Oil Price Shocks and their Impact on Capital Expenditure in Nigeria

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Abstract: Crude oil has been a major contributor to the growth of Nigeria economy, particularly as a source of revenue. However, the negative effect of its price volatility has tend to cripple the economy. Therefore, this study investigated on the outcome of the volatility of oil prices on Nigeria's capital expenditure. Annual time series data spanning from 1970 to 2018 was used in a vector error correction model when cointergration was found among the variables. Capital expenditure was found to respond negatively to oil price volatility and government total revenue while it responded positively to domestic debt and this has highly hinder the substantial impact of capital expenditure on the growth of the country. Variations in capital expenditure was found to be largely accounted for by shocks in oil price volatility in the short run and government revenue in the long run. The study among others consequently recommend, a diversification of sources of revenue

Keywords: Capital expenditure; Diversification; Oil price; Volatility

JEL Classification: C32; H50; H60; Q3

1. Introduction

Crude oil has played vital roles in Nigerian economy since its discovery in 1956. The discovery of the huge economically viable oil reserve led the country into dependence on a single resource. This hydrocarbon-rich mixture of crude oil and gases runs our factories, our cars, cools some homes and has provided Nigerian government with an unprecedented income in recent decades, accounting for about 70% and 69% of total government revenue in march 2018 and march 2019 respectively (Central Bank of Nigeria – CBN, 2019).

However, a major drawback of oil is its price volatility and the associated macroeconomic implications. Oil price fluctuation being found as a key cause of many crisis and economic instability in oil importing countries, it is also their key

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input in production activities but of most important is that it is main source of government revenues for the exporting countries (Elmi & Jahadi, 2011). In oil exporting countries, oil revenue affects Gross Domestic Product (GDP) as a part of export revenues directly. Following this direct effect, it indirectly affects the other aspects of GDP's equation. Volatility distracts oil exporting governments because they rely greatly on oil revenues as the principal budgetary source. Hence, the vital important channel of transferring the price shocks in these countries is government budget. Low prices lead to severe reduction of government expenditures. Conversely, high prices lead to demands for expenditure increases that are not sustainable in the long run. Thus, the volatility of oil prices results in difficulty in budgetary planning and fiscal management because frequent and large changes in government expenditure typically involve heavy costs. Also, sharp fluctuations in government spending make it difficult for the private sector to make long-term investment plans and decisions. (Ugo, 2003).

Given the vital role of oil in the world economy and the volatility associated with it prices, some studies have been conducted to unveil the various effects of the volatility of oil price; pioneer research in this direction include Darby (1982), Hamilton (1983), Burbidge and Harrison (1984), and Mork (1989). Most existing studies focus on the influence of the volatility of oil price on macroeconomic aggregates such GDP, inflation, government expenditures etc. Studies that focus on how oil price volatility impacts on disaggregate government expenditure hardly exist. Revenue shortfall due to low oil prices compels government to adjust its expenditures downward. Most often, capital expenditure suffers large downward adjustments because recurrent expenditures, which are essentially salaries and overhead, could hardly be adjusted automatically. Thus, Capital expenditure performance might be jeopardized by lower oil prices in the short run as government strives to keep its deficit within the limits of the fiscal responsibility act whist ensuring it meets its day-to-day obligations. Richard and Ronald (1980; cited in Oriakhi & Iyoha 2013) state that total abandonment of policies and projects had also characterized such times in Nigeria. Consequently, it will be of it interest to know how capital expenditures are affected by oil price volatility.

2. Review of Some Empirical Literature

Ademola (2006) using a VAR model examines the influence of changes in oil price on government expenditure and real imports in Nigeria. The result suggests that changes in oil price influences real imports and government expenditures. Studying the activities of oil in Kuwait Eltony and Al-Awadi (2001), found that shocks in oil price are significant in explaining fluctuations in Kuwait’s macroeconomic variables, pointing to the relevance of the shocks in in oil price on government expenditures.

In a survey on the impact of fluctuations in petroleum prices on key macroeconomic variables in ECOWAS member states, WAMA (2008) employed the unrestricted VAR methodology. Findings show that in general, oil prices take one-year lag before their effects are felt on the fiscal deficits of the countries and that it aggravates fiscal deficit positions of importing countries, while it largely improved fiscal deficit of oil producing countries. Regarding the reaction of deficits balance to changes in oil prices, it was found that Benin Gambia and Senegal had elastic responses of 1.09, 1.27 and 1.53 respectively while Nigeria had an elastic (negative) response of -1.83 percent. Also, Burkina, Cote d'Ivoire and Ghana had inelastic responses of deficits balance changes in oil price of (0.86, 0.37 and 0.05 respectively).

