OIL PRICE VOLATILITY AND MACROECONOMIC PERFORMANCE IN TWO TOP NET OIL PRODUCING COUNTRIES IN AFRICA

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Abstract

This study examined the relationship between oil price volatility and macroeconomic performance in two top net oil exporting countries in Africa (Angola and Nigeria). Quarterly data which were sourced from international monetary fund online database and Central Bank of Nigeria and Angola were used to carry out the empirical analysis. Structural Vector Autoregressive model (SVAR), E(GARCH) and Granger Causality test were used as estimation techniques. Findings from the results showed that oil price volatility has marginal impact on growth rate of Gross Domestic Product of both countries. However, both Impulse Response Function and Variance Decomposition showed that shocks to exchange rate from oil price volatility was the highest. That is, exchange rate appreciates when oil price increases and depreciates when oil price reduces. This has much impact on the economies of Angola and Nigeria being net oil exporting countries.

The Granger causality test showed that the direction of causality between oil price volatility and macroeconomic variables in Nigeria was bi-directional while the relationship in Angola was uni-directional during the study period. Based on this findings, it is recommended that, both countries Angola and Nigeria should improve upon their crude oil refining capacity. Also Economic diversification should be strengthened to promote indigenous production so as to reduce importation of those goods that could be endogenously produced.

Key words: Oil price volatility, macroeconomic performance, E(GRACH), (SVAR), and Granger causality.

Background to the study

Crude oil represents one of the most important natural resources and it has the largest commodity market in the world. Unlike other commodities, oil is probably one of the few or the only production input that can have both symmetric and asymmetric effects on economic growth. To a large extent, oil price fluctuation can lead to a recession Gonzalez and Nabiyev, (2009). Since the 1970s, the international crude oil price has witness persistent fluctuation. Gonzalez and Nabiyev, (2009) point out that oil prices are not just rising, but the volatility is also worsening – fluctuations are more pronounced than they were in the 1970s, creating unpredictable consequences. On the other hand, Li and Zhao (2011), crude oil price fluctuation from 1970s to 2011 has been increasingly erratic with the volatility being more erratic since 2002. Oil price volatility dampens growth through different channels, from an increase in production cost to inflation expectations. Besides, oil price increases can translate into higher transportation, production, and heating costs, which can put a drag on corporate earnings, it can also affect price stability, firm profitability and a country's financial system stability Li & Zhao, (2011).

Furthermore, the impact of oil price shock and volatility on the output growth of net oil exporting nations are not the same with the impact on net oil importing nations. For instance, oil price increases might be considered bad for oil-importing nations but good news for oil-exporting nations. The reverse might be expected for oil price decreases. The immediate effect of positive oil price shocks is to increase the cost of production for oil importing countries. This is likely to reduce the output, and its magnitude depends on the shape of the aggregate demand curve. Higher oil prices lower disposable income and this decreases consumption. Once the oil price increases are perceived as permanent, private investments also decrease. Moreover, if the shocks are perceived as persistent, oil is used less in production, capital and labour productivity both decrease and potential output falls Hakan and Nukhet, (2010). From empirical studies such as Rasche and Tafom, (1977, 1981), Darby, (1982); Mork, (1989) justify the rising oil prices reduce output and increase inflation. Based on this, tax revenue reduces and budget deficit increase. Oil price changes also affect trade and exchange rates. When oil prices increase, the inelastic demand curve for oil means total spending on oil imports increases. This puts pressure on the exchange rate and depreciate the local currency. This reduction in the value of currency may further reduce economic performance.

For Oil exporting countries, Oil production usually accounts for a large share of the GDP of oil-exporting countries and increasing in one price directing increase the country's currency value (total production increase because the value of oil production increases the income). However, the total effect of oil price shocks on economic performance mostly depends on what the oil producer do with the additional revenue Hakan, Nildag & Nukhet, (2010).

The level at which oil price changes engender macroeconomic performance continue to attract theoretical and empirical discussions especially in developing nations. In recent time, the debate has been given impetus in African countries the basis of that agitation is due to the argument that the seemingly steady growth that has been recorded over the past decades has not translated to a reasonable level of output growth. Furthermore, the sharp drop in oil prices since mid – 2008 till date has brought to the fore a different challenge whether oil exporters in African can sustain spending levels reached in previous years. Joseph, and Festus (2013)

The impact (positive or negative) which oil price shocks/volatility could have on any economy demands on what part of the divide such economy falls into and of course the nature of such price change (either increase or decrease). However, eighty percent of oil producing countries in African qualifies as both an oil exporters and importers by reason of the fact that they exports crude oil, but imports refined petroleum products. Therefore, making a conclusive and authoritative statement on the impact of oil price shocks/volatility on them become so controversial Iyoha & Oriakhi, (2013). Therefore, investigating the consequences of oil price changes on output growth is particularly relevant in the case of oil producing countries in Africa. This is because oil price changes influence their economies as an exporter of crude oil and

importer of refined petroleum products. It implies by simple reasoning that oil price change whatever the nature (either a rise or fall) can both benefit and hurt their economies at the same time. However, the crux of the problem lies in the fact that those oil producing countries in Africa continent entirely depend on oil over the Years making their economies mono-product and this has triggered severe structural difficulties for their economies.

