The Effects of Crude Oil Price, its Volatility and Subsidy Removal on Economic Growth: Experience from Nigeria

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Abstract:- **The paper studies the effects of crude oil price, its volatility and subsidy removal on Nigeria's economic growth. The time series data on gross domestic product (GDP) and crude oil price (COP) used covered the period of 1973 to 2017. GARCH(1,1) was adopted to measure volatility of crude oil price. And the results of least squares(LS) estimation method applied to the multiple regression model specified showed that; COP and its volatility have positive effect on economic growth, significant at 1% and 5% levels respectively. This implies that the effects of positive shocks of global oil price are greater than negative shocks, hence, GDP growth rate is higher when crude oil price rises than GDP decline rate when crude oil price drops. The result also showed negative effect of subsidy removal on economic growth and it is significant under 1% level. This implies that GDP decreases as government withdraws subsidy. Hence, it becomes imperative for government and policy makers to reassess its economic policies frameworks to make Nigeria more investment friendly, so that other areas of the sector can contribute more to GDP growth,**

Keywords: **crude oil price, subsidy removal, economic growth, generalized ARCH**

I. INTRODUCTION

Since the discovery of oil in commercial quantity in 1956 at Olobiri, Bayelsa state , about 90 per cent of the country's foreign exchange earnings are accounted for by the exportation of crude oil. Thereafter, there have been a multiplicity of oil discoveries in the Niger-Delta area of Nigeria which has earned Nigeria the position of 6th largest oil producing countries in the world as recognized by organisation of petroleum exporting countries (OPEC) and 1st in Africa. Despite Nigeria's statutory position in the community of oil producing countries in the world, Nigeria has struggled to translate its resource wealth into developed economy where poverty level is very low.

For about five decades now, crude oil has been the major source of foreign exchange earnings and the leading source of revenue for the Nigerian government yet, Nigeria has remained undeveloped and according Adebayo(2018), Nigeria has overtaken India as the country with the largest number of people living in extreme poverty, with an estimated 87 million Nigerians, or around half of the country's population, thought to be living on less than $1.90 a day. Nigeria is also faced with important social, economic, and political challenges. Factors weighing on the economy include a large infrastructure gap, high gender and income inequality, corruption, and the ongoing humanitarian crisis in the northeast. Nigeria needs to forcefully address these challenges so that it can provide enough jobs for its young people in the years ahead. The economy is growing at close to 3 percent annually, with youth (0 to 19 years of age) accounting for more than 54 percent of the population. Demographic trends imply that Nigeria could be the third most populous country in the world by 2050. This could present a significant challenge to per capita growth, requiring faster action to improve per capita incomes, reduce high unemployment, and bring down poverty (IMF, 2018)

In the view to address the challenges that bedeviled the downstream oil sector has necessitated the fuel subsidy reform policy. These reforms and policy measures, though, not without their challenges are proposed to speed up the growth of the economy. This happens through the re-allocation of the subsidy fund to priority sectors such as education, health, infrastructure and agriculture (Umar and Umar, 2013; Akinyemi *et al.* 2015). the fuel subsidization which should be a helping factor to the poor and the poorest has become an opportunity for public funds embezzlement by corrupt stakeholders in the downstream sector and has also become more beneficial to the wealthy in the society (the majority consumers of this subsidized fuel).

These problems coupled with volatile oil prices and a sharp fall in oil production plunge the country into economy recession in 2016. According to IMF report of March 15, 2018, growth in Nigeria recovered to 0.8 percent in 2017 after a historic collapse in oil prices—exacerbated by falling oil production and inadequate policies—took a major toll on the economy The recent rise in oil prices is supporting the recovery, but more needs to be done to reduce unemployment and address poverty(IMF,2018).

Nigeria have taken several steps to reform the energy sector which includes the removal of subsidy in order to diversify the economy so as to boost domestic market and reduce overdependence on crude-oil exports. The Petroleum Industry Bill (PIB) is an example of reform attempts by the government to make the petroleum industry more competitive. Hence, in May 2011, the government announced the

withdrawal of the Fuel Subsidy and increased fuel pump price from the current regulated price- N65 to over N130 per liter. This increment generated an unprecedented nationwide demonstration against the government decision to increase the fuel pump price.

