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# Modeling the Construction Sector and Oil Prices toward the Growth of the Nigerian Economy: An Econometric Approach

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**Abstract:** This study empirically examined the interrelationship between the construction sector, oil prices, and the actual gross domestic product (GDP) in Nigeria. Using annual economic data from the National Bureau of Statistics (NBS), the OPEC Annual Statistical Bulletin, and econometric statistics, we found that although very strong positive and significant correlations exist between the construction sector output and total GDP output (0.934), the construction sector output and oil prices (0.856), and the total GDP output and oil prices (0.822), these linear relationships only exist for a short time. However, these relationships do not result in any direct causal influence on each other, except for the uni-directional Granger causal relationship that flows from the total GDP output to the construction sector output, which implies that economic activities of other major non-oil sectors stimulate the construction activities in Nigeria. Thus, we argue that neither the construction sector nor the oil prices directly influence the aggregate economy; rather, the other sectors' activities stimulate the construction sector in Nigeria. Two policy recommendations for achieving the Federal Government's medium term Economic Recovery and Growth Plan (ERGP) are suggested: (1) the Nigerian government should de-emphasize overreliance on the oil sector through policy readjustment and (2) an urgent need for economic diversification in Nigeria exists, since we revealed that an increase in the aggregate GDP output is due to the activities of other non-oil sectors.

**Keywords:** construction sector; economic growth; GDP; Nigerian economy; oil prices

**JEL Classification:** L74; O11; O41; O47

## 1. Introduction

Although Nigeria recently lost its number one position as the largest economy in Africa to South Africa, restructuring of the Nigeria National Account through rebasing has helped to improve Nigerian economic prospects. According to Euromoney Institutional Investor Company (EMIS), Nigeria generated one-fifth of the African gross domestic product (GDP) in 2015, as its contribution to the Sub-Saharan African GDP increased from 18% in 2009 to around 32% in 2013. The National Bureau of Statistics (NBS) report (NBS 2015a) showed that the Nigerian economy changed considerably in terms of the volume of activity in all economic sectors as the post-rebasing data in the construction sector was more optimistic, modern construction activities were captured, and prices were correctly deflated. Since the rebasing of the GDP, PricewaterhouseCoopers Limited (2017) showed that the Nigerian economic structure has become more diversified, with oil becoming less relevant, and accounting for 8.4% of the GDP, but only from an activity perspective.

Both the oil and construction sectors play significant roles in the development of any economy. According to [Khan et al. \(2013\)](#), the products of these two sectors are indispensable for industry, including industrial processes and outputs. Furthermore, demand for these commodities continues to grow due to their various uses and direct links to the industry and social well-being of a society. [PricewaterhouseCoopers Limited \(2017\)](#) reported that the oil sector remains the predominant source of fiscal and export revenue, highlighting a growing relationship between oil and non-oil sectors through the exchange rate channel.

Historically, the boom in the oil sector has impacted the economic growth in Nigeria; however, the current global oil market crisis and recent depression in the Nigerian economy has created serious problems for progressive economic growth. This has also presented a major risk for the construction industry, as budget revenues have been reduced and the government's ability to invest in infrastructure has been restricted ([EMIS 2015](#)). The latest 2017 GDP reports ([NBS 2017a, 2017b](#)) indicate some signs of recovery, as does the 2017–2020 medium-term Economic Recovery and Growth Plan (ERGP) of the Federal Republic of Nigeria ([Ministry of Budget and National Planning 2017](#)), which aims to maximize the capacity of various sectors with the greatest potential to restore economic growth and diversification by, for example, facilitating foreign exchange and increasing economic resilience to external shocks. Despite this, the nation's economic indices remain poor and NBS reports ([NBS 2017c, 2017d](#)) show that the Nigerian economy is seriously dwindling. Additionally, the accuracy and truthfulness of current economic reports have been questioned.

[Dlamini \(2012\)](#) posited that the construction industry has the potential to positively impact economic growth and is an important component of investment programs in developing economies, [Roodman and Lenssen \(1994\)](#) stated that 1/10 of the global economy was dedicated to constructing, operating, and equipping buildings, and this activity accounts for 40% of the material flow entering the world economy, destined for roads, bridges and vehicles to connect the buildings. [Du Plessis \(2001\)](#) noted that the construction industry is the world's largest industrial employer with 111 million employees, and in most countries, it accounts for more than half of capital investment and as much as 10 per cent of the Gross National Product (GNP). Thus, in the race toward economic and social development in Nigeria, the scenarios above suggest that the construction and oil sectors are closely tied. Unfortunately, the rebasing of the national account, the drop in global oil prices, the economic depression and instability, the Dollar-Naira issue, and foreign direct investment flow are all economic issues that have seriously altered the Nigerian economic equation.

The link between oil prices, GDP, and construction output can be explained with the classic supply-side effect which states that rising oil prices are indicative of the reduced availability of the basic input to production, leading to a reduction in potential output ([Abel and Bernanke 2001](#)). This link between oil prices, GDP, and the construction sector has been widely, separately, and globally studied in the literature ([Hamilton 1996; Tse and Ganesan 1997; Brown and Yücel 2002; Hamilton 2005; Lescaoux and Mignon 2008; Alper and Torul 2009; Bolaji and Bolaji 2010; Olatunji 2010; Syed 2010; Rasmussen and Roitman 2011; Bouzid 2012; Khan et al. 2013; Shaari et al. 2013; Difulio 2014; Idrisov et al. 2015](#)). Global oil prices are believed to be the most important external economic factor for the Nigerian economy, thus Nigeria has been dubbed an oil economy ([Igberaese 2013](#)).

However, the available literature lacks consensus on the nature and extent of the interrelationship between oil prices, Nigeria's economy, and the construction activities in Nigeria, and the correlation between GDP output, construction output, and oil prices. Studies ([Hamilton 1996; Lescaoux and Mignon 2008; Alper and Torul 2009; Bolaji and Bolaji 2010; Syed 2010; Rasmussen and Roitman 2011; Bouzid 2012; Shaari et al. 2013; Difulio 2014](#)) have shown that oil price shocks influence all sectors of the economy including construction. Specifically, [Shaari et al. \(2013\)](#) stated that oil price increases influence the construction sector by increasing the costs of raw materials. They further argued that suppliers inevitably increase raw material prices for contractors to cover higher transportation costs, increasing the cost of raw materials for contractors. Even in Nigeria, [Olatunji \(2010\)](#) found that the

high cost of construction was due to the high cost of finance and wild volatility that were stimulated by issues in oil price regimes.

