IMPACT OF OIL PRICE VOLATILITY ON ECONOMIC GROWTH IN NIGERIA: A VAR ANALYSIS

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ABSTRACT

This study assessed the *effect of oil price volatility on economic growth in Nigeria, for the period 1981-2016, using vector Autoregressive modeling approach. The focus was on the relationship between oil price changes and selected macroeconomic variables with particular emphasis on real GDP which acted as proxy for economic growth. From the findings, it was observed that oil price at the prevailing exchange rate determines the level of government spending, which in turn determines real GDP. Also, own innovations and innovations due to oil price volatility, exchange rate and consumer price index, are to a large extent, the leading sources of economic shocks in Nigeria. From the foregoing, the core emphasis should be centered on the attainment of a long-lasting breakthrough by way of mitigating the damaging effects of oil price unpredictability to attain a swift and sustainable development in Nigeria. From the findings, it was observed that, Oil price at the prevailing exchange rate determines the level of government spending, which in turn determines real GDP. Overall, it can be said that there is a crucial relationship between oil price volatility and economic growth and due to the fact that the Nigerian economy is highly vulnerable to oil price changes, expected growth targets are hardly met.*

KEY WORDS: Oil Price, real GDP, FEVD, IRF, Vector Autoregression, Nigerian.

1.0 INTRODUCTION

Issues in oil price volatility and how it impacts on economic growth have continued to generate controversies among economic researchers and policy makers. While some (such as Akpan (2009), Aliyu (2009), Olomola (2006), etc) argue that it can promote growth or has the potential of doing so others (such as Darby (1982), Cerralo (2005) etc) are of the view that it can inhibit growth. The former argue that for net-oil exporting countries, a price increase directly increases real national income through higher export earnings, whereas,

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the latter cite the case of net-oil importing countries (which experience inflation, increased input costs, reduced non-oil demand, lower investment, fall in tax revenues and ultimately an increase in budget deficit which will further reduce welfare level) in advancing their argument. Thus the impact (positive or negative) which oil price volatility could have on any economy, depends on what part of the divide such economy falls into and of course the nature of such price change (rise or fall). However, the Nigerian economy uniquely qualifies as both an oil exporting and importing economy, by reason of the fact that she exports crude oil, but imports refined petroleum products. Making a conclusive and authoritative statement on the impact of oil price volatility on the Nigerian economy is therefore difficult. Estimating the consequences of oil price shocks on growth is particularly relevant in the case of Nigeria. As a small open economy, it has no real influence on the world price of oil, whereas, it is greatly influenced by the effect of oil price volatility both as an exporter of crude oil and importer of refined petroleum products. It thus implies by simple reasoning that oil price volatility whatever the nature (either a rise or fall) can both benefit and hurt the economy at the same time. Basically, the crux of the problem lies in the fact that the country has extremely relied on this commodity over the years, making its economy a monoproduct economy and this has triggered severe structural difficulties for the economy. For example, in 2008 when oil price fell from a peak of $147 to about $37.81 per barrel, the budget witnessed significant cuts in budgeted revenue and expenditure. These cuts had attendant effect on all aspects of the Nigerian economy; apparently budgetary operations in Nigeria are strongly linked to happenings (price, demand and supply) in the international oil market. Oil price volatility has been found to have had a more direct effect on the exchange rate of the Naira than probably any other economic variable, this is because crude oil export earnings accounts for a large chunk of Nigerians foreign exchange (about 90%) and thus ultimately determines the amount of foreign reserves of the country which is alarmingly low (about $30billion from over $60billion in 2008) and continuously keeps depleting.

OBJECTIVE OF THE STUDY

This paper has as its main objective, the examination of the consequences of oil price volatility on the growth of the Nigerian economy within the period of 1981 and 2016 using quarterly time series data sourced from the CBN Statistical Bulletin. In order to achieve this objective, the paper is structured into five sections. The introduction makes up Section 1, Section 2 reviews related literature (theoretical and empirical). Section 3 highlights the theoretical foundations of the study. The model for our empirical work is also specified in this section. Empirical analysis and discussion of the policy implication of the empirical results are presented in Section 4. Section 5 contains the recommendations and conclusion.

2.0 LITERATURE REVIEW

As crude oil arguably constitutes one of the single most important driving forces of the global economy, oil price fluctuations a rebound to have significant effects on economic growth and welfare. Indeed, the level of oil dependency of industrialized economies became particularly clear in the 1970s and 1980s, when a series of political incidents in the Middle East disrupted the security of supply and had severe effects on the global price of oil. Since then oil price shocks have continuo usly increased in size and frequency (Rentschler, 2013).. While demand for oil is likely to remain relatively slow moving, mainly driven by economic growth and to some extent climate policies, supply will remain highly uncertain, not least considering persistent instability in exporting countries and the uncertainty regarding the discovery of new resources. As a result of such uncertainties, an d in the context of today's tightly traded markets, future oil prices are also expected to undergo (increasingly) drastic fluctuations.

Theoretically, an oil price shock can be transmitted into the macro-economy via various channels. Principally, a positive oil price shock will increase production costs and hence restrict output (henceforth denoted as *'input channel'*) (Barro, 1984). Energy intensive industrial production will be more affected than service based industries. A prolonged oil price increase will necessitate cos tly structural changes,to production processes with potentially adverse employment effects. However, it is crucial to note that the frequency of oil price shocks (both positive and negative) increases perceived price uncertainty. According to Bemanke (1983), such oil price volatility will reduce planning horizons and cause firms to postpone irreversible business investments *('uncertainty channel*').

THE OIL-GDP LITERATURE — REVIEW OF EMPIRICAL EVIDENCE

The literature on oil price volatility and its attendant consequence on economic growth are quite broad and continue to expand. As Adelman (2000) notes; —crude oil prices have been more volatile than any other commodity price [although in principle it ought to be less volatile]. He notes that though oil price movements have always occurred mainly due to seasonal changes in demand, such movements were small.