The first effect of the withdrawal of fuel subsidy in Nigeria is that the fuel prices become higher than usual, 'from the current regulated price- N65 to over N130 per liter (Ogundipe, et al., 2011), and this will also raise the prices of products and services in the society, especially in the market. Key components of basic needs indicators such as food, housing, clothing, and health will be affected, as access to them becomes costly. The cost of living becomes higher than it has been. This must be frightening especially to the poor. In the early 1980s when petrol prices climbed from less than 20 kobo per liter to the current regulated price of N65 per liter, there were immediate hikes in the price of virtually every product or service (Ogundipe, et al., 2011)

The downstream petroleum sector on 11th May, 2016 received a major policy turn that seemed to have altered the age long dynamics of the industry as the Nigerian National Petroleum Corporation (NNPC) announced the removal of petroleum subsidy and provided new pricing guidelines, designed to be cost reflective in line with market dynamics. According to the Nigerian petroleum minister, the subsidy on kerosene will stay, and of course, diesel is currently deregulated (The Guardian, 2011).

One of the contentious issues in Nigeria today is the removal of fuel subsidy on Premium Motor Spirit (PMS) (Akinwale et al., 2013). The subsidy is a form of price manipulation whereby the government fixes the pump price for sale to consumers and pays the retailer difference between the actual market price and the regulated or official price per litre. For me, subsidy can be seen as the extra money the government paid or incurred to make PMS pump price affordable to low income earners.

Jelilov and Alimi (2017). Discussed on Subsidy Removal from Nigerian Economy; Effect on Growth. They found that SMEs have played and continue to play significant roles in the growth, development, and industrialization of many economies the world over. In the case of Nigeria, SMEs have performed below expectation due to a combination of problems which ranges from attitude and habits of SMEs themselves through environmental related factors, instability of governments and frequent government policy changes etc.

Previous empirical researches have produced contradictory results chiefly on the effect of crude oil price on economic growth measured by real GDP. The study re-examine this using larger time series data. The present study also investigates the effects of crude oil price volatility and subsidy removal on the Nigeria's economic growth. This is the thrust of the study. The remaining part of the paper is arranged as follows; section 2 deals with the materials and methods, section 3 presents the empirical application, analysis and results and section 4 presents the conclusion and implications.

II. LITERATURE REVIEW

Olomola and Adejumo (2006) analyzed the effects of oil price shocks on output, inflation, real exchange rate and the money supply in Nigeria over the period 1970-2003.The vector autoregressive (VAR) method was employed to analysis data. Their findings indicated that the oil price shocks did not affect output and inflation but had strong effect on money supply and exchange rate. The implication is that a high real oil price may give rise to wealth effect that appreciates the real exchange rate. This may squeeze the tradable sector, giving rise to the "Dutch disease".

Delavari et al. (2008) reviewed the relationship between the oil price and the economic growth by using quarterly data from 1989 to 2007 in Iran. They understood that the oil shocks have the asymmetric effect on the economic growth.

Nwanna and Eyedayi (2016) investigated the impact of crude OPV on economic growth of Nigeria during period of 1980-2014. The results revealed that there is a positive and significant relationship between oil price and economic growth. Based on the findings, the researchers concluded that OPV does not have a positive impact on the economy. In the light of the above findings, the researchers recommended that, the country should diversify its export revenue base as a means of minimizing reliance on crude oil and petroleum products, Such as fiscal prudence, reform in budgetary operations, export diversification, revival of the non-oil sector of the economy, accountability and corporate governance.