According to [Idrisov et al. \(2015\)](#), understanding and identifying the basic mechanics of the impacts that oil prices have on economic development, including the interrelationship with the construction sector, are important for understanding the reasons for the current slowdown in GDP growth and for developing a plan to accelerate growth or minimize the slowdown. Based on this premise, the need to determine the nature and extent of interrelationship between oil prices, the construction sector, and the aggregate GDP in Nigeria has become apparent, which was the goal of this study. Therefore, this study aimed to determine the empirical relationships between the real aggregate GDP, the construction sector output, and the annual oil prices in Nigeria.

## 2. Literature Review

Several studies have focused on the relationship between the oil prices and GDP, and between construction sector and GDP, both globally and for Nigeria specifically ([Tse and Ganesan 1997](#); [Hamilton 2005](#); [Lescaroux and Mignon 2008](#); [Bolaji and Bolaji 2010](#); [Olatunji 2010](#); [Syed 2010](#); [Rasmussen and Roitman 2011](#); [Khan et al. 2013](#); [Shaari et al. 2013](#); [Difiglio 2014](#); [Idrisov et al. 2015](#)). However, few empirical studies link the real aggregate GDP, the construction sector output, and the annual oil prices for Nigeria. The few available studies were separately completed and lacked consensus ([Odularu 2008](#); [Bolaji and Bolaji 2010](#); [Olatunji 2010](#); [Akinlo 2012](#); [Igberaese 2013](#); [Ftiti et al. 2016](#); [Nwanna and Eyedayi 2016](#); [Gummi et al. 2017](#)). For example, [Isa et al. \(2013\)](#) found that the construction sector contribution to the GDP ranged between 3% and 6% since Nigeria gained independence until the 1980s, before decreasing to about 1% since then. The study observed an upward progression in the contribution of the construction industry to GDP, which was about 3% in 2012 due to an improved budgetary implementation and private sector participation.

Conversely, [Trade Invest Nigeria \(2012\)](#) argued that the key factors that contributed to the growth in the construction and property sector included: high demand for buildings across all sectors of the economy, the focus on infrastructural development by state and federal governments, the adoption of privatization and commercialization as instruments of federal government policy, and attempts at implementing regulations related to the oversight, process, and business dealings of the construction industry in the country. In addition, the Central Bank of Nigeria ([CBN 2013](#)) reported that building and construction output lag value, government capital expenditure, the nominal exchange rate, and the maximum lending rate also drive the construction sector output. Consequently, [Isa et al. \(2013\)](#) asserted that the all-inclusive effects of this sector, and especially its employment generating potential, make it a platform for sustainable development, especially if proper mechanisms are implemented to stimulate the growth of the sector.

[Saka and Lowe \(2010\)](#) used economic sectoral output data to investigate the relationships between the construction sector and other sectors in the Nigerian economy. To analyze the significance of construction linkages with other sectors of the economy, they applied econometric techniques such as the unit root test, co-integration test, and Granger causality test. Construction was found to significantly lead many sectors and almost all economic sectors feedback into the construction sector, highlighting the mutual interdependence of construction with other sectors of the economy. The study concluded that the Nigerian construction sector is important because of its significant forward and backward linkages and multipliers on sectors of the economy.

[Salami and Kelikume \(2011\)](#) examined the linkage between the manufacturing sector and other sectors of the Nigerian economy using a more dynamic estimating tool. The impact of changes in manufacturing output on the output of the other sectors and the effects of changes in output of other sectors on the manufacturing sector were determined using the Granger causality test and vector auto regression. Using quarterly time series data for 1986 to 2010, a weak link between the manufacturing sector and other sectors of the Nigerian economy was established. The manufacturing sector output showed no causal relationship with real economic activities or the financial sector output as measured

by the real GDP. However, only two major sectors, building and construction and hotel and restaurant, appear to be driving the manufacturing sector with the latter exhibiting a bi-directional relationship with the manufacturing sector (Salami and Kelikume 2011).

To examine the relationship between GDP and agriculture, industry, building and construction, wholesale and retail, and trade and services for the period of 1960 to 2008, Anyanwu et al. (2013) applied multiple regression analysis. Their results showed that the agriculture share of the GDP was the highest, followed by the services sector, then the wholesale and retail trade sector, then the industry sector, whereas building and construction made the smallest contribution to GDP. The study revealed that building and construction consistently made the least contribution to the GDP from 1960 to 2008. This result is supported by the Nigeria Industrial Revolution Plan (NIRP 2014) which recognized the disproportionate contribution of construction industry to the growth of Nigeria's total GDP when compared to the growth of the sector.

Yusuf (2016) revealed that the construction industry is significantly related to and plays significant roles in all the sectors of Nigeria economy, having a medium strength relationship with the Nigerian Annual % Growth Rate (NA%GR). This indicates that the construction industry adds to the gross value of the Nigerian economy.

Although Okoye et al. (2016a) found no significant difference between the growth rate of construction sector and GDP before and after the rebasing of Nigeria national accounts, econometric techniques were used to establish a strong positive and bi-directional causal relationship between the aggregate real GDP and the construction sector output of Nigeria, implying that the construction sector Granger causes the total GDP and vice versa. Both the construction sector and aggregate GDP influenced each other (Okoye 2016). In another study, Okoye et al. (2016b) found that during periods of economic fluctuation, the construction sector growth rate is more volatile than the GDP growth rate, meaning instability in the activities of construction sector also exist, which invariably affects the aggregate economic activities.

Olatunji (2010) found that construction costs are high due to the high cost of finance and intense volatility caused by issues in oil price regimes. The study further revealed that whereas the Nigerian construction industry shows positive growth and has significantly contributed to the aggregate GDP growth since 2000, the oil industry has persistently failed to contribute to positive GDP growth. Another empirical study conducted by Akinlo (2012) revealed that the oil industry can cause other non-oil sectors to grow. Specifically, bidirectional causality was found between oil and manufacturing, oil and building and construction, manufacturing and building and construction, manufacturing and trade and services, and agriculture and building and construction. Akomolafe and Jonathan (2014) revealed that industrial sectors including construction are not directly affected by oil prices, but are sensitive to oil price changes.

Nwanna and Eyedayi (2016) reported a positive and significant relationship between oil price and economic growth, stating that oil price volatility does not positively impact the economy, but the oil price does. This is in contrary to the study of Igberaese (2013) who concluded that short-term economic growth in Nigeria is a result of the volatility in oil prices. For Gummi et al. (2017), no long-term relationship exists between oil prices and economic growth in Nigeria, but rather a significant unidirectional causality was found between the oil prices and the short-term economic growth in Nigeria.

