Oil price Fluctuation and Aggregate Output Performance in Nigeria

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ABSTRACT

This paper investigates the relationship between oil price fluctuation and output performance in Nigeria during the period 1970 to 2015. It synthesizes the standard neoclassical growth model and the Keynesian national income identity by augment the typical production function to include oil price as one of the factors of production and then super-impose the augmented production function on the Keynesian national income identity. The Two Stage Least Square (2SLS) estimation technique that accounts for the plausibility of endogeneity was adopted in the study. The ADF unit root and Johansen cointegration tests were used to determine the time series properties of the data used in the study. Findings suggest that oil price impacted positively on aggregate output but negatively on agricultural, manufacturing and service sector suggesting that fluctuation in oil price create uncertainty in the production capacity of the productive sectors and it also undermines the effectiveness of the government fiscal management of crude oil revenue. The study, therefore, recommends that the Nigerian government need to diversify its export revenue base in order to minimize the over reliance on crude oil. Also, the country needs to develop the local capacity of its refinery so as to reduce the importation of refined petroleum which serves as input to most productive sectors of the economy.

Keywords: Oil Price, Aggregate output, Agricultural output, Manufacturing output, Service output, Nigeria, Two-Stage Least Square (2SLS)

JEL classification: E32, O13, O40

1. Introduction

Crude oil as an energy source since its discovery in the 1800's has been vitally important to the economy of the world. Gronwald (2008) posited that the importance of oil has risen to the extent that in a world suddenly without oil, all the major distribution system that induce economic transactions on a more than local basis would fall and the world economy would collapse. It is the major source of foreign exchange earnings and dominant source of revenue for Nigeria government, in which its high dependence serve as the basis upon which revenue distribution, budgeting, and capital allocations are determined in the country. Thus, the upward or downward movement of oil price (fluctuation) has an attendant multiplier effect on crude oil and economic growth in Nigeria.

The high dependence on oil has attributed to the rise and fall of Gross domestic product (GDP) growth rate in Nigeria. According to the world development indicators (WDI) database, from 1980-1984, the GDP growth rate was -3.41% and average oil price was $31.73 per barrel. The negative GDP growth recorded within this period is largely associated with the collapse of oil in the global market. Between 1985 and 1989, oil price fell to $17.29 per barrel, but 0.57% positive growth rate was achieved. This was due to the adoption of structural adjustment program (SAP) by the government and the rationing of foreign exchange. An increment was recorded in GDP growth rate (3.12%) from 1990 to 1994, and oil was priced at an average of $16.78 per barrel within the same period. This decrease in oil price was as a result of Gulf war, which resulted to supply shock and precautionary demand shock.

Furthermore, the average price of oil fell slightly to $16.46 per barrel from 1995-1999, while the growth rate also fell to an average of 2.14%. The decrease was thus, due to Asian financial crisis which causes demand shock. Oil price increased to an average of $26.63 per barrel for the period 2000 to 2004. This was partly due to the Venezuelan crisis and Iraq war which causes supply shock. This supply shock increased the growth rate of output within the period to 5.52%. The period from 2005 to 2009 saw the rise in oil price to $66.95 per barrel while GDP growth rate stood at 6.34%. The rise in oil price was due to world commodity super cycle which resulted to strong demand and stagnant supply thereby leading to precautionary demand shock in the global oil market. The price of oil averaged $99.17 between 2010 and 2014. This can be partly attributed to the Arab uprisings which led to the supply shock. In 2015, the price of oil fell drastically to $51.6. On the other hand output growth rate averaged 5.73% between 2010 and 2014 but fell drastically to 2.6% in 2015. Further, the trend of sectoral output performance and oil price also followed the same pattern. Thus, indicating that there is a direct link between output growth rate and oil price fluctuation in Nigeria.

Several empirical works indicate that oil price increases have a significant negative effect on real GDP growth in oil importing countries, the increase in the price of oil generates a positive relationship with the output growth in Nigeria. The most thorough research to date has found that post-shock recessionary movements of output are largely attributable to the oil price fluctuation, not to monetary policy. Likewise, Obioma (2006) argued that there is a positive relationship between oil price and government expenditure, claiming that this

relationship is significant and have fiscal implications and linkages. And these linkages arise from the use of increasing oil revenue by the government to develop other sectors of the economy such as Agriculture, Education, and Infrastructures etc. which are components of various government capitals and recurrent expenditures. Lack of implementation is said to be the genetics of this current lingering economic crises. Therefore, an increase in the price of oil will obviously boost government revenue and its total expenditures.

