



## Oil Price Movements, Deficit Financing and Economic Growth in Nigeria: A Simultaneous Equation Approach

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### Abstract

The study investigates the inter-relationships between deficit financing (DF), oil price movement and economic growth in Nigeria. The paper employed annual time series data from 1980 to 2014. The causality between these variables were also examined. The study employed granger causality test and the 2SLS estimation techniques in a semi-log form after first considering the status of identification of the equations in the system. Both rank and order conditions of identification showed that the model was identified. The findings revealed the existence of a strong relationship between real GDP and oil price movement while deficit financing (DF) proved to be weak determinant of real GDP. In the model of oil price movement, only real GDP proved to be significant at 5 per cent while DF managed to explain oil price movement at 10 per cent level. Both real GDP and oil price movement proved to be significant determinants of DF. Uni-directional relationship exists between real GDP and DF; oil price movement and DF while a bi-directional relationship exists between real GDP and oil price movement.

**Keywords:** Real GDP, Oil Price Movement, Deficit Financing, 2SLS & Granger Causality

**JEL Classification:** F43, H62, C26

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### Introduction

Over the years, growth has been the major goal of most developing economies. Hence most emerging economies play key importance on drivers of economic growth. Evidence has shown in the literature that several factors such as capital, labour, technology, exports, foreign direct investment etc are significant determinants of economic growth in developing countries. Recently, especially in oil producing states, evidence of oil-led growth has also emerged. This is why most of the oil-rich nations (like Saudi Arabia) are experiencing accelerated growth in their economies. But for most developing countries, particularly in Africa, the abundance of oil could not explain why most of the states are poor, the presence of high level poverty and stunted growth rate. Intuitively, it can be argued that mismanagement or misallocation of oil resources, DUTCH disease syndrome, oil price fluctuations and the lack of policy direction on the part of African leaders may explain the reason for stunted growth amidst oil abundance.

In Nigeria for stance, hitherto, the economy highly dependent on oil revenue and so its activities revolve round oil prices and changes in oil prices. Nigeria's high dependence on oil revenue has nonetheless promoted the importance of oil as playing a key role in the determination of key national affairs (growth) ranging from budgetary allocations to its final impact on the economy as a whole. However, an examination of the trend or oil profile in Nigeria has shown series of oil shocks occurring overtime. These series of shocks so witnessed are as a result of fluctuations which play out itself in the changes that occur in demand and supply of oil in international market (Wakeford, 2006). However, these changes that occur are not without cause and effect on growth.

Furthermore, it is ascertained that governments make their budgetary decisions on the basis of expected revenue, and then it can also be posited that any activity that affects revenue, affects its source and so directly or indirectly affects the budget plan. If such is the case, then the proposition that the uncertainty accruing from oil price shocks will somewhat affect economic growth is not out of place. Because, deficits in budget which accrue from oil price shocks are financed through various means such as borrowings (both internally and externally), grants and aids, sales of government securities etc. Borrowing (which serves as a major source of deficit budget financing) affects the economy negatively in the long run as it translates to low economic performance, debt overhang, inflation etc. Since uncertainty or shocks in oil prices often lead to short fall in revenue, in the instance where reserve is not sufficiently adequate to accommodate the short fall in budget, deficit financing is believed to be the viable option. This has been found to promote economic growth (Osuji and Ozurumba, 2013).

Evidence of deficit-financed-led- growth in economic literature is still budding and same is true of oil-led growth. Based on this, it is widely believed that oil price movements and increase in deficit finance impact enormously on economic growth. Thus, it is imperative to undertake a complete investigation of the inter-relationships between and among these variables so as to provide policy direction for policy makers in Nigeria.

Therefore, the current study is focused to fill this observed gap in literature by investigating the inter-relationships between oil price movement, deficit financing and economic growth in Nigeria. Basically, the current study is designed to investigate the impact of oil price movement and deficit financing on economic growth in Nigeria as its broad objective. The specific objective therefore will be to examine the causality between these variables using time series data which covered the period 1980 to 2014 based on simultaneous equation approach.

