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A VECTOR AUTOREGRESSIVE ANALYSIS OF OIL PRICE VOLATILITY AND ECONOMIC GROWTH IN NIGERIA (1997-2017)

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ABSTRACT

In Nigeria, oil prices have frequently fluctuated but at the moment there is a decline and not an increase. The effect of this condition on economic growth is not clear in literature as studies reveal contradicting results. This study sought to investigate the effect of oil price volatility on economic growth in Nigeria. An explanatory research design was employed. Time series data spanning 20 years was used. The study used VAR and Granger causality to analyze the data using STATA statistical software version 13. The study led to the conclusion that the first lag of GDP growth positively affects the current GDP growth significantly and has a negative significant effect on the current oil price volatility. The study also concludes that the second lag of GDP growth on oil price volatility is negative and significant. Another conclusion is that the first and second lags of oil price volatility have a negative and significant effect on the current GDP growth rate but the current oil price volatility was not related to its lags. The study also concludes that in Nigeria, both GDP Growth and Oil Price volatility, can affect each other.

The findings imply that oil price volatility leads to a decline in household welfare and increase in poverty and that with the increase in elasticity of substitution of demand for imports to domestically produced crude oil, welfare loss for household groups goes on increasing. The study recommends a need for Nigerian government to have an energy regulatory commission to regulate the price of gasoline and disease since its fluctuations have a negative impact on the economy. The Nigerian government can control oil and energy prices typically in the form of price freezes or ceilings for increasing prices rather than price floors; given that price decreases are typically politically popular to consumers. Another government tactic for controlling price increases and volatility is the introduction of price subsidies and tax reductions. Nigerian government may also target specific industries with subsidies and tax reductions to reduce costs. These industries can be those that rely heavily on petroleum products such as gasoline and diesel and may include agriculture, public and goods transport, and fisheries, to avoid consumers receiving substantial price shocks to essential purchases. The Nigerian governments can also buildup its strategic oil reserves to make it possible for it to supply the market in the case of sharp price spikes that typically result from physical disruptions to supply, such as hurricanes and other natural disasters.

Key Words: *Oil Price Volatility, Economic Growth, Nigeria*

INTRODUCTION

Sharp increases in the price of oil are generally seen as a major contributor to business cycle asymmetries. Moreover, the highs and lows registered in the world oil market are cause a concern about possible slowdowns in the economic performance of the most developed countries. Thus, not surprisingly, a considerable body of economic research has studied the channels through which oil price shocks influence economic variables. From the theoretical point of view several economists have offered a number of explanations to account for the relationship between oil price changes and aggregate economic activity (Cologni & Manera, 2008). To the extent they correlate negatively with economic indicators, future oil (and natural gas) price streams represent a highly risky obligation for energy consumers. Every time oil (and natural gas) prices rise, economic activity for instance people's income and the value of their assets– declines by some measure. Based on capital market theory (and common sense), any future cost stream that rises at a time when economic activity and asset values are in decline is highly risky. This adds an important dimension to fossil price risk and the idea of energy security and diversity (Awerbuch, 1993).

More recently, the research emphasis has broadened to include not only the effects of changes in oil price level (mean price in a given period), but also the effects of price volatility (standard deviation in a given period) as well. The evidence confirms that volatility has a considerable influence on economic output (Ndungu, 2013). Even though more studies have been conducted on oil price volatility and economic growth, Cologni and Manera (2008) state that most studies focused on oil price increases and not decline (Cologni & Manera, 2008). Frequent upward adjustments of petroleum product prices have resulted in inflation, high cost of living, and inequitable distribution of income in Nigeria. Between 1978 and 2009, the various Nigerian regimes increased fuel prices a total of 18 times. Most of the increase occurred in the 1990-2007 period when the prices were adjusted, sometimes twice a year (Arinze , 2011). Furthermore, Arinze (2011) states that whenever petroleum product prices increase, the inflation rate and the rise price of petroleum products is significant in Nigeria.

In Uganda, Twimukye and Matovu (2009) established that the changes in oil prices have sizable negative effects especially at the sectoral level. While at the aggregate level, GDP might not be affected as more activity is realized in the trading sector, increase in oil prices would significantly reduce the output for agriculture, manufacturing and transports. The reduction in output for these sectors is subdued when the oil price shock is temporary. On the other hand, the low efficiency in the electricity sector has also negatively affected the sectors. The combined effects of oil price shocks and reduction in electricity generated would reduce overall growth rate of the manufacturing sector by 2 percentage points on annual basis.