More so, there are other variables that can also affect output growth in Nigeria, and these variables could have a direct or indirect effect on output growth. These variables include real government expenditure, real exchange rate, inflation rate, real money supply, and real import, it should be noted that the real money supply represents the monetary sector, while real imports represent the external sector of the economy. Consequently, based on the aforementioned issues, this study examines the impact of oil price fluctuation on aggregate and sectoral output in Nigeria between 1970 and 2015. The remaining part of the paper is organized as follows. The next section, present the literature review. This is followed by the discussion of the theoretical framework and methodology in section 3. The fourth section presents the empirical results, while section 5 is the concluding remarks.

2. Literature Review

Theoretically, no single theory explains the relationship between crude oil price and output. Thus, different theoretical approach has been advanced in the literature to ascertain this relationship. Starting with the Dutch Disease which indicates that windfalls from a sharp surge in oil price cause inflation in most developing countries because the economy is not well diversified to absorb the inflow of foreign earnings. Therefore, resource pull and spending effects occur when large inflow from oil export hits a less diversified economy (Mieiro and Ramos, 2010). The booming export sector experiences rise in marginal productivity and thus, pay factors employed relatively more than other sectors. As a result, factor inputs/resources are pulled to the booming sector (oil/export sector) at the expense of other tradable sectors (agriculture and manufacturing) and the non-tradable sector, which is expected to boom accordingly, for sustainable economic growth. This implies that fluctuation in oil price affects both aggregate and sectoral output in most resource based economies.

Furthermore, the standard growth theories focus on primary inputs such as; Capital, labour and land and some include technology. According to the traditional neo-classical growth theory, output growth is achieved through an increase in labour quality and quantity

(through education and population growth), increase in capital (through saving and investment) and improvement in technology (Todaro and Smith 2004). Again, the neoclassical viewpoint which is based on a technological relationship between output and productive inputs as considered in the pioneering work of Robert Solow (1978), its extensions finds an empirical variant in the Cobb-Douglas production function. However, this Model fails to recognize the role of primary energy inputs such as; oil deposits. Therefore, natural scientists and some ecological economists have made efforts at evolving some theories which capture the role of oil price fluctuation on economic growth, thus incorporating the linkage between energy resources and output growth.

In the light of recognizing the role of primary energy inputs, the Mainstream theory of economic growth was developed by Samuelson and Nordhaus in the 20th century. The theory postulates that production is the most important determinant of growth of any economy, and production which is the transformation of matter in some way requires energy. This theory categorizes capital, labour and land as primary factors of production that exist at the beginning of the production period and is not directly used up in production (though they can be degraded or added to). While energy resources (such as; oil and gas, fuels, coal) are categorized as intermediate inputs created during the production process and are entirely used up during the production process. In determining the marginal product of oil as an energy resource useful in determining economic growth, this theory considers in one part its capacity to do work, cleanliness, amenability to storage, flexibility of use, safety, cost of conversion and so on, it also considers other attributes such as; what form of capital, labour or materials it is used in conjunction with. The theory estimates the ideal price to be paid for crude oil as one that should be proportional to its marginal product.

In addition, the Linear/Symmetric relationship theory of growth which has its proponents, Hamilton (1983), Gisser and Godwin (1986), Hooker (1986) and Laser (1987) argued that volatility in the growth rate of output is driven by fluctuation in oil price. They based their arguments on the happenings in the oil market between 1948 and 1972 and its impact on the economies of oil-exporting and importing countries respectively. Hooker (2002), after rigorous empirical studies, demonstrated that between 1948 and 1972, oil price level and its changes exerted influence on output growth significantly. Laser (1987), who was a late entrant into the symmetric school of thought, endorses the symmetric relationship between oil price volatility and economic growth. Laser (1987) submitted that an increase in

oil prices necessitates a decrease in GDP, while the effect of an oil price decrease on GDP is ambiguous because its effects varied from country to country.

The Asymmetry-in-effects theory of economic growth used the U.S economy as a case study. The theory posits that the correlation between crude oil price decreases and economic activities in the U.S economy is significantly different and perhaps zero. Mark et al. (1994) in a study of some African countries, confirmed the asymmetry in effect of oil price volatility on economic growth. Ferderer (1996) explained the asymmetric mechanism between the influence of oil price volatility and economic growth by focusing on three possible ways: Counter-inflationary monetary policy, sectoral shocks, and uncertainty. The study found a significant relationship between oil price increases and counter-inflationary policy responses. Balke (1996) supports Federer‘s position/submission. The study opined that monetary policy alone cannot sufficiently explain real effects of oil price fluctuation on real GDP.

