Oil Price Shocks and Economic Performance in Africa's Oil Exporting Countries

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Abstract: This study applied recently developed Panel Structural Vector Autoregressives (P-SVAR) estimating technique to empirically assess the transmission processes of oil price shocks and how it impacts economic performance within the monetary framework of the Africa's net oil exporting economies. The study considered, among other variables; inflation, money supply, bank rate, exchange rate, gross domestic product, unemployment and oil price shocks which is treated as exogenous while other variables as endogenous variables. The period of the study covered 1980-2015. The analysis of the data revealed that there were significant responses to oil price shocks during this period. The result of the study showed that oil price shocks have large impact on the economic performance of Africa's oil exporting countries and also that transmission of oil price ensues monetary medium. Hence, the study suggests that strong monetary control measure should be put in place whenever positive shocks in oil is experienced.

Keywords: Oil Price Shocks; Economic Performance; Panel SVAR, Oil Exporting.

JEL Classification: O13

1. Introduction

Since the oil price shocks in 1973 and following the stagnation especially in the developed countries, studies on the relationship between oil price shocks and economic activities have increased (Kose & Baimaganbetov, 2015). These studies employed different econometric techniques, consequently coming up with different results (Hamilton, 1983; Akpan, 2009). A critical evaluation of these studies reveals a bias in focus on developed oil importing countries, leaving out the developing countries. A further review of these studies shows that while some of the scholars believe that oil price shocks is a blessing, others are of the opinion that it is a curse[3]. In another observation, Hooker (1996) asserts that, there was no

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[3] see (Akpan, 2009; Olomola, 2010; Ushie, Adeniyi & Akinwale, 2012).

relationship between oil prices shocks and macroeconomic variables. However, the question of whether oil price shocks play any significant role in explaining variations in economic performance in the Africa environment remains contentious. While this debate remains, the oil price shocks transmission channels process is still not equivocally established in the oil exporting developing economies (Akpan, 2009; Olomola, 2010), more importantly that (Hamilton, 1983) claims that a rise in oil prices has been acknowledged as one of the primary causes of economic recession. Therefore, this problem leaves us with the following objectives: to determine whether oil price shocks play any significant role on the economy of Africa's oil exporting countries and to also identify the transmission channel of oil price into the economy? Consequently, a few studies that have attempted to look at issues surrounding oil price and economic activities in Africa with specific focus on the significance of oil price shocks on the economic performance remains inconclusive and more importantly when a group of countries is considered for study[1]. More so that limited studies on the Africa's oil exporting countries have not adequately addressed economic performance in relation to oil price shocks, leaves the doubt as to whether oil price shocks really play any significant role on economic performance or not[2]. However, the impact of oil price shocks on economic performance is expected to vary from the oil exporting countries and oil importing countries. For instance, positive (negative) oil price shocks should be considered a good (bad) news for the oil exporting (importing) countries.

This study reviews findings of empirical research works with varying methodological approaches and discussion of different findings. It differs from those in the existing literature by shifting focus from the developed oil importing countries to developing African oil exporting countries to examine the relationship between oil price shocks and economic performance within the framework of the monetary policy transmission process. The study also provides another view point in oil price shocks-economic performance relationship through the methodology employed in the study which to the best of our knowledge it has not been employed in any study relating to oil price shocks. In addition, our study deviates from the study of Kutu and Ngalawa (2016) by differencing its variables. In view of this, the study aims to contribute to energy literature in such a way as to emphasize the relationship between oil price shocks and economic performance within the context of the oil exporting developing economies in Africa.

The rest of this paper is organized as follows: section two reviews literature and theoretical issues, section three presents overview of Africa's oil exporting countries and scope of the study, while section four presents data, data sources and

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[1] see (Akpan, 2009; Olomola, 2010).

[2] see (Berument, Ceylan & Dogan, 2010; Mehrara & Mohaghegh (2011); Ushie, Adeniyi & Akinwale, 2012).

measurement of variables. While estimation and results were presented in section five, section six summarizes and concludes the study.

2. Literature Review and Theoretical Issues

Relationship between oil price shocks and macroeconomic variables have been viewed in different ways. Study like Bjornland (2008) indicates that the relationship of oil price movements and economic output vary depending on the source and direction of the movement of the price of crude oil. In terms of interest rate structure, Ushie, Adeniyi and Akinwale (2012) assert that, the transmission mechanism comes through the systematic response to monetary policy. These varied view of choices have made it difficult to draw sound policy recommendations regardless of the disparities in variables and level of development. Contrary to this and supporting the submission of various economists, Olomola (2010) asserts that oil has fallen its potentials, that the growth rates of oil economy underperform. Though, this claim has almost become a presumption. As regards inflation, studies like Hamilton (1983) and Hathaway (2009) associate high inflation rate in the United States (US) and other oil importing countries to positive oil prices shocks. Other studies reveal that oil price shocks play significant role in determining variations in output which consequently stimulates economic activity. For example, Lescaroux and Mignon (2008) posit that oil is a potential driver of currencies. Some studies also show that oil has significant influence on the real exchange rates and also enhances higher economic activity among the oil exporting countries.[1] Kamin and Rogers (2000) established that oil production frequently accounts for a large share of the GDP of the oil-exporting countries and oil price increase directly increases the value of country's currency. Empirical findings of the pioneering researchers on oil price shocks and economic performance in the US report a clear negative correlation between oil prices and real output.[2] In a similar view, using Vector Autoregressive (VAR) estimating technique to examine the relationship of oil price and economy, the study of Papapetrou (2001) shows a negative effect of real oil price changes on industrial production and employment. Bjornland (2008), Jimenez-Rodriguez and Sanchez (2005) find that Norway has benefited from increased oil prices, displaying temporary higher growth and reduced unemployment rates. Similarly, Hooker (2002) shows a long-run cointegrating relationship between oil prices, unemployment and interest rate. In a study carried out on the economy of Spain by Miguel, Manzano, and Martin- Moreno (2003), their result reveal that there is negative effect of oil prices on the country's welfare. Some studies like Cunado and

[1] see (Majid, 2006; Lescaroux & Mignon, 2008).