No single study has been able to aggregate the interrelationship between these variables, and they lack consensus. Secondly, the change in the overall economic order and the recent depression, in both the oil prices and the Nigerian GDP in the rebased economy, need to be investigated. These scenarios and the failure of the previous studies to capture the current trends in the construction sector and Nigeria economy and their interrelationships with oil prices created the motivation to complete this investigation.

Thus, we measured the construction sector output and the Nigerian real GDP in relation to the changes in oil prices to ascertain if the construction sector has any causal effect on the Nigerian economy and/or oil prices, to which extent, and vice versa. Secondly, the direction of the effect, if any,

was also determined, including whether the construction sector leads the Nigeria economy and/or oil prices, vice versa, or both, and to what extent.

### 3. Methodology

#### 3.1. Data and Data Description

To analyze the dynamic relationship between real economy (GDP), construction sector output, and real oil prices, the annual statistical rebased data from 1981 to 2016 for the construction sector output and total real GDP were extracted from the NBS publications in Million Naira, and the Annual Average Oil Prices were extracted from the OPEC Annual Statistical Bulletin 2017 and BP Statistical Review of World Energy June 2017. Contemporaneous correlation was examined, and evidence of Granger causality between these variables was determined. Table 1 presents the total real GDP, total construction sector output, and the real annual average oil prices at 2010 constant basic price year-on-year from 1981 to 2016. Annual observations of GDP and construction sector data were extracted from the following NBS publications: Nigerian Construction Sector Summary Report 2010–2012, Nigerian Gross Domestic Product Quarterly Report, Quarter Four 2016 (NBS 2017c), Nigerian Gross Domestic Product Quarterly Report, Quarter One 2017 (NBS 2017d), Revised and Final GDP Rebasings Results by Output Approach (NBS 2014), Nigerian Gross Domestic Product Quarterly Report, Quarter Four 2014 (NBS 2015b), Nigerian Gross Domestic Product Quarterly Report, Quarter Four 2015 (NBS 2016a), and Post GDP Rebasings Revision: 1981–2010 (NBS 2016b).

**Table 1.** Annual real gross domestic product (GDP) and construction sector output at 2010 constant basic price year-on-year and annual average oil prices.

Observation (Year)	Total GDP (₦/Million)	Total Construction Output (₦/Million)	Annual Average Oil Prices (US\$)
1981	15,258,004.34	851,561.61	36.18
1982	14,985,078.32	679,200.42	33.29
1983	13,849,725.17	598,782.27	29.54
1984	13,779,255.49	488,143.29	28.14
1985	14,953,913.05	336,270.79	27.75
1986	15,237,987.29	335,758.58	14.46
1987	15,263,929.11	367,003.84	18.39
1988	16,215,370.93	404,395.72	15.00
1989	17,294,675.94	421,214.38	18.30
1990	19,305,633.16	442,274.21	23.85
1991	19,199,060.32	459,966.20	20.11
1992	19,620,190.34	477,904.06	19.61
1993	19,927,993.25	501,799.00	17.41
1994	19,979,123.44	516,853.08	16.25
1995	20,353,202.25	530,808.44	17.26
1996	21,177,920.91	537,177.87	21.16
1997	21,789,097.84	571,557.91	19.33
1998	22,332,866.90	605,850.87	12.62
1999	22,449,409.72	628,872.48	18.00
2000	23,688,280.33	654,027.49	28.42
2001	25,267,542.02	732,511.60	24.23
2002	28,957,710.24	764,328.51	25.04
2003	31,709,447.39	831,207.14	28.66
2004	35,020,549.08	774,859.94	38.13
2005	37,474,949.16	868,587.00	55.69
2006	39,995,504.55	981,454.90	67.07
2007	42,922,407.93	1,109,313.11	74.48
2008	46,012,515.31	1,254,300.33	101.43
2009	49,856,099.08	1,404,496.02	63.35
2010	54,612,264.18	1,570,973.47	81.05
2011	57,511,041.77	1,905,574.90	113.65
2012	59,929,893.04	2,188,718.59	114.21
2013	63,218,721.73	2,272,376.69	111.95
2014	67,157,384.39	2,568,464.75	101.35
2015	69,023,929.95	2,680,216.00	54.41
2016	68,652,430.36	2,520,852.18	44.54

Source: Authors' extracts and compilation from various NBS Reports; (BPplc 2017; OPEC Organization of the Petroleum Exporting Countries).



### 3.2. Unit Root Test

In determining whether economic data are stationary or integrated using classical methods, Kwiatkowski et al. (1992) noted that performing tests of the null hypothesis using stationarity and the null hypothesis of a unit root were effective. For this study, a unit root test was used to check the stationarity of a data series. Ajide (2014) stated that the order of integration is a pre-requisite for almost all time series analyses. This step is important because if non-stationary variables are not identified and used in the model, spurious regression problems are created (Granger and Newbold 1974), whereby the results suggest that statistically significant relationships exist between the variables in the regression model even when evidence of contemporaneous correlation exist rather than meaningful causal relations (Granger and Newbold 1974; Harris 1995). However, the unit root test can equally be referred to as the augmented Dickey Fuller (ADF) test (Dickey and Fuller 1979) and can be represented in the following mathematical formulation:

$$\Delta Y_t = \alpha_0 + \alpha_1 T + \alpha_2 Y_{t-1} + \sum_{i=1}^n \gamma_i \Delta Y_{t-i} + \mu_t \quad (1)$$

where  $\Delta Y_t = Y_t - Y_{t-1}$ ,  $\alpha_0$  is a drift term,  $T$  is the time trend with the null hypothesis,  $H_0: \alpha_2 = 0$  and its alternative hypothesis  $H_1: \alpha_2 \neq 0$ ,  $n$  is the number of lags necessary to obtain white noise, and  $\mu_t$  is the error term. However, the implied  $t$  statistic is not the student's  $t$  distribution, but instead is generated from Monte Carlo simulations (Engle and Granger 1987). Note that failing to reject  $H_0$  implies the time series is non-stationary. Unit-root test are classified into series with and without unit roots, according to their null hypothesis, to determine if each variable is stationary.