The Renaissance growth theory/model was an offshoot of the symmetric and asymmetry in effect schools. Lee and Ratti (1995) attempts to distinguish between oil price changes and oil price volatility. They defined volatility as the standard deviation in a given period. The study found that oil price changes and oil price volatility both have negative impacts on economic growth but in different ways. Volatility has a negative and significant impact on economic growth immediately, while the impact of oil price changes delays until after a year. The study concludes by stating that shocks/change in crude oil prices rather than oil price level has a significant influence on economic growth.

Based on the above theoretical works, various empirical studies have shown that both positive and negative oil price changes significantly affect the level of output in the economy. For instance, Gou and Klieses (2005) examined the impact of oil price shock on macroeconomic fundamental in the US economy for the period 1996 to 2011 using Vector Auto-regressive model (VAR). The study found that post shock recessionary movement of GDP is largely attributable to the oil price shocks and are not event that alternative monetary policy largely could have avoided. In the same vein, Farzanegan and Makwardt (2008) used the VAR model to examine the effects of oil price fluctuation on Iranian economy between 1988 and 2004. The study found that both positive and negative oil price changes significantly affect the level of output. The study concluded that oil price fluctuation is the

Achilles heel of the Iranian economy and also remain an opportunity and threat for the current and future generation of Iran.

Using Vector Autoregressive model (VAR), Gronwald (2008) examined the impact of a large oil price shock on US economy from 1959-2004. The study found that the new oil price specification allows for a well-founded distinction between "large" and "normal" oil price increases. This study observed that the impact of oil price shocks on real GDP growth is largely attributable to no fewer than three large oil price increases, namely those of 1973-1979 and 1991, while variable such as consumer and import prices are also affected by normal oil price increase. The study concluded that global economy has been persistently confronted with large oil price shocks over the last few decade. The most prominent examples are the oil crises in the 1970 and the 1980s, and the oil shock caused by Gulf war in the early 1990s.

Using data from Nigeria, Oriakhi and Osaze (2013) examined the impact of oil price volatility and the consequences on the growth of the Nigeria economy spanning from 1970 to 2010. The utilized vector Autoregressive model (VAR) and found that oil price changes determine government expenditure level, which in turn determine the growth of the Nigeria economy. The study concluded that fluctuation in oil price has made the Nigerian economy to be highly vulnerable thereby making it difficult for the government to achieve its expected growth target.

In another study for Nigeria, Alley, Ayodele, Hakeem, and Adeniran (2014) examined the impact of oil price shocks on economic growth between 1981 and 2012. The study utilized the general method of moment (GMM) estimation technique and found that oil price shock insignificantly affects economic growth while oil price itself significantly improves growth. The study concluded that the positive significant effect of oil price on economic growth affirms the conventional perception that oil price increase is beneficial to oil-exporting and producing country like Nigeria.

Herath (2014) used monthly data spanning from 2000 to 2013 to investigate the impacts of oil price shocks on Sri Lankan economy. The utilize the augmented Toda and Yamamoto causality procedure to show that positive oil price shocks affect foreign reserves and the interest rate, while negative oil price shocks affect GDP, interest rates, and exports. The study also found evidence for the presence of asymmetric oil price affect the GDP while no evidence was found on the link between oil price shocks cause inflation. Thus indicating

that the Sri Lankan government has the ability to employ expansionary monetary policy to avoid stagflation during high oil price. The study concluded that the Sri Lankan economy has a certain degree of insulation from international oil price increases due to the reduction in energy intensity.

Bartolomeo, Bondzie, and Fosu (2014) used the dynamic stochastic general equilibrium (DSGE) model to investigate the persistent effects of world oil price and monetary policy shocks (money supply-interest rate induced) on economic growth in Ghana. The results of the study reveal that fluctuation in oil price has both negative and positive output shock on Ghanaian economy.

Isah, Dikko, and Ejiemenu (2015) utilized quarterly data from 2000 to 2014 to investigate the impact of crude oil shocks on exchange rate, external reserves, gross domestic product, inflation rate, international trade and money supply in Nigeria using GARCH and VAR models. The results of the study show that oil price shocks did not pose a significant inflationary threat to the Nigerian economy in the short run; rather, it improves the level of gross domestic product. The study concluded that there is need to diversify the economy in order to advantage of the gains from positive oil price fluctuation.