Akinlo and Apanisile (2015) investigated the impact of the volatility of oil price on economic growth in 20 Sub-Saharan African countries from the period of 1986-2012. These countries were divided into Group A and Group B. Group A consists of 10 oil exporting countries, while Group B consists of non-oil exporting countries in sub-Saharan Africa. Panel data were used for the analysis. Panel pooled OLS, panel fixed effect model and generalized method of Moment model were employed in the estimation for both oil exporting and non-oil exporting countries. The estimation of panel A model consisting of the oil exporting countries showed that the OPV has a positive and significance effect on the economic growth of oil exporting countries. The result of panel B consisting of non-oil producing countries showed that the volatility of oil price also has a positive and insignificant impact on economic growth.

Mgbame et al. (2015) based on the empirical review found that there is a significant and positive relationship between oil price volatility (OPV) and Nigeria economic growth. the believe that oil price changes determines government expenditure level, rate of inflation, level of unemployment, which in turn determines the growth of the Nigerian economy

Jiménez-Rodríguez (2008) examined the hence, the country should diversify its export revenue base as a means of

minimizing reliance on crude oil and petroleum product thereby diversifying to agriculture, operations of budgetary, fiscal prudence, corporate governance, encourage savings and proper accountability

Benramdane (2017) tried to test the impact of OPV on economic growth in Algeria applying a VAR model using annual data over the period 1970-2012. This study's results indicated that the negative effects of OPV offset the positive impact of oil boom; therefore, it is argued that OPV drives the "resource curse" paradox in Algeria

Amir and Mohammad(2017) investigated the impact of oil price volatility on the economic growth in iran: using a threshold regression model and time series data period of 1980-2014 extracted from the Central Bank of Iran. Their findings showed that the OPV equal to 1147.77 acts as a threshold value. Also, due to the fact that the coefficient of OPV has decreased in the second regime compared to the first one, the effectiveness amount of the OPV on economic growth has decreased over time.

Lardic and Mignon (2008) studied the long run relationship between the oil price and economic activity on USA, G7, Europe and Euro area economies. The results indicated that the impact on GDP is bigger for rising of the oil price than for declining it.

Sarzaiem (2007) in his paper examined the relationship between oil shocks and behavior of macroeconomic variables (GNP, the real income from oil export, CPI, money supply, exchange rate and the government expenditure) in Iran. The results showed that the oil shocks affected variables in short run, but their impact disappeared in long run. Also, he stated that the oil shocks did not determinate the behavior of the economic different variables, but the economic policies adopted in response to positive and negative shocks, created change in the macroeconomic variables.

Oriakhi and Iyoha (2013) examined the consequences of OPV on the growth of the Nigerian economy within the period 1970-2010. Using quarterly data and employing the VAR methodology, the study found that among six variables employed, OPV impacted directly on real government expenditure, real exchange rate and real import, while impacting on real GDP, real money supply and inflation through other variables, notably real government expenditure

Oyeyemi (2013) confirms the positive relationship between oil price increases and economic situation; showing that during the periods of oil price decreases disruption effects occurred in balance of payments and government finances. Moreover, it was mentioned that even a small shock in global oil prices will have a long-term effect on the economic growth of the country. Similarly, Ani *et al*,(2014) studied on Oil price volatility and economic development: Stylized evidence in Nigeria, investigated chiefly the causal relationship between oil prices and key macroeconomic variables with data spinning from 1980 to 2010. Their findings indicate that there is a positive but insignificant relationship between oil price and the Nigerian GDP. Generally, oil prices have no significant impact on real GDP and exchange rate in Nigeria.

III. MATERIALS AND METHOD

This section provides information on source of data collection, variable measurement and definition, unit root test, Volatility measure, model specification and estimation and diagnostic tests..

3.1. Source of Data Collection

The data sets on gross domestic product (GDP) and crude oil price were obtained from published Central Bank of Nigeria (CBN) statistical bulletin of 2018. The yearly data sets cover the period of 1973 to 2017.

3.2. Variable Measurement

- Economic growth is measured using gross domestic product (GDP)
- Crude oil (COP) is measured in U.S dollars per barrel.
- Volatility of crude oil price $\left(V^{COP}\right)$ is measure using generalized ARCH model
- Subsidy is represented with dummy variable (SR), bearing 0 before removal and 1 during and after the subsidy removal.