To understand the nature of the oil-GDP relationship, it is crucial to consider the existence of asymmetry, i.e. adverse effects of oil price increases exceed stimulating effects of oil price decr eases. However, the empirical evidence for the nature of this asymmetry is ambiguous. While it is generall y agreed that increases have adverse effects, evidence for the effects of decreases is far from conclusive. Mork (1989) distinguishes between positive and negative oil price shocks and finds t hat oil price increases reduce GDP while decreases have hardly any impact. However, Mork et al. (1994) find that oil price increases and decreases both have negative consequences for the US economy, while results for the UK, Japan, France, Norway, Germany and Canada are inconclusive. Mory welfare. Indeed, the level of oil dependency of industrialized economies became particularly clear in the 1970s and 1980s, when a series of political incidents in the Middle East disrupted the security of supply and had severe effects on the global price of oil. Since then oil price shocks have continuo usly increased in size and frequency (Rentschler, 2013).. While demand for oil is likely to remain relatively slow moving, mainly driven by economic growth and to some extent climate policies, supply will remain highly uncertain, not least considering persistent instability in exporting countries and the uncertainty regarding the discovery of new resources. As a result of such uncertainties, an d in the context of today's tightly traded markets, future oil prices are also expected to undergo (increasingly) drastic fluctuations.

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(1993) and Lee et al. (1995) find that oil price decreases have no impact on the US economy. Lardic and Mignon (2006) show that standard cointegration is rejected for most of the twelve European sample countries, while *asymmetric* cointegration is determined to be of major relevance in explaining the impact of oil price shocks. The underlying reasoning is that asymmetry is caused by asymmetric monetary policy, i.e. more drastic policy measures in response to oil price increases, than to decreases (Hamilton and Herrera, 2004). Ferderer (1996) indeed confirms a strong link between oil price shocks and monetary policy responses, but nevertheless argues that oil prices Granger cause GDP directly. Hence he concludes that asymmetric monetary policy alone is not sufficient to account for the asymmetric oil-GDP relationship. In addition to monetary policy, downward stickiness of wages and prices due to, e.g. institutional regulation or contractual commitments, is a standard explanation for asymmetric effects. For the purposes of this study asymmetry is of major importance: While in a symmetric scenario a positive and a negative oil price shock would cancel each other, in an asymmetric setting the presence of price movements (i.e. volatility) per se will impact on economic indicators.

Many studies on oil price volatility and the economy adopt the GARCH analytical framework. Duffie and Gray (1995) construct in-sample and out-of-sample forecasts for volatility in the crude oil, heating oil, and natural gas markets over the period May 1988 to July 1992. Forecasts from GARCH(1,1), EGARCH(1,1), bi-variate GARCH, regime switchingl8, implied volatility, and historical volatility predictors are compared with the realized volatility to compute the criterion RJV1SE for forecast accuracy. They find that implied volatility yields the best forecasts in both the in-sample and out-of-sample cases, and in the more relevant out-of-sample case, historical volatility forecasts are superior to GARCH forecasts.

Cunado and de Gracia (2005) study how oil price shocks affect the growth rate of output of a number of developed countries employing alternative regime switching models. The findings of their analysis show that positive oil price changes, net oil price increases and oil price volatility have an effect on output growth. Cologni and Manera (2009) using a Markov-switching analysis for the G-7 countries show that positive oil price changes, net oil price increases and oil price volatility tend to have a greater impact on output growth. Moreover, their analysis suggests that the role of oil shocks in explaining recessionary episodes have decreased over time. Finally, they conclude that oil shocks tend to be asymmetric.

Rentschler (2013) investigated the adverse effects of oil price volatility on economic activity and the extent to which countries can hedge against such effects by using renewable energy. By considering the Realized Volatility of oil prices, rather than following the standard approach of considering oil price shocks in levels, the effects of factor price uncertainty on economic activity were analyzed. The;

paper found that the sensitivity to oil price volatility varies widely across countries and discusses various factors which may determine the level of sensitivity (such as sectoral composition and the energy mix). Overall, the study provided an additional rationale for reducing exposure and vulnerability to oil price volatility for the sake of economic growth.

EMPIRICAL LITERATURE ON NIGERIA

A number of studies have been carried out on oil and the Nigerian economy which gives the direction the oil price volatility may ne inimical to the economy. However evidences from other studies have not been as straightforward as those just reviewed. Akide (2007) investigated the impact of oil pri ce volatility on economic growth indicators in Nigeria using quarterly data from 1970 to 2000. He found out that within the period of study oil price shocks did not affect output and inflation in Nigeria , but significantly influenced real exchange rate. In another study for Nigeria, Olomola (2006) found out that oil price volatility is hi ghly significant in explaining GNP growth and unemployment.

Apere and Ijomah (2013) investigated the time-series relationship on the impact of oil price volatility on macroeconomic activity in Nigeria using exponential generalized autoregressive conditional heteroskedasticity (EGARCH), impulse response function and lag-augmented VAR (LA-VAR) models. They found evidence that there is a unidirectional relationship between the interest rate, exchange rate and oil prices, with the direction from oil prices to both exchange rate and the interest rate. However, a significant relationship between oil prices and real GDP was not found.

Oriakhi and lyoha (2013) this study examines the consequences of oil price volatility on the growth of the Nigerian economy within the period 1970 to 2010. Using quarterly data and employing the VAR methodology, the study finds that of the six variables employed, oil price volatility impacted directly on real government expenditure, real exchange rate and real imp ort, while impacting on real GDP, real money supply and inflation through other variables, notably real government expenditure. This implies that oil price changes determine government expenditure level, which in turn determines the growth of the Nigerian economy. This result seems to reflect the dominant role of government in Nigeria. Considering the destabilizing effects of oil price fluctuations on economic activity and government spending in Nigeria, the study makes some recommendations. Some of these include; fiscal prudence, reform in budgetary operations, export diversification, revival of the non-oil sec tor of the economy, accountability and corporate governance.