Statement of the Problem

González and Nabiyev (2009) argue that oil represents one of the most important macroeconomic factors in the world economy and the crude oil market is the largest commodity market in the world. As a difference from other commodities oil is probably one of the few or the only production input that can affect both positively and negatively economic growth, to an extent that it might even lead to a recession. The relationship between oil price volatility and economic growth is widely researched topic. However, most studies focused on oil price increases and not decline (Cologni & Manera, 2008). Mureithi (2014) as well as Ndungu (2013) argued that the effect of oil volatility on economic growth has mixed results. The effect of oil price volatility on economic growth is not clear in literature as studies reveal contradicting results. Will oil price decline necessarily lead to a better economic performance?

Cologni and Manera (2008) argue that the failure of the 1986 oil price collapse to produce an economic boom lead several authors to argue the existence of an asymmetric relationship between oil prices changes and economic activity: while oil price increases have clear negative effect, oil price declines have no clear positive effect and may indeed slow output growth. In particular, Mork (1989) tested the symmetry hypothesis on U.S. data by allowing real increases and decreases in the price of oil to have different coefficients in a regression equation with real GNP growth as the dependent variable. The coefficients on oil price increases now turned out negative and highly significant; the coefficients on price declines tends to be positive, but small, and no statistically significant; moreover, coefficients on oil price increases and oil price decreases were significantly different from each other demonstrating that the effects of oil price increases and decreases were asymmetric. On the other hand, Mork, Olsen and Mysen (1994) argued that all countries except Norway experienced negative relationships between oil price increases and GDP growth. A different view from Mork (1989).

Studies on the effect of oil price volatility on economic growth considering both an increase and decline of oil prices also yield mixed results. Babatunde, Adenikinju and Adenikinju (2013) states that the characteristics of the economy in each country matter for the kind of association that is found between oil prices and economic growth. Akpan (2009), Aliyu (2009), Olomola (2006) on the other hand argue that oil price volatility can promote growth or has the potential of doing so while Darby (1982) and Cerralo (2005) are of the view that it can inhibit growth. Other studies for instance a study by Adeniyi, Oyinlola and Omisakin, (2011) establish no significant relationship between oil price volatility and economic growth. Based on this empirical inconclusivity of the effect of oil price volatility on economic growth, and also on the existence of contextual and conceptual research gaps arising from the studies, the current study sought to investigate the effect of oil price volatility on economic growth in Nigeria.

Research Objectives

i. To establish the short run and long run effect of oil price volatility and its lag on economic growth in Kenya
ii. To establish the causation between oil price volatility and economic growth in Kenya

LITERATURE REVIEW

Theoretical Review

Symmetric Relationship Theory

The Symmetric relationship theory of growth was proposed by Hamilton (1983), Gisser (1985), Goodwin (1985), Hooker (1986) and Laser (1987) who argued that volatility in GNP growth is driven by oil price volatility. The argument was mainly hinged on the happenings in the oil market between 1948 and 1972 and its impact on the economies of oil-exporting and importing countries respectively. Hooker (2002), after rigorous empirical studies demonstrated that between 1948 and 1972 oil price level and its changes exerted influence on GDP growth significantly. Laser (1987), who was a late entrant into the symmetric school of thought, confirms the symmetric relationship between oil price volatility and economic growth. After an empirical study of her own, she submitted that an increase in oil prices necessitates a decrease in GDP, while the effect of an oil price decrease on GDP is ambiguous, because its effects varied in different countries.

Asymmetry-in-Effects theory of Economic Growth Theory

Asymmetry-in-effects theory of economic growth states that the correlation between crude oil price decreases and economic activities in an economy is significantly different and perhaps zero. One of the proponents of the theory, Mark *et al*. (1994), argued that there is asymmetry in effect of oil price volatility on economic growth. According to Ferderer (1996), another member of this school, the asymmetric mechanism between the influence of oil price volatility and economic growth by focusing on three possible ways: Counter-inflationary monetary policy, sectoral shocks and uncertainty found out a significant relationship between oil price increases and counter-inflationary policy responses. Balke (1996) supports Federer ‘s position / submission. He posited that monetary policy alone cannot sufficiently explain real effects of oil price volatility on real GDP.