Jbir and Zouari-Ghorbel (2009) using quarterly data and the VAR methodology, examined the connectivity linking oil price shocks to economic activities in Tunisia. The results obtained portrays no direct influence of oil price shock in the linear and non-linear specifications used, rather, oil prices indirectly affects economic activities and it was discovered to be mostly transmitted via government's spending. In same vain, Akpan (2009) used VAR analysis and discovered an affirmative substantial effect of shocks in oil prices on Nigeria's real government expenditure, with marginal effects on growth of industrial output and real exchange rate appreciating substantially.

Also, on study in Nigeria, Omisakin, Adeniyi and Omojolaibi (2009) examined the short run implications of oil price shocks using Vector Error Correction (VECM) model on data for the period 1970-2006. Their study found that a 10% upswing in oil price brings about 79% upshot in oil revenue, 45% rise in government expenditure, 17% rise in money supply, 11% fall in CPI and 31% decline in GDP in short run, which implies that the economy is vulnerable to foreign oil price volatility. While using VAR approach, Lorde, Jackman, and Thomas (2009) saw that unplanned shocks to oil price volatility results in random swings but smaller impact on the economy of Trinidad and Tobago. However, it was government revenue and general price level that exhibited substantial responses. Also, causality was seen to flow from oil price to output and government revenue.

Further study on the ifluence of the shocks in prices of oil on the Nigeria's macroeconomic behaviour was carried out by Akinleye and Ekpo (2013) using the VAR estimation technique. The outcome revealed a support of the Dutch disease syndrome in the both long and short run. It showed that positive and negative shocks in oil price influences real government expenditure in the long run only, while on all forms of shocks to external reserves, it showed stronger consequences for expenditure and RGDP in the long run when it is positive price shocks than negative thus, triggering inflationary pressure and domestic currency depreciation as importation rises.

In more recent studies, Sadeghi (2017) looked at the size of government captured by the ratio of government expenditure to non-GDP as determining factor of influence of oil price shocks on economic growth with emphasis to 28 the oil-exporting countries between 1990 and 2016. The upshot of the analysis posits that unexpected upshot in oil prices was found to increase government expenditure which is larger with larger sizes of the government.

Following this is the study on the upshot of shocks in oil price on government expenditure particularly in the health and educational sector, carried out by Saudi Arabia Abdel-Latif, Osman, Ahmed and Charfeddine (2018) who made use of quarter data for the period 1990 to 2017. They employed, the non-linear autoregressive distributed lag model and outcome showed the existence of a non-linear connectivity linking oil prices and government expenditures with a substantial impact of negative shocks on government expenditure in the long-run as compared to positive shocks.

Also, Adedokun, (2018) studied the dynamic connectivity linking oil price shocks and government expenditure/government revenue employing a VAR and SVAR on the major variables while VEC was used for the general variables. Outcome showed that shocks in oil price do not account for changes in government expenditure in the short-run while in the long-run, shocks in oil price predicts the changes in government expenditure. The spend-tax hypothesis was confirmed in the long-run linking oil revenue to government expenditure.

3. Methodology

3.1. Model Specification

To capture the objective we employed the Vector Autoregressive (VAR) model as stated below:

$$X_t = \alpha + \sum_{j=1}^{p} X_{t-j}\, \emptyset_j + u_t$$

Where X_t = the vector of Government Capital Expenditure (GCEXP), Oil Price Volatility (OILP), Government Revenue (GOVR), Real Gross Domestic Product (RGDP), and Domestic Debt (DDT)

3.2. Estimation Procedures

In this study, we employed a three step econometric methodology in a VAR frame work. First, the staionarity of the time series of the variables were tested using the ADF, PP and KPSS with the KPSS test, having the null of stationarity, helps to resolve conflicts between ADF and PP tests. This is followed by a test for co-integration. The bond test for cointergration of Pesaran and Shin (1999) was used. It

demonstrates that cointegrating systems can be estimated as ARDL models, with the advantage that the variables in the cointegrating relationship can be either I(0) or I(1). It also has the advantages over other co-integration methods by helping to resolve problem of endogeneity associated with the Engle and Granger method in addition to treating the variables as endogenous estimating the long and short run parameters of the model simultaneously. In addition, unlike other methods, the ARDL procedure do not require equal lag lengths. The test is represented as follows:

$$\Delta Xt = \delta_{oi} + \sum_{i=1}^{k} \alpha_i \Delta Y_{t-1} + \sum_{i=1}^{k} \alpha_2 \Delta X_{t-1} + \delta_i Y_{t-1} + \delta_2 X_{t-1} + V_{1t}$$

The long run relationship of the underlying variables is detected through the F-statistic (Wald test).