[2] see (Darby, 1982; Hamilton, 1983; Bjornland, 2008; Jimenez-Rodriguez & Sanchez, 2012; Kilian, 2010).

De Gracia (2003), Jimenez-Rodriguez and Sanchez (2005) examine the effects of oil prices shocks on oil exporting countries such as Denmark, Canada, the United Kingdom and Norway. Their analysis reveal that even if the correlation coefficient between output growth and oil price changes is positive for Denmark, and it is negative for the UK, the impulse response of the study suggests that oil price shocks negatively affect Danish industrial production but positively affect that of United Kingdom. Also, Raguindin and Reyes (2005) carried out a study on the economy of Philippine to examine the effects of oil price shocks on the economy from 1981 to 2003. Their result from impulse response functions for the symmetric transformation of oil prices shows that oil price shocks lead to prolonged reduction in the real GDP of the Philippines. A few studies believe that oil price shocks positively impact economic performance.[1] In a different study, Aleisa and Dibooglu (2002) note that Saudi Arabia oil policy influences world inflation and also that oil production shocks in the Saudi Arabian economy have a sizable effect on output through real exchange rate movements. Akpan (2009) employs VAR estimating technique to analyze the dynamic relationship between oil price shocks and major macroeconomic variables in Nigeria. finding shows that both positive and negative oil price shocks significantly increase inflation and directly increase real national income through higher export earnings. The result also established a strong positive relationship between positive oil price changes and real government expenditures and GDP.

There are also a few other studies carried out on the relationship between oil price shocks and economy growth in Africa[2] Different empirical studies have been carried out to examine the role of oil price on the macroeconomic variables in oil exporting countries. Among other studies are Olomola and Adejumo (2006) who examine the effects of oil price shocks on real exchange rate, output, money supply and inflation in Nigeria. They conclude that oil price shocks significantly affect real exchange rate in the short run and money supply in the long run. Similar to this are the results of Boye (2001) on Ecuador economy, Ward and Siregar (2001) on the Indonesian economy, Farzanegan and Markwadt (2009) on the Iranian economy. The study of Berument et al (2010) also examine the effects of oil price shocks on output growth for North Africa and middle Eastern countries which are either oil importers and exporters. The result of their study reveals that the effects of international oil price on GDP are positively significant on most oil exporting countries like Iraq, Iran, Algeria, Kuwait Jordan, Syria, Qatar, UAE, Omar and one oil importing country- Tunisia while there are exceptions in Yemen, Morocco, Bahrain, Lebanon and Egypt.

[1] see (Salai-I-Martins & Subramanian, 2003; Kaldor & Said, 2007).

[2] see (Olomola & Adejumo, 2006; Akpan, 2009; Iwayemi & Fowowe, 2010).

Enormous literature exists on the theoretical and empirical linkages between energy and economic growth for review. The study of (Dasgupta et al., 2002) shows a strong correlation between oil prices and the economic growth in the exporting countries. Energy, especially oil prices have always played a crucial role in determining the cycles of the world economy, inclusive of both oil producing and oil importing countries. Therefore, higher oil prices lead to inflation, increased input costs, lower investment and reduced non-oil demand. Revenue from tax declines and the budget deficit rises. This is due to government expenditure rigidities, which moves interest rates up. As a result of resistance to real fall in wages, rise in oil price may typically lead to upward pressure on nominal wage levels. Pressures in wages together with reduced demand lead to higher level of unemployment, at least in the short term. Majid (2006) notes that these effects are greater, more sudden and more pronounced when the prices rise and are magnified by the impact of higher prices on business and consumer confidence. Nonetheless, this degree of the direct effect of a given price increase depends on the share of the cost of oil in national income, the magnitude of dependence on imported oil and the ability of end-users to reduce their consumption and switch away from oil. In addition, Majid (2006) notes that this also depends on the extent of increase in oil prices, the oil intensity of the economy and the impact of higher prices on other forms of energy that compete with oil.

On the impacts of oil price shocks on the economy, Brown and Yucel (2002) note that when oil prices increase, the effect on the economy can be measured in two ways: through positive income and wealth effects and through negative trade effects. With regards to the first channel, increase oil prices represent an immediate transfer of wealth from oil importers to oil exporters. In the case of the second channel- the negative trade effect, advocates that as the oil importing trading partners suffer oil induced recession, they demand less export of traditional goods and services from the oil exporting countries. This goes to the extent that export sector of the oil exporting country will grow large and this channel may provide a negative stimulus to the oil exporting countries. Therefore, a rise in oil prices does not only affect the output and the prices in an economy, but it also affects the currency exchange rate of a country.[1] On the exchange rate, the theory of exchange rate determination suggests that an increase in the oil price causes the currency of an oil exporting country to appreciate as the demand for its currency increases in the foreign exchange market. Conversely, an increase in oil price depreciates the currency of an oil importing country because the supply of its domestic currency in the foreign exchange market increases.

[1] see (Hamilton, 1996; Amano & Norden, 1998; 2000; Issa et al., 2008).

3. Overview of the Africa's Oil Exporting Countries and Scope of the Study

3.1. Overview of the Africa's Oil Exporting Countries

Africa remains a major player in oil production among the oil exporting regions of the world. Only a few are net exporters out of the 54 countries in Africa (US EIA, 2016). US EIA data also reveals that, proven oil reserves in Africa have significantly grown by nearly 243.5% from 1980 to 2013. It is estimated that at the off shore of Africa, there is about 100 billion barrels awaiting discovery. Therefore, the Africa's prospects and potentials for further oil search discoveries remain remarkably positive. The overall Africa's oil reserves, production and export will be expected to increase overtime with production of oil likely to remain and be concentrated in Algeria, Nigeria, Angola, Equatorial Guinea and other Gulf of Guinea nations (EIA, 2015).