In summary, the relationships between oil price and macroeconomic variables have been examined in several developed and developing countries. In this study, we focus on whether these causal relationships exist in Nigeria. We analyze the relationships between oil price volatility and macroeconomic variable volatility based on the data of Nigeria from 1981 to 2016. Furthermore, we use an EGARCH model to estimate the volatility of the oil price and of macroeconomic variables. Moreover, the lag-augmented VAR (LA-VAR) approach is applied to investigate the causal relationships between oil price volatility and macroeconomic variable volatility.

3.0 THEORETICAL FRAMEWORK AND MODEL SPECIFICATION

There exist some theories on the oil price v olatility effect on economic growth in the literature, such as; the Decoupling theory, Income transfer model of growth etc. The theories reviewed are still at their crude stage, this is vivid from the quality of their analysis, ambiguit y in conclusions and submissions and a clear absence of an econometric face. This is not unconnected to the background of the proponents of these theories, many of whom are scientists, ecological and environmental economists. The submissions of these theories however provide analytical foundations on which to compose our empirical investigations.

3.2 MODEL SPECIFICATION

From the review of literature and the discussion and examination of the theoretical framework, we specify our model. The model uses oil prices and real GDP figures since our main objective is to analyze the effects of change in the former on the later. This research study uses real GDP as the measure of economic growth and the four quarter standard deviation of oil price as the measure of oil price volatility. Th e unrestricted VAR model of order P is presented in equation

1; $Y_t = A_1 Y_t + ... + A_p Y_{t-p} + BZ_t + E_t$ (1)

$Z_t = [constant, D_1, D_2, D_3, D_4]$

Where; Y_t is the vector of endogenous variables Z_t is the vector of exogenous variables

A_i and B_s are coefficient matrices p is the lag length

E_t is an unobservable zero-mean white noise process of the errors

$D_1 - D_4$ are the variables chosen with data from 1981-2016 in the VAR model.

Given a theoretical autoregressive equation that allows a set of n^{th} time series variables;

$$Y_t = F(Y_{t-i}, X_{1t}, X_{2t} ..., X_{nt}) ....(1a)$$

and also following the reviewed literature as well as the theoretical basics of the study, causation problems are addressed in a multivariate arrangement, by projecting the parameters of the Vector Autoregressive distributed lags model of order p (VAR(p)) presented as follows;

$$Y_t = \delta + \sum_{i=1}^{j}\phi_i Y_{t-i} + \sum_{i=1}^{k}\alpha_i X_{1t-i} + \sum_{i=1}^{l}\psi_i X_{2t-i} + \sum_{i=1}^{m}\beta_i X_{3t-i} ..... + \sum_{i=1}^{n}\omega_n X_{nt-i} + \xi_{it} ....(2a)$$

$$X_{1t} = \delta + \sum_{i=1}^{j}\phi_i X_{1t-i} + \sum_{i=1}^{k}\alpha_i Y_{t-i} + \sum_{i=1}^{l}\psi_i X_{2t-i} + \sum_{i=1}^{m}\beta_i X_{3t-i} ..... + \sum_{i=1}^{n}\omega_n X_{nt-i} + \xi_{it} ....(2b)$$

$$X_{2t} = \delta + \sum_{i=1}^{j}\phi_i X_{2t-i} + \sum_{i=1}^{k}\alpha_i Y_{t-i} + \sum_{i=1}^{l}\psi_i X_{1t-i} + \sum_{i=1}^{m}\beta_i X_{3t-i} ..... + \sum_{i=1}^{n}\omega_n X_{nt-i} + \xi_{3t} ....(2c)$$

Where the $\delta_i, \phi_i, \alpha_i, \psi_i$ β_i and ω_i are (nxn) coefficient matrices,

$$\sum_{i=1}^{m}\beta_i X_{3t-i} = \beta_1 X_{3t-1} + \beta_2 X_{3t-2} + \beta_3 X_{3t-3} ....\beta_m X_{3t-m},$$

$\delta_i = \delta_1, \delta_2, \delta_3, ...\delta_n$; the intercepts in the VAR system.

t = 36 (the estimation period) and $\xi_{1t}, \xi_{2t}, \xi_{3t}, ...\xi_{nt}$ are the unobservable error terms with zero means and constant variances. These stochastic disturbance terms are amalgams of the structural innovations from the simple equations (see equation 3).

The empirical model represented by the real GDP equation is presumed to be influenced by Oil Price Volatility (OPRV), Total Government expenditure (GOVEXP), Exchange Rate (EXRT) and Consumer Price Index (CPI) which influence economic growth (RGDP). The simple equation is specified as follows;

RGDP$_t$ = ? $_0$+ ? $_1$OPRVt + ? $_2$GOVEXP$_t$ + ? $_3$EXRT$_t$ + ? $_4$CPI$_t$ + ε_t.................(3)

Where ? 's denote the parameters in the model and ε_t is the error term.

Equation (3) is a static model that can be estimated with the classical least squares estimation technique without difficulty. However, the dynamic Vector Autoregressive distributed lags version of the model targeted at estimating the parameters is stated as follows;

$$RGDP_t = \delta_i + \sum_{i=1}^{j}\theta_i RGDP_{t-i} + \sum_{i=1}^{k}\phi_i OPRV_{t-i} + \sum_{i=1}^{l}\alpha_i GOVEXP_{t-i} + \sum_{i=1}^{m}\psi_i EXRT_{t-i}$$

$$+ \sum_{i=1}^{n}\beta_i CPI_{t-i} + \xi_{it} ....(4)$$

Where $\delta_i = \delta_1, \delta_2, \delta_3, ...\delta_n$; the intercepts in the VAR system.