## Literature Review

The role of oil in the conduct of fiscal and monetary policies in Nigeria has been evident. Apparently, records have shown that it accounts for about 95 percent of foreign exchange earnings, revenue to government 80 per cent and 12 per cent of real GDP (Anyanwu, 1997). Oil price movements upward or downward swings observed over time is likened to oil price shocks. Hamilton (1983) defined oil shocks "as the log of change in oil prices under the implicit assumption that the effect of oil shocks on economic activity was symmetric". Researchers have shown that oil shocks tend to have dampening influences on growth (Hamilton 1983, Kilian 2008). More so, oil price shocks have also been defined in regard to price fluctuations arising from the supply or demand side of the global oil market (Wakeford, 2006). Thus, unexpected oil price fluctuations are mainly referred to as oil price shocks. This can either be negative or positive depending on the cause and or perhaps the given situation at the period of the price change.

While positive shocks in oil price depict increase in oil price, negative oil price shocks in contrast depict decrease in oil price.

Deficit financing is not a relatively new concept in public finance economics. The concept is as old as man existence. But the concept gained prominence when the practice exists- where government's development and non-development expenditure exceed both current revenue and capital budget such that the government results in borrowing as a means of closing the gap. Also, when government indulges in different activities aimed at offsetting public debt. Thus, deficit financing according to CBN (2012) is seen as "the practice of seeking to stimulate a nation's economy by increasing government expenditures beyond revenue sources". Implicitly, deficit financing is financing embark on by an entity (either corporation or government) with a view to plummeting the effect of revenue shortfalls.

Nwaotka (2004) sees deficit financing "as a planned excess expenditure over income, dictated by government policy or creating fund to finance deficit by borrowing whether from internal or external sources, which must be repaid with interest within a specific period of time". Conversely, Stiglitz (2005) regarded deficit financing "as a situation in which the federal government's excess fund of outlays over receipt or revenue for a given period is financed by borrowed funds from the public". Thus, when a government spends more than it currently receives; it runs a deficit budget which is the brain behind deficit financing.

Several studies have shown mixed relationships pertaining to oil price movement and economic growth relationships. Hooker (2002), Lee (1998), Laser (1987), Goodwin (1985), Gisser (1985) and Hamilton (1983) found evidence of negative relationships. For example, Hooker (2002) opined that there exists a link between oil price level, oil price changes and economic growth proxy by GDP. In another study, Laser (1987) affirmed the nexus established between GDP and oil price movement. The result of the study shows that GDP (economic growth) decreases with increase in oil price. Lee (1998) in contrast, distinguish between the effect of oil price volatility and oil price changes on economic growth. While both were observed to have negative influence on growth, oil price volatility was seen to affect economic growth in the short-run as against price changes which affect economic growth in the intermediate run.

Conversely, Mark, et al. (1994), Ferderer (1996), Omisakin, et al. (2009), Oriakhi and Iyoha (2013) and Balke (1996) showed evidence of positive relationship. For example, Mark, et al. (1994) confirmed the positive connection between growth and oil price volatility. Ferderer (1996) also obtained similar results in which he established an asymmetric link between growth and oil price volatility.

In variant to previous findings, Morana (2013) found a weaker connection between growth and oil price fluctuations. In a related study, Olomola and Adejumo (2006) utilizing VAR methodology obtained a result quite contradictory to previous research. The outcome of their study indicates that shocks in oil price haveno significant influence on output. Similar findings were established in Jimenez-Rodriguez and Sanchez (2012) and Apere and Ijeoma (2013).

In another study conducted in India between oil price shocks, output and inflation, Sinha and Binde (1997) established a positive connection between oil price shocks and output. Using data from 1975-1992, Ayadi, et al. (2000) employed the VAR approach to investigate the impact of oil production shocks on Nigeria's economy. The outcome shows that there exists a positive link between oil production shocks and output. Furthermore, Ranguidin and Reyes (2005) conducted a study on the Philippine's economy employing VAR method and obtained the result that oil price

shocks leads to a protracted decrease in real GDP. The study conducted by Aliyu (2009) showed the outcome which indicates that distorted oil price increases have greater positive bearings on real GDP increase than other specifications.