3.2. Scope of the Study and Justification

This study considers Africa region and specifically focusing Nigeria, Algeria, Egypt, Libya and Gabon. The choice for this pool of countries is informed by the OPEC (2015) data classification benchmark. OPEC classified the oil exporting countries into three segments on the basis of their production and output capacity. The total output of these countries constitute about 90% and 70% of Africa's proven oil reserve and oil production respectively. This is considered significant enough as good representative of Africa's oil exporting countries.

4. Data, Data Sources and Measurement of Variables

4.1. Data and Sources of Data

This study relies on quarterly data for the period spanning 1980:1 to 2015:4 following the idea of Bernanke, Gertler and Watson (2004). The choice of starting date is influenced by the period that has some of the needed data for this study. Following Iwayemi and Fowowe (2010) and Chaudourne, Feve and Guay (2014), the cut-off date is considered long enough to capture some of the latest shocks in the global oil price. Data have been sourced from Organization for Economic Cooperation and Development (OECD), OPEC, World Bank (WB), International Monetary Fund (IMF), the United State Energy Information Administration (US EIA), International Labour Organization (ILO) and the World Development Indicator (WDI).

In order to capture the dynamics of world oil price shocks on the economies of these countries, we have used variables composed of oil price (OP) as an exogenous variable, inflation (INF), real exchange rate (EXR), and real GDP similar to the studies of Kamin and Rogers (2000), and Berument and Pasaogullari

(2003). Variables including Interest Rates (INR), Money Supply (MS) and Unemployment (UNE) have been added in this study as a way of expanding the study to generate a more robust and Reliable Outcome.

4.2. Variables and Definitions of Variables

4.2.1. Crude Oil Prices (OP)

Oil price is the amount of crude oil per barrel sold in the international market. It is expressed in dollar. For the purpose of this study, the Brent Blend (also referred to as Brent Crude) is used as the oil price measure because it is the largest in Africa among many major classifications of oil.

4.2.2. Real Gross Domestic Product (GDP)

Real GDP is an inflation-adjusted measure of all goods and services produced at constant national prices for each country annually at a given base year for all the selected countries. Following Berkelmans (2005). The GDP is included to examine the impact of shocks evolving from exogenous variable on total output of the economy.

4.2.3. Exchange Rate (EXR)

Exchange rate (EX) measures the expression of the price of each country's currency in another country's currency. The US dollar exchange rate is selected as the benchmark in this study due to its wider acceptability and the fact that it is the most traded on the foreign exchange market.

4.2.4. Inflation (INF)

Inflation which is proxied with consumer price index (CPI) measures all items national composite price with 2000 as the base year. It is a key monetary policy responding to oil price shocks. It also serves as a control variable that has a link with monetary policy decisions, more especially with the interest rates through which economic stability is attained.

4.2.5. Money Supply (MS)

M2 comprises M1 plus short-range time deposits in banks and twenty-hour money market funds (see Ihsan and Anjum, 2013). It serves as an intermediate target of monetary policy in response to oil price shocks.

4.2.6. Bank Interest Rates (INT)

The interest rate is the average monthly real REPO rate. It serves as a basis through which the central or Reserve bank of each individual country sets interest rates as a monetary policy indicator (see Iturriaga, 2000; Disyatat and Vongsinsirikul, 2003). The interest rate is introduced to allow us to determine the extent of inflation caused by shocks evolving from oil prices.

4.2.7. Unemployment Rate (UNE)

International Labour Organization, “unemployed workers” are those who are currently not working but are willing and able to work for pay, currently available to work, and have actively searched for work. It measures the prevalence of unemployment in an economy.

4.3. Data Measurement

OP, GDP, MS and EXE rate have been expressed in logarithm form. To ensure consistency, various approaches including Levin, Lin and Chu (LLC); Im, Pesaran and Shin (IPS); Augmented Dickey-Fuller Test (ADF) and Phillip Peron Test (PP) have been used to test for stationarity of the variables. However, the results show that oil price, inflation and money supply are stationary at level (I_0) while GDP, INT, UNE and EXE rates are found to be in order of difference one (I_1). However, the study proceeds to estimate P-SVAR, a procedure which is arguably consistent with literature (See Sim, Stock and Watson, 1990).

4.4. Research Methodology

4.4.1. Model Specification

Following Kutu and Ngalawa (2016), the study employs the $P-SVAR$ model to capture the dynamics of the world oil price shocks on the selected domestic oil exporting economies. Similar

to Kamin and Rogers (2000) and Berument and Pasaogullari (2003) for SVAR, the model is a seven-variable model comprising oil prices, real exchange rate, inflation, money supply, interest rate, unemployment and GDP. The $\mathrm{P-SVAR}$ has the same structure as $P-VAR$ models, in the sense that all variables are assumed to be endogenous and inter-reliant, except for those identified as exogenous. This model is based on the assumption that the six domestic performance variables of each country cannot affect the world oil prices. The $P-SVAR$ is built with the same logic applied in the standard $P-VAR$ except for the structural restrictions, which are imposed on the former, making it a different and much stronger tool for addressing macroeconomic policy. The $P-SVAR$ methodology suggests the imposition of restrictions on the contemporaneous structural parameters only for reasonable economic structures to be derived. The traditional restrictions are denoted by “$f_{21}-f_{76}$” and “0” for the contemporaneous and sluggish lagged relationships, respectively.

In view of this understanding, supposing that oil exporting countries is represented by the following structural panel equation:

$$\lambda\Phi_{it} = \Omega_{io} + \Psi_1\Phi_{it-1} + \Psi_2\Phi_{it-2} + \ldots + \Psi_p\Phi_{it-p} + \mathrm{M}\theta_t + \Delta\varepsilon_{it}$$

where λ represents an invertible $(\upsilon \times \upsilon)$ matrix that describes the contemporaneous relationship among the variables employed; Ψ_{it} symbolises $(\upsilon \times 1)$ vector of endogenous variables such that $\Phi_{it} = \Phi_{1t,} \Phi_{2t,} \dots \Phi_{nt}$. Ω_{io} is a $(\upsilon \times 1)$ vector of constants representing country-specific intercept terms; Ψ_i is a $(\upsilon \times \upsilon)$ matrix of coefficients of lagged endogenous variables (for every $i = 1 \dots p$); M and θ_t are vectors of coefficients and the exogenous variable, respectively. This captures external shocks; Δ is a $(\upsilon \times \upsilon)$ matrix whose non-zero diagonal elements allow for direct effects of some shocks on more than one endogenous variables in the system; and ε_{it} is a vector of uncorrelated error terms (white-noise structural disturbances).