Where,

RGDP = real GDP

OPRV = oil price volatility (which is measured by deriving the standard deviation of international oil prices between 1981 and 2016 over four quarters)

GOVEXP = government expenditure (which measures one of the channels in which oil price fluctuations affect the economy)

EXCR = naira-dollar exchange rate (it captures the switching pattern of revenue inflows arising from international oil market behaviour)

Using Cholesky (1977), this research work assumes the following ordering of the seven

3.3 METHODOLOGY

This study employs the method of cointegration and Vector Autoregressive modeling approach for the data analysis. It also considers the empirical examination of the stationarity position of the series employed by utilising the Augmented Dickey-Fuller and Phillip-Perron tests, while the Johansen Rank Test for cointegration was adopted as well. Additionally, in view of the lengthy period considered in the study, the structural sensitivity was examined, by means of Forecast Error Variance Decomposi tion (FEVD) as well as the Impulse Response Function (IRF).

3.4 THE DATA

The data set for this study includes annual time series from 1981 to 2016. The data for all the variables were sourced from the Central Bank of Nigeria annual statistical Bulletin and the World development indicators of the World Bank. The summary statistics of the variables for the study are also revealed

4.0 DISCUSSION OF EMPIRICAL FINDINGS AND THEIR POLICY IMPLICATIONS

This section presents and analyses the various empirical findings of the study as well as their implications for policies recommendati ons.

4.1 DESCRIPTIVE STATISTICS

The summary statistics of the variables for the study are reported in table 4.1. From the result, Real GDP, Oil Price Volatility, Total Government expenditure, Exchange Rate and Consumer Price Index averaged 30723.60, 4.51, 1421.47, 71.51 and 47.42 correspondingly, while their standard deviations are reported as follows; 17308.63 for Real GDP, 5.88 in the case of Oil Price Volatility, 1768.14 for Government expenditure, 66.25 for Exchange Rate, and 51.33 for Consumer Price Index in that order. Also as displayed by the corresponding Jarque-Bera chi-squared statistics as well as their corresponding probabilities, only Real GDP, Exchange Rate and Consumer Price Index were normally distributed. In addition, all the variables were positively skewed. While Oil Price Volatility has excess kurtosis values, suggestive of leptokurtic distribution, others were found to be platykurtic in their behaviour (See Table 4.1).

Table 4.1: Descriptive statistics of all Variables Employed

Statistics	RGDP	Oil Price Volatility	Government expenditure	Exchange Rate	Consumer Price Index
Mean	30723.60	4.508571	1421.473	71.51371	47.42086
Median	22332.87	2.160000	487.1100	22.05000	27.93000
Maximum	69023.93	30.83000	5185.320	192.4400	164.1300
Minimum	13779.26	0.570000	9.640000	0.610000	0.530000
Std. Dev.	17308.63	5.876979	1768.144	66.25310	51.32882
Skewness	0.948702	2.898791	1.047195	0.223180	0.951196
Kurtosis	2.519243	12.74132	2.560264	1.345245	2.665525
Jarque-Bera	5.587266	187.4035	6.678928	4.283784	5.440998
Probability	0.061198	0.000000	0.035456	0.117432	0.065842
Observations	35	35	35	35	35

Source: Author's Computation Using E-Views 9

4.2 STATIONARITY TEST

In order to understand the actual behaviour of the variables under consideration, it becomes crucial to check the stationarity status of these series by carrying out Unit Root tests (Granger and Newbold, 1977). As a result, the Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test were conducted. The results are presented in Table 4.2 below. It is Note worthy that, the Phillips-Perron (PP) test is considered for its robustness in the face of autocorrelation and time dependent heterosk edasticity. From the result above, both the Augmented Dickey Fuller test and the Philips Perron Unit Root Tests results indicate that, all the series became stationary at first difference. In similar version, both tests results indicate that, oil price volatility, total government expenditure, and exchange rate were stationary at 1percent level while real GDP and consumer price index became stationary at 10percent level in both the ADF and PP test. Table 4.2 reports the results of both the Augmented Dickey Fuller and Philips Perron Unit Root Tests.

Table 4.2: Augmented Dickey Fuller and Philips Perron Unit Root Tests

Variable	ADF test statistic	ADF Critical values	Re	Phillips-Perron statistic	PP critical values	Re
CPI	-3.411244	-3.207094*	I(1)	-3.411244	-3.207094*	I(1)
EXRT	-6.291299	-4.262735***	I(1)	-12.16906	-3.639407***	I(1)
GOVEXP	-6.534812	-4.252879***	I(1)	-6.596692	-4.252879***	I(1)
OPRV	-6.782808	-4.252879***	I(1)	-12.91627	-4.252879***	I(1)
RGDP	-3.312884	-3.209642*	I(1)	-3.320129	-3.209642*	I(1)

NOTE: ****denote significance at 1%,*denote significance at 10%*

Source: Author's Computation Using E-Views 9

4.3 STRUCTURALSTABILITYANALYSIS

Before we check for the presence (or otherwise) of a long run relationship among the series in the estimated model, it essential to test for the stability of the model. The table below reports the inverse roots of the characteristic AR polynomial (see Lütkepohl, 1991). The test result shows that, all roots have modulus less than one and lie inside the unit circle. In other words, no root lies outside the unit circle, thus, the estimated Vect or Autoregressive Model satisfies the stability condition. Therefore, the VAR model is good and stable. See the table below.

Table 4.3: Roots of Characteristic Polynomial
Endogenous variables: RGDP OPRV CPI EXRT GOVEXP
Exogenous variables: C
Lag specification: 1 3
Date: 11/11/17 Time: 17:23

Root	Modulus
0.966115 - 0.072427i	0.968826
0.966115 + 0.072427i	0.968826
0.084217 - 0.684433i	0.689595
0.084217 + 0.684433i	0.689595
0.607557 - 0.289447i	0.672982
0.607557 + 0.289447i	0.672982
0.597260	0.597260
0.284649 - 0.384640i	0.478511
0.284649 + 0.384640i	0.478511
-0.326110 - 0.072387i	0.334047
-0.326110 + 0.072387i	0.334047
0.158319	0.158319

Source: Author's Computation Using E-Views 9
No root lies outside the unit circle.
VAR satisfies the stability condition.