Like the connection between oil price movement and economic growth, mixed findings also exist in literature as regards deficit financing and economic growth. For example, Adeboye (2003) studied the long run link between economic growth and budget deficit using 64 developing countries which were categorized into three based on rate of interest. The findings revealed a significant impact of budget deficit on growth. In another study, De Castro (2004) examined the impact of deficit financing in Spain. The outcome indicated that shocks arising from government spending lead to growth of GDP, investment and private consumption. Okoye and Akenbor (2010) in their study, obtained a positive connection between economic growth and deficit financing. Examining the link between growth and fiscal deficit on 45 developing countries, Adam and Bevan (2004) found that there exists a 1.5 percent level of deficit on GDP. This effect was however adduced to consistency in the treatment of budget constraint.

Furthermore, the study of five OECD countries conducted by Perotti (2004) shows that fiscal policy (deficit financing) has a negligible impact on GDP and thus the effect resulting from shocks that occur in government expenditure and tax cuts arising from GDP, and its constituent become substantially weaker overtime. Ojong and Hycenth (2013) looked at the impact of deficit financing on economic development in Nigeria employing OLS method. The outcome of the study indicated a significant connection between growth and government expenditure. Hence, it advocates reduction to the barest minimum of deficit financing.

In another study, Vincent, Wilson and Ioraver (2012) examined the link between fiscal deficit and GDP growth in Nigeria, adopting modelling technique that includes structural analysis and co-integration from 1970 to 2006. The study using co-integration techniques shows that fiscal deficit impacts economic growth negatively, and that there is a strong negative connection between government expenditure and economic growth. Ojong and Hycenth (2013) investigated the impact of deficit financing on economic development in Nigeria employing OLS regression techniques. They observed a significant connection between economic growth and government outlays while significant link does not exist between revenue and economic growth.

The study was conducted by Akinmulegun (2014) on the impact of deficit financing on economic growth utilizing variables which include inflation rate, real interest rate, budget deficit, gross capital formation, and real GDP. He observed no significant connection between deficit financing and economic growth. In a related study, Iyoha (2000) found that deficit financing depresses investment through both crowding out and dis-incentive effect thus affecting economic growth.

## The Model and Estimation Methodology

The study uses simultaneous equation approach to investigate the inter-relationship between and among oil price movement, deficit financing and economic growth in Nigeria. Based on the observed literature review, the various equations specified in the model are as shown below.

### Equation Explaining Economic Growth

Following Akinmulegun (2014), and Ojong and Effiong (2013), with some modifications, we specify economic growth equation, proxy by real GDP functionally as:

$$RGDP = F(OILP, DF, EXCHR, M2_{-1}, RGDP_{-1}) \text{-----} (1)$$

$$F_1 < 0, F_2, F_3, F_4 \text{ and } F_5 > 0,$$

Where: RGDP is real GDP, OILP is oil price movement, FD is fiscal deficit, EXCHR is real exchange rate while  $M2_{-1}$  is one period lagged broad money supply and  $RGDP_{-1}$  is one period lagged of real GDP.

Based on theoretical expectation, oil price movement (upward) affect economic growth positively, and vice versa. However, the overall net effect depends on the movement (upward or downward) that manifested the most in a given period. Deficit financing can affect growth positively but the debt burden arising from deficit financing has a negative effect. Exchange rate appreciation affects growth positively, and vice versa, and finally, money supply can affect growth positively including it-lagged values. One period lagged of real GDP has a positive consequence on current level of real GDP.

### Equation Explaining Oil Price Movements

In literature, several factors have been identified to cause variations or movements in oil prices, this include activities and issues resulting from OPEC operations, and the upheavals in the Middle East oil rich countries as well as other illegal activities affecting the individual oil producing countries at home (Kolawole, 2002 and Adelman, 2000). More so, since this paper investigates the inter-relationships between oil price movements, deficit financing and economic growth, the equation explaining oil price movements is specified as:

$$OILPM = T (RGDP, DF, EXCHR, INF, GEXP) \text{-----} (2)$$

Where INF is inflation and GEXP is government recurrent expenditure.  $T_1, T_2, T_3, T_4, T_5 < 0$  depending on the direction of oil price movement. Intuitively, stable and steady growth rate signal upward trends in oil price, and vice versa. Also, deficit financing can affect oil price movements either way (negatively or positively) depending on the frequent pattern of oil price movements. Exchange rate, like DF, may have a positive or negative effect on oil price movement. Inflation can affect oil price movement either positively or negatively depending the direction of price movements. Government recurrent expenditure may affects oil price movement negatively or positively too.