The drastic reduction in world oil price since mid 2014 till date has equally called for the renewal in the interest of findings the relationship between oil price and output growth. The analysis of macroeconomic effects of oil price has evolved along two distinct directions. On the one hand, a wave of empirical studies aimed at quantifying the effect of higher energy prices on macroeconomic variables. Most of these studies were purely empirical, lacked a solid theoretical basis and the results seems to depend essentially on the empirical approach. Depending on estimation technique, the identification of oil price shocks, or the sample period. Very different conclusion can be arrived at. On the other hand, though theoretical studies examine the channel in which oil price might impart macroeconomic performance while these studies provide important insight regarding the transmission mechanism, the practical relevance of the different theoretical studies is not always clear given the lack of empirical evidence. Therefore, this research work is out to integrate both theoretical and empirical method to establish the relationship between oil price dynamics and macroeconomic performance in two top net several studies have been conducted in Africa to establish the relationship between oil price volatility and macroeconomic performance. However, majority of these studies are country specific. The rest of the paper is structured as follows. This introductory chapter is followed by section two that discusses literature. Section three presents theoretical underpinning method and materials. Section four centers on result presented and analysis. Section five concludes the paper.

Section II

In this section, both theoretical and empirical literature are presented.

Empirical Review from Developed Countries

Several studies have been conducted on the relationship between oil price volatility and macroeconomic performance both in developed and developing economies. However, some of these studies are herby presented.

Arouri. Lathiani and Nguyen (2011) investigate the six countries members of the Gulf Cooperation Council (GCC) from 2005-2010. The study employed VAR as the estimkation techniques and found that the existence of significant return and volatility spillovers between world oil prices and GCC stock markets. To support this,s Basher and Sadorsky (2006) investigate the relationship between oil price risk and stock market returns in 21 emerging stock markets using cointegration and error correction as estimation technique and found strong evidence that oil price risk impacts stock price returns in emerging markets.

Also in line with the two previous studies, Park and Ratti (2007) examine the U.S and 13

European countries using VAR and GARCH as estimation technique to establish the relationship between oil price and output growth. The study found that increased volatility of oil prices significantly depresses real stock returns in the European countries. And that the contribution of oil price shocks to variability in real stock returns in U. S and most other countries is greater than that of interest rate. They also find that increase in real oil price significantly raises the short-term interest rate in the U.S and eight out of 13 European countries within one or two months. Counter to findings for the U.S., there is no evidence of asymmetric effects on real stock returns of positive and negative oil price shocks for any of the European countries.

In another study by Agren, (2006) studies the weekly stock market data for Germany, Japan, Sweden, the United Kingdom and the United states, from 1989 to 2005 employed VAR and ARCH as estimation technique. And finds strong evidence of volatility spillover for Germany, Japan, and the U.K. Out of these countries, German and British stock markets seem to have an asymmetric volatility-response to oil shocks, meaning that positive shocks affect stock market volatility more than negative ones do. Evidence of volatility spillover from oil prices to U. S stocks is found, but is considered rather weak since it does not hold under some intuitively appealing parameter restrictions. No support for oil price volatility spillover to the Swedish stock market is presented over the sample period. Furthermore, empirical evidence is found that oil price changes have an impact of U.S stock returns and some evidence is provided that supports the asymmetry of oil price volatility.

In the work of Ramos and Veiga (2010) examine 43 stock markets, the study employed co-integration and error correction as estimation technique. And find that for developed countries that oil price shocks depress international stock markets, but oil price drops do not necessarily increase stock market returns. And that the volatility of oil prices has a negative impact on international stock market returns. While emerging market returns are not sensitive to oil price variations. In addition, the asymmetry of oil price changes impacts oil volatility, i.e. when oil prices soar, oil volatility also increase, while negative oil price changes dampen volatility.

To support the view of the previous authors, Ito (2008) investigated impact of oil prices and monetary shocks on the levels of inflation, interest rate and real gross domestic product (GDP) for Russia during the period 1995:Q3-2007:Q4, using the co-integrated VAR model. The results show that an oil price increase has a positive effect on real GDP and inflation and this shock effects are greater than monetary shock for Russia.