In conducting a unit root test, Baumöhl and Lyócsa (2009) argued that providing results of at least two tests is a convention in economic literature. Most frequently ADF, Phillips-Perron (PP) test, and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test are used, and are also incorporated into the majority of statistical or econometric software. However, since KPSS includes a transposed null hypothesis, which identifies a dataset as stationarity against alternative of a unit root, the results of this test could be mixed (Baumöhl and Lyócsa 2009). Thus, the KPSS test was not included in this study; rather, a modified Dickey-Fuller (DF) unit root test transformed via a generalized least squares (GLS) regression that was proposed by Elliott et al. (1996) was used: the DF-GLS test.

Therefore, to compare the results in this study, Augmented Dickey- Fuller Test (ADF) (Dickey and Fuller 1979), the Dickey-Fuller Test with GLS Detrending (DF-GLS) (Elliott et al. 1996), and the PP test (Phillips and Perron 1988) unit root tests were used to determine the existence of unit roots and the degree of differences to obtain the stationary series of total GDP, total construction output, and annual average oil prices. Kulaksizoglu (2014) observed that the ADF test is the most used unit root test in econometrics, Kwiatkowski et al. (1992) noted that the test is a reasonable first attempt to test stationarity, but the available methods all suffer from the lack of a plausible model in which the null of stationarity is naturally framed as a parametric restriction. Since the DF and ADF tests have low power for small samples (Cheung and Lai 1995) and a high probability of an error of the second type (i.e., the probability of not rejecting a false  $H_0$ ), the PP unit root test was also applied to check the robustness of the estimation results.

Since all the series are not expressed in the same unit, they were transformed into their natural logarithm for uniformity. The logarithm values were then used to test the existence of the unit root. Thus, for each time series, the ADF, DF-GLS, and PP tests were run three times: with no constant included and no trend, with a constant included assuming that the series does not exhibit any trend and has a non-zero mean, and with a constant and a trend included, assuming that the series contains a trend. Also, the number of lagged first difference terms for the ADF test and the number of periods of serial correlation to include in the test regression for the PP test were determined for each time series, whereas the DF-GLS is a simple modification of the ADF test, in which the data are

detrended so that explanatory variables are removed from the data prior to running the test regression (IHS Global Inc. 2014).

A “1” indicates that the series is integrated at order one, i.e., has one unit root, and “0” denotes that the series is stationary at level. If the time series data of each variable are found to be non-stationary at level, then a long-term relationship between the variables may exist. The ADF approach controls for higher-order correlation by adding lagged difference terms of the dependent variable  $Y$  to the right-hand side of the regression (IHS Global Inc. 2014). The PP test corrects the t-statistic of the coefficient from the first order autoregressive model to account for the serial correlation in the series by estimating the non-augmented DF test equation, and modifying the t-ratio of the  $\alpha$  coefficient so that the serial correlation does not affect the asymptotic distribution of the test statistic. Conversely, the DF-GLS-ratio follows a Dickey-Fuller distribution only in the constant case, and the asymptotic distribution differs when both a constant and trend are included (IHS Global Inc. 2014).

### 3.3. Autoregressive Distributed Lag (ARDL) Cointegration Test

To maintain their long-term information, modeling a time series can be completed using cointegration (Nkoro and Uko 2016). The cointegrating equation is also known as the stationary linear combination, which may be interpreted as a long-term equilibrium relationship between variables under consideration. However, several cointegration techniques are applicable for time series analysis: Autoregressive Distributed Lag (ARDL) cointegration technique, bound cointegration testing technique (Pesaran and Shin 1999; Pesaran et al. 2001), and Johansen’s cointegration technique (Johansen 1991, 1995), but their common objective is to determine the most stationary linear combination of the time series variables. Therefore, ARDL bounds testing (Pesaran et al. 2001), that handles mixed integration orders of the time series was used to investigate the stable long-term relationships between the variables in this study. According to Nkoro and Uko (2016), the ARDL model is preferable when dealing with integrated variables of different orders:  $I(0)$ ,  $I(1)$ , or combination of both, and the model is robust when a single long-term relationship exists between the underlying variables in a small sample size. An ARDL model contains both lagged dependent and lagged other explanatory variable(s).

The AR part of ARDL refers to the regression of the dependent variable on its past values; whereas the DL refers to the distributed lag effect of the lagged other explanatory variable(s) in the model. The ARDL model captures the dynamic effects from lagged dependent variables and lagged other explanatory variable(s), eliminating error serial correlation by including sufficient lags. The ARDL model can also be transformed into one with only lagged order explanatory variable(s) that go back into the infinite past.

The general autoregressive distributed lag (ARDL) model is written as:

$$\phi(L)y_t = \delta + \theta(L)x_t + \mu_t \quad (2)$$

where  $\phi(L)$  is an order- $p$  polynomial that, for stability, has roots lying outside the unit circle and  $\theta(L)$  is an order- $q$  polynomial. Expanding the lag polynomials, Equation (2) can be written as:

$$y_t = \delta + \phi_1 y_{t-1} + \dots + \phi_p y_{t-p} + \theta_0 x_t + \theta_1 x_{t-1} + \dots + \theta_q x_{t-q} + \mu_{1t} \quad (3)$$

or

$$x_t = \delta + \phi_2 x_{t-1} + \dots + \phi_p x_{t-p} + \theta_0 y_t + \theta_1 y_{t-1} + \dots + \theta_q y_{t-q} + \mu_{2t} \quad (4)$$

$$t = 1, 2 \dots T \quad \mu \sim iid(0, \delta^2)$$

With a sample of T observations, this model can be estimated for T-max {p, q} observations. In this case, 34 observations were included in the model. Furthermore, both sides of Equation (2) can be divided by the autoregressive polynomial to obtain:

$$y_t = \frac{\delta}{\phi(L)} + \frac{\theta(L)}{\phi(L)}x_t + \frac{\mu_t}{\phi(L)} \quad (5)$$

$$y_t = \alpha + \frac{\theta(L)}{\phi(L)}x_t + v_t \quad (6)$$

where  $\alpha$  and  $v$  are the constant and error term defined in Equation (2). The ARDL model sometimes is called the rational lag because its lag distribution cause can be represented by the ratio of two finite lag polynomials, where the rational numbers can be represented as the ratio of two integers.

The lag structure of the ARDL models on the right-hand side of Equation (2) was applied to an explanatory variable  $x$  rather than to a white-noise error term  $\varepsilon$  as in Equation (1). However, the coefficients of the order- $p$  polynomial  $\theta(L)$  only affect the first  $q$  lags of the dynamic lag distribution of the effect of  $x$  on  $y$ . The behavior of the “tail” of the lag distribution beyond  $q$  entirely depends on the auto-regressive polynomial  $\phi(L)$ . The dynamic effect is stable only if the roots of  $\phi(L)$  lie outside the unit circle are carried over from the autoregressive lag model. If the error term  $\mu_t$  is assumed to be a white noise process, or more generally, is stationary and independent of  $x_t, x_{t-1}, \dots$  and  $y_t, y_{t-1}, \dots$ , the ARDL models can be consistently estimated by ordinary least squares.