4.4 TESTING FOR CO-INTEGRATION

Having established that the model is good and stable, the test for a long run association becomes germane. The co-integration test employed in this study is in line with the procedure advanced by Johansen (1988), Johansen and Julius (1990), Johansen (1991), and Johansen (1995). The trace statistic and Maximum Eigenvalue test the null hypothesis of r cointegrating vectors as against the alternative hypothesis of k cointegrating equations. Table 4.4 presents the results of the Johansen-Fisher cointegration rank tests. The co-integration tests result shows a proof of long-run relationship as revealed by the statistical significance of the Fisher statistics from Trace test as well as that of Max-Eigen test results obtainable in Table 4.4. Evidently, Trace test indicates 5 cointegrating equations at both 5% and 1% levels while Max-eigenvalue test indicates 5 cointegrating equations at the 5% level and 3 cointegrating equations at the 1% level respectively. In addition, the result shows that the variables used in the study are all statistically significant at the conventional test levels as displayed in the Table below.

Table 4.4: Johansen-Fisher Cointegration Test Results: Trace and Maximum Eigenvalue

Null Hypothesis	Trace Statistics	Critical value at 5%	Critical value at 1%	Max-Eigen Statistics	Critical value at 5%	Critical value at 1%
? =0	207.8018**	68.52	76.07	100.4519**	33.46	38.77
? =1	107.3500**	47.21	54.46	46.54863**	27.07	32.24
? =2	60.80135**	29.68	35.65	28.74350**	20.97	25.52
? =3	32.05784**	15.41	20.04	18.04994*	14.07	18.63
? =4	14.00790**	3.76	6.65	14.00790**	3.76	6.65

Note: ? represents number cointegrating vectors.
****denote significance at 1%, *denote significance at 5%.**
Source: Author's Computation Using E-Views 9

4.5 VECTOR AUTOREGRESSION LAG EXCLUSION WALD TESTS AND LAG ORDER SELECTION CRITERIA

In conducting a Vector Autoregression analysis, it is indispensable to check the appropriateness of the length of lag reflected in the assessment procedure and this is achieved by conducting the Vector Autoregression lag order selection test. Also, the Vector Autoregression lag exclusion Wald tests is conducted to validate the joint significance of the coefficients of the lagged series in the VAR modeling. The result of the lag order selection test shows that, the lag structure (1, 3) considered in our evaluation is optimal as signified by the lag order selected by the criterion. The VAR Lag Exclusion Wald Tests further revealed that, the coefficients of the lagged variables are simultaneously and significantly different from zero. This is evidenced by the probabilities (0.00) of the Chi-squared test statistics. The results are simultaneously reported in Table 4.5A and Table 4.5B below.

Table 4.5A VAR Lag Order Selection Criteria
Endogenous variables: RGDP OPRV CPI EXRT GOVEXP
Exogenous variables: C Date: 11/12/17 Time: 16:41 Sample: 1981 2016 Included observations: 33

Lag	LogL	LR	Final prediction error	Akaike information criterion	Schwarz information criterion
0	-963.0430	NA	2.08e+19	58.66927	58.89602
1	-785.1091	291.1647	2.00e+15	49.40055	50.76101
2	-740.7234	59.18082*	6.91e+14	48.22566	50.71984*
3	-705.3545	36.44077	5.03e+14*	47.59724*	51.22514

Source: Author's Computation Using E-Views 9
* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)

Table 4.5B: Vector Autoregression Lag Exclusion Wald Tests

Date: 11/12/17 Time: 16:41 Sample: 1981-2016 Included observations: 33

Chi-squared test statistics for lag exclusion: Numbers in [ ] are p-values

	RGDP	OPRV	CPI	EXRT	GOVEXP	Joint
DLag 1	46.45650	20.50686	28.62579	25.52525	3.123432	153.4931
	[0.000000]	[0.001004]	[0.000000]	[0.000110]	[0.680963]	[0.000000]
DLag 2	19.16512	11.62603	9.537529	16.98195	9.413334	105.2050
	[0.001791]	[0.040287]	[0.089451]	[0.004534]	[0.093671]	[0.000000]
DLag 3	16.37638	5.141101	3.564923	18.11788	8.447756	53.73062
	[0.005848]	[0.398904]	[0.613588]	[0.002802]	[0.133224]	[0.000720]
df	5	5	5	5	5	25

Source: Author's Computation Using E-Views 9

Source: Author's Computation Using E-Views 9

4.6 THE VECTOR AUTOREGRESSION ESTIMATES

The proof of a long-run convergence among the series does not overtly present us with the mechanisms through which the variables interrelate. However, such channels are captured by the Vector Autoregression relations presented in Table 4.6 below.

Table 4.6: Vector Autoregression Estimates
Date: 11/11/17 Time: 18:48 t-statistics in [ ]