Mpatswe, (2011) examines fiscal cyclicality in six African countries during 1980-2008 using equations with the lagged values of explanatory variables as proxies for the long-run values and run the regression in their first differences. Their results show that total public expenditure is strongly pro-cyclical and although the cyclicality coefficients vary from one country to another. The public investment is the most pro-cyclical component, which overreacts to economic growth with elasticity of more than a unity.

Erbil (2011) examines the cyclicality of fiscal policy in 28 oil-exporting countries during the period 1990-2009, using pooled OLS regression, Diff-GMM and Sys-GMM methods and found that all fiscal variables are strongly pro-cyclical in the full sample, but results are not the same across income groups. The results further shows that government expenditure is pro-cyclical in low and middle-income countries, while it is countercyclical in the high-income countries

Husain, (2008) assess the impact of oil price shocks on non-oil economic cycle in 10 oil-rich countries, including Oman over the period 1990-2007. The obtained results from a panel VAR show that in countries where the oil sector is dominant, oil price changes affect the economic cycles through the fiscal policy channel. In their examination of the behaviour of government expenditure during boom-bust in commodity price cycles of 32 oil-rich countries over the period 1992-2009.

Empirical Review from Developing Countries

In Africa, several attempts have been made to examine the asymmetric effect of oil price on output. Aliyu (2009) assesses empirically, the effects of oil price shocks on real macroeconomic activity in Nigeria. In line with the approaches employed in the literature – that is classifying oil price as asymmetric and net specifications oil price specifications – Granger causality tests and multivariate VAR analysis were carried out using both linear and non-linear specifications. Inter alia, the latter category includes two approaches employed in the literature, namely, the asymmetric and net specifications oil price specifications. The paper finds evidence of both linear and non-linear impact of oil price shocks on real GDP. In particular, asymmetric oil price increases in the non-linear models are found to have positive impact on real GDP growth of a larger magnitude than asymmetric oil price decreases adversely affects real GDP. The non-linear estimation records significant improvement over the linear estimation and the one reported earlier by Aliyu (2009). Further, utilizing the Wald and the Granger multivariate and bivariate causality tests, results from the latter indicate that linear price change and all the other oil price transformations are significant for the system as a whole. The Wald test indicates that our oil price coefficients in linear and asymmetric specifications are statistically significant.

To corroborate the view of Aliyu. Berument, Ceylan and Dogan (2010) study the effects of oil price shocks on output growth (proxied by industrial production) for a selected the Middle East and north Africa (MENA) countries, including Oman. They use several VAR models for the period 1960 to 2003. Their results show that the impact of oil price on GDP of Iraq, Algeria, Kuwait, Oman, Jordan, Syria, Qatar, UAE and Tunisia are significantly positive, but not significant for other countries in their dataset. I extend this analysis by using more data, using a higher dimension VAR models and considering other key macroeconomic variables such as government expenditure, government revenue.

In line with the previous authors, Bounchaout and Ai-zeaud (2012) used a Vector Error Correction Model (VECM) and Variance Decomposition analysis (VD) to explore the effect of oil price volatility on Algerian economy during the period 1980-2011. Their

results reveal that oil price changes have a very limited impact on most macroeconomic variables in short run except a positive effect on inflation and negative influence on real exchange rate. However, in the long run oil prices change have positively affected real GDP and inflation and have a negative effect on unemployment and real effective exchange rate.

To support the view of Bounchaout and Ai-zeaud. Part and Ratti (2007) using multivariate vector autoregressive approach for a sample period of 1986-2005 in Norway (an oil-exporting economy like Nigeria), their findings reveal that oil price fluctuations account for a six percent volatility in real stock returns. However, for most European economies understudied, it has been shown that increased volatility of oil prices significantly depresses real stock returns. For the United States, the study reveals that oil price shocks, rather than interest rates, explain more of the fluctuations in real stock market returns. This also conforms to the study of Sadorsky (1999) that oil prices explain a larger fraction of the forecast error variance in real stock returns than interest rates after 1986.

In related study, Wakeford (2006) assesses the impact of oil price shocks on the South African macro economy. The study traced the history of oil shocks and their impact on South Africa. The study used trend analysis as estimation technique. The findings reveal that while commodity exports-especially gold-provided an initial buffer, the economy was not immune to sustained price shocks. The paper considered the outlook for future oil shocks and their possible impact, given South Africa's strengths and vulnerabilities. The study concludes that while there are several short-run supply risks, the major threat is the inevitable peaking of oil production which may occur within 5 to 10 years. This, the study argues will result in recurrent oil shocks and greater volatility and recommended governments' accelerated action on the shocks.

To further enhance previous studies, Olaokun (2000), in a related study, arrived at some interesting conclusions; He showed that oil price increases exerts a negative effect on the economies of Ghana and Nigeria (although the latter is an oil-producing country), but has a positive effect on Russia, which liken Nigeria is an oil producing country. This outcome raises a lot of questions. Relating this volatility to the Nigerian economy.