We continue with VAR if cointegration is not established, if otherwise, we proceed to run a Vector Error Correction Model (VECM). Important components of the VAR are the IRF (Impulse Response Functions) and the Variance decompositions (VD). IRF traces out how responsive the regressand in the VAR is to shocks to all the variables. So, for the variable from each equation separately, a unit shock is applied to the error, and the effects upon the VAR system over time are noted. The VD itself, gives the share of the movements in the regressand that are accounted to their 'own' shocks, vis a vis shocks to other variables. It determines how much of the *s*-step-ahead forecast error variance of a given variable is explained by innovations to each explanatory variable for *s* = 1, 2, . . .(Gujarati & Porter 2009).

3.3. Data

The data was obtained from the Central Bank of Nigeria Statistical Bulletin from 1970 to 2018. This period covers the different times of the various shocks in the oil price. The Eviews econometric package is used for the analysis

4. Emprical Analysis

4.1 Preliminary test

4.1.1 Correlation matrix

The result as shown in table 4.1.1 shows that there is no multicollinearity among the variables. Positive correlation was found among all the pairs of the respective variables. The correlation linking government revenue to capital government expenditure seems high. But it shows that government capital expenditures are mainly from government revenue.

Table 4.1.1. Correlation Matrix

	CGEXP	OIL_PVOL	GOVR	RGDP	DDT
CGEXP	1	0.649225823	0.903	0.902	0.847
OIL_PVOL	0.649	1	0.756	0.676	0.573
GOVR	0.903	0.756	1	0.708	0.722
RGDP	0.902	0.676	0.708	1	0.780
DDT	0.846	0.573	0.721	0.780	1

Source: Author's computation in Eviews 9 on the data

4.1.1 Unit Root Test: The ADF, the Philip-PERRON and the KPSS tests were used to look at variable's stationarity state. Government capital expenditure (GCEXP), Domestic debt (DDT), and Real GDP were integrated at order one for the three test. Oil price volatility (OIL_PVOL) was stationary at levels for the ADF and KPSS but integrated of order one for PP, and given the uniformity of two tests, we conclude that it is station at levels. For government revenue (GOVR), while it was stationary at levels using ADF, PP and KPSS showed it to be integrated of order one. Hence, we conclude with the outcome of I(1) of the two test.

Table 4.1.2. Summary Presentation of Stationarity Test

VARIABLES	ADF		Remarks	Philip-PERRON		REMARKS	KPSS		Remarks
	T-Stat.	Critical Values		T-Stat.	Critical Values		LM-Sat	Critical Values	
CGEXP	-6.09310	-2.92516	I(1)	-5.946668	-2.92516	I(1)	0.43079	0.46300	I(1)
DDT	-3.61500	-3.52660	I(1)	-5.802499	-2. 92516	I(1)	0.27080	0.46300	I(1)
OIL_PVOL	-5.42387	-2.93694	I(0)	-6.530391	-2.92516	I(1)	0.45348	0.46300	I(0)
GOVR	-4.91993	-2.93694	I(0)	-6.976924	-2.92516	I(1)	0.21166	0.46300	I(1)
RGDP	-5.983528	-2.925169	I(1)	-5.983528	-2.92516	I(1)	0.35755	0.46300	I(1)

4.1.3. VAR Lag Selection Criteria

The VAR for criteria lag selection was used to determine the appropriate lag. Table 4.1.3.showed that LR, FPE, AIC, SC and HQ lag criteria estimators selected lag 4 as the most efficient estimator and this was used for the analysis.