Series		DEPENDENT/EXPLAINED VARIABLES				
		RGDP	OPRV	GOVEXP	EXRT	CPI
INDEPENDENT / EXPLANATORY VARIABLES	RGDP(-1)	1.197422	8.88E-05	-0.003799	0.004757	0.000142
		[5.97376]***	[0.06697]	[-0.05842]	[1.18417]	[0.21343]
	RGDP(-2)	-0.488522	-0.001076	-0.036445	-0.004543	-0.000121
		[-1.67026]*	[-0.55610]	[-0.38411]	[-0.77504]	[-0.12398]
	RGDP(-3)	0.320398	0.001169	0.040446	0.000109	3.66E-05
		[1.82463]*	[1.00630]	[0.71003]	[0.03100]	[0.06267]
	OPRV(-1)	-18.26869	-0.055307	-11.64926	-2.036375	-0.010981
		[-0.35579]	[-0.16280]	[-0.69936]	[-1.97888]*	[-0.06432]
	OPRV(-2)	97.46995	0.080783	13.26823	-0.201100	0.005691
		[3.18826]***	[0.39939]	[1.33787]	[-0.32823]	[0.05599]
	OPRV(-3)	-55.34101	0.004617	30.59977	-0.326462	0.000417
		[-1.46139]	[0.01843]	[2.49089]**	[-0.43016]	[0.00331]
	GOVEXP(-1)	0.892222	0.007009	0.497091	0.012316	0.000394
		[1.17333]	[1.39316]	[2.01511]**	[0.80815]	[0.15581]
	GOVEXP(-2)	-1.434343	-0.012380	0.634566	-0.006410	0.002998
		[-1.84999]**	[-2.41344]**	[2.52296]**	[-0.41253]	[1.16306]
	GOVEXP(-3)	1.343411	-0.001619	-0.762481	-0.061929	-0.002311
		[1.19621]	[-0.21793]	[-2.09289]**	[-2.75153]**	[-0.61892]
	EXRT(-1)	12.34005	-0.135119	-4.826450	0.692651	0.009583
		[1.29796]	[-2.14808]**	[-1.56490]*	[3.6353]***	[0.30318]
	EXRT(-2)	0.114010	0.102791	0.685419	-0.187710	0.017018
		[0.00881]	[1.20053]	[0.16327]	[-0.72375]	[0.39554]
	EXRT(-3)	19.59628	0.083448	6.173754	-0.070611	-0.008030
		[1.69549]*	[1.09127]	[1.64660]*	[-0.30484]	[-0.20897]
	CPI(-1)	-19.85927	-1.315026	17.84671	3.663755	1.400874
		[-0.25296]	[-2.53171]**	[0.70075]	[2.32858]**	[5.3673] ***
	CPI(-2)	-74.90624	1.185869	-59.48413	-9.714531	-0.605746
		[-0.46965]	[1.12380]	[-1.14968]	[-3.039] ***	[-1.14240]
	CPI(-3)	45.62855	0.518590	67.12220	9.295415	0.176587
		[0.35614]	[0.61178]	[1.61497]*	[3.6202] ***	[0.41458]
R-squared		0.882036	0.654214	0.864801	0.592357	0.579913
Adj. R-squared		0.771445	0.330039	0.738052	0.210191	0.186082
F-statistic		7.975645	2.018090	6.822934	1.549999	1.472492

***denote significance at 1%, **denote significance at 5%. *denote significance at 10%.
Source: Author's Computation Using E-Views 9

Though, the estimates of the Vector Autoregression relations are presented above, adjudging from the submission by Sims (1980) and Blanchard and Perroti (2002), the direct output of the Vector Autoregression assessment does not feed us with a good deal of empirical information, since the correlations appears to be just numerical in nature. Consequently, we cannot center the discussion of our empirical investigation on the vector autoregression estimates in the table above. The center of attention is for that reason, on the estimates of the Forecast Error Variance Decompositions and the Impulse Response Functions which will be presented and discussed in details as we advance in the study.

4.7 SENSITIVITY ANALYSIS: FORECAST ERROR VARIANCE DECOMPOSITION AND IMPULSE RESPONSE FUNCTION

The study further examined the forecast error variance decomposition (FEVD) and its associated Impulse Response Function (IRF), in the discussion of transmission channels. The forecast error variance decomposition indicates the percentage of unexpected shocks in a variable that is due to its own innovations and the shocks of other variables in the VAR structural array, whereas the Impulse Response Function tells the dynamic responses of a variable to shocks predicated on another variable over the estimation horizon. The Forecast error variance decomposition and Impulse Response Function results are communicated in table 4.7A through table 4.7D below.

Table 4.7A: Variance Decomposition of RGDP, OPRV

Variance Decomposition of RGDP:						
Period	S.E.	RGDP	OPRV	GOVEXP	EXRT	CPI
1	604.3916	100.0000	0.000000	0.000000	0.000000	0.000000
3	1195.546	92.79853	0.192402	1.573403	4.943743	0.491922
5	1992.130	60.16433	9.269318	5.582820	13.09318	11.89035
7	2890.615	44.62121	23.40725	3.897548	20.90804	7.165956
9	4182.253	29.98856	36.69911	6.741491	21.47398	5.096853
10	4994.683	24.04432	40.35436	7.898103	20.92183	6.781391
11	5946.352	19.21325	41.86583	8.922838	19.91809	10.07999
13	7638.374	14.75159	42.08340	8.235635	18.68524	16.24414
14	8264.708	14.15288	41.40749	7.579388	18.43981	18.42043
15	8772.663	14.06140	40.43152	7.134455	18.31558	20.05704
Variance Decomposition of OPRV:						
Period	S.E.	RGDP	OPRV	GOVEXP	EXRT	CPI
1	3.998761	1.671004	98.32900	0.000000	0.000000	0.000000
3	5.759463	2.648324	50.32855	12.95345	7.455337	26.61435
5	6.339043	2.491000	44.65950	16.06511	8.960441	27.82396
7	7.094789	1.997092	46.18070	14.00930	9.653365	28.15954
9	7.279147	2.056142	44.88545	13.75457	9.501562	29.80228
11	7.335592	2.050707	44.80963	14.09616	9.575413	29.46809
13	7.386540	2.025889	44.90545	14.31422	9.548310	29.20612
15	7.422823	2.033765	44.59544	14.55019	9.665935	29.15467
Cholesky Ordering: RGDP OPRV GOVEXP EXRT CPI						