Renaissance Growth Theory

Renaissance growth theory/model, proposed by Lee (1998), was an off-shoot of the symmetric and asymmetry in effect schools. Lee (1998) focused her theoretical work on attempting to distinguish between oil price changes and oil price volatility. Lee (1998) defined volatility as the standard deviation in a given period. She submitted that both have negative impacts on economic growth, but in different ways: Volatility has a negative and significant impact on economic growth immediately, while the impact of oil price changes delays until after a year. She concludes by stating that ―it is volatility/change in crude oil prices rather than oil price level that has a significant influence on economic growth.

Oil Price Volatility

The impact of the high energy prices on the economy both at the macro and micro level is well documented in many studies. Not only does it affect the firms’ activities but it also generally impacts negatively on the whole economy (Twimukye and Matovu, 2009). Lee and Ni (2002) found that for industries that have a large cost share of oil, such as petroleum refinery and industrial chemicals, oil price shocks mainly reduce supply but for other industries, with the

automobile industry being a particularly important example, oil price shocks mainly reduce demand, suggesting that oil price shocks influence economic activities beyond that explained by direct input cost effects, possibly by delaying purchasing decisions of durable goods. Ndungu (2013) argues that the idea that rising oil prices and price volatility serve to stifle economic activity and reduce asset values has by now become widely accepted in the literature and seems virtually axiomatic. Yang, Hwang and Huang (2002) state that "Higher oil prices yield subsequent recessions in oil consuming nations, as oil prices are negatively correlated to economic activities. According to Abeysinghe (2001), the transmission effect of oil prices on growth may not be that important for a large economy like the US but it could play a critical role in small open economies with the biggest impact being the effect of the shock and its interaction with consumer and investor confidence.

Economic growth

The existence of a negative relationship between oil prices and macroeconomic activity has become widely accepted since Hamilton's (1983) work indicating that oil prices increases reduced US output growth between 1948 and 1980. Hamilton's results have been confirmed and extended by a number of other researchers. More recently, the research emphasis has broadened to include not only the effects of changes in oil price level (mean price in a given period), but also the effects of price volatility (standard deviation in a given period) as well Ndungu (2013).

Changes in oil prices have sizable negative effects especially at the sectoral level. While at the aggregate level, GDP might not be affected as more activity is realized in the trading sector, increase in oil prices would significantly reduce the output for agriculture, manufacturing and transports. The reduction in output for these sectors is subdued when the oil price shock is temporary. On the other hand, the low efficiency in the electricity sector has also negatively affected the sectors. The combined effects of oil price shocks and reduction in electricity generated would reduce overall growth rate of the manufacturing sector (Twimukye & Matovu, 2009).

Empirical Review

Pradhan, and Sahoo (2000) used CGE to analyse the impact of international oil price shock on the Indian economy found that it affects the welfare and poverty of households directly as well as indirectly. The paper found that oil shock leads to decline in household welfare and increase in poverty and that with the increase in elasticity of substitution of demand for imports to domestically produced crude oil, welfare loss for household groups goes on increasing. The paper found that the rise in rural poverty is concentrated among non-agricultural labour and other household groups, while that for urban area is reflected in non-agricultural household group.

Tang, Wu and Zhang (2010) carried out a study to investigate the long run and short run effects of oil price volatility in the Chinese economy, using a structural vector auto-regressive model. The study findings indicated that an oil-price increase negatively affects output and investment, but positively affects inflation rate and interest rate. However, with price control policies in China, the impact on real economy, represented by real output and real investment, lasts much longer than that to price/monetary variables. The decomposition results of the study also showed that the short-term impact, namely output decrease induced by the cut in capacity–utilization rate, is greater in the first 6 periods (namely half a year), but the portion of the long-term impact, defined as the impact realized through an investment change, increases steadily and exceeds that of short-term impact in the 7th period. Afterwards, the long-term impact dominates, and maintains for quite some time.