Yusuf (2015) examined the impact of oil price shocks on the growth of the Nigeria economy from 1970-2011 using structural vector auto regression (SVAR). The findings of the study show that the response of oil price shocks on economic growth depicts both positive and negative impact suggesting that a long-run impact on economic growth. The study concluded that oil price, exchange rate, agricultural output contained some useful information in predicting the future path of economic growth in Nigeria. The study, therefore, recommends that government should diversify the economy away from oil to real sectors and also improve the security situation in the Niger Delta in order to boost oil output and revenue which has implication on the economic growth of the nation.

The study by Nwanna and Eyedayi (2016) for Nigeria, examine the impact of crude oil price volatility on economic growth for the period 1980 to 2014 using multiple regression model. The study found that there is a positive and significant relationship between oil price and economic growth. The study concluded that oil price fluctuation does not impact positively on the economy. Though this result differs from other earlier studies, however, the study suggests that oil price itself affects economic growth positively.

Gummi, Buhari, and Muhammad (2016) examined the relationship between oil price and economic growth in Nigeria using annual time series data for the period 1974 to 2014. The study utilized the Johansen cointegration test and the VAR granger causality test to show the long and short link between oil price and economic growth in Nigeria. The results of the study reveal that there is no long-run relationship between the variables while there exists a significant unidirectional causality running from oil price to economic growth in the short run. The study, therefore, recommends stability of oil price in order to achieve high economic growth in the short run, a substantial amount of government budgetary allocation should be directed towards educational sector in order to strengthen economic growth through human capital in the short run.

Aimaer (2016) employed the VAR model and co-integration techniques to investigate the effect of fluctuations in oil prices on Libya's economic growth from 2000 to 2015. The results of the study indicate that is a long-term relationship between crude oil price and growth suggesting that higher oil price has a positive and statistically important impact on Libyan economic growth.

3.0 Theoretical Framework and Methodology

3.1 Theoretical Framework and Model Specification

In line with the Mainstream theory of growth proposed by Samuelson and Nordhaus in the 20th century which integrates energy as factors of production, this study synthesis the standard neoclassical growth model and the Keynesian national income identity by augment the typical production function to include oil price as one of the factors of production and then super imposing the augmented production function on the Keynesian national income identity. The essence of adopting this approach to show the impact of oil price fluctuation on aggregate and sectoral output is in two folds. First, the synthesis of the two theories makes it easier to incorporate both the supply and demand determinant of output growth in an economy. Second, it allows for the introduction of sectoral specific variables in the model so as to show the peculiarity of the sector and the economy in general. For instance, no theory specify the importance of rainfall to agricultural output, however, empirical findings and the importance of rainfall as shown over the years that rainfall is very important in agricultural production. Thus, the starting point is the specification of a typical production function:

$$Y = f(K, L) \tag{1}$$

Augmenting equation (1) to include oil price to account for its impact output growth gives:

$$Y = f(K, L, op) \tag{2}$$

Where at time t, Y is the output, K is capital stock, L is labour, op is oil price.

In an open economy, there are three classes of agents; households, businesses, and the government. However, since the economy is open it engages in foreign trade, accounted for as net receipt from abroad which denoted by the difference between exports and imports (X – M). Thus the national income identity is expressed as:

$$Y = C + I + G + X - M \tag{3}$$

Where Y is total output, C is household consumption, I is domestic investment, G is government expenditure, X is export, M is import and (X-M) is net export (NX). In order to explain the demand determinant of total output, each of the components of output (Y) in equation (3) is specified in its structural form using an eclectic approach.

Household consumption which is the major component of the aggregate demand is determined by disposable income given as:

$$C_t = \alpha_0 + \alpha_1(Y^d) \tag{4a}$$

Where the disposable income is define as:

$$Y^d = (1-\tau)Y \tag{4b}$$

Where at time t, C is household consumption expenditure, Y is national income, τ is tax rate, parameter α_0 is the autonomous consumption while α_1 is the marginal propensity to consume (MPC).

Domestic investment, another major component of aggregate demand in its simplest form is determined by the rate of interest which is the cost of capital and the change in output in the previous period expressed as:

$$I_t = \beta_0 + \beta_1 R_t + \beta_2 \Delta Y_{t-1} \tag{5}$$

Where I is investment demand, R is interest rate, ΔY_{t-1} is change in output and implies that $\Delta Y_{t-1} = Y_1 - Y_{t-1}$.