### Equation Explaining Deficit Financing

The influence of government fiscal policy on growth is mostly measured by the extent of the surplus or deficit. According to Cameron (1978), an increasing public expenditure is determined by relative richness of the state. Fiscal deficit is mostly funded by borrowings from the banking and external sector (NCEMA, (2004). In Nigeria for example, revenue from oil is the major source of financing public expenditure. In addition, the imports of goods and services, expenditure on social and economic infrastructure have been greatly boosted by increasing oil prices over the years (Hamdi and Sbia, 2013). Again, for the purpose of this study, the deficit financing in equation 3 is specified as:

$$DF = Y (OILP, RGDP, EXCHR, INF, DF_{-1}) \text{-----} (3)$$

It is expected that:  $Y_1 < 0, F_2, F_3 > 0, F_4 F_5 > 0$

Either positive or negative relationship can exist between oil price movements and deficit financing. This strongly depends on the net effect of oil price movements. Increase in economic growth is considered to have positive effect on deficit financing. Also, exchange rate appreciation

will affect DF positively. High level of inflation leads to decrease in DF as a way of reducing price level. Finally, the lagged values of DF may affect the current level positively.

From equation 1 to 3 therefore, we can now specify the simultaneous equation in semi-log econometric form as:

$$\text{LRGDP} = \text{OILP} + \text{DF} + \text{EXCHR} + \text{M2}_{-1} + \text{LRGDP}_{-1} + \text{-----} 4$$

$$\text{LOILPM} = \text{RGDP} + \text{DF} + \text{EXCHR} + \text{INF} + \text{GEXP} + \text{-----} 5$$

$$\text{DF} = \text{OILP} + \text{RGDP} + \text{EXCHR} + \text{INF} + \text{DF}_{-1} + \text{-----} 6$$

Where L indicates logarithm and 's are the stochastic error terms for each of the equation and they are assumed to be white noise. The log of the variables was the logical thing to do in order to present the estimates of the structural parameters in elasticity form. However, due to the presence of some negative values in DF observation, semi-logged form has been resorted to. This is quite plausible too.

The system of simultaneous equation in 4 to 6 has three dependent variables and the others are exogenous. The study employs 2SLS simultaneous equation regression technique to estimate the structural parameters of equation 4 to 6 with a view to investigating the inter-relationship between the dependent variables (RGDP, OILPM and DF). More so, to ensure that the independent variables are uncorrelated with the stochastic terms or residuals, and more importantly, to obtain a consistent and efficient parameters, this technique uses OLS in stage one to obtain the reduced form in each equation, that is, the estimated values of the dependent variables. In the next stage, the obtained values of the dependent variables are replaced with their actual or observed estimates in each of the equation and then, the structural parameters are obtained by estimating the equations using again OLS technique.

Nevertheless, to determine whether the system of simultaneous equations is estimable, the identification property or status of the equations is carried out. This is very vital, as unidentified system of simultaneous equation cannot be estimated. In this regard, both the necessary (Order) and enough (Rank) conditions to determine the identification properties of the equations in the model were employed. Apart from this, it was also necessary to test for simultaneity or endogeneity among the dependent variables, but unfortunately, this was overlooked due to the small sample size of the data, as this test is only plausible for large samples (see Gujarati and Porter, 2009).

From the Order condition results (Appendix 1), it was observed that all the equations (4 to 6) in the model were over-identified. Therefore, it is concluded that the system or model is over-identified. This procedure, though necessary but it is not enough for the identification of a system of simultaneous equations thus we proceed to the enough condition. Again, like the results of order condition, the rank condition results (Appendix 1) revealed that the system of equations in the model are identified. With this, the structural parameters of the system of equations in the model using 2SLS regression technique can be estimated, and as instrumental variable estimator, this is certain to yield consistent, asymptotically efficient and asymptotically normal estimates.

## Sources of Data

Time series data which cover the period of 1980 to 2014 were employed in the analysis. Data employed for the regression analysis were obtained from the Nigerian Central Bank Statistical Bulletin (2014). The data were analysed using E-views 9.0 statistical software.