Rafiq, Salim and Bloch (2009) also sought to investigate the impact of crude oil price volatility on economic activities in Thailand using the vector auto-regression (VAR) system. According to the study findings, the Granger causality test, impulse response functions, and variance decomposition show that oil price volatility has significant impact on macroeconomic indicators, such as unemployment and investment, over the period from 1993Q1 to 2006Q4. Furthermore, a VAR for the post-crisis period shows that the impact of oil price volatility is transmitted to budget deficit. A study was conducted by Lee and Ni (2002) to investigate the effect of oil price volatility at micro and macro level. The findings of the study indicated that for industries that have a large cost share of oil, such as petroleum refinery and industrial chemicals, oil price shocks mainly reduce supply but for other industries, with the automobile industry being a particularly important example, oil price shocks mainly reduce demand, suggesting that oil price shocks influence economic activities beyond that explained by direct input cost effects, possibly by delaying purchasing decisions of durable goods.

Schneider (2004) on the other hand investigated the effect of oil price volatility on economic growth. He found that oil price shocks affect the economy through the supply side (higher production costs, reallocation of resources), the demand side (income effects, uncertainties) and the terms of trade. The paper also found that an increase in the price of oil feeds through to GDP growth to a much larger extent than a decline, a phenomenon that can be attributed to adjustment costs associated with sectoral reallocations, the implications of uncertainties for spending on consumer durables and investment, and nominal wage rigidities. Furthermore, the element of surprise in oil price hikes seems to play a considerable role. Thus, the paper continues, when a rise in the price of oil occurs after a prolonged period of oil price stability, it has a larger impact than a price hike which immediately follows previous cuts.

Suleiman (2013) studied the causes of oil consumption/import volatility and its effects on economic growth in North America, Europe, Africa, and the Middle East for the period 1970-2010. The study used structural time series to analyse the data. The study findings established that oil consumption and import volatility is mainly caused by international oil prices in all regions. In North America, GDP per capita is also a significant determinant of oil consumption and importation. In their study of the factors that determine volatility in oil production, Metcalf and Wolfram (2010) used data collected from OPEC and OECD countries concerning oil production levels, oil import volumes, GDP, and the composite democracy index for the period 1970-2007. The study used a two-stage least squares econometric technique for analysis. The findings of the study found that political stability is one of the major determinants of oil production volatility in OPEC countries. Countries with very democratic political systems had less volatility in oil production than their counterparts with autocratic political systems. Fluctuations in oil production were found to affect global oil prices, thereby causing price volatility in countries that import oil. In addition, the level of oil consumption and the size of the economy determined oil import volatility (Metcalf & Wolfram, 2010).

Alun, Muhleisen, and Pant (2011) used panel data for the period 1996 to 2010, to study causes of sharp oil price movements and its effects on oil imports in OECD countries. The set consisted of nominal oil prices, demand for oil in each country, inflation expectations, exchange rate, political risk, and oil supply from non-OPEC countries. The data was analyzed using co-integration tests and error correction model. In the short run, the variables that had statistically significant effects on oil prices were political risk and oil supply. In the long-run, oil prices were determined by demand for oil, political risks, and exchange rate (Alun, Muhleisen, & Pant, 2011). A significant increase in oil prices led to volatility in oil imports in the OECD countries.

In Nigeria, Oriakhi and Iyoha (2013) examined the effect of oil price volatility on the growth of Nigerian economy and established that oil price volatility 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. On the other hand, Akide (2007) investigated the impact of oil price volatility on economic growth and found that within the period of study oil price shocks did not affect output and inflation, but significantly influenced real exchange rate. Furthermore, a study by Jimenez and Sanchez (2005) to assess the effect of oil price volatility on the real economic activity established evidence of non-linear impact of oil price volatility on real GDP. Importantly, oil price increases had an impact on GDP growth of a larger magnitude than that of oil price declines.

A study by Adeniyi, Oyinlola and Omisakin, (2011) on the relationship between oil price shocks and economic growth established no significant relationship between price shocks observed movements in macroeconomic aggregates. Additionally, the relationship between oil price volatility and economic growth has been complicated by the fact that most governments and supra national organizations advocates green energy sources. In Ghana, Marbuah (2013) examined the oil import behavior in Ghana. His data set consisted of international oil prices, real income, exchange rate, domestic oil production, and population growth. The study used the ARDL approach to model the relationship. The findings of the study indicated that Oil imports in Ghana were found to be price-inelastic implying that the country's oil consumption increase regardless of price increases. Economic activity (industrial production), exchange rate, and domestic oil production led to oil imports volatility in the short and long-run.