To revalidate his previous study, Okonju (2009), after a careful assessment of Nigeria's growth path in post oil discovery period, using co-integration and error correction model as estimation technique. He explained that during the oil boom era GDP grew positively by 6.2% annually, but the growth rate turned negative through the larger part of the 80's when oil prices crashed; this period also saw inflation rate jump to 11.8% on average, with a period peak of 41% in 1989; Gross Domestic Investment (GDI) as percentage of GDP fell from 16.3% to 14%. However GDP growth rate managed to turn positive (averaging about 4%) between 1988 and 1997 as a result of structural adjustment policies (SAP). Okonju concluded that oil price volatility has been a major contributory factor to instability in GDP growth pattern in Nigeria.

Richard and Ronald (1980) lamented the continuous over reliance of the Nigerian

budget on oil revenue. They noted that periods of oil price upheavals especially price slumps have necessitated significant alterations in budget figures, plans, targets and even allocations to states and government-owned parastatals and agencies. Total abandonment of policies and projects have also characterized such times, this they opined had serious growth implications for the Nigerian economy. The study employed descriptive statistics.

Rahman and Serletis (2008) investigate the asymmetric effects of uncertainty on output growth and oil price changes as well as the response of uncertainty about output growth and oil price changes to shocks using general bivariate framework in a modified vector autoregressionn in some selected oil exporting countries in Africa. They employ simulation methods to calculate Generalized Impulse Response Functions (GIRFs) and Volatility Impulse Response. Functions (VIRFs) to trace the effects of independent shocks on the conditional means and the conditional variances, respectively, of the variables. They find that bivariate, GARCH-in-mean, asymmetric VAR-BEKK model embodies a reasonable description of the monthly U.S. data, over the period from 1981 to 2007. They show that the conditional variance-covariance process underlying output growth and the change in the real price of oil exhibits significant non-diagonality and asymmetry, and presents evidence that increased uncertainty about the change in the real price of oil is associated with a lower average growth rate of real economic activity.

To buttress others studies, Olomola (2006) investigated the impact of oil price shocks on aggregate economic activity (output, inflation, the real exchange rate and money supply) in Nigeria using quarterly data from 1970 to 2003. The findings revealed that contrary to previous empirical findings, oil price shocks do not affect output and inflation in Nigeria significantly. However, oil price shocks were found to significantly influence the real exchange rate. The author argues that oil price shocks may give rise to wealth effect that appreciates the real exchange rate and may squeeze the tradable sector, giving rise to the – Dutch-Disease.

Akpan (2009) analyses the dynamic relationship between oil price shocks and economic activities. His findings show that major oil price shocks significantly increase inflation and also directly increase real national income through higher export earnings, though part of this gain is seen to be offset by losses from lower demand for exports generally due to the economic recession suffered by trading partners. The findings also reveal a strong positive relationship between positive oil price changes and real government expenditures.

Aloui, (2008) provide another piece of evidence that crude oil markets matter in forecasting major stock major stock market behavior. They adopted an Unrestricted Vector Autoregressive model and Multivariate GARCh type process to analyze crude oil volatility shocks and stock markets returns in six major industrial countries: France, Japan, U.S.A., Germany and Canada from 1989-2007. Their results showed that oil price changes have a negative impact on major stock market equity returns.

Bjorn land (2008) are consistent with what we would expect from oil producing country. He used Structural Vector Autoregressive model

to study the relationship between oil price shocks and stock market booms in an oil exporting country using Norway as example for the period 1993 to 2005. He concluded that higher oil prices increase stock returns.

Guo and Kliesen (2005) investigated the impact of oil price volatility on macroeconomic activity in U.S. Using Granger Causality Test, they found a significant negative impact of oil price volatility on GDP growth over the period 1984 to 2004. Moreover, the study indicates asymmetric effect of oil price volatility on macroeconomic activities. Examining macroeconomic dynamics in oil exporting countries in Africa with the use of Panel VAR, Mohaghegh and Mehrara (2011) established that oil shocks are not necessarily inflationary. Further, domestic policies, instead of oil boom causes inflation and money is the main cause of macroeconomic fluctuations.

Wilson, David, inyiama and Beatrice (2012) examined the relationship between oil price volatility and economic development in Nigeria. Applying Ordinary Least Square and Granger Causality Test, the study shows that there is no significant relationship between oil price volatility and key macroeconomic variables (Real GDP, inflation, interest rate and exchange rate).

Asaolu and oil (2012) used Cointegration analysis and Vector Error Correction Framework to analyze the impact of oil price on the Nigerian stock market performance. The found out that oil prices and stock market performance are tied together in the long run. A rise in price of oil leads to a decline in the return performance of the stock market.