3.3 Unit Root Test

The unit root test here, is based on Augmented Dickey Fuller (ADF) test and is of the form

$$\nabla y_t = \alpha + \alpha_1 t + \beta y_{t-1} + \sum_{i=1}^{k} \xi_i \nabla y_{t-i} + a_t \quad (1)$$

$$\nabla y_t = \alpha + \beta y_{t-1} + \sum_{i=1}^{k} \xi_i \nabla y_{t-i} + a_t \quad (2)$$

$$\nabla y_t = \beta y_{t-1} + \sum_{i=1}^{k} \xi_i \nabla y_{t-i} + a_t \quad (3)$$

where k is the number of lag variables. In (1) there is intercept term, the drift term and the deterministic trend. The non deterministic trend term removes the trend term as seen in (2) And (3) removes both the constant and deterministic trend term in the above regression. ADF unit root test null hypothesis $H_0 : \beta = 0$ and alternative $H_a : \beta < 0$. According to Dickey and Fuller(1979), if the ADF test statistic is greater than 1%, 5% and 10% critical values, the null hypothesis of a unit root test is accepted.

3.4 The Generalized ARCH (GARCH) Model

The volatility of crude oil price will be measure using GARCH(1,1) specification. And according Bollerslev (1986) a simple GARCH(1,1) can be given as

$$D(COP)_t = \theta + \varepsilon_t \quad (4)$$

$$\sigma_t^2 = \mu + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \quad (5)$$

where (4) is the mean equation and it is written as a function of mean θ with an error term ε_t. Since σ_t^2 is the one-period ahead forecast variance based on past information, it is called the conditional variance. The conditional variance equation specified in (5) is a function of a constant term μ, news about volatility from the previous period, measured as the lag of the squared residual from the mean equation ε_{t-1}^2 (ARCH term) and the Last period's forecast variance σ_{t-1}^2 (GARCH term). GARCH(1, 1) denotes the presence of a first-order autoregressive GARCH term (the first term in parentheses) and a first-order moving average ARCH term (the second term in parentheses). Note that the errors are conditionally normally distributed. α and β are parameter coefficients. If $(\alpha + \beta) < 1$, the model is covariance stationary.

3.5 Model Specification

The model specification in (6) represents the effects of crude oil price(COP), its volatility $\left(V^{COP}\right)$ and subsidy removal (SR) on economic growth (GDP) are presented in (6) below;

$$D(GDP)_t = \phi_0 + \phi_1 D(COP)_t + \phi_2 V_t^{COP} + \phi_3 SR_t + e_t \quad (6)$$

where $\phi_i (i = 0,1,2,3)$ are parameter coefficients, $V_t^{COP} = \sigma_t^2$ and e_t is the random error term.

3.6 Method of Estimation and Diagnostic Test

The method of estimating generalized ARCH will be based on Maximum Likelihood using Marquardt Algorithm. The multiple regression model will be estimated using method of Least Squares. Diagnostic test will be based on Breusch-Godfrey test for Serial Correlation and Heteroscedasticity test, and correlagram of squared residuals.

IV. DATA ANALYSIS AND RESULTS

This section deals with analysis of unit root test, summary statistics, generalized ARCH estimation, residuals diagnostic check for the fitted multiple regression analysis and discussion of results.

Table 1. ADF Unit Root Test

Variable	Deterministic Trend	Lag	Test Statistic	1%	5%	10%
GDP	C, t	1	-2.180734	-4.186481	-3.518090	-3.189732
COP	C, t	0	-1.899926	-4.180911	-3.515523	-3.18825
D(GDP)	C, t	0	-4.910447	-4.186481	-3.518090	-3.189732
D(COP)	C, t	0	-5.733416	-4.186481	-3.518090	-3.189732

The result of ADF unit root test indicates that GDP and COP are all integrated order one I(1) in their level series and integrated order zero I(0) in their first difference. In other words, GDP and COP are all stationary in their first difference.