RESEARCH METHODOLOGY

The study adopted an explanatory research design. The study used data from secondary sources only collected between 1997 and 2017 from the databases of the Central Bank of Nigeria, Nigerian Bureau of Statistics as well as World Bank sources. To examine the relationship between oil price volatility and economic growth; the study employed Vector Autoregressive Model. A VAR model gives the long run causality which is equivalent to the long run relationship in a single equation model (Juselius, 2006).The study used VAR model because VAR model is a theory-free method used for the estimation of economic relationships (Cologni & Manera, 2008). The use of the model is because of its ability to capture the evolution and the interdependence between multiple time series, generalizing the univariate Auto Regressive (AR) models (Juselius, 2006). All the variables in the VAR model were treated symmetrically by including an equation explaining evolution of each variable based on its own lags and the lags of all the other variables in the model. The model was also used to test for causality between two or more variables and their lags.

The general VAR (p) model has many parameters, and they may be difficult to interpret due to complex interactions and feedback between the variables in the model. As a result, the dynamic properties of a VAR (p) are often summarized using various types of structural analysis. The three main types of structural analysis are (1) Granger causality tests; (2) impulse response functions; and (3) forecast error variance decompositions.

The basic p-lag vector autoregressive (VAR(p)) model has the following general form:

$Y_t = c + \Pi_1 Y_{t-1} + \Pi_2 Y_{t-2} + \cdots + \Pi_p Y_{t-p} + \varepsilon t,\ t = 1, \ldots..T,$

Where Π_i are ($n \times n$) coefficient matrices and εt is an ($n \times 1$) unobservable zero mean white noise vector process (serially uncorrelated or independent) with time invariant covariance matrix Σ.

A VAR model for this study took the following form:

$ECG = ß_0 + ß_1 OPV_{t-1} + µt$

Where:

ECG_t is the GDP Growth of Nigeria at a time t

OPV_{t-1} is the lag of the Oil Price Volatility at a time t

$ß_1$ is coefficient of lagged variable

µt in the model is residual

Time Series Properties of the Data, Estimation and Testing

Testing for Stationarity

The initial step will be to test for Stationarity or non-stationarity of the data through the Augmented Dickey Fuller Tests. This test, as opposed to the Dickey Fuller Test, includes lagged changes of the independent variable as a regressor. The unit root tests are applied to determine if the variables in the regression are stationary or non-stationary (Alexander & Baptista, 2002).

Granger Causality Test

The direction of causality will be tested by the use of the Granger Causality test. It tests whether lagged values of one variable explains the time path of the other variables being investigated. Thus, a variable K is said to granger because another variable L if past values of K can predict the present values of L (Alexander & Baptista, 2002). If the causality is in one direction (k>l), we can say it is a uni-directional causality. If k causes l and l causes k, then it is a bi-directional causality.

Lag Length Selection Procedure

The lag length can be selected using the information selection criteria which include: Sequential Modified Likelihood Ratio (LR), Final Prediction Error (FPE),Akaike Information Criterion (AIC), Schwarz Bayesian Information Criterion (SBIC) and Hannan-Quinn Information Criterion (HQIC) and ensuring that the residuals are white noise as suggested by Mangeni (2018). According to Mangeni and Mike (2018), there is no clear rule of thumb on which criterion to use for optimal lag length selection among the above methods. However, the decision rule is to choose the model with lowest value of information criteria.

The lag length for the VAR (p) model may be determined using model selection criteria. The general approach is to fit VAR (p) models with orders p = 0,...,p*max* and choose the value of p which minimizes some model selection criteria. Model selection criteria for VAR (p) models have the general form

$IC(p) = \ln |\tilde{\Sigma}(p)| + c_T \cdot \phi(n,p)$

where $\tilde{\Sigma}(p) = T^{-1} \sum_{t=1}^{T} \hat{\varepsilon}_t \hat{\varepsilon}_t'$ is the residual covariance matrix without a degrees of freedom correction from a VAR(p) model, c_T is a sequence indexed by the sample size T, and $\phi(n,p)$ is a penalty function which penalizes large VAR(p) models.