Table 4.1.3. VAR Lag Order Selection Criter

VAR Lag Order Selection Criteria
Endogenous variables: CGEXP OIL_PVOL GOVR RGDP DDT
Exogenous variables: C
Date: 10/14/19 Time: 11:31
Sample: 1970 2018
Included observations: 45

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3239.791	NA	2.94e+56	144.2129	144.4137	144.2878
1	-2984.392	442.6903	1.06e+52	133.9730	135.1774	134.4220
2	-2925.762	88.59760	2.48e+51	132.4783	134.6864	133.3015
3	-2875.337	64.99161	8.95e+50	131.3483	134.5602	132.5457
4	-2792.259	88.61644*	8.52e+49*	128.7671*	132.9826*	130.3386*

*portrays lag selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Author's calculation using Eviews 9 on the data

4.1.4. Cointegration Test

The bounds testing cointegration procedure was used because of the different orders of integration. The result showed an F sat of 9.001410 and this is higher than the Narayan's 5% critical value of 2.823 and 3.872 at the lower and upper bounds respectively (see appendix). Therefore, we finalize there exist cointegration amidst the variables and fail to accept no cointegration. The model is hence estimated using the Vector Error Correction mechanism (VECM).

4.2. Impulse Responses to Shocks

The result of the IRF showing the individual and an accumulated impulse response to shocks of the individual variables to shock in itself and to other variables at 5% substantial level is present in Table 4.2 and Figure 4.1. The result reveals GCEXP responded positively to one standard innovation in itself all through the period with the exception of the 8th period. GCEXP responded negatively to shock in OIL_PVOL and GOVR all through the period with the exception of the 10th period 2nd period respectively. It responded positively to RGDP and DDT all through the period. The outcome of positive response of GCEXP to itself, RGDP and DDT all through the period and to GOVR in the 2nd period are in conformity with our expectation. The negative response of GCEXP to OIL_PVOL is not unexpected. Government capital expenditure in Nigeria is adversely affected by severe movement in oil prices. The policy implication of these findings is that Nigeria government often falls back to borrowing and deficit financing hence GCEXP is found to respond positively to DDT.

Table 4.2. Response of GCEXP

Response of GCEXP: Period	GCEXP	OIL_PVOL	GOVR	RGDP	DDT
1	70183.95	0.000000	0.000000	0.000000	0.000000
2	5422.331	-46674.99	32422.11	3507.699	8719.309
3	93748.60	-526.3655	-289.3599	21258.58	23300.70
4	57525.39	-88027.41	-38235.54	29990.40	53154.64
5	118117.2	-89155.15	-65171.50	42878.79	42371.19
6	36668.52	-100282.6	-37820.70	34822.61	53577.39
7	99429.18	-62042.66	-175209.3	37095.52	9513.211
8	-56784.05	-66214.90	-139847.6	20561.83	37905.66
9	93117.38	-14151.77	-322785.6	18677.77	9941.086
10	12108.44	24313.53	-351993.6	11135.68	94557.13

Source: Author's calculation in Eviews 9 on the data

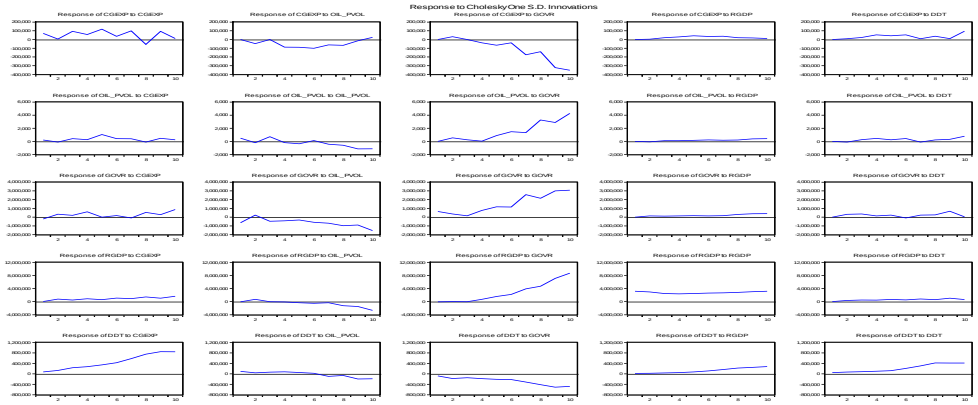

Figure 4.1. Impulse Responses

Source: Author's calculation in Eviews 9 on the data

4.3. Variance Decomposition

The forecast error variance decomposition outcome of GCEXP are as presented in Table 4.2 and Figure 4.2. It shows that majority of the source of the changes in the forecast errors of GCEXP, was own shocks especially in the short run. This was between the ranges of 13% to 100% over the ten years. The result shows that after own shocks, the other major contributors to innovations in GCEXP were OIL_PVOL and GOVR.OIL_PVOL contributed more of the forecast error in the short run and in the intermediate period, rising from 26% in the 2nd period to 34% in the 6th period and then to 9% in the 10th period; indicating that about 26% and 34% of the forecast error variance in GCEXP is being explained by OIL_PVOL in the short run and intermediate period respectively.