Table 2. Analysis of volatility of crude oil price using GARCH(1, 1) Model

Dependent Variable: D(COP)

Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)

Sample (adjusted): 1974 2017

Included observations: 44 after adjustments

Convergence achieved after 19 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	1.050885	1.395290	0.753166	0.4514
Variance Equation				
C	3.390524	4.244035	0.798892	0.4244
RESID(-1)^2	0.411023	0.225648	1.821526	0.0685
GARCH(-1)	0.726526	0.145297	5.000277	0.0000
R-squared	-0.000000	Mean dependent var		1.055568
Adjusted R-squared	-0.000000	S.D. dependent var		13.02849
S.E. of regression	13.02850	Akaike info criterion		7.435723
Sum squared resid	7298.893	Schwarz criterion		7.597922
Log likelihood	-159.5859	Hannan-Quinn criter.		7.495874
Durbin-Watson stat	1.802567			

The result of Table 2 shows that volatility of crude oil price is strongly persistent since $(\alpha + \beta) > 1$. However, news about volatility from the previous period (ARCH term) has positive influence on the present volatility and is significant at 10 per cent level. And the Last period's forecast variance σ_{t-1}^2 (GARCH term) also has positive influence on present volatility and it is significant at 1 per cent level.

Table 3. Least Squares Estimate of Equation (6)

Dependent Variable: D(GDP)

Method: Least Squares

Sample (adjusted): 1974 2017

Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2684.098	5984.754	0.448489	0.6562
D(COP)	1453.788	378.4824	3.841098	0.0004
V_t^{COP}	45.92415	20.85599	2.201964	0.0335
SR	-116480.4	31199.23	-3.733438	0.0006
R-squared	0.411033	Mean dependent var		8195.636
Adjusted R-squared	0.366861	S.D. dependent var		40589.97
S.E. of regression	32297.45	Akaike info criterion		23.68987
Sum squared resid	4.17E+10	Schwarz criterion		23.85207
Log likelihood	-517.1772	Hannan-Quinn criter.		23.75002
F-statistic	9.305188	Durbin-Watson stat		1.917425
Prob(F-statistic)	0.000086			

The result in Table3 above indicates that changes in COP has positive effect on GDP and this is significant under 1 per cent level. Persistent crude oil price volatility exerts positive effect on GDP and it is significant under 5 per cent level.

Subsidy removal has negative effect on GDP and this is significant under 1 per cent level. These imply that crude oil price and its volatility enhance economic growth and Subsidy removal effects economic growth negatively. The value of R-squared indicates that about 41% of the variations in GDP have been explained by the explanatory variables. The p-value of F-statistic (9.3052) is significant hence, specifying the existence of linear relationship between the explained variable and the explanatory variables. Durbin-Watson statistic (1.92) is close to 2, indicating absence of serial correlation but a further test of serial correlation using Breusch-Godfrey Serial Correlation LM test as shown in Table4 indicates absence of serial correlation in the model residuals.

Sample: 1973 2017

Included observations: 44

Q-statistic probabilities adjusted for 3 dynamic regressors

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
.|. |	.|. |	1	0.033	0.033	0.0511	0.821
.*|. |	.*|. |	2	-0.082	-0.084	0.3788	0.827
.*|. |	.*|. |	3	-0.179	-0.175	1.9653	0.580
.*|. |	.*|. |	4	-0.081	-0.081	2.2965	0.681
.*|. |	.*|. |	5	-0.077	-0.108	2.6068	0.760
.|. |	.*|. |	6	-0.042	-0.091	2.6989	0.846
.|. |	.*|. |	7	-0.039	-0.092	2.7818	0.904
.|. |	.|. |	8	-0.002	-0.063	2.7821	0.947
.*|. |	**|. |	9	-0.171	-0.247	4.4811	0.877
.|. |	.|. |	10	0.062	-0.007	4.7078	0.910
.|. |	.*|. |	11	0.024	-0.077	4.7425	0.943
.|** |	.|*. |	12	0.253	0.169	8.8024	0.720
.*|. |	.*|. |	13	-0.074	-0.137	9.1555	0.761
.*|. |	.*|. |	14	-0.138	-0.160	10.431	0.730
.*|. |	.*|. |	15	-0.149	-0.164	11.979	0.681
.|*. |	.|*. |	16	0.178	0.148	14.273	0.578
.|*. |	.|. |	17	0.110	0.057	15.183	0.582
.|. |	.*|. |	18	-0.052	-0.143	15.390	0.635
.|*. |	.|*. |	19	0.078	0.134	15.889	0.665
.|. |	.|. |	20	0.002	-0.012	15.889	0.723
.|. |	.|. |	21	-0.060	0.054	16.209	0.758
.|. |	.|. |	22	0.022	0.015	16.255	0.803
.|. |	.|. |	23	-0.010	0.005	16.264	0.844
.|. |	.|. |	24	0.018	-0.050	16.296	0.877