FINDINGS AND DISCUSSION

Trend Analysis

The study conducted the trend analysis in order to establish and graphically represent the change in the variables over time. This trend gives a picture of the stationarity of the variables. The study findings indicated that both GDP growth and oil price volatility in Nigeria indicated unsteady trends.

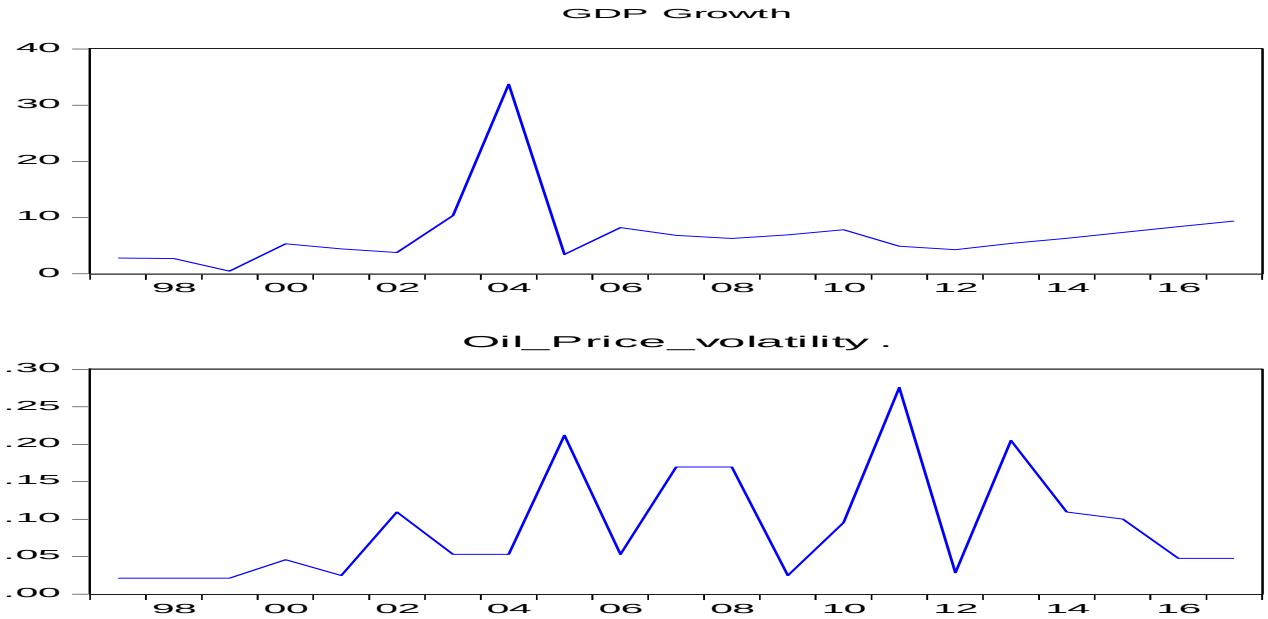

Figure 1: Trend Analysis

Descriptive Statistics

Descriptive analysis was conducted to indicate the mean, standard deviation, Skewness, Kurtosis and normality of the variables using the Jarque Bera statistic which is a combination of both Skeweness and Kurtosis. Under the null hypothesis of a normal distribution, the Jarque-Bera statistic is distributed with 2 degrees of freedom. The reported Probability is the probability that a Jarque-Bera statistic exceeds (in absolute value) the observed value under the null—a small probability value leads to the rejection of the null hypothesis of a normal distribution. The descriptive findings indicated high variations in GDP growth in Nigeria in the study period. The variations in oil price volatility was however not high (Std Dev = 6.566 and 0.075). It was also established that the two variables used in the study were normally distributed as shown by insignificant JB value (Sig >0.05). There was hence no need to conduct log transformations.