Source: Author's Computation Using E-Views 9

Table 4.7B : Variance Decomposition of GOVEXP, EXRT, CPI

Period	S.E.	RGDP	OPRV	GOVEXP	EXRT	CPI
Variance Decomposition of GOVEXP:						
1	196.0656	0.009837	43.27828	56.71189	0.000000	0.000000
3	313.1453	0.681839	49.46606	41.95282	4.161204	3.738069
4	362.8221	0.557882	61.10090	31.72432	3.832298	2.784602
5	411.0276	0.448260	61.95071	28.83199	3.889957	4.879084
6	420.6504	0.692706	61.77692	29.06935	3.745646	4.715374
7	425.2708	0.835488	60.85361	28.83265	4.518320	4.959936
9	541.6568	0.602435	44.55440	26.12925	9.159449	19.55447
15	969.9464	0.220070	23.33352	14.96059	8.636418	52.84940
Variance Decomposition of EXRT:						
Period	S.E.	RGDP	OPRV	GOVEXP	EXRT	CPI
1	12.11270	0.241911	19.50776	0.025494	80.22483	0.000000
3	21.63567	1.068511	41.90118	0.031970	47.00482	9.993520
4	25.04556	1.063687	45.60604	4.953178	38.00912	10.36797
5	29.06062	0.857031	40.97715	14.65582	29.54711	13.96288
6	34.29773	0.617613	35.45874	21.23816	22.34975	20.33574
8	46.26308	0.379403	30.02720	19.80139	14.71170	35.08031
10	52.60431	0.319883	26.12252	15.78463	12.68742	45.08555
13	56.31761	0.498548	29.34508	16.80058	11.58008	41.77571
15	58.25088	0.550172	32.50168	16.05226	10.99717	39.89871
Variance Decomposition of CPI:						
Period	S.E.	RGDP	OPRV	GOVEXP	EXRT	CPI
1	2.009330	3.971585	6.315091	6.884497	0.061056	82.76777
4	5.203321	2.300996	6.976782	2.819855	2.053333	85.84903
6	6.240412	1.760041	7.974857	2.108125	3.436120	84.72086
7	6.688041	1.535482	8.034038	2.087743	4.135338	84.20740
8	7.278671	1.298674	6.886467	3.587243	5.262447	82.96517
12	13.25225	0.422844	7.997681	9.752012	10.79215	71.03531
14	17.07337	0.372029	8.865726	8.980837	11.25789	70.52351
15	18.72107	0.410666	8.602732	8.530344	11.26093	71.19533
Cholesky Ordering: RGDP OPRV GOVEXP EXRT CPI						

Source: Author's Computation Using E-Views 9

From the table above, the forecast error variance decomposition of real Gross Domestic Products (a proxy for economic growth) by own shocks accounts for 100percent in the first year while oil price volatility, total government expenditure, exchange rate and consumer price index account for 0.00percent respectively in that same year. Also, own innovations account for about 29.99 percent of the total shocks in real Gross Domestic Products in the ninth year, while oil price volatility, total government expenditure, exchange rate and consumer price index account for 36.70percent, 6.74percent, 21.47percent, and 5.1percent of the remaining shocks in the same year respectively.

Furthermore, about 14.75percent of the aggregate innovations in real GDP is explained by own stocks, while the stock of oil price volatility, total government expenditure, exchange rate and consumer price index account for about 42.08percent (maximum innovation), 8.24percent, 18.69percent, and 16.24percent of the remaining shocks (respectively) in the thirteenth year. Though oil price volatility retained its strength by way of maximum innovations to changes in real GDP, its contribution howeve r dropped by about 1percent in the fourteenth and fifteenth year, while innovations of real GDP due to shocks in total government expenditure, exchange rate and consumer price index were 7.58percent, 18.44percent and 18.42percent in that particular order.

In a nutshell, as regards the total shocks in real GDP in the fifteen year Horizon, oil price volatility made its maximum impacts in the twelfth year while total government expenditure, exchange rate and consumer price index made their maximum impacts in the eleventh, eighth and fifteenth year, respectively. In similar outcome, oil price volatility accounts for about 49.47percent, 61.95percent, 60.85percent, and 44.55percent of the total shocks in total government spending in the third, fifth, seventh, and ninth year respectively. It also accounts for about 41.90percent, 45.61percent and 32.51percent of the total innovations in exchange rate in the third, fourth and fifteenth year respectively. Oil price volatility further accounts for about 6.32percent, 8.03percent and 8.60percent of the total shocks in consumer price index in the first, seventh, and fifteenth year, correspondingly.

The significance of the forecast error variance decomposition in this respect is that; own innovations and innovations due to oil price volatility, exchange rate and consumer price index, are to a large extent, the leading sources of economic shocks in Nigeria. Table 4.7C reports the summary statistics of the Variance Decomposition of real GDP in Nigeria over the fifteen years estimated.

Table 4.7C: Summary statistics of the Variance Decomposition of real GDP in Nigeria over the fifteen years Estimated

statistic	Consumer price index	Exchange Rate	Total Govt. Expenditure	Oil Price Volatility	Real GDP
Average Innovation	9.05%	15.05%	5.61%	24.38%	45.91%
Median Innovation	10.08%	18.44%	6.74%	30.54%	38.11%
Maximum Innovation	20.06% (Yr.15)	21.93% (Yr.8)	8.92% (Yr.11)	42.46% (Yr.12)	100.00% (Yr.1)
Minimum Innovation	0.00% (Yr.1)	0.00% (Yr.1)	0.00% (Yr.1)	0.00% (Yr.1)	14.06% (Yr.15)
Std. Dev. of Innovation	6.35	7.50	2.81	18.07	31.54
Obs.	15	15	15	15	15

Source: Author's Computation

The results in Table 4D show estimates from the impulse response function of real GDP as against its own innovations and the innovations attributable to oil price volatility, total government expenditure, exchange rate and consumer price index over a fifteen year projection period. The length of time considered will boost the incorporation of both the short-term, medium-term and long-term responses of real l GDP to other variables employed in the study. However, the result indicates that real GDP has a positive relationship with its past values, as well as exchange rate over the fifteen year assessment period.