Somoye and Ilo (2008) examined the Nigerian stock market performance using vecto-autoregressive (VAR). the study concluded that among the variables examined in the VAR model the price of the Nigerian crude oil, exchange rate and the rate of inflation are the most significant macroeconomic variables influencing the aggregate stock market returns in Nigeria. Gunu and Kilishi (2010) studied the impact of crude oil prices on key macroeconomic variable in Nigeria. They employed Vector Autoregressive model The study concluded that crude oil prices have significant effect on the three key macroeconomic variables in Nigeria; GDP, money supply and unemployment. Despite the significant nature of this topic, not many studies have been undertaken to analyze the individual industrial effect of oil price shock in Nigeria. This paper aims to fill the gap.

Cologne 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.

In summary

The empirical Literature

The empirical literature reviewed above is far – reaching with respect to the relationship between oil price dynamics and output growth both in oil importing and oil exporting countries. The results from the empirical review seem to be contradictory. The results

are based on different estimation techniques, sample periods. The earlier researchers employed ordinary least square as estimation technique with a very small sample period. The few studies that employed co-integration and error correction model either used Engel and Granger or Johansen and Juselius with different sample periods. The most recent studies that made used of vector autoregressive distributive model were specific countries. Therefore, this study intends to solve these mentioned problems by using panel structural vector autoregressive model and granger causality test. Also, majority of the studies on oil price macroeconomic relationship concentrated in oil importing nations. However, there are few studies in oil exporting nations but those few studies are country specific and carried out majorly when oil price was increasing and before global financial crisis of 2008. Therefore, this study shall segregate the study periods into two: crisis periods and boom periods. This is to enabling the researcher to examine both symmetric and asymmetric effects on output growth in those selected countries.

METHODOLOGY

In this section, the theoretical framework, research methods, model specification, a *priori* expectation, estimation technique and sources of data are presented.

Theoretical Framework

Many of the theories relating to oil price dynamic and output growth had been presented in the section two under theoretical literature. However, our approach here is to use the most closed theory out of these theories to provide foundation for our model. The theory is named as the "Asymmetric theory of economic growth".

The Asymmetry theory of economic growth.

This theory was developed, by Mark (1994), Ferderer, (1996) and Balke, (1996). The theory discusses the strength and the asymmetry in effect of oil price volatility on output growth. A member of this school Ferderer (1996) providess a sufficient detailed reports or asymmetric mechanism between the influence of oil price volatility and output growth by concentrating on three possible ways, counter-inflationary monetary policy, sectoral shocks and uncertainly. From his study, he discovered a statistically significant relationship between increase in oil price and counter inflationary policy responses. This position of Balke, (1996) was confirmed by the Federer submissions. The theory says monetary policy alone cannot adequately strengthen real impact of oil price dynamics on output growth and that fiscal policy should be incorporated.

3.2 Model specification

Reference to the theoretical framework and with requirements for specifying Panel Vector Autoregressive Distributive Model. the below equation is now being presented to examine the relationship between oil price volatility and output growth in ten top oil producing states in Africa.

$$GDP_{gr} = Y_{10} + y_{11}ocp_{t-1} + y_{12}nocp_{t-1} + y_{13}impv_{t-1} + Y_{14}excpv_{t-1} + y_{15}exr_{t-1} + y_{17}INF_{t-1} + \sum GDP_{gr}$$

$$ocp = Y_{20} + y_{21}GDP_{gr+} \quad y_{23}nocp_{t-1} + y_{24}impv_{t-1} + y_{25}excpv_{t-1} + y_{26}exr_{t-1} + y_{27}inf_{t-1} + \sum ocp$$

$$nocp = Y_{30} + y_{31}\ ocp = + \quad y_{21}GDP_{t-1+}y_{31}impv_{t-1} + y_{32}excpv + y_{33}exr_{t-1} + y_{34}inf_{t-1} + \sum nocp$$

$$impv = Y_{41} + y_{42}nocp + \quad y_{43}ocp\ Y_{t-1} + \quad y_{44}GDP_{t-1+}y_{45}excpv_{t-1} + \gamma_{46}exr_{t-1} + \gamma_{47}inf_{t-1} + \sum impv$$

$$inf = y_{50} + y_{51}\ impv = + y_{52}\ nocp + \quad y_{53}ocp\ Y_{t-1} + \quad y_{54}\ GDP_{t-1+}y_{55}excpv_{t-1} + \gamma_{56}exr_{t-1} \sum inf$$

$$exr = y_{60} + y_{61}\ impv = + y_{62}\ nocp + \quad y_{63}ocp\ Y_{t-1} + \quad y_{64}\ GDP_{t-1+}y_{65}excpv_{t-1} + \gamma_{66}exr_{t-1} \sum exr$$

$$excpv = y_{70} + y_{71}\ impv + y_{72}\ nocp + y_{73}ocp\ Y_{t-1} + \quad y_{74}\ GDP_{t-1+}y_{75}excpv_{t-1} + \gamma_{76}exr_{t-1} \sum excpv\} \ldots\ldots 1$$