Table 1: Descriptive Analysis

	GDP Growth	Oil Price Volatility
Mean	7.101	0.090
Median	6.270	0.053
Maximum	33.736	0.276
Minimum	0.474	0.021
Std. Dev.	6.566	0.075
Skewness	3.319	1.051
Kurtosis	14.306	3.000
Jarque-Bera	15.409	3.867
Probability	0.068	0.145

Correlation Matrix

The study used correlation to establish the association between oil price volatility economic growth. The results indicated negative and significant associations between oil price volatility economic growths (Sig < 0.05). The findings imply that high volatility in the price of gasoline and diesel in Nigeria led to a decrease in economic growth since the industrial sector was driven by oil. The findings are consistent with that of Pradhan, and Sahoo (2000) used CGE to analyse the impact of international oil price shock on the Indian economy found that it affects the welfare and poverty of households directly as well as indirectly. This also agrees with Tang, Wu and Zhang (2010) carried out a study to investigate the long run and short run effects of oil price volatility in the Chinese economy, using a structural vector auto-regressive model. The study findings indicated that an oil-price increase negatively affects output and investment, but positively affects inflation rate and interest rate. Similarly, a study by Rafiq, Salim and Bloch (2009) which sought to investigate the impact of crude oil price volatility on economic activities in Thailand using the vector auto-regression (VAR) system. Furthermore, a VAR for the post-crisis period shows that the impact of oil price volatility is transmitted to budget deficit.

Table 3: Correlation Matrix

	GDP Growth	Oil Price Volatility
GDP Growth	1	
Oil Price Volatility	(0.104)*	1

Stationarity Test

Most economic variables are usually non-stationary in nature and prior to running a regression analysis. Unit root tests were thus conducted using the ADF test to establish whether the variables were stationary or non-stationary. The purpose of this is to avoid spurious regression results being obtained by using non-stationary series.

Augmented Dickey Fuller (ADF) test was employed to determine existence stationarity or otherwise. ADF was chosen because it takes care of autocorrelation in case it is present in the series (Brooks, 2008).

HO: $\alpha = 0$ (the series has a unit root).

H1: $\alpha \neq 0$ (the series has no unit root).

The decision criterion is through comparison of the absolute tau statistic value (tau calculated) and Dickey - Fuller critical table value and if the absolute tau statistic value is greater than the absolute Dickey - Fuller critical table value the null hypothesis that the series has a unit root is not rejected. The results indicated that the two variables were stationary at level hence first differencing was conducted (ADF Statistic < ADF Statistic at 1%, 5% and 10%).

Table 4: Unit Root (None and Level)

Variable name	ADF Statistic	1% Level	5% Level	10% Level	Comment
Debt service	-3.978	-3.808	-3.021	-2.650	Stationary
GDP	-4.727	-3.808	-3.021	-2.613	Stationary

Optimal Lag Length Selection

In choosing the optimal lag length, this study used the information criterion such as Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC) and the Scharz Bayesian Information Criterion (SBIC). These criteria were preferred because they are more effective than graphical procedures which determine the number of lags by examining autocorrelation function (ACFs) and the partial autocorrelation function (PACFs) patterns. Although no criterion is superior to the others the study chose Akaike Information Criterion because of its efficiency property, thus the study chose 2 lag length to be used in running the VAR model. The optimal lag length decision is supported by likelihood ratio test and the final prediction error criterion results.

Table 5: Lag Order Selection Criteria

VAR Lag Order Selection Criteria						
Lag	**Log L**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-871.8154342	44.21520	1.92e+10*	37.82920	39.95267	38.63484
1	-855.097148	22.51851	2.93e+10	38.16723	41.25592	39.33907
2	-819.017092	41.23435*	2.22e+10	37.71498*	41.76888	39.25303
* indicates lag order 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						

Vector Auto Regression Analysis

After the decision to use 2 lags, the study adopted VAR regression model and the findings presented in Table 6. It was established that the first lag of GDP growth positively affects the current GDP growth significantly ($t > 1.96$). Furthermore, the first lag of GDP growth had a negative significant effect on the current oil price volatility ($t > 1.96$). The findings also showed that there was no significant relationship between the second lag of GDP growth and the current GDP growth ($t < 1.96$). The effect of the second lag of GDP growth on oil price volatility was however negative and significant ($t > 1.96$). The study findings indicated further that the first and second lags of oil price volatility had a negative and significant effect on the current GDP growth rate ($t > 1.96$). However, the current oil price volatility was not related to its lags. Overall, the findings revealed that the first and second lags of both GDP growth and oil price volatility in Nigeria can explain up to only 2.1% of the variation in GDP growth. However, the same can explain up to 22.6% of the variation in oil price volatility. This therefore implies that oil [rice volatility is inherently determined. The findings are consistent with the findings of a study by Lee and Ni (2002) which investigated the effect of oil price volatility at micro and macro level and suggested that oil price shocks influence economic activities. The findings also agree with the findings of a study by Schneider (2004) which investigated the effect of oil price volatility on economic growth and found that oil price shocks affect the economy through the supply side (higher production costs, reallocation of resources), the demand side (income effects, uncertainties) and the terms of trade. The paper also found that an increase in the price of oil feeds through to GDP growth to a much larger extent than a decline, a phenomenon that can be attributed to adjustment costs associated with sectoral reallocations, the implications of uncertainties for spending on consumer durables and investment, and nominal wage rigidities.