Government expenditure is assumed fixed because the government has a social contract with its citizens to provide public goods and this cannot be easily changed. Thus government expenditure is expressed as:

$$G = g_o \tag{6}$$

Export is determined by real exchange rate, foreign income and oil price in the case of Nigeria where oil is the major product in her export basket. This is expressed behaviourally as:

$$X_t = f(Yw_t, exr_t, op_t) \tag{7}$$

Where: X is real exports of goods and services, Yw is real world (US) income, exr is real exchange rate and OP is oil price.

Import is the component of national income that accounts for all goods and services consumed or invested in a country that is not produced domestically. Thus, real import function is expressed as:

$$M_t = a_0 + a_1 Y_t + a_2 exr_t \tag{8}$$

Where M_t is real import while parameter a_1 is the import multiplier. Other variables are as defined earlier.

Since net export is the difference between export and import, equation 7 and 8 can be combine together to give X-M (NX) which is expressed as:

$$NX = \sigma_1 Yw + \sigma_2 Y + \sigma_3 exr + \sigma_4 op \tag{9}$$

At equilibrium, total output is derived by substituting equation 4, 5, 6 and 9 into equation 3.

$$y = F(L, K, op, \Delta Y, ir, g_o, Y_w, exr) \tag{10}$$

Super imposing equation 2 into equation 3 in order to synthesize the standard neoclassical growth model and the Keynesian national income identity gives:

$$F(L,K,op)=c(F(L,K,op)\cdot(1-\tau))+I(\Delta Y,ir)+g_o+NX(Y_w,Y,op,exr) \quad (11)$$

The left side of equation (11) represents the supply of goods and services that make up the total output of the economy while the right-hand side are the demand determinants of total output.

Since nominal aggregate output is expressed as: $Y=f(K,L,op)$, deflating Y by inflation in order to arrive at real aggregate output, equation (11) is re-writing as

$$y=c(F(L,K,op)\cdot(1-\tau))+I(\Delta Y,ir)+g_o+NX(Y_w,Y,op,exr) \quad (12)$$

Based on equation (12), real aggregate can be expressed as the function of labour (L), capital (K), oil price (op), total tax (τ), change in output (ΔY), real interest rate, government expenditure (g_o), world income(Y_w) and real exchange rate.

$$y=F(L,K,op,\tau,\Delta Y,ir,g_o,Y_w,exr) \quad (13a)$$

The estimable equation for aggregate output from equation (13a) is given as:

$$y_t=\theta_0+\theta_1 L_t+\theta_2 K_t+\theta_3 op_t+\theta_4\tau_t+\theta_5\Delta Y_t+\theta_6 ir_t+\theta_7 g_{Ot}+\theta_8 Y_{Wt}+\theta_9 exr_t+\varpi_t \quad (13b)$$

For the sectoral output, the output produced by a sector is a function of the basic variables in equation (13a) and other factors in relation to the sector in question. In this study, three sectors that are considered as productive sectors selected. These sectors are agriculture, manufacturing, and Services. These sectors are chosen primarily because they are regarded as engine room of the nonoil sector and availability of data.

Based on the variables in equation (13a), agriculture sector output (agy) is determine by labour force engaged in the sector (agl), fixed capital asset in agricultural sector (agk), oil price (op), change in agricultural output (Δagy), disbursement of credit to the sector (agcre), interest rate (ir), availability of water - majorly rainfall (raf) and government capital expenditure in agricultural sector (aggex). The output of manufacturing sector (Mafy) in included in to account for the forward-backward linkages. Thus, the agricultural sector output model is specified as:

$$Agy_t = \lambda_0 + \lambda_1 agl_t + \lambda_2 agk_t + \lambda_3 op_t + \lambda_4 \Delta Agy_t + \lambda_5 agcre_t + \lambda_6 ir_t + \lambda_7 raf_t + \lambda_8 aggex_t + \lambda_9 Mafy_t + \varepsilon_t \quad (14)$$