Conversely, in its own response to the shocks of oil price volatility, a negative association was revealed throughout the estimation period (with the exception of year 3), while in its own response to the shocks of total government expenditure and consumer price index, it oscillated between negative and positive. Specifically, while it maintained a negative correlation with the shocks of consumer price index between the second and seventh year, the response however turned out to be positive between the eighth and fifteenth years. In similar finding, the response of real GDP to the shocks in total government expenditure was positive between the second and six year, while the relationship became negative between the seventh and fifteenth year. Table 4.7D below reports the estimates o f the Impulse Response of Real GDP and other series employed in the study

Table 4.7D : Impulse Response of Real GDP and other series employed in the study

Response of RGDP:					
Period	RGDP	OPRV	GOVEXP	EXRT	CPI
1	604.3916	0.000000	0.000000	0.000000	0.000000
2	731.3074	-33.40231	144.5948	132.8929	-36.30323
3	652.9151	40.42714	39.76772	230.2214	-75.58613
4	719.8114	-92.46458	412.5803	382.2229	-509.2128
12	932.4901	-2227.891	-914.5580	1385.268	1615.782
15	1074.436	-1682.972	-559.9267	1224.833	1689.281
Response of OPRV:					
Period	RGDP	OPRV	GOVEXP	EXRT	CPI
1	0.516909	3.965211	0.000000	0.000000	0.000000
5	0.205160	-1.034456	-1.156274	0.910384	1.510013
9	0.195269	-0.432699	-0.334552	0.091739	0.858535
11	0.032979	0.435872	-0.384016	-0.197593	0.236698
15	0.102816	-0.108844	-0.175967	0.316648	0.354702
Response of GOVEXP:					
Period	RGDP	OPRV	GOVEXP	EXRT	CPI
1	1.944586	128.9841	147.6517	0.000000	0.000000
2	-17.37264	52.75766	63.05389	-51.47676	32.62422
7	-16.89092	27.28895	-26.60974	39.29148	25.03207
8	-13.81086	-78.28244	-132.0883	89.39435	134.3322
12	2.613821	-151.4379	-136.5520	107.5947	305.2596
15	11.84046	-5.956837	-16.77749	51.41524	233.9301
Response of EXRT:					
Period	RGDP	OPRV	GOVEXP	EXRT	CPI
1	0.595756	-5.349888	0.193402	10.84914	0.000000
5	0.751999	-7.744835	-9.628135	3.332790	7.272074
10	0.855253	-3.492704	1.492153	3.079794	13.96584
11	1.400518	2.721166	4.918677	0.202803	8.161516
13	1.536639	11.41518	5.645146	-3.313133	-2.605802
15	1.105796	7.230716	0.429169	0.167682	-3.093857
Response of CPI:					
Period	RGDP	OPRV	GOVEXP	EXRT	CPI
1	-0.400436	0.504941	-0.527215	0.049649	1.828024
5	-0.220131	0.757485	0.214694	0.592527	2.219163
8	-0.034724	0.234026	-0.983180	0.968639	2.507644
9	-0.022111	-0.367838	-1.395731	1.331056	3.078056
13	0.345325	-2.467916	-2.127616	2.622507	6.174352
15	0.595677	-2.075363	-1.928181	2.578835	6.629349
Cholesky Ordering: RGDP OPRV GOVEXP EXRT CPI					

Source: Author's Computation Using E-Views 9

4.8: VAR GRANGER CAUSALITY/BLOCK EXOGENEITY WALD TESTS

Vector Autoregression Granger Causality/Block Exogeneity Wald Test is piloted in a VAR multivariate framework to examine causation issues among the variables in a regression model. It is used to determine whether a variable can be categorized as an endogenous (explained), exogenous (explanatory) variable, or both. The probability of the Wald test revealed the joint significance of the lagged endogenous series in the Real GDP model. See table 4.8 below.

Table 4.8: VAR Granger Causality/Block Exogeneity Wald Tests
Date: 11/11/17 Time: 19:32
Sample: 1981 2016
Included observations: 32

Dependent variable: RGDP			
Excluded	**Chi-sq**	**df**	**Prob.**
OPRV	10.64774	3	0.0138**
GOVEXP	7.870477	3	0.0438**
EXRT	13.66610	3	0.0034***
CPI	4.499000	3	0.2124
All	**45.33230**	**12**	**0.0000*** **

***denote significance at 1%, **denote significance at 5%.
Source: Author's Computation Using E-Views 9

4.9 POLICY IMPLICATIONS OF FINDINGS

From the empirical results above, all variab les were found to be of huge relevance in the study. Also, shocks originating from these series (oil price shocks in particular) were discovered to cause major innovations in the stock of real GDP in the period of estimation. The implication for Nigeria is that, for a desired level of economic expansion to be accomplished in the country, proper recognition should be given to oil price precariousness, total government expenditure, exchange rate and consumer price index. In other words, the issues of oil price vacillations must be critically addressed in order to mitigate its devastating effects on economic growth in Nigeria in addition to optimizing economic welfare originating from the fiscal activities.

5.0 CONCLUSION

This study is focused on the empirical investigation of the effect of oil price volatility on economic growth in Nigeria, for the period 1981-2016, using vector Autoregression modeling approach. Results from the vector Autoregression model reveal that, as regards the total shocks in re al GDP in the fifteen year Horizon, oil price volatility made its maximum impacts in the twelfth year while total government expenditure, exchange rate and consumer price index made their maximum impacts in the eleventh, eighth and fifteenth year, respectively. Also, own innovations and innovations due to oil price volatility, exchange rate and consumer price index, are to a large extent, the leading sources of economic shocks in Nigeria.

From the foregoing, the core emphasis should be centered on the attainment of a long-lasting breakthrough by way of mitigating the damaging effects of oil price unpredictability to attain a swift and sustainable development Nigeria. From the findings, it was observed that, Oil price at the prevailing exchange rate determines the level of government spending, which in turn determines real GDP.

It can be said that there is a vital interaction between oil price volatility and economic growth and d ue to the fact that the Nigerian economy is highly susceptible to oil price dynamics, expected growth targets are hardly met. Concrete policy measures will need to be defined based on an in-depth sector specific analysis, which is beyond the scope of this paper.

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