Dependent variables	Description
Growth rate of gross domestic product	Real GDP growth rate represents the change in each country's GDP from one period of time (usually a year) to the next after being adjusted to inflation.
Exchange rate (EXR)	Exchange rate represents the price of each country's currency in terms of another currency. This shall be were expressed as units of local currencies to US dollars
Foreign Interest Rate represented by (USA) treasury Bills Rate	This represents the united state of America's lending rate adjusted for inflation
World Oil Price (WOP) mark	World oil price represents the benchmark price for purchases of oil worldwide and it is measured in US dollars per barrel
Inflation rate	This is a measure of the stability in the domestic economy
Domestic Real Interest Rate	This represents the lending rate adjusted for inflation in the selected African nations
Money Supply (MS)	This is the combination of both narrow and broad money supply that has been corrected from prices fluctuation.

Estimation Techniques.

This is studies to employ three estimation techniques to study the relationship between oil volatility and macro economic performance in two top net oil producing countries in Africa. (Nigeria and Angola)

Roberts, (2004) For the purpose of this research work, two volatility measurements shall be used. First, the oil price volatility measured by equation (3.2) and oil price uncertainty represented by equation (3.3). This equation 3.2 and 3.3 are estimated based on auto-regressive estimated to account for deviations from an expected trend by taking the standard deviate employing the rolling window technique

$$wop_t = \beta_1 + \beta_2 wop_{t-1} + \beta_3 wop_{t-2} + \varepsilon_{1t} \quad (3.2)$$

$$wop_t = \beta_4 + \beta_5 T + \beta_6 T^2 + \varepsilon_{2t} \quad (3.3)$$

T is take to be the time trend. Oil price volatility is represented by equation (3.2) The importance of equation (3.3) it takes care of oil price uncertainty as simple variability around a time trend. Therefore, the GARCH mode can now be presented by below equation.

$$Y(E) = x(t)\,P + e(t) \quad (3.4)$$

$$e(t)\ \phi_{c-1} \sim N[0,\ \sigma^2(t)] \quad (3.5)$$

$$\sigma^2(t) = {}_0 + {}^2(t\text{-}1) + {}_j\sigma^2(t\text{-}j) \quad (3.6)$$

the implication of the above equation is that if the asymmetric effect is present $\theta < (>)\ o$ implying that negative (positive) shocks increase volatility more than positive (negative) shock of the same magnitude while if $\theta = 0$, there is no asymmetric effect. The Schwartz information criterion (sic) as given above is used for the choice of best model sic (g) = log (EE/n) + g log n/n

5 Data, methods and materials

This section presents the empirical results of the analysis starting with the time series properties of the variables used for the estimation.

Unit Root Test for variables in Nigeria

The results of the estimated models, for the ADF stationarity test is presented in table 4.1 in the appendix. From results in table 4.2, not all the variables of interest were stationary at level but became stationary after the first difference. This shows that the variables are integrated of order one.

Unit Root Test for variables in Angola

The result of the ADF unit root test presented in table 4.2 in the appendix for Angola, shows the existence of non stationarity in all the data series (except CPT) in level, as the absolute values of ADF test statistics, of the variables in level were less than the absolute (values of the) 95% critical value of the ADF statistic, thereafter, the variables were subjected to Stationarity Test at 1st difference where they became stationary. Therefore, the variables of interest are integrated of order one 1 (1).

Testing significance and Granger causality in Nigeria

Table 4.3 in the appendix shows the estimated values for pairwise tests of Granger Causality. From the first line result, the null hypothesis cannot be accepted. Therefore, oil price variable Granger cause economic growth that is used to proxy macroeconomic performance directly in Nigeria. The results from the table further shows that oil price volatility Granger causes consumer price index (CPI) at 5% level of significance. Also, from the table, we cannot accept the null hypothesis therefore, we accept the alternative hypothesis that world oil price Granger causes real exchange rate in Nigeria. Considering the direction of causality between world oil price and money supply, the null hypothesis cannot still be accepted leaving us to accept the alternative hypothesis that world oil price Granger causes money supply in Nigeria, focusing attention on the direction of causality that exists between the only exogenous valuable (foreign interest rate) and world oil price: The Granger causality result shows that world oil price Granger causes foreign interest rate. Finally, the result on the table equally shows that the world oil price Granger causes domestic real interest rate.