For the manufacturing sector (Mafy), labour force engaged in the sector (Mafl), fixed capital asset in manufacturing sector (Mafk), oil price (op), changes in manufacturing output (ΔMafy), interest rate (ir), company income tax (Maftx) and government capital expenditure in manufacturing sector (mafgex) are the determinant of its output. The output of agricultural sector (Agy) in also included in the model to account for the forward-backward linkages. Thus, the manufacturing sector output model is given as:

$$Mafy_t = \varphi_0 + \varphi_1 mafl_t + \varphi_2 mafk_t + \varphi_3 op_t + \varphi_4 \Delta Mafy_t + \varphi_5 ir_t + \varphi_6 maftx_t + \varphi_7 mafgex_t + \varphi_8 Agy_t + \mu_t \quad (15)$$

The services sector in this study includes transport, communication, utilities, hotel and restaurant, finance and insurance, and real estate and business services. Therefore based on variables in equation (13), the service sector output (Sery) is determined by labour force engaged in the sector (serl), fixed capital asset in service sector (serk), oil price (op), disbursement of credit to the service sector (sercre), interest rate (ir), value-added tax (VAT), changes in service output (Δsery) and government capital expenditure in service sector (sergex).

$$Sery_t = \phi_0 + \phi_1 serl_t + \phi_2 serk_t + \phi_3 op_t + \phi_4 \Delta Sery_t + \phi_5 sercre_t + \phi_6 ir_t + \phi_7 Vat_t + \phi_8 sergex_t + \nu_t \quad (16)$$

3.2. Estimation Technique and Procedures

To estimate equations 13b, 14, 15 and 16, the two stage least squares (2SLS) instrumental variable estimator was adopted. This estimation technique was adopted to correct for the possibility of endogeneity because of the forward-backward linkage accounted for in the models. The 2SLS an equation by equation technique produces a consistent estimate if the predetermined variables therein to be estimated should be in the set of instrumental variables. This implies that the instrumental variables must be uncorrelated with the error disturbance and correlated with the endogenous variables in the model. Diagnostic tests are conducted on the results obtained from the 2SLS to validate the robustness of the estimates and their goodness of fit. To validate the instruments utilized, the J-statistics (along with p-values) and Cragg-Donald F-statistics were conducted. The J-statistics was used to test whether the

instruments are valid. The decision rule is that the larger it is, the more likely the instruments are invalid. While Cragg-Donald F-statistics was used to test the weakness of the instruments.

Further, the time series properties of the variables were examined by conducting stationary and cointegration tests. The Augmented Dickey Fuller (ADF) was used to ascertain the stationarity of the data while Johansen maximum-likelihood cointegration approach was to determine the long run linear combination of the variable in the model.

3.3. Data Sources

This study made use of macroeconomic time series from 1970 to 2015. A detail description of the variables of used in terms of their names, acronyms, sources, and types is presented in Table 3.1.

Table 3.1: Data Description

S/N	Series	Acronym	Source	Type of variable
1	Real aggregate output (N'M)	Y	CBN Statistical Bulletin (various issues)	Endogenous
2	Real agricultural output (N'M)	Agy	CBN Statistical Bulletin (various issues)	Endogenous
3	Real manufacturing output (N'M)	Mafy	CBN Statistical Bulletin (various issues)	Endogenous
4	Real service output (N'M)	Sery	CBN Statistical Bulletin (various issues)	Endogenous
5	Total labour force (000 persons)	L	CBN Statistical Bulletin (various issues)	Exogenous
6	Labour force engaged in agricultural sector (000 persons)	Agl	NBS Annual Abstract (various issues)	Exogenous
7	Labour force engaged in manufacturing sector (000 persons)	Mafl	NBS Annual Abstract (various issues)	Exogenous
8	Labour force engaged in service sector (000 persons)	Serl	NBS Annual Abstract (various issues)	Exogenous
9	Total fixed capital asset (N'M)	K	CBN Statistical Bulletin (various issues)	Exogenous
10	Fixed capital asset in agricultural sector (N'M)	Agk	CBN Statistical Bulletin (various issues)	Exogenous
11	Fixed capital asset in manufacturing sector (N'M)	Mafk	CBN Statistical Bulletin (various issues)	Exogenous
12	Fixed capital asset in service sector (N'M)	Serk	CBN Statistical Bulletin (various issues)	Exogenous
13	credit to agriculture (N'M)	Agcre	CBN Statistical Bulletin (various issues)	Exogenous
14	credit to service (N'M)	Sercre	CBN Statistical Bulletin (various issues)	Exogenous
15	Total tax (N'M)	τ	CBN Statistical Bulletin (various issues)	Exogenous
16	Company income tax (N'M)	Maftx	CBN Statistical Bulletin (various issues)	Exogenous
17	Value-added tax (N'M)	Vat	CBN Statistical Bulletin	Exogenous