The F-statistic was applied to the joint null hypothesis so that the coefficients of the lagged variables are zero. The hypothesis that the coefficients of the lag level variables are zero was tested. The null of the non-existence of the long-term relationship is defined by:

**H0.**  $\delta_1 = \delta_2 = 0$  (null, i.e., the long-term relationship does not exist)

**H1.**  $\delta_1 \neq \delta_2 \neq 0$  (alternative, i.e., the long-term relationship exists)

This was tested in each of the models as specified by the number of variables.

This can also be denoted as follows:

$$F_x(X_1 | Y_1, \dots, Y_k) \quad (7)$$

$$F_y(Y_1 | X_1, \dots, X_k) \quad (8)$$

The hypothesis was tested using the F-statistic (Wald test) in Equations (7) and (8), respectively. The distribution of this F-statistics is non-standard, regardless of whether the variables in the system are I(0) or I(1). The critical values of the F-statistics for different numbers of variables (K), and whether the ARDL model contains an intercept and/or trend were generated from the E-view analysis, based on the study by Pesaran et al. (2001), which provides two sets of critical values. One set assumes that all the variables are I(0) (i.e., the lower critical bound assumes all the variables are I(0), meaning that no cointegration exists among the underlying variables), and another assumes that all the variables in the ARDL model are I(1) (i.e., the upper critical bound assumes all the variables are I(1), meaning that cointegration exists among the underlying variables). For each application, a band covers all the possible classifications of the variables into I(0) and I(1).

If the relevant computed F-statistic for the joint significance of the level variables in each of Equation (7) and (8) falls outside this band, a conclusive decision can be made without needing to know whether the underlying variables are I(0) or I(1), or fractionally integrated. That is, when the computed F-statistic is greater than the upper bound critical value, then the H0 is rejected, meaning the variables are cointegrated. If the F-statistic is below the lower bound critical value, then the H0 cannot be rejected, meaning there is no cointegration among the variables.



### 3.4. Granger Causality Test

The standard Granger framework is usually used to test the direction of causation between two variables. The basic concept of the Granger causality tests is that future values cannot predict past or present values. If past values for the construction sector output significantly contribute to the explanation of the total GDP, then the construction sector output is said to Granger-cause Nigerian economy. This means that the construction sector output is Granger-causing Nigerian economy when the past values of the construction sector have predictive power for the current value of the real GDP, even if the past real GDP values are considered. The same can be applied to construction sector output and annual average oil prices, and to total real GDP and annual average oil prices. Conversely, if the Nigerian economy is Granger-causing construction sector output, the real GDP change would take place before a change in the construction sector output. This is the same for other comparable variables in this study. Thus, in this present study, the Granger causality test is used, and fitted with annual data from 1981 to 2016 to test the direction of causation between:

- (1) the construction sector output and the Nigerian economy, to determine whether construction sector output stimulates Nigerian economy or vice versa,
- (2) the construction sector output and annual average oil prices, to determine whether construction sector output stimulates annual average oil prices or vice versa, and
- (3) the Nigerian economy and annual average oil prices, to determine whether the Nigerian economy stimulates annual average oil prices or vice versa.

In all cases, the test also determines if feedback effects occur between comparable variables. Therefore, the Granger causality test consists of estimating the following equations:

$$Y_t = \alpha_0 + \sum_{i=1}^n \alpha_{1i} Y_{t-1} + \sum_{i=1}^n \alpha_{2i} X_{t-i} + V_t \quad (9)$$

$$X_t = \beta_0 + \sum_{i=1}^n \beta_{1i} X_{t-1} + \sum_{i=1}^n \beta_{2i} Y_{t-i} + U_t \quad (10)$$

where  $U_t$  and  $V_t$  are the uncorrelated and white noise error term series, respectively. Causality may be determined by estimating Equation (1) and testing the null hypothesis that  $\sum_{i=1}^n \beta_{2i} = 0$  and  $\sum_{i=1}^n a_{2i} = 0$  against the alternative hypothesis that  $\sum_{i=1}^n \beta_{2i} \neq 0$  and  $\sum_{i=1}^n a_{2i} \neq 0$  for Equations (9) or (10), respectively.

If the  $\beta_{2i}$  coefficients are statistically significant, but those of  $\alpha_{2i}$  are not, then the GDP output is said to have been uni-directionally caused by construction sector output. The reverse causality holds if the coefficients of  $\alpha_{2i}$  are statistically significant whereas those of  $\beta_{2i}$  are not. However, if both  $\alpha_{2i}$  and  $\beta_{2i}$  are statistically significant, then causality is bi-directional. This also holds for other variables combinations in this study.

Meanwhile, the entire analysis was completed with EViews, version 9.0, an econometric software package used for economic and financial data. The results are presented in the section below.

## 4. Results and Discussion

### 4.1. Descriptive Statistics

The results of the descriptive statistics show that average values of total GDP, construction output and oil prices were ₦31,777,309, ₦967,712.70, and US\$42.62, respectively (Table 2). The standard deviations are ₦18,193,384, ₦699,153.80, and US\$32.12, respectively. This indicates a wide variation from the mean of the dataset. The skewness and kurtosis results indicate that the variables are all positively skewed with excess kurtosis in construction output for the period. The Jarque-Bera test of normality shows that the series in GDP follows a normal distribution, whereas that of construction output and oil prices does not.

**Table 2.** Descriptive statistics result.

	GDP	CON	OILP
Mean	31,777,309	967,712.7	42.61972
Median	22,391,138	666,614.0	28.28000
Maximum	69,023,930	2,680,216	114.2100
Minimum	13,779,255	335,758.6	12.62000
Std. Dev.	18,193,384	699,153.8	32.12396
Skewness	0.879474	1.344379	1.168440
Kurtosis	2.331207	3.468711	2.993084
Jarque-Bera	5.311773	11.17367	8.191587
Probability	0.070237	0.003747	0.016643
Sum	$1.14 \times 10^9$	34,837,658	1534.310
Sum Sq. Dev.	$1.16 \times 10^{16}$	$1.71 \times 10^{13}$	36,118.20
Observations	36	36	36

#### 4.2. Unit Root Test

Tables 3–5 show the results of the Monte Carlo Experiment (unit root test) for the logs of the total real GDP, annual construction output, and average annual oil prices for three specifications. Table 3 shows that the ADF statistics indicate that all the series are stationary at first differencing in all specifications except that logs of total GDP and construction output are only stationary at 10% significance level when intercept and trend are added in the regression. Generally, all the series are stationary at first differencing and in all the specifications.