Conclusively, we can say emphatically that the interaction between world oil price and macroeconomic variables in Nigeria is significant with the direction of causality going at least one direction as showed by the pairwise Granger causality tests.

Testing of significance and Granger causality for Angola

The Granger causality test for Angola as presented in the table 4.4 in the appendix followed the same pattern with that of

Nigeria. From the Granger causality results, world oil price Granger causes all the macroeconomic variable (consumer price index, exchange rate, real interest rate, and money supply) and foreign interest rate.

Volatility measurement

ARCH/GARCH RESULT FOR NIGERIA

The regression shows the nature of the volatility of variance of the world oil price. From table 4.5 in the appendix, shows that the variance of world oil price has a mean variance of 3.83 to establish the nature of the shock, the sum of the roots is expected to be less than one and close to unity in this case, we say that it has a mean reverting process and this process mean reverts slowly. Engel (2001) from the result on the table 4.5 in the appendix, the sum of the root is given as (0.063) a value that is close to unity. This shows that the variance in the world oil price is not stable and volatile always to its original position.

ARCH/GARCH RESULT FOR ANGOLA

The volatility test for Angola shows a mean variance of 4.062 to establish the nature of volatility shock, the volatility shocks are not persistent since the parameter is greater in absolute value. It will require more time for this effect die out. This parameter is (0.3214). This is an evidence for existence of no volatility.

The volatility test for Angola shows a mean variance of 4.062. The volatility shocks are not persistent since the sum of the roots is less than one and not even closed to unitary. This shows that the variance in the world oil price is stable in Angola but not very volatile unexpectedly and in most occasions reverts quickly to its origin position . this result implies that the variation in the world oil price is not responsible for by the lag of its error term. Therefore, volatility and shock in world oil price are not really as a result of news about volatility and shock from the previous. This confirmed the fact that a major cause of world oil price volatility is speculation around the prices by the agent in the market.

IMPULSE RESPONSE FUNCTION

VAR (Auto regression) estimates could be employed to determine or trace the effect of one standard deviation shock to one of the innovation current and feature values of endogenous variables. A shock to the L-th variable directly. Influences the J-th variables and this is also transmitted to all endogenous through dynamic structural of VAR.

Impact analysis for Nigeria

The results of impulse response functions are presented in Appendix figure 4.1, from the figure, the response of GDP growth rate to shocks emanating from world oil price volatility was negative and significant from the first quarter and this persisted till the fifth quarter when the response die down till seventh quarter. Thereafter, the response further became negative and significant till the tenth quarter. The implication of this is that world oil price volatility has negative impact on the growth of Nigerian economy during the study period. This has always been confirmed with the macro economic performance in Nigeria either during crude oil price reduction or during oil price increase. For instance, Nigerian Economy has been in recession since almost three quarters now because of sudden reduction in global oil price reduction at international oil market in mid-2014

The response of money supply to the shock coming from world oil price was negative and insignificant from first quarter till the fourth quarter. Thereafter, the response became positive and still insignificant till the eight quarter. After this, the response was now oxillating but became positive till the tenth quarter. Looking critically at the results in figure 4.1, the result equally confirms that a standard deviation shock coming from world oil price inflicts negative and significant effects on exchange rate in Nigeria. This conforms with the theoretical prediction. The response of consumer price index to shock coming from world oil price was initially. Significant and positive from first quarter till fourth quarter but later oscillating toward equilibrium from fifth quarter till seventh quarter. Thereafter, the response further became negative and significant till the tenth quarter. The result in figure 4.1 exhibits that a standard deviation shock from world oil price has negative but significant impact on real interest rate in Nigeria. The impulse response function maintains an equilibrium level from quarter one up to the sixth quarter struggling to rise but the surge was impossible because on inbuilt nature of developing economies (Nigeria inclusive)

VARIANCE DECOMPOSITION FOR NIGERIA

In this sub-section, we determine the percentage of variances in each endogamous variable that is determined by the other variables. These assist to provide the amount of influence the endogenous factors exert on each other.

The variance decomposition result is presented in table 4.9 in the appendix.

The variance decomposition suggests that world oil price as reported in table 4.9 had the highest impact on exchange rate for the entire period of the analysis. it increases steadily and significant over time world oil price responsible for about six percent of shocks to exchange rate in the first quarter and increase to about twenty five percent in the tenth quarter. From the results on table 4.9 the growth rate of gross domestic product essentially explains itself for the first five periods of the analysis. Thereafter, world oil price accounted for the largest variations in growth rate of gross domestic product, take for instance almost four percent variation in GDPgr in the first three quarter was from WOP this increased persistently to almost twenty percent in the tenth quarter. The contribution of real interest rate to variation in GDPgr was not significant average of thirteen percent throughout the analysis. The variations in money supply was explained majorly by growth rate of gross domestic product. GDPgr accounted for about 30% of the variation in the first quarter, this increased to about forty eight percent in the fifth quarter and increased steadily to about 70% in the tenth quarter. The contribution of world oil price volatility was significant. The contribution of consumer price index was significant oxillating between five to seven percent within the first and tenth quarter.