			(various issues)	
18	Total government expenditure	G	CBN Statistical Bulletin (various issues)	Exogenous
19	Capital expenditure in agricultural sector (N'M)	Aggex	CBN Statistical Bulletin (various issues)	Exogenous
20	Capital expenditure in manufacturing sector (N'M)	Mafgex	CBN annual statement of account (various issues)	Exogenous
21	Capital expenditure in service sector (N'M)	Sergex	CBN annual statement of account (various issues)	Exogenous
22	Oil price	Op	CBN Statistical Bulletin (various issues)	Exogenous
23	Real interest rate (%)	Ir	CBN Statistical Bulletin (various issues)	Exogenous
24	World income (N'M)	Y_w	WDI (2015)	Exogenous
25	Average annual rainfall	Raf	CBN Statistical Bulletin (various issues)	Exogenous
26	real exchange rate	Exr	CBN Statistical Bulletin (various issues)	Exogenous

Source: Author's Compilation

4.0 Empirical Results

4.1 Time Series properties of the Data

As stated earlier, the Augmented Dickey Fuller (ADF) was used to test for unit roots The Akaike Information Criterion (AIC) was used to select the order of augmentation. The results of the unit root test reveal that all the variables stationary after first difference. In adopting the Johansen cointegration test which shows the long run relationship between the variables in equations 13b, 14, 15 and 16; the optimal lag length of the Vector Autoregressive (VAR) model was selected using the lag selection criteria. The result of the selection reveals that all the five information criteria [Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQ), Final Prediction Error (FPE) and Sequential modified LR test statistic (LR)] suggested 1 as the optimal lag length. After establishing the order of integration and optimal lag length, the Johansen and Juselius (1990) cointegration procedure was conducted. The results show that there exist a long run relationship between the variables in equation 13b, 14, 15 and 16. Specifically, the trace and Maximum eigenvalue tests indicated between 7 and 8 cointegrating equations, suggesting that there is a long relationship between oil price, aggregate output, sectoral output and other control variables.

4.2. The Two Stage Least Square (2SLS) Results

Table 4.1. 2SLS Regression Results

Model/Regressors	Coefficient/t-statistics
Aggregate Output equation (13b)	
constant	9.339 (2.386)**
L	0.116 (1.930)*

K	0.055 (2.851)**
Op	0.562 (4.145)***
τ	0.478 (1.234)
ΔY	0.207 (2.372)**
Ir	-0.053 (-2.314)**
G	0.178 (1.950)*
Y_w	0.113 (0.499)
Exr	-0.175 (-1.821)*
R^2	0.844
Adj R^2	0.832
Durbin Watson	2.428
J-statistic	1.946
Prob (J-statistic)	0.548
Instruments: Y(-1) L(-1) K(-1) Op(-1) τ (-1) ΔY(-1) Ir(-1) G(-1) Y_w(-1) Exr(-1)	
Cragg-Donald F-statistics: 3.261	
Agricultural Output equation (14)	
Constant	-9.508 (1.389)
Agl	0.034 (1.814)*
Agk	0.323 (1.476)
Op	0.069 (1.910)*
ΔAgy	0.164 (2.567)**
Agcre	0.014 (1.155)
Ir	0.020 (2.248)**
Raf	-0.134 (-1.542)
Aggex	0.155 (1.284)
Mafy	0.181 (1.429)
R^2	0.692
Adj R^2	0.689
Durbin Watson	1.93
J-statistic	1.569
Prob (J-statistic)	0.210
Instruments: Agy(-1) Agl(-1) Agk(-1) ΔAgy(-1) Agcre(-1) Ir(-1) Raf(-1) Aggex(-1) op(-1) Mafy(-1)	
Cragg-Donald F-statistics:	1.132
Manufacturing Output equation (15)	
Constant	4.119 (0.501)
Mafl	-0.251 (-0.493)
Mafk	0.584 (2.781)**
Op	0.058 (2.203)**
ΔMafy	0.031 (1.899)*
Ir	-0.001 (2.479)**