Equation (1) presents the $P - SVAR$ model. According Enders (2004), this model cannot be estimated directly due to the feedback that is inherent in the SVAR process. The structure of the system incorporates feedback, which makes it difficult to estimate because the endogenous variables are allowed to affect each other in the current and past realisation time path of $\lambda\Phi_{it}$. Nevertheless, the information in the system can be estimated and recovered by estimating a reduced-form $SVAR$ implicit in the equations (see Ngalawa and Viegi, 2011). Pre-multiplying equation (1) by λ^{-1} gives:

$$\Phi_{it} = \lambda^{-1}\Omega_{io} + \lambda^{-1}\Psi_1\Phi_{it-1} + \lambda^{-1}\Psi_2\Phi_{it-2} + \dots + \lambda^{-1}\Psi_p\Phi_{it-p} + \lambda^{-1}\mathrm{M}\theta_t + \lambda^{-1}\Delta\varepsilon_{it} \quad (3)$$

This can be represented as,

$$\lambda^{-1}\Omega_{io} = C_i, \lambda^{-1}\Psi_1 \dots\dots \lambda^{-1}\Psi_p = D_i \dots\dots D_p,\ \lambda^{-1}\mathrm{M} = \alpha \text{ and } \lambda^{-1}\Delta\varepsilon_{it} = \mu_{it} \quad (4)$$

We therefore transform equation 3 to derive equation 4:

$$\Phi_{it} = C_i + D_1\Phi_{it-1} + D_2\Phi_{it-2} + \cdots \dots\dots\dots + D_p\Phi_{it-p} + \alpha\theta_t + \mu_{it} \quad (5)$$

However, the difference between equations (1) and (4) is that the first is called a $P - SVAR$ or primitive system where all variables have contemporaneous effects on each other while the second is called a reduced form $P - SVAR$ or a $P - SVAR$ expressed in standard form in which all the variables that are contained in the right-hand side are predetermined at time *t* and no variable has a direct contemporaneous (immediate) effect on another in the model. Furthermore, Enders (2004) concluded that the error term (μ_{it}) is a composite of shocks in Y_{it}.

For simplicity sake, equation (5) can be expressed in a short form shown in (6):

$$\Phi_{it} = C_i + \lambda(L)\Phi_{it} + G(L)\theta_t + \mu_{it} \quad (6)$$

where Φ_{it} and θ_t are $(n \times 1)$ vectors of variables given by

$$\Phi_{it} = (gdp, une, exr, inf, ms, int) \quad (6.1)$$

$$\theta_t = (op) \quad (6.2)$$

Equation (6.1) embodies the vector of the oil exporting countries that are treated endogenous variables as used in the study. Equation 6.2 represents the vector of the exogenous variable that controls for external shocks. C_i is vector of constants which represents the country intercept terms. $\lambda(L)$ and $\Delta(L)$ symbolise the matrices of polynomial lags that capture the relationship between the endogenous variables and their lag lengths. $\mu_{it} = \lambda^{-1}\Delta\varepsilon_{it}$ denotes a vector of random disturbances, which can also be expressed as $\lambda\mu_{it} = \Delta\varepsilon_{it}$.

The features of equations (7) and (8) are similar because both are reduced form P − SVARs derived from the primitive P-SVAR system of equations (2) where all variables are assumed to have simultaneous effects on each other and are also assumed to describe the performance of the Africa's oil exporting economies. For the information in the structural equation to be recovered, it is necessary and to impose restrictions in matrices λ and Δ in the system of equations (7) and (8).

$$\lambda = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ c_{21} & 1 & 0 & c_{24} & 0 & 0 & 0 \\ 0 & c_{32} & 1 & 0 & 0 & 0 & 0 \\ c_{41} & 0 & c_{43} & 1 & 0 & 0 & 0 \\ c_{51} & c_{52} & c_{53} & c_{54} & 1 & c_{56} & 0 \\ 0 & c_{62} & c_{63} & c_{64} & c_{65} & 1 & c_{67} \\ c_{71} & c_{72} & c_{73} & c_{74} & c_{75} & 0 & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{OP} \\ \mu_{it}^{GDP} \\ \mu_{it}^{MS} \\ \mu_{it}^{EXR} \\ \mu_{it}^{INF} \\ \mu_{it}^{INT} \\ \mu_{it}^{UNE} \end{bmatrix} = \quad (7)$$

$$\Delta = \begin{bmatrix} b_1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_2 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_5 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_6 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_7 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{OP} \\ \varepsilon_{it}^{GDP} \\ \varepsilon_{it}^{MS} \\ \varepsilon_{it}^{EXR} \\ \varepsilon_{it}^{INF} \\ \varepsilon_{it}^{INT} \\ \varepsilon_{it}^{UNE} \end{bmatrix} \quad (8)$$

Equations (7) and (8) presents the restricted matrixes. While the first matrix in equation (7), represents the λ-matrix which pertains to the non-recursive restrictions in the model, the second matrix in equation (8), represents the Δ-matrix known as a diagonal matrix. The terms $\mu_t^{OP}, \mu_{it}^{GDP}, \mu_{it}^{MS}, \mu_{it}^{EXR}, \mu_{it}^{INF}, \mu_{it}^{INT}$ and μ_{it}^{UNE} are residuals in reduced-form disturbances to both the endogenous (domestic) and the exogenous (Foreign) variables which further symbolises the unexpected movements (Shocks, given information in the system) of each variable. The associated structural shocks with the corresponding equations are denoted with the following residuals: $\varepsilon_t^{OP}, \varepsilon_{it}^{GDP}, \varepsilon_{it}^{MS}, \varepsilon_{it}^{EXR}, \varepsilon_{it}^{INF}, \varepsilon_{it}^{INT}$ and ε_{it}^{UNE}.