In Table 4, the DF-GLS tests indicate that with intercept only, all but the log of the construction output is stationary at first differencing. When intercept and trend are added into the series, all the datasets are stationary at first differencing but the log of construction output is only stationary at the 10% significance level. The results from Table 5 reveal that the PP tests indicate that each of the series is stationary after first differencing when no intercept and no trend are introduced into the series, but the log of GDP is stationary at the 10% significance level. When only the intercept is introduced, all the sets are stationary at first differencing. However, only the log of the construction output was stationary at first differencing when both intercept and trend were introduced into the regression.

This suggests that the variables are not integrated at the same order. Since the stationary variables are not modeled by any special cointegrating vector; the Johansen's cointegration tests may not be the most appropriate technique to determine whether a stable long-term relationship exists between the variables. Thus, a more appropriate cointegration technique was required to test the long-term relationship between the variables. In this case, the Autoregressive Distributed Lag (ARDL) approach, which has the additional advantage of yielding consistent estimates of the long-term coefficients, that are asymptotically normal regardless of whether the underlying regressors are  $I(1)$  or  $I(0)$ . Thus, the maximum order of integration of the series in the system is  $I(1)$ ; that is, the time series of the system being study was integrated in order  $d$  such that  $0 \leq d \leq 1$ , although they may not be of the same order of integration. This provides further justification for the use of the bounds testing ARDL approach in this study.

Table 3. ADF unit root test.

Model	Variable	ADF-Stat	Levels of Critical Values			p-Value	Stationarity	
			1%	5%	10%			
<b>At Level Form</b>								
With Intercept only	LNTGDP	0.209	-3.63	-2.95	-2.61	0.9692	NS	
	LNTCON	1.201	-3.63	-2.95	-2.61	0.9975	NS	
	LNOILP	-1.125	-3.63	-2.95	-2.61	0.6949	NS	
	<b>At First differencing</b>							
	D(LNTGDP)	-3.287 **	-3.64	-2.95	-2.61	0.0235	S	
	D(LNTCON)	-3.309 **	-3.64	-2.95	-2.61	0.0223	S	
D(LNOILP)	-5.515 *	-3.64	-2.95	-2.61	0.0001	S		
<b>At level form</b>								
With Intercept & Trend	LNTGDP	-2.388	-4.25	-3.55	-3.21	0.3789	NS	
	LNTCON	-4.704 *	-4.24	-3.54	-3.20	0.0031	S	
	LNOILP	-2.131	-4.24	-3.54	-3.20	0.5112	NS	
	<b>At first differencing</b>							
	D(LNTGDP)	-3.229 ***	-4.25	-3.55	3.21	0.0959	NS	
	D(LNTCON)	-3.265 ***	-4.25	-3.55	3.21	0.0894	NS	
D(LNOILP)	-5.434 *	-4.25	-3.55	-3.21	0.0005	S		
<b>At level form</b>								
No Intercept & No Trend	LNTGDP	2.441	-2.63	-1.95	-1.61	0.9955	NS	
	LNTCON	1.665	-2.63	-1.95	-1.61	0.9744	NS	
	LNOILP	-0.086	-2.63	-1.95	-1.61	0.6471	NS	
	<b>At First differencing</b>							
	D(LNTGDP)	-2.061 **	-2.63	-1.95	-1.61	0.0393	S	
	D(LNTCON)	-3.047 *	-2.63	-1.95	-1.61	0.0034	S	
D(LNOILP)	-5.596 *	-2.63	-1.95	-1.61	0.0000	S		

Note: \*, \*\*, and \*\*\* denote the rejection of unit root at 1%, 5%, and 10% significance level, respectively. NS = Non-stationary, S = Stationary; LN = LOG.

Table 4. Dickey-Fuller Test with GLS Detrending (DF-GLS) unit root test results.

Model	Variable	DF-Stat	Level of Critical Value			Stationarity	
			1%	5%	10%		
<b>At level form</b>							
With Intercept only	LNTGDP	-0.187	-2.63	-1.95	-1.61	NS	
	LNTCON	-0.977	-2.63	-1.95	-1.61	NS	
	LNOILP	-1.149	-2.63	-1.95	-1.61	NS	
	<b>At First differencing</b>						
	D(LNTGDP)	-2.694*	-2.63	-1.95	-1.61	S	
	D(LNTCON)	-1.596	-2.64	-1.95	-1.61	NS	
D(LNOILP)	-5.445*	-2.63	-1.95	-1.61	S		
<b>At level form</b>							
With Intercept & Trend	LNTGDP	-1.750	-3.77	-3.19	-2.89	NS	
	LNTCON	-1.679	-3.77	-3.19	-2.89	NS	
	LNOILP	-1.788	-3.77	-3.19	-2.89	NS	
	<b>At first differencing</b>						
	D(LNTGDP)	-3.345 **	-3.77	-3.19	-2.89	S	
	D(LNTCON)	-3.183 ***	-3.77	-3.19	-2.89	NS	
D(LNOILP)	-5.592 *	-3.77	-3.19	-2.89	S		

Note: \*, \*\*, and \*\*\* denote the rejection of unit root at the 1%, 5%, and 10% significance levels, respectively. NS = Non-stationary, S = Stationary; LN = LOG.

Table 5. Phillips Perron (PP) unit root test results.