Conclusively, the variance decomposition result shows that shock to exchange rate and growth rate of gross domestic product were accounted for twenty four and twenty two percent for by world oil price volatility. The implication of this is that, Nigeria as a net oil exporter, the naira appreciated when oil price increases and depreciates when oil price falls

in international world oil market. This finding is compatible with Iyoha & Oriraki, (2013), Olomola, (2006) Akpan, (2008).

IMPACT ANALYSIS FOR ANGOLA

Using the structural vector Autoregressive Distributive model, the impulse response functions of Angola is estimated by using quarterly data. The result on figure 4.2 in the appendix shows that one standard deviation shock in oil price has statistically significant, contemporaneous, and positive effects on the growth rate of the Angola economy. This is because the response of GDPgr was positive and significant right from first quarter till the tenth quarter from the analysis, higher oil prices increase output during the period of analysis.

Our VAR analysis in Angola also includes exchange rate, consumer price index, real interest rate and money supply. From the results, the response of exchange rate was positive but not statistically significant. As net oil exporting nation, when price of oil increases at world oil international market, her currency appreciates. The response of money supply was negative but significant from first quarter to the fifth quarter but became positive but still maintain significant level. However, the response of consumer price index was positive and significant right from first quarter till the fifth quarter before its starts to become negative and significant till the eight quarter. Thereafter, it starts to be positive and insignificant. The response of real interest rate was not significant but before it eventually dies of in the tenth quarter.

VARIANCE DECOMPOSITION FOR ANGOLA

The result from IRF corroborates the findings generated from the variance decomposition result. From table 4.10 in the appendix, the 15.2% or the variation in growth ratio of Gross Domestic Product can be explained by world oil price volatility at the end of the fifth quarter. This is followed by the exchange rate that explained fair portion of the growth rate of Gross Domestic Product. Exchange Rate explain almost 14% variation in GDPgr. Inflation rate equally explain some of this variations. Consumer price index was equally significant and positive almost 5% till the seventh quarter.

Comparative Analysis of the relationship between oil price volatility and macro – economic performance in Angola and Nigeria.

Angola and Nigeria are the two largest net oil exporting countries in Africa. The empirical analysis started with stationarity test. In both countries, the variables of interest were stationary after the first difference. Thereafter, E (GARCH) was used to establish the oil price volatility. It was confirmed from the result that oil price was volatile in both nations. This now enable as to test for Granger Causality test. In Nigeria, the Causality that runs between world oil price and macroeconomic variables was bi-directional. That is, world oil price Granger Causes all macroeconomic variables also macroeconomic variables Granger Causes World Oil Price. While in Angola, the direction of Causality was uni-directional. That is, World Oil Price Granger causes only Growth rate of Gross Domestic Product, money supply and Exchange rate but did not

Granger Causes Real Interest Rate. The result of both Impulse Response Function and Variance Decomposition were the same in the two countries (Nigeria and Angola). The response of Growth Rate of GDP to shocks emanating from world oil price was positive and significant In both countries, the contribution of world oil price to variation in Growth Rate of Gross Domestic was the highest. The implication of this is that increased in world oil price have positive impact on microeconomic performance but not significant while decrease in world oil price has negative and significant impact on the macroeconomic performance of these two countries (Nigeria and Angola). The findings of this paper are compatible of the previous studies on this topic,\
Olomolu, (2006), Iyoha & Orinka, (2013)

Summary and conclusion

This study examined the relationship between oil price volatility and macroeconomic performance in Nigeria and Angola between 1990 and 2014. The study made used of structural vector Autoregressive model, E(GARCH) and Granger Causality test as estimation techniques. The Augmented Dickey fuller (ADF) test showed that all the variables of interest in both countries were stationary at first difference. That is integrated of order one 1(1). Results from both impulse response and variance decomposition show that oil price volatility has marginal impact of Growth Rate of Gross Domestic product which was used to proxy Economic growth. The E (GARCH) result shows that oil price was relatively volatile during the study periods. Also, pairwise Causality Test show a bi-directional relationship between oil price and macroeconomic variables in Nigeria while it shows a uni-directional relationships in Angola. Based on these findings, it is recommend that both nations (Nigeria and Angola) should strength their crude oil refining capacity. Also, that economic diversification should be encouraged by various governments of these nations to improve their indigenous productive capacity to reduce importation of those goods that could be produced locally.

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