In the short run SVAR, we develop identification by placing restrictions on λ and Δ matrices, which are assumed to be non-singular ensuring exact identification of the scheme. Nevertheless, since there are $p(p+1)/2$ free parametres in the $\sum_{\varepsilon}$, given its symmetric nature, several parametres may be estimated in matrixes λ and Δ. As there are $2p^2$ parametres in matrices λ and Δ, the order condition for identification requires that $2p^2 - 0.5p(p+1)$ or *0.5p(3p-1)* additional restriction be placed on the elements of the matrices. For justification and procedural purposes however, our study follows Amisano and Giannini (1997) in which $P - SVAR$ needs $2p^2 - 0.5p(p+1)$ or 70 restrictions be placed wholly on λ and Δ matrices (p is the number of the variables in the study). Therefore, for the scheme to be precisely identified, since matrix λ is assumed a non-singular diagonal matrix, there will be 42 exclusion restrictions imposed on it while 28 exclusion restrictions are expected to be imposed on matrix λ. But since our non-recursive P-SVAR has imposed 22 zero restrictions on matrix λ, the system is therefore characterised over identified and 8 free parametres in matrices λ and 7 in matrix Δ. As presented in the system components of equation 6, this has to be estimated.

In consideration of the order to identify the parametres and the shocks of the structural model, the identifying restrictions used in this study assumed the following economic intuitions- variables influencing one another on the basis of economic theory and depending on their position in the identification scheme; domestic shocks from other variables do not affect oil prices being an international variable. Rather, the transmission of international shocks to the domestic economy can be very rapid. In that sense, oil price is defined as an exogenous variable and as such, given the fact that the selected countries under study are oil producing economies, such assumption is plausible[1]; while real exchange rate affects inflation, it is not affected by its shocks. Given the fact that, the non-zero coefficients (c_{kj}) in the non-singular matrices is used to show that variable j instantaneously affects variable k. For instance, the oil price is captured in the first row and it is used to measure the external pressure on the domestic economies. It is denominated in the US$ per barrel and determined by market activities at the international level which is independent of the forces from the regional market.

Oil prices shock is captured in row 1, while rows 2 and 3 are equations respectively representing gross domestic products (GDP) and MS. Rows 4 and 5 respectively denote equations for EXR and INF. While in rows 6 and 7, we have the INT and UNE respectively. Based on the λ matrix in equation 6, oil prices in row 1 does not respond contemporaneously to other variables used in this study. It is independent

[1] see (Berkelmans, 2005; Kutu & Ngalawa, 2016).

of other variables as it places an external pressure on the local economies of the selected countries. Rather, other variables may contemporaneously respond to it. Row 2 presents the GDP equation, GDP responds contemporaneously to oil prices shocks, exchange rates and unemployment which their restrictions have been denoted with c_{21}, c_{24}, c_{27}. This implies that GDP responds to positive shocks from oil prices. This transmission confirms the assertion of Kamin and Rogers (2000) that oil production accounts for a large share of the GDP of the oil-exporting countries and oil price increase directly increases the value of country's currency. Similar phenomenon is expected in unemployment for the oil exporting countries. It declines when more job opportunities are created from oil proceeds. This in turn creates and increases the income level of both the individuals and the economy. Money supply responds contemporaneously to only GDP as represented as c_{32}, captured in the MS equation in row 3. Rows 4 and 5 respectively present the exchange rate and inflation rate equations. As shown, c_{41} and c_{43} confirm that the exchange rate contemporaneously responds to oil price shocks and money supply only, while inflation rate contemporaneously responds to oil prices shocks, GDP, money supply, exchange rate and interest rate as their imposed restrictions respectively expressed as c_{51}, c_{52}, c_{53}, c_{54} and c_{56}. Similarly, rows 6 and 7 contain the INT and unemployment rates equations. In equation six, INT contemporaneously responds to GDP, money supply, exchange rate, inflation and unemployment, depicted as c_{62}, c_{63}, c_{64}, c_{65} and c_{67}. This result is similar to Elbourne (2007). Also similar to equation 6 is equation 7 captured in row seven which showcases the unemployment rate and also confirms that unemployment contemporaneously responds to oil price shocks, GDP, money supply, exchange rate and inflation expressed in c_{71}, c_{72}, c_{73}, c_{74} and c_{75}.

5. Estimation and Results

5.1. Lag Length Test

We selected our optimal lag for this study guided by the established criteria, an approach that has been applied consequent to several models[1]. All lag order selection criteria suggest lag 7 as most suitable for the model. There are also similar studies that guide this study.[2] The result of the test for roots of characteristic polynomial reveals that all the seven inverse roots of the characteristic Auto Regressives (AR) polynomial have modulus which is less than one and also lie inside the unit circle. This indicates that the estimated VAR procedure is stationary.

[1] see (Ngalawa, 2011).

[2] see (Elbourne, 2007; Sharifi-Renani, 2010; Kose & Baimaganbetov, 2015; Kutu & Ngalawa, 2016).

Similar to Ngalawa (2009), this study carried out a VAR lag exclusion Wald test to check for joint significance of variables. The result shows that all endogenous variables in the model are jointly significant at each lag length for all equations. Disjointedly, all equations are also significant at first lag length order. Similar to the result obtained at the lag length order 1, all the endogenous variables are also significant at the lag length of order 7.

5.2. Analyses of the Impulse Response Functions:

Figures 1.1(a-f) present the result of impulse response functions of GDP, INF, INT, MS, EXR and UNE to oil price shocks. All variables have statistically significant response to oil price shocks with either negative or positive response. This result supports the study of Eltony and Al-Awadi (2001) on Kuwait economy. It asserts that oil price shocks are significant in explaining fluctuations in macroeconomic variables within an oil exporting economy.