Model	Variable	PP-Stat	Level of Critical Values			p-Value	Stationarity	
			1%	5%	10%			
<b>At Level Form</b>								
With Intercept only	LNTGDP	1.294	-3.63	-2.95	-2.61	0.9981	NS	
	LNTCON	0.311	-3.63	-2.95	-2.61	0.9756	NS	
	LNOILP	-1.161	-3.63	-2.95	-2.61	0.6801	NS	
	<b>At first differencing</b>							
	D(LNTGDP)	-3.109 **	-3.64	-2.95	-2.61	0.0353	S	
	D(LNTCON)	-3.167 **	-3.64	-2.95	-2.61	0.0309	S	
D(LNOILP)	-5.515 *	-3.64	-2.95	-2.61	0.0001	S		
<b>At level form</b>								
With Intercept & Trend	LNTGDP	-2.521	-4.24	-3.55	-3.21	0.3166	NS	
	LNTCON	-4.382 *	-4.24	-3.5	-3.20	0.0071	S	
	LNOILP	-2.163	-4.24	-3.54	-3.20	0.4942	NS	
	<b>At first differencing</b>							
	D(LNTGDP)	-3.036	-4.25	-3.55	3.21	0.1376	NS	
	D(LNTCON)	-2.863	-4.25	-3.55	3.21	0.1864	NS	
D(LNOILP)	-5.434 *	-4.25	-3.55	-3.21	0.0005	S		
<b>At level form</b>								
No Intercept & No Trend	LNTGDP	4.376	-2.63	-1.95	-1.61	1.0000	NS	
	LNTCON	1.016	-2.63	-1.95	-1.61	0.9152	NS	
	LNOILP	-0.083	-2.63	-1.95	-1.61	0.6479	NS	
	<b>At first differencing</b>							
	D(LNTGDP)	-1.890 ***	-2.63	-1.95	-1.61	0.0569	NS	
	D(LNTCON)	-2.941 *	-2.63	-1.95	-1.61	0.0045	S	
D(LNOILP)	-5.596 *	-2.63	-1.95	-1.61	0.0000	S		

Note: \*, \*\*, and \*\*\* denote the rejection of the unit root at the 1%, 5%, and 10% significance level, respectively. NS = Non-stationary, S = Stationary; LN = LOG.

#### 4.3. Cointegration Test

The ARDL bound testing result in Table 6 shows the calculated F-statistic (0.986), when the log of the total GDP is the dependent variable, falls below the lower bounds of critical values I(0). This indicates that the null hypothesis (H0) cannot be rejected, and implies that no cointegration among the variables exists and that the variables should be considered separately. Thus, since no cointegration exists between the variables, there is no long-term equilibrium contemporaneous relationship between the variables, implying they cannot have a common trend.

Table 6. Result of the autoregressive distributed lag (ARDL) bounds test.

<b>ARDL Bounds Test</b>		
Date: 19 November 2017; Time: 06:24 a.m.		
Sample: 1983 2016		
Included observations: 34		
Null Hypothesis: No long-term relationships exist		
Test Statistic	Value	k
F-statistic	0.985919	2
<b>Critical Value Bounds</b>		
Significance	I(0) Bound	I(1) Bound
10%	3.17	4.14
5%	3.79	4.85
2.5%	4.41	5.52
1%	5.15	6.36

The results are not surprising because [PricewaterhouseCoopers Limited \(2017\)](#) had earlier determined that, since the rebasing of the GDP series, the economic structure of Nigeria has increasingly diversified, with oil becoming less relevant, but only from an activity perspective. However, the oil sector remains the predominant source of fiscal and export revenues in Nigeria. This implies that the restructuring of the Nigerian economy was geared away from an oil economy with increased optimization of the non-oil sectors, thereby diminishing the contribution of the oil sector to the real GDP. The oil sector accounted for 8.42% of the GDP in 2016. Conversely, the result could be attributed to the minimal contribution of the oil and construction sectors to the real GDP in Nigeria, contributing 3.71% and 8.42%, respectively in 2016 ([NBS 2017c](#)).

The result of the correlation analysis is presented in [Table 7](#). The Pearson correlation coefficients show that the logs of the construction output and oil prices are positively and significantly correlated with total GDP, respectively. Each of the construction output and oil prices has a strong linear association that is very significant with the real GDP. The result also indicates a strong positive and significant correlation between construction output and oil prices in Nigeria, implying that the independent variables are equally correlated among themselves. A mutual dependency also exists between the variables and they interact positively.

**Table 7.** Correlation analysis.

Covariance Analysis: Ordinary			
Date: 5 October 2017; Time: 08:23 a.m.			
Sample: 1981 2016			
Included observations: 36			
Correlation <i>t</i> -Statistic Probability	LNTGDP	LNTCON	LNOILP
LNTGDP	1.000000 - -		
LNTCON	0.933951 15.23727 0.0000	1.000000 - -	
LNOILP	0.822328 8.426787 0.0000	0.855869 9.649265 0.0000	1.000000 - -

#### 4.4. Granger Causality Test

The Pairwise Granger causality test revealed a uni-directional relationship running from total GDP to construction output without feedback. As shown in [Table 8](#), the causality test result reveals that the total GDP Granger Causes construction output with a lag order of two. This implies that total GDP drives construction output by two years. This causation can be interpreted as the forward linkage from total GDP to the construction output. Conversely, the null hypothesis that states that total GDP does not Granger Cause construction output is rejected since the probability is less than 0.05; whereas the hypothesis states that the construction output does not Granger Cause total GDP is not rejected since the probability is greater than 0.05.

However, no Granger causal relationship exists between the total GDP and annual average oil price. The same is true for construction output and oil prices as per the results of this study. Statistically, the Granger causal effect is only running from total GDP to the construction output at a 5% significance level. The uni-directional relationship implies that only the total GDP can influence the construction output to a certain extent, without return, and in the short-term. This refutes the long-term assumption



that construction activities drive the economy, as we have shown that multiple activities in various sectors of the economy that actually trigger the construction activities in Nigeria.

**Table 8.** Granger causality between the total GDP, construction sector output and average annual oil prices.

Pairwise Granger Causality Tests			
Date: 5 October 2017; Time: 08:13 a.m.			
Sample: 1981–2016			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
LNTCON does not Granger Cause LNTGDP	34	1.77090	0.1881
LNTGDP does not Granger Cause LNTCON		12.9517 *	0.0001
LNOILP does not Granger Cause LNTGDP	34	0.78819	0.4642
LNTGDP does not Granger Cause LNOILP		1.88737	0.1696
LNOILP does not Granger Cause LNTCON	34	1.69191	0.2018
LNTCON does not Granger Cause LNOILP		2.03443	0.1490

Note: \* indicates significant at the 5% significance level. The null hypothesis of no causality is rejected if the probability is less than 0.05.

## 5. Discussion

The results of this study demonstrated the interrelationships between the aggregate economy, the construction sector, and the oil prices both historically and presently in the rebased economy in Nigeria. Basically, the construction sector is one of the main sectors of the economy and is one of the few that was estimated to have a significantly higher share in the GDP after rebasing the Nigerian national account (World Bank 2014). As a result, the future of this sector is more optimistic because more modern construction activities have been captured and the prices correctly deflated (NBS 2015a) in the new estimate.

