude oil and labour relationship, the study recommends that the proceeds from oil export should be used to establish a world-class university of oil and natural resources; where the requisite specialised labour and human capital are trained and developed. This will eventually stop the importation and infiltration of expatriates into the Nigerian oil sector. Also, funds accumulated from oil export should be used for purposeful and sustainable development of the Nigerian industrial and, science and technology sectors. These will fast-track the development of home-grown technology, and provide substitutes for imported spare parts that are often needed in the oil sector. Finally, a directorate of national capacity utilisation and, capital accumulation fund should be established to facilitate optimal utilisation of the windfalls from oil export for the purpose of accelerating the growth of the industrial sector in particular and economic growth in general.

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