5.2.1. Impulse Response Function of GDP to Oil Price Shocks

The GDP shows positively significant response to structural one standard deviation innovation in oil prices. GDP continuously increases in period 1 up to period 12. This validates the result of Kamin and Rogers (2000) that oil directly transmits to GDP. Salai-I-Martins and Subramanian (2003), Kaldor and Said (2007) that oil price shocks positively impact economic growth.

5.2.2. Impulse Response Function of Inflation To Oil Price Shocks

The impulse response of inflation to oil price shocks shows that inflation significantly responds to oil prices shocks throughout the period. Though, the result shows a negative response within the first three periods and later became positive from the 4th to 12th periods. This submission validates the result of Haldane (1997) that response to structural one standard deviation innovation may put upward pressures on inflation which often appreciates in oil exporting countries.

5.2.3. Impulse Response Function of Interest Rate to Oil Price Shocks

Interest rate negatively responds to positive oil shocks. Response of interest rate to structural one standard deviation innovation is negative. It started rising in period 1 and peaked in period 2 and began to decline continuously up till period 12. This supports Hooker (2002) who posits that long-run cointegrating relationship exists between oil prices and interest rate. The decline of the rate associates with the argument that positive oil prices cause increase in the volume of money supply putting a downward pressure on the interest rate. This may also cause further drop in the rate at which bank lends out.

5.2.4. Impulse Response Function of Money Supply to Oil Price Shocks

Similar to the response of GDP to oil price shocks, the MS positively and significantly responds to price shocks as depicted in figure 1(d). Although, MS drops in the first three periods bottoming in period 3 and begins to rise as it proceeds to period 4. The increase is consistent up till period 12. This suggests that positive shocks in oil prices positively causes a rise in the volume of money in the oil exporting economy. The result validates the assertion of the study of Olomola and Adejumo (2006) that oil price shocks significantly affect the economy in the short run and long run. This submission is budded to the fact that as oil price shocks persists, the volume of proceeds from oil increases which transmits to increase in the volume of money in circulation.

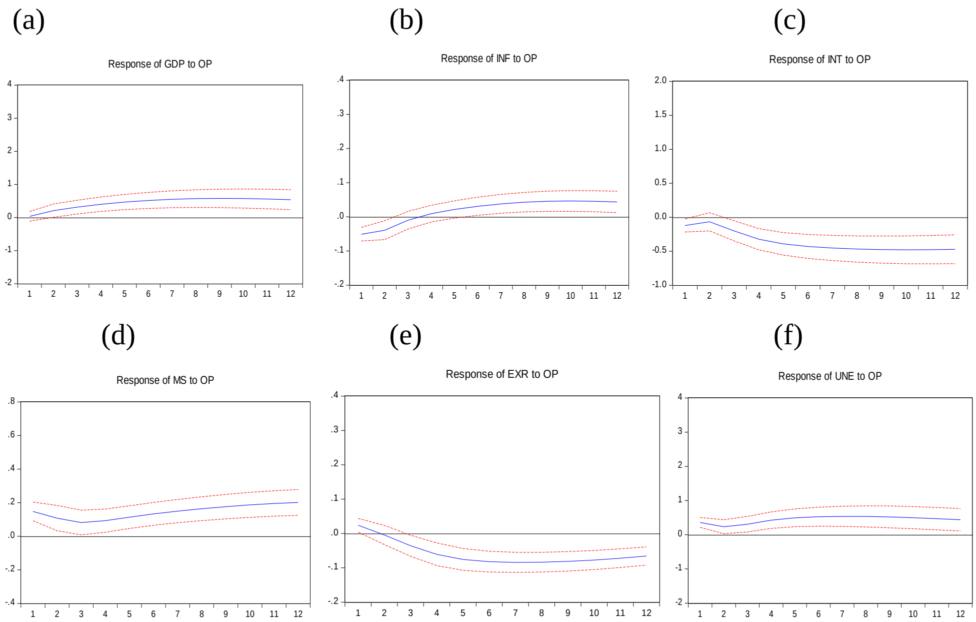

Figure 1

5.2.5. Impulse Response Function of Exchange Rate to Oil Price Shocks

Exchange rate significantly and negatively responds to oil price shocks. Exchange rate consistently decrease from period 1up to period 6 and remains stable till period 9 and begins to rise again as it moves towards period 12. This opines that local currency of the oil producing economies appreciates in value because more demand for local currency in exchange for stronger currencies especially dollars will rise. This aligns with the theoretical argument of Corden (1984) and Zhou (1995) that oil exporting countries may experience exchange rate appreciation (depreciation) when oil price rise (fall).

5.2.6. Impulse Response Function of Unemployment Rate to Oil Price Shocks

Unemployment responds significantly to structural one standard deviation innovation in oil price shocks. The unemployment rate declines within the first two periods bottoming at period 2 and slightly rose and remains constant as it moves through to period 10. The response declines again in period 11 and this continues as it proceeds to period 12. This implies that unemployment declines when more job opportunities are created from oil proceeds.

In the foregoing, the overall responses of the variables to structural one standard innovation in oil price reveal that variables are significant and stable. This further validates the submission that oil price shocks transmission occurs through the GDP, EXR, MS and other selected variables.