Table 5: Vector Auto Regression

Vector Auto regression Estimates		
	GDP Growth	**Oil Price Volatility**
GDP Growth (-1)	0.046	-0.046
	(0.022)	(0.003)
	[2.068]	[17.556]
GDP Growth (-2)	0.007	- 0.261
	(0.296)	(0.020)
	[0.02522]	12.857
Oil Price Volatility (-1)	-3.242	-0.086
	(0.882)	(0.266)
	[3.675]	[-0.32230]
Oil Price Volatility (-2)	11.302	0.170
	(3.175)	(0.230)
	[3.559]	[0.73942]
C	6.422	0.054
	4.414	0.044
	[1.45494]	[1.23855]
R-squared	0.021	0.226
Adj. R-squared	-0.258	0.005
F-statistic	0.077	1.025
Log likelihood	-62.527	25.142
Standard errors in ( ) & t-statistics in [ ]		

Causality Test

Causality analysis is normally carried out to review the presence of casual relationship between the variables in a study. The Granger causality test was employed to determine the presence or otherwise of these relationships between the dependent variable and the explanatory variables. Causality tests reviews the causal relationship between variables in the model and the direction to which the relationships is running from or to (Mangeni, 2018). The null hypothesis is rejected if the F-statistic is significant. The findings in Table 6 indicated a bi-directional relationship between GDP growth and oil price volatility. It was established that the null hypothesis that Oil Price Volatility does not Granger cause GDP Growth as well as GDP Growth does not Granger Cause Oil Price Volatility was rejected (Sig > 0.05). This therefore implies that in Nigeria, both GDP Growth and Oil Price volatility, can affect each other.

Table 6: Granger Causality Test

Null Hypothesis:	Observation	F-Statistic	Prob.
Oil Price Volatility does not Granger Cause GDP Growth	19	0.13234	0.8771
GDP Growth does not Granger Cause Oil Price Volatility		1.59819	0.237

CONCLUSIONS

The study led to the conclusion that the first lag of GDP growth positively affects the current GDP growth significantly and has a negative significant effect on the current oil price volatility. The study also concludes that the second lag of GDP growth on oil price volatility is negative and significant. Another conclusion is that the first and second lags of oil price volatility have a negative and significant effect on the current GDP growth rate but the current oil price volatility was not related to its lags. The study also concludes that in Nigeria, both GDP Growth and Oil Price volatility, can affect each other. The findings imply that oil price volatility leads to a decline in household welfare and increase in poverty and that with the increase in elasticity of substitution of demand for imports to domestically produced crude oil, welfare loss for household groups goes on increasing.

RECOMMENDATIONS

The study recommends a need for Nigerian government to have an energy regulatory commission to regulate the price of gasoline and disease since its fluctuations have a negative impact on the economy. The Nigerian government can control oil and energy prices typically in the form of price freezes or ceilings for increasing prices rather than price floors; given that price decreases are typically politically popular to consumers. Another government tactic for controlling price increases and volatility is the introduction of price subsidies and tax reductions. Nigerian government may also target specific industries with subsidies and tax reductions to reduce costs. These industries can be those that rely heavily on petroleum products such as gasoline and diesel and may include agriculture, public and goods transport, and fisheries, to avoid consumers receiving substantial price shocks to essential purchases. The Nigerian government can also buildup its strategic oil reserves to make it possible for it to supply the market in the case of sharp price spikes that typically result from physical disruptions to supply, such as hurricanes and other natural disasters.

CONFLICT OF INTEREST

No potential conflict of interest was recorded by the Author.

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