### Presentation and Discussion of 2SLS Regression Results

The results of 2SLS simultaneous equation regression results are presented below in the following tables.

**Table 1: Economic Growth Equation**  
Dependent variable: LRGDP

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	2.20	0.90	2.44	0.02
LOILP	0.08	0.04	2.02	0.05
DF	8.81E-06	3.94E-05	0.22	0.82
LEXCHR	0.01	0.02	0.51	0.61
LM2(-1)	0.06	0.03	1.83	0.07
LRGDP(-1)	0.71	0.11	6.13	0.00
R <sup>2</sup> = 0.99	Adj. R <sup>2</sup> = 0.99	F-stat. = 1280.22 Prob. = 0.00	S.E = 0.04	DW = 1.66

Source: E-views 9.0 output, computed by authors

**Table 2: Oil Price Movement Equation**  
Dependent variable: LOILP

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-13.98	1.79	-7.80	0.00
LRGDP	1.90	0.21	8.92	0.00
DF	0.00	0.00	1.33	0.19
LEXCHR	-0.08	0.10	-0.82	0.41
LINF	0.01	0.05	0.33	0.73
LRECGOVEXP	-0.21	0.12	-1.71	0.09
R <sup>2</sup> = 0.92	Adj. R <sup>2</sup> = 0.91	F-stat. = 70.06 Prob. = 0.00	S.E = 0.20	DW = 1.84

Source: E-views 9.0 output, computed by authors

**Table 3: Deficit Financing Equation**  
**Dependent variable: DF**

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	4737.64	1703.67	2.78	0.00
LOILP	255.66	132.79	1.92	0.06
LRGDP	-594.85	220.96	-2.69	0.01
LEXCHR	79.06	40.09	1.97	0.05
LINF	-14.98	36.44	-0.41	0.68
DF(-1)	0.72	0.11	6.17	0.00
R <sup>2</sup> = 0.87	Adj. R <sup>2</sup> =0.84	F-stat. = 38.06 Prob.= 0.00	S.E = 148.63	DW = 1.66

Source: E-views 9.0 output, computed by authors

### Discussion of Results

In Table 1, the 2SLS regression result shows the inter-relationship between real GDP (proxy for economic growth), oil price movement and deficit financing. The growth equation indicates that the equation is highly robust given the high values of the coefficient of determination and the adjusted coefficient of determination values of 0.995 and 0.995 respectively. This implies that over 99 percent systematic variants in the growth equation are explained by the systematic variations in the explanatory variables using both R-squared and Adjusted R-squared coefficients. Only an infinitesimal variation in the growth equation was not explained by the variations in the explanatory variables but attributed to the error term. Thus, the equation has a good fit. The F-statistics as a measure of the significance of the coefficient of determination is highly significant at 1 percent level using the F-probability value of 0.000. This means that the independent variables are conjointly significant in explaining variants in the growth equation. The DW statistic of 1.66 is quite satisfactory and the standard error of regression is very low (0.046 value).

From the theoretical perspective, all the explanatory variables in the result in Table 1 are correctly signed. In addition, only three of the explanatory variables proved to be strong determinants of economic growth at 5 percent level of significance in Nigeria in the period under review. This includes log of oil price movement (t-value: 2.029), one period lagged value of broad money supply (t-value: 1.835) and one period lagged value of real GDP (t-value: 6.139). Deficit financing and exchange rate proved otherwise to be very weak determinants of economic growth at 5 percent level of significance. The policy implication of the result showed that oil price movement positively and significantly explained changes in economic growth while DF proved otherwise. Thus, oil price stability is critical to the growth of Nigerian economy. In addition, there is a strong inter-relationship between log of real GDP and log of oil price movement while that of DF and log of real GDP proved rather weak.

In the equation explaining oil price movement in Table 2, both the coefficient and adjusted coefficient of determination values of 0.927 and 0.914 respectively show a robust goodness of fit. In the same vein, R-squared and Adjusted R-squared proved to be highly significant at 1 percent level judging by the F-probability value of 0.000. This means that the explanatory variables combined, simultaneously explained variations in the log of oil price movement. The DW statistic



is highly satisfactory because it indicates the absence of first order autocorrelation in the equation. Thus, the equation is valid for making predictions.