However, the available literature suggests that no consensus exists about the nature and extent of the influence of the construction sector on the aggregate GDP output in Nigeria. However, as one of the economic activities in Nigeria, the global oil prices have been assumed to directly influence the construction sector output and the aggregate economy contrary to the findings of previous studies (Akomolafe and Jonathan 2014; Nwanna and Eyedayi 2016).

The result of this study shows that only the total GDP output that Granger Causes the construction output without feedback, and no Granger causal relationship exists between the total GDP output and the oil prices; and between the construction output and the oil prices. This implies that oil prices do not have any direct effect on both the GDP output and construction sector output under the current economic condition in Nigeria in the long term despite the fact that the result of Pearson correlation analysis reveals that the oil prices have very strong linear association with the real GDP output and the construction output under the same economic condition in Nigeria. It also suggests that economic activities of the non-oil sectors of the economy trigger construction activities in Nigeria. This particular result supports that report of CBN (2013).

The coefficient of the correlation further indicates that there is a very strong positive correlation between construction output and oil prices in Nigeria. Invariably, this implies that both construction sector and oil sector are ingredients of Nigerian economy which made them to be correlated among themselves, and linearly associated. However, the association is only in the short term. This can be evidently seen in Table 1 which shows that during the period of oil boom in the recent past, both the GDP output and construction output marginally increased for a short while. This result supports that of (Akomolafe and Jonathan 2014; Nwanna and Eyedayi 2016).

Furthermore, the study found that all the unit root tests performed on the variables revealed that they are not stationary at the same order, thus the ARDL bound testing result shows that the variable are not cointegrated. As a result, the null hypothesis of no cointegration is not rejected. It therefore

implies that there is no long-term equilibrium contemporaneous relationship between the variables. It can also be deduced that the effect of oil prices and construction output on the total real GDP output may be observed only in the short term, during the transition from a long-term equilibrium at one level of oil prices and construction output to a long-term equilibrium at another level of oil prices and construction output.

Generally, the result implies that the aggregate GDP output in Nigeria cannot be predicted in the long-term from both the oil prices and the construction sector output. The Nigeria GDP output (economy) is not mainly dependent on oil prices and the construction sector output, and simultaneously, oil prices do not directly affect the construction output and vice versa.

The overall results of the study aligned with the findings of [Akomolafe and Jonathan \(2014\)](#), [Nwanna and Eyedayi \(2016\)](#), and [Gummi et al. \(2017\)](#), but are contrary to those of [Olatunji \(2010\)](#), [Saka and Lowe \(2010\)](#), [Salami and Kelikume \(2011\)](#), [Akinlo \(2012\)](#), [Igberaese \(2013\)](#), [Okoye \(2016\)](#), and [Yusuf \(2016\)](#), who established a bi-directional causal relationship between the construction sector and the Nigerian economy. In terms of correlation, the results of this study are supported by the results of the above authors, even though [Yusuf \(2016\)](#) specifically found a medium positive correlation between the construction sector and the real GDP output.

## 6. Conclusions

The results of this study are not surprising, as the data collected from various NBS reports and the OPEC Annual Statistical Bulletin were used to empirically examine the interrelationships between the construction sector output, the total GDP output, and the oil prices in Nigeria to measure the nature and extent to which the construction sector and oil prices influence and relate to the Nigerian economy in terms of aggregate GDP output.

We found that although very strong positive and significant correlations exist between the construction sector output and the total GDP output, the construction sector output and oil prices, and the total GDP output and oil prices, these linear relationships only existed in the short term. Explicitly, none of the variables directly influence each other, except the total GDP output on the construction sector output, meaning only a uni-directional causal relationship flow from the total GDP output to the construction sector output without feedback.

Fundamentally, both the construction and oil sectors are ingredients for the national economy as suggested by the strong positive correlations. However, these relationships do not translate to any direct causal influence on each other, except for the total GDP output on the construction sector output, which further suggests that the economic activities of other non-oil sectors lead to improved construction activities in Nigeria. The causal effect is only marginal and in the short term, as it can only predetermine short term transitional trends from one long term equilibrium to another. Additionally, a critical look at the trend shows that in the long term, the short-term relationship is coincidental.

The empirical result affirms that although oil prices and the construction sector are economic variables, their influence in determining the outcome of the Nigerian economic output is not pronounced, and growth in the GDP through activities in other major sectors of the economy will instead trigger construction activities in Nigeria. Therefore, the oil prices should receive less attention from the government. The Nigerian government should re-strategize and refocus their attention to those sectors that contribute more substantially to the aggregate economy to address the current economic challenges.

Based on this premise, we argue that neither the construction sector nor the oil prices directly influence the aggregate economy; rather, the activities of other sectors of the economy stimulate the construction sector in Nigeria. Although Nigeria still believes and relies on the effect of oil prices on the economy, we propose that the effect of oil prices on the GDP output and construction has dramatically decreased under current economic conditions.

The results of study have challenged the status quo of the current economic management in Nigeria, providing a veritable tool in the hands of economic managers and policy makers in Nigeria.

The country is still struggling to recover from the economic depression; the current study is a pointer toward the direction of economic rejuvenation in Nigeria. The Nigerian government needs to redirect its attention to formulating policies that ensure sustainable economic growth rather than relying on oil prices and construction sector activities.

From the above, two important policy recommendations are suggested: (1) the Nigerian government should de-emphasize over-reliance on the oil sector through policy readjustment, and (2) an urgent need exists for economic diversification in Nigeria, since the results of this study suggest that an increase in the aggregate GDP output is a result of the activities of other non-oil sectors. Optimization of other sectors of the economy will assist with the achievement of the federal government's medium term Economic Recovery and Growth Plan (ERGP) in Nigeria.

Finally, these results underpin the [PricewaterhouseCoopers Limited \(2017\)](#) results which state that after the rebasing of the GDP series, the oil sector has become less relevant in determining the economic structure of Nigeria from an activity perspective, despite its dominance in the fiscal and export revenues of the country.

**Author Contributions:** Peter Uchenna Okoye conceived and initiated the study; Chinwendu Christopher Mbakwe and Evelyn Ndifreke Igbo sourced the data and did a literature review; Peter Uchenna Okoye, Chinwendu Christopher Mbakwe and Evelyn Ndifreke Igbo sorted and selected the relevant data; Peter Uchenna Okoye analyzed the data, interpreted and wrote the paper; Peter Uchenna Okoye, Chinwendu Christopher Mbakwe and Evelyn Ndifreke Igbo read and approved the final paper.

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