GOVR accounted for majority of the forecast error in the very long period with its forecast error rising from 12% to 71% implying that about 71% of the forecast error variance of GCEXP is explained by GOVR in the long run. Hence, we can inferred that the influence of the volatility of oil prices on GCEXP is felt much in Nigeria at the very short period. This finding implies that Capital expenditure performance might in the short run be threatened by reduction in oil prices as government strives to maintain its deficit within the limits of the fiscal responsibility act whist ensuring it achieves day-to-day obligations. We can thus conclude that the variations in GCEXP are largely due to own shocks, variations in OIL_PVOL in the very short run and largely by GOVR in the long run.

Table 4.3. Variance Decomposition of GCEXP

Variance Decomposition of GCEXP:

Period	S.E.	GCEXP	OIL_PVOL	GOVR	RGDP	DDT
1	70183.95	100.0000	0.000000	0.000000	0.000000	0.000000
2	90957.50	59.89397	26.33247	12.70590	0.148719	0.918940
3	134377.4	76.11329	12.06623	5.821902	2.570882	3.427698
4	185208.2	49.71466	28.94186	7.326770	3.975432	10.04127
5	253147.4	48.38184	27.89527	10.54959	4.996981	8.176321
6	284602.1	39.93837	34.48575	10.11251	5.450556	10.01282
7	356228.4	33.28292	25.04532	30.64591	4.563435	6.462416
8	394872.7	29.15514	23.19494	37.48391	3.985087	6.180915
9	519070.2	20.09059	13.49751	60.36256	2.435695	3.613646
10	634930.0	13.46381	9.167625	71.07689	1.658643	4.633034

Source: Author's calculation using Eviews 9 on the data

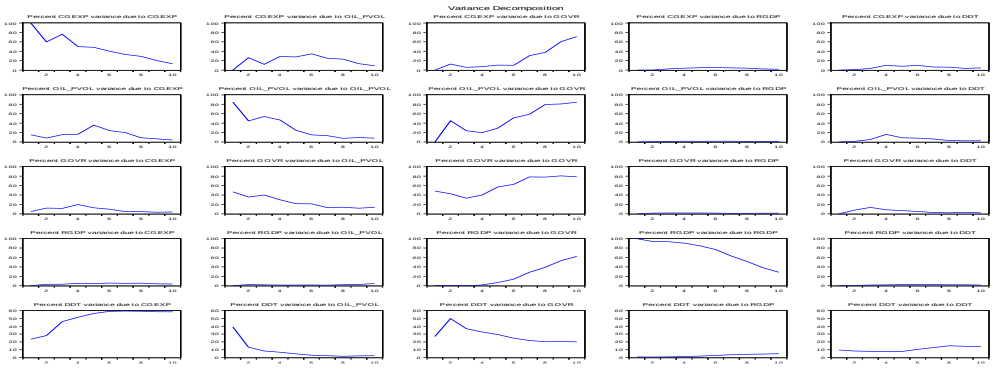

Figure 4.6.2. Variance Decomposition of GCEXP

Source: Author's calculation using Eviews 9 on the data

5. Policy Corollaries of Empirical Findings

5.1. Policy suppositions

Given the empirical outcome, the following are the policy suppositions drawn from the result:

i. Government capital expenditures responded negatively to oil price volatility all through the period which was however not unexpected and the variations in CGEXP apart from own shocks are largely due to variations in OIL_PVOL which varied between the short run and long run. This indicates an adverse effect of the severe movement in oil prices. Hence, we recommend that diversification of sources of revenue for government expenditure, particularly, capital expenditure;

ii.Government capital expenditure responded negatively to government revenue and shocks to GCEXP was due to GOVR largely in the long run. This is attributed to the fact that the major source of revenue is from oil, and given the volatility of oil price, the revenue follows the same trend being volatile. It is thus impetus to separate government revenue from oil price through increase the contribution of the non-oil sectors of the country;

iii. Government capital expenditure was seen to respond positively to domestic debt all through the period. The policy implication is that Nigeria government often falls back to borrowing and deficit financing for capital expenditures.