*Probabilities may not be valid for this equation specification.

Figure1. Correlogram of Squared Residuals

The correlogram in Figure1 above has no significant spikes up to 24th lag. The Q-statistics are not significant at all lags, indicating absence of serial correlation in the residuals.

Table 4. Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.167625	Prob. F(2,38)	0.8463
Obs*R-squared	0.384790	Prob. Chi-Square(2)	0.8250

The result of Table4 above shows that the p-values of the F-statistic (0.8463) and the Chi-Square statistic (0.8250) are not significant, hence, there is no serial correlation in the residuals of the model.

Table5. Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.045702	Prob. F(3,40)	0.9868
Obs*R-squared	0.150303	Prob. Chi-Square(3)	0.9852
Scaled explained SS	1.093375	Prob. Chi-Square(3)	0.7787

The result of Table5 above indicates that the p-values of the F-statistic (0.9868) and the Chi-Square statistic (0.9852) are not significant, hence, there is no heteroskedasticity in the residuals of the model.

4.1 Discussion of Results

The results of the study indicate that crude oil price exerts positive impact on economic growth Which is measure using GDP and this is significant under 1 per cent. This finding agrees with that of Nwanna and Eyedayi (2016), Oyeyemi (2013) for Nigeria and Lardic and Mignon (2008) for USA. On the contrary is the finding of Ani *et al*,(2014) who reported insignificant positive relationship between oil price and GDP in Nigeria.

The result of Table3 indicates that oil price volatility has positive impact on economic growth and this significant under 5 per cent. This finding is in line with that of Akinlo and Apanisile (2015), Mgbame et al. (2015) for Nigeria and contrary to the findings of Benramdane (2017) for Algeria, Nwanna and Eyedayi (2016) for Nigeria and , Akinlo and Apanisile (2015) for 10 oil exporting countries in Sub-Sahara Africa. But on the contrary are the findings of Nwanna and Eyedayi (2016) for Nigeria, Amir and Mohammad(2017) for Iran

The result in Table3 also indicates that subsidy removal has a significant negative effect on economic growth. The implication is that GDP decreases as government withdraws subsidy. In other words, as pump price increase due to subsidy removal, cost of goods and services invariably increases and the overall contribution of SMEs to GDP growth decreases. This inference is in line with the observation of Ogundipe, *et al*.(2011) who said in the early 1980s when petrol prices climbed from less than 20 kobo per liter to the current regulated price of N65 per liter, there were immediate hikes in the price of virtually every product or service.

V. CONCLUSION AND POLICY IMPLICATIONS

It can be wrapped up that empirical results have shown that oil price and its volatility exert significant positive influence on Nigeria's economic growth. The implications are that were crude oil revenue contributes over 80 per cent of foreign exchange earnings like that of Nigeria, GDP growth must have a positive relationship with crude oil price; again, the significant positive effect of crude oil price volatility on economic growth implies that the effects of positive shocks of global oil price are greater than negative shocks, hence, GDP growth rate is higher when crude oil price rises than GDP decline rate when crude oil price drops.

Moreover, oil subsidy removal has a significant negative influence on economic growth. This is as a result of induced inflation, high cost of managing SMEs, private and public companies etc. However, it becomes imperative for government and economic policy makers to reassess its economic policies framework to make Nigeria more investment friendly so that other areas of the sector can contribute more to GDP growth,

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