5.3. Results of Forecast Error Variance Decomposition for the Model

Table 1. Variance Decomposition of GDP

Period	Shock OP	Shock GDP	Shock MS	Shock EXR	Shock INF	Shock INT	Shock UNE
3	2.690350	93.41573	2.797994	0.990813	0.000458	0.093534	0.011117
6	2.177872	85.47482	9.003760	3.142448	0.000315	0.168304	0.032481
9	4.800447	77.47640	13.01898	4.467265	0.000318	0.191766	0.044820
12	7.179574	71.89279	15.63266	5.058588	0.000332	0.191086	0.044972

Table 5.3.1. shows that shocks to inflation, bank rates and unemployment, each accounts for less than 0.05% fluctuation in GDP in period three. As evidenced from the table, the result shows that 2.7%, 2.8% and 1% fluctuation in GDP is respectively accounted for by oil price, money supply and exchange rate during the third period. During this period, OP and MR are markedly noticed to affect GDP performance. For the ninth and twelfth periods, the contribution of shocks to oil price, money supply and exchange rate increased evidently. Oil price, money supply and exchange rate respectively contribute 4.8%, 13% and 4.4% in period nine to the fluctuation in the performance of the GDP. Similarly, variance in the performance of GDP is accounted for by 7.1% shocks to oil price, 15.6% shocks to money supply and 5.1% shocks to exchange rates. From the foregoing, the result shows that oil price is a major source of a change to GDP performance. Aside money supply and GDP itself, other variables summed together are less than the contribution of oil to variance of the GDP performance. This also translates that the contribution of oil to GDP is more significant than other variables for all periods covered under our study.

Table 2. Variance Decomposition of MS

Period	Shock OP	Shock GDP	Shock MS	Shock EXR	Shock INF	Shock INT	Shock UNE
3	33.16422	11.24427	54.11443	1.437199	0.000335	0.019545	0.019996
6	33.15846	14.81366	49.69755	2.252784	0.001549	0.016123	0.059883
9	25.40719	32.63683	36.75176	5.074861	0.002772	0.019114	0.107468
12	20.89574	44.23862	28.65184	6.056401	0.002440	0.032840	0.122117

The result for variance decomposition for money supply is presented in table 5.3.2 showing that oil price accounts for about 33% forecast error variance of MS during the 3-step period and GDP is associated with 11%. This result evidences finding in the literature that oil price affects the performance of MS. Although this declines over time. For instance, OP continuously drops from about 33% in period 6 to about 25% in period 9 and about 21% in period 12. This occurrence may be associated or influenced by the period of continuous fall in the price of oil. Invariably while the forecast error variance in MS associated with OP is falling, the GDP is otherwise. GDP continuously rose from about 14% in period 3 to about 33% in period 6 and about 44% in period 12.

Table 3. Variance Decomposition of EXR

Period	Shock OP	Shock GDP	Shock MS	Shock EXR	Shock INF	Shock INT	Shock UNE
3	15.80417	29.43187	7.616951	46.45244	0.005123	0.635663	0.053788
6	12.39385	22.90127	7.339512	56.00081	0.012909	1.062714	0.288936
9	11.85323	27.07235	13.56934	45.92072	0.013966	1.097937	0.472454
12	13.17512	34.21903	18.57007	32.57297	0.010919	0.969384	0.482506

The result shown in table 5.3.3. shows that both inflation and unemployment rate have marginal effect on exchange rate in periods three through six to twelve. At each period, their individual shock accounts for less than 0.05% of the fluctuation that occurs in the exchange rate. Similarly, shocks to bank rate also accounts for low fluctuation in the exchange rate. Inversely, shocks to OP, GDP and MS are markedly displayed to account for large fluctuation to exchange rate for periods three, six, nine and twelve. For instance, OP accounts for 15.8% fluctuation in exchange rate in period three, 12.4% in period six but declines to 11.8% in period nine and later appreciates to 13.2% in period twelve. GDP and MS follow a similar pattern. Shock to both GDP and MS are noticeably noted to account for fluctuation in exchange rate.

Table 4. Variance Decomposition of INF

Period	Shock OP	Shock GDP	Shock MS	Shock EXR	Shock INF	Shock INT	Shock UNE
3	9.568176	53.85589	26.82009	7.354384	2.193164	0.194247	0.014046
6	6.340614	63.33756	24.31811	4.307105	1.260035	0.424704	0.011873
9	5.331734	64.60773	24.21865	4.305951	1.040911	0.365191	0.129830
12	5.037791	62.96081	24.62951	5.625247	0.958362	0.377867	0.410408

Table 5.3.4 presents the variance decomposition of inflation. It reveals that bank interest and unemployment explain a very small variance in inflation. While oil price remarkably explains variation by 9.5%, 6.3%, 5.8% and 5% in periods three, six, nine and twelve respectively, the variation in inflation is also associated with MS by 26.8% in period three, 24.31% in the period six and 63% in the period twelve. Also, the decrease in the variance decomposition of inflation to oil price may be associated with continuous fall in oil price over time. Similarly, money supply and exchange rate follow a downward trend. During the third period, the variance decomposition of inflation is associated to 26.8% of money supply and 7.3% of exchange rate and drop to 24.3% and 4.3% respectively in period six but appreciate in period twelve to 24.6% for money supply and 5.6% for exchange rate.

Table 5. Variance Decomposition of UNE

Period	Shock OP	Shock GDP	Shock MS	Shock EXR	Shock INF	Shock INT	Shock UNE
3	5.783332	1.700247	7.328742	35.07679	0.442176	2.630676	47.03804
6	3.476390	5.719980	9.274700	49.95029	0.287680	4.419484	26.87147
9	5.209593	5.651556	10.54329	53.83777	0.203828	5.130323	19.42365
12	6.864607	4.117125	12.72452	55.18056	0.156772	5.475494	15.48092

As regards the variance decomposition of unemployment rate shown in table 5.3.5., the result reveals that apart from inflation rates which accounts for less than one percentage of the fluctuation in unemployment, shocks to other variables account for the fluctuation in unemployment. During the third period, sixth, ninth and twelfth periods, OP respectively accounts for 5.8%, 3.5%, 5.2% and 6.8% fluctuation in unemployment rate. Although, shocks to MS and EXR are reportedly more accountable to the fluctuation in unemployment.