6. Conclusion

This study examined the influence of volatility of crude oil prices on the economy of Nigerian from 1970 to 2018 using annual data. This outcome of the research implies that the performance of Capital expenditure in Nigeria is being threatened particularly in the short run by the volatility oil prices while in the long run, government resorts to domestic debt to finance the expenditure. This has highly hinder the substantial impact of capital expenditure on the country's economic growth as government always strives to maintain low deficit. Obviously, capital expenditures suffer in the short run because there is the haste to spend on recurrent items, as they are fixed charges. Arising from the above, the Nigerian government must make concerted effort to open up various sources of government revenue to protect the country against negative shocks in oil prices

References

Abdel-Latif, H.; Osman, R.; Ahmed, H. & Charfeddine, L. (2018). Asymmetric impacts of oil price shocks on government expenditures: Evidence from Saudi Arabia. *Cogent Economics and Finance, 6(1), Taylor and Francis online*. Accessed 3/3/2020 from https://www.tandfonline.com/doi/full/10.1080/23322039.2018.1512835.

Adedokun, A. (2018). The effects of oil shocks on government expenditures and government revenues nexus in Nigeria (with exogeneity restrictions*). Future Business Journal*, 4(2): pp. 219-232, December accessed 3/3/2020 from https://www.sciencedirect.com/science/article/pii/S2314721017300427.

Akinleye, E. S. O. & Ekpo, S. (2013). Oil Price Shocks and Macroeconomic Performance in Nigeria. *Economical Mexicana*, 2: pp. 565-624.

Akpan, E. (2009). Oil price shocks and Nigeria's macro economy. *Journal of Economics*, 4(2): pp. 12-19.

Burbidge J. & Harrison, A. (1984). Testing for the effects of oil-price rise using vector autoregressions. *International Economic Review*, *25*: pp. 459–484.

Central Bank of Nigeria Statistical Bulletin, (2019), 29, December.

Darby, M. R. (1982). The price of oil and world inflation and recession. *American Economic Review*, 72: pp. 738–751.

Elmi, Z. & Jahadi, M. (2011). Oil price shocks and economic growth: Evidence from OPEC and OECD. *Australian Journal of Basic and Applied Sciences*, 5(6): pp. 627-635.

Eltony, M. N. & Al-Awadi, M. (2001). Oil price fluctuations and their impact on the macroeconomic variables of Kuwait: A case Study using a VAR model. *International Journal of Energy Research*, 25 (11), pp. 939-959.

Gujarati, D. N. & Porter, D. C. (2009). *Basic econometrics* (5th Ed), New York: McGraw- Hill.

Hamilton, J. D. (1983). Oil and the macroeconomy since World War II. *Journal of Political Economy*, 91: pp. 228-248.

Jbir, R. & Zouari-Ghorbel, S. (2009). Recent oil price shocks and Tunisian economy. *Energy Policy*, 37: pp. 1041-1051.

Lorde, T.; Jackman, M. & Thomas, C. (2009). The macroeconomic effects of oil price fluctuations on a Small Open Oil-Producing Country: The case of Trinidad and Tobago. *Energy Policy*, 37: pp. 2708-2716.

Mork, K. A. (1989). Oil and the macroeconomic when prices go up and down: An extension of Hamilton's results. *Journal of Political Economy*, 97:pp. 740-744.

Omisakin, O, Adeniyi, O. & Omojolaibi. A (2009). A vector error correction modeling of energy price volatility of an oil dependent economy: The case of Nigeria. *Pakistan Journal of Social Sciences*, 6 (4): pp. 207-213.

Oriakhi, D. E. & Iyoha, D. O. (2013). Oil price volatility and its consequences on the growth of the Nigerian economy: An examination (1970-2010). *Asian Economic and Financial Review*, 3(5): pp. 683-702

Pesaran, M. H. & Shin, Y. (1999). An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis. *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, Strom, S. (ed.). Cambridge University Press.

Sadeghi, A (2017). Oil price shocks and economic growth in oil-exporting countries, does the size of government matter? *International Monetary Fund WP/17/287.*,

Ugo, F. (2003). *Fiscal policy in oil exporting countries and the role of stabilization funds.* IMF/ U.N. Workshops Bonn, May.

Appendix

Table 1. Cointegration Test

ARDL Bounds Test
Date: 10/14/19 Time: 11:29
Sample: 1971 2018
Included observations: 48
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	K
F-statistic	9.001410	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06