Based on apriori expectation, log of real GDP, DF and log of INF have positive signs in relation to log of oil price movement while log of exchange rate and elasticity of recurrent expenditure proved to be negative. This may be an indication of a downward movement in oil prices in the period under review. Log of real GDP and log of recurrent expenditure prove to be significant determinants of log of oil price movements at 5 percent level of significance based on their t-values of 8.920 and -1.714 respectively. Thus, a strong inter-relationship exists between logarithm of real GDP and logarithm of oil price movement. However, DF with t-value of 1.333 manages to pass the t-test significant level at the 10 percent level of significance. While log of inflation and log of exchange rate did not pass the t-test level of significance. By extension, they (INF and EXCHR) are not significant determinants of log of oil price movement in the period under review.

Table 3 shows the results of equation explaining deficit financing. In the result, R-squared and R bar-squared are quite robust. This implies that over 84 percent systematic changes in the DF equation are explained by the systematic changes in the regressors using adjusted coefficient of determination. Thus, the equation has a good fit. Also, the hypothesis of a semi-log relationship between DF and the regressors combined in the equation cannot be rejected at 1 percent level of significance using the F-probability value of 0.000. The DW value of 1.662 is quite good.

Further, the t-statistics show that all the regressors except log of inflation are strong determinants of deficit financing including its one period lagged value at 5 per cent level of significance. This means that log of oil price movement and log of real GDP are important in explaining changes in DF. Unlike log of oil price movement, the negative sign of real GDP did not conform to apriori expectation. This may be expected during recession thus explains the negative sign. Log of exchange rate, log of inflation and one period lagged of DF are correctly signed though inflation proved to be weak determinant of DF. Overall, the log of oil price movement and the log of real GDP are significantly related to DF.

**Table 4: Causality Results: FD, LOILPM and Log of real GDP**

Null Hypothesis:	Obs.	F-Statistic	Prob.
FD does not Cause LR GDP	33	0.54	0.58
LR GDP does not Cause FD	33	3.66	0.03
LOILP does not Cause LR GDP	33	4.68	0.01
LR GDP does not Cause LOILP	33	5.96	0.00
LOILP does not Cause FD	33	4.11	0.02
FD does not Cause LOILP	33	2.29	0.11

**Source:** E-view 9.0 computed by Author

Though the study employed a simultaneous equation system approach to investigate the inter-relationship between oil price movement, deficit financing and economic growth, it was also worthwhile to examine the causality between these variables to determine the level of causation

between them. Using lag 2, the granger causality results in Table 4 shows that a uni-directional relationship exists between logarithm of real GDP and DF. The hypothesis is accepted that FD does not granger cause log of real GDP at 5 per cent level and the hypothesis is rejected that logarithm of real GDP does not granger cause DF at 5 per cent level. This means that causality runs from log of real GDP to DF and not vice versa. This result justifies the simultaneous equation results in Table 1 and 3, that log of real GDP is a significant determinant of DF (Table 3) and DF proved to be weak determinant of log of real GDP (Table 1).

More so, a bi-direction causality or relationship exists between logarithm of real GDP and logarithm of oil price movement. The hypothesis is rejected that the log of real GDP does not cause log of oil price movement, vice versa at 5 per cent level. This also justifies the simultaneous equation results in Table 1 and 2. Finally, rejected the hypothesis of oil price movement not granger causing FD at 5 per cent level and accepted the reverse. Thus, a uni-directional causality exists between LOILPM and DF, with causality running from LOILPM to DF.

## Conclusion

So far, study has attempted to investigate the inter-relationship between oil price movement, deficit financing and economic growth in Nigeria, in addition to the examination of their causality. The study used 2SLS simultaneous equation system approach and granger causality test. The findings obtained show that significant inter-relationship exists between the three key variables real GDP, oil price fluctuations and deficit financing in Nigeria. The study recommends oil price stability, fiscal provident and stable economic growth as the focus of government by ensuring proper monetary and fiscal policy coordination as well as exchange rate policy. The overall finding of this study is the inter-relationship between oil price movement, deficit financing and economic growth in Nigeria in the period under review.

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