Maftx	-0.270 (-1.435)
Mafgex	0.682 (3.102)***
Agy	0.312 (1.896)*
R^2	0.725
Adj R^2	0.713
Durbin Watson	1.973
J-statistic	1.784
Prob (J-statistic)	0.182
Instruments: Mafy (-1) Mafl(-1) Mafk(-1) Op(-1) ΔMafy(-1) Ir(-1) Maftx(-1) Mafgex(-1) Agy(-1)	
Cragg-Donald F-statistics:	1.120
Service Output equation (16)	
Constant	-4.454 (-1.233)
Serl	0.495 (1.798)*
Serk	0.009 (3.521)***
Op	-0.019 (-2.562)**
Sercre	0.162 (2.419)**
Ir	0.006 (0.736)
VAT	-0.031 (-2.218)**
Δsery	0.162 (0.770)
Sergex	0.145 (3.621)***
R^2	0.811
Adj R^2	0.809
Durbin Watson	2.162
J-statistic	0.457
Prob (J-statistic)	0.499
Instruments: Sery(-1) Serl(-1) Serk(-1) Op(-1) Sercre(-1) Ir(-1) VAT(-1) Δsery(-1) Sergex(-1)	
Cragg-Donald F-statistics:	1.334

***, ** and * denote significance at 1%, 5% and 10%, respectively.
Figures in parenthesis are t-statistics

As articulated earlier, the results of the 2SLS for the aggregate output equation (13b), agricultural output (14), manufacturing output (15) and service output (16) are jointly presented in Table 4.1. From the result, oil price impacted positively on aggregate output but negatively on agricultural, manufacturing and service sector. This implies that an increase a 10% increase in oil price will trigger about 0.8% increase in aggregate output, 0.6%, 0.5% and 0.2% decrease in agricultural, manufacturing and service outputs respectively. This suggests that at the aggregate level, oil price tend to increase total output while the increase in

oil price tends to impact negatively on the output of productive sectors because it serves as input in the production process of these sectors. This result is in tandem with the findings of Alley, et al. (2014) that oil price has positive effect on economic growth in Nigeria.

The coefficients of labour engagement in the three sectors considered in this study reveal a positive and significant relationship with the outputs of agricultural and service sectors while that of manufacturing indicate a negative and insignificant relationship. This suggest that labour in manufacturing sector do not impact meaningfully on the output level in the sector this can be partly attributed to the low capacity utilization of the manufacturing because of the low technology development in the sector. Fixed capital assets in the three sectors affected the sectors' output positively with the coefficient for the fixed capital asset in the manufacturing sector indicating the highest suggesting that a 10% increase in fixed asset in the manufacturing sector would increase output in the sector by 5.5%.

Capital expenditure in the three sectors impacted meaningfully on the outputs of the sectors while real interest rate indicates a positive and significant effect on agricultural output but a negative and significant impact was found for manufacturing output. This further explains the low level of patronage of the financial institution by manufacturing firms due to high lending rate. The effect of VAT on the output of service sector can also be seen in Table 4.1. The coefficient of VAT suggests a negative relationship with output in the service sector. This result corroborates the argument of most studies that tax is a burden to most productive sectors of the economy.

The diagnostics i.e. the Durbin Watson, shows that there is no presence of serial correlation in the equations estimated. The adjusted R^2 which define the joint contribution of the explanatory variables in explaining variation in the dependent variable is above 70% indicating that there are no issues of missing variable or wrong specification in the models estimated. The test for the validity of the instruments (J-statistics) used in all the estimated equations indicates that the instruments chosen were valid while the Cragg-Donald F-statistics which is the test of the weakness of the instruments suggest that the instrument a strong and they all contributed in correcting for the possibility of endogeneity in the models estimated.

6. Conclusion and Recommendation

This study investigated the relationship between oil price fluctuation and aggregate output performance in Nigeria during the period 1970 to 2015. It employs the ADF unit root test and Johansen cointegration procedure to determine the time series properties of the data. The 2SLS instrumental estimation technique was used to estimate the impact of oil price on aggregate and sectoral outputs. Specifically, the three main nonoil productive sectors of the namely agriculture, manufacturing and service were considered in this study. The results obtained reveal that oil price impacted positively on aggregate output but negatively on agricultural, manufacturing and service sector suggesting that at the aggregate level, oil price tend to increase total output while an increase in oil price impacted negatively on the outputs of productive sectors since it serves as an input factor in the production process of these sectors. This indicates that fluctuation in oil price creates uncertainty in the production capacity of the productive sectors and it also undermines the effectiveness of the government fiscal management of crude oil revenue. The study, therefore, recommends that the Nigerian government need to diversify its export revenue base in order to minimize the over reliance on crude oil. Also, the country needs to develop the local capacity of its refining so as to reduce the importation of refined petroleum which serves as input to most productive sectors of the economy.

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