6. Summary and Conclusion

This study estimates a seven variable P-SVAR model to investigate the transmission process through which oil price shocks affect the economic performance of the Africa's oil exporting economies spanning 1980-2015. The paper also determines the significant response of the selected variables to oil price shocks. In contrast to the oil importing developed countries, the result shows significant response of the variables to oil price shocks. It also reveals that there is significantly positive connection between oil price shocks and GDP in the Africa's Oil exporting countries. This validates the assertion that oil price shocks play significant role in determining variations in economic output which consequently stimulates economic activity. This response reports a clear positive correlation between oil prices and GDP, showing higher growth and reduction in unemployment rates. Although significant but sluggishly correlated as reported by our finding. Therefore, this may not assure automatic and continuous reduction in unemployment as they proceed into the future. Also, the result finds that oil price shocks significantly influences the real exchange rates evolving via currency appreciation. Positive oil price shocks enhance higher economic activity among the oil exporting countries. The study also reveals that oil prices shocks significantly increases MS, signaling inflation in the economy. This suggests a strong monetary control measure being put in place to guide against possible shocks that may arise in oil price.

The result of the variance decomposition reveals that shocks to oil prices largely accounts for fluctuation in the variables considered in the study evidencing the medium of transmission of oil. This validates the claim that oil price shocks significantly transmit through the selected variables to impact economic performance.

7. Bibliography

Akpan, E.O. (2009). Oil Price Shocks and Nigeria's Macroeconomy. paper presented at the Annual *Conference of csae Conference*. Economic Development in Africa, 22nd-24th March, Oxford.

Aleisa, E.A. & Dibooglu, S. (2002). Sources of Real Exchange Rate Movements in Saudi. *Journal of Economics and Finance*, 26(1), pp. 101-110.

Amisano, G. & Giannini, C. (1997). *Topics in Structural VAR Econometrics*. 2nd edn, Springer, Berlin.

Bernanke, B.S.; Gertler, M. & Watson, M.W. (2004). Oil Shocks and Aggregate Macroeconomic Behavior: The Role of Monetary Policy. *Journal of Money, Credit & Banking,* Ohio State University Press, 36(2), pp. 287-291.

Berument, H. & Pasaogullari, M. (2003). Effects of the Real Exchange Rate on Output and Inflation: Evidence from Turkey. *Developing Economies*, 41(4), pp. 401-435

Berument, M.H.; Ceylan, N.B. & Dogan, N. (2010). The Impact of Oil Price Shocks on the Economic Growth of Selected MENA Countries. *The Energy Journal*, Vol. 31, No. 1, pp. 149-176, International Association for Energy Economics, http://www.jstor.org/stable/41323274.

Bjornland, H.C. (2008). Oil Price Shocks and Stock Market Booms in an Oil Exporting Country, Norwegian School of Management (BI) and Norges Bank, *Working papers* (16), pp. 2-39.

Chaudourne, Jeremy; Feve, Patrick & Guay, Alain, (2014). Understanding the effect of technology shocks in SVARs with long-run restrictions. *Journal of Economic Dynamics and Control*, Elsevier, vol. 41(C), pp. 154-172.

Cunado, J. & De Gracia, F.P. (2005). Oil prices, economic activity and inflation: Evidence for some Asian countries. *The Quarterly Review of Economics and Finance*, 45(1), pp. 65-83.

Dasgupta, P. (2002). Valuing Objects and Evaluating Policies in Imperfect Economies. *Economic Journal*, 111(471): Cl-29.

Disyatat, P. & Vongsinsirikul, P. (2003). Monetary policy and the transmission mechanism in Thailand. *Journal of Asian Economics*, 14(3), pp. 389-418.

Elbourne, A. (2007). The UK housing market and the monetary policy transmission mechanism: An SVAR approach. *Journal of Housing Economics,* 17(8), pp. 65-87.

Enders, W. (2004). *Applied Econometric Time Series*. Hoboken, John Wiley & Sons 2nd Ed.

Farzanegan, M. & Markwardt, G. (2009). The effect of oil price shocks on Iranian economy. *Energy Economics*, 31, pp. 134-151.

Gottschalk, J. (2001). An Introduction into the SVAR Methodology: Identification, Interpretation and Limitations of SVAR models. *Kiel Working Paper*, No. 1072. Kiel Institute of World Economics, Duestern Brooker Weg 120, 24105 Kiel, Germany.

Gujarati, N. (2003). *Basic Econometrics*. 4th Edition, International edition, McGraw-Hill/Irwin, a business unit of the McGraw-Hill companies, Inc.

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

Hatemi-J, A. & Hacker, R.S. (2009). Can the LR test be helpful in choosing the optimal lag order in the VAR model when information criteria suggest different lag orders?. *Applied Economics*, 41(9), pp. 1121-1125.

Hoare Z. & Hoe, J (2013). *Understanding quantitative research: Part 2. Nursing Standards,* 27(18), 48-55.

Ihsan Ihsan and Saleem Anjum (2013). Impact of Money Supply (M2) on GDP of Pakistan. Global Journal of Management and Business Research Finance Volume 13, Issue 6. Online ISSN: 2249-4588 & Print. ISSN: 0975-5853.

ILO, http://www.ilo.org/public/english/bureau/stat/res/index.htm.

Im, K.S.; Pesaran, M.H. & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics,* 115, pp. 53–74.

Iturriaga, F.J.L. (2000). More on the credit channel of monetary policy transmission: An international comparison. *Applied Financial Economics*, 10(4), pp. 423-434.

Iwayemi, A. & Fowowe, B. (2010). Impact of oil price shocks on selected macro- economic variables in Nigeria. *Energy Policy*, 39, pp. 603–612.

Jimenez-Rodriguez, R. & Sanchez, M. (2005). Oil shocks and real GDP growth: Empirical evidence from OECD countries. *Applied Economics.* 37, (45), pp. 210-228.

Kamin, S.B. & Rogers, J.H. (2000). Output and the Real Exchange Rate in Developing Countries: An Application to Mexico. *Journal of Development Economics* 61, pp. 85-109

Kilian, L. (2006). The effects of exogenous oil supply shocks on output and inflation: evidence from the G7 countries. *Centre for Economic Policy Research*, Discussion Paper No. 5404.

Kilian, L. (2010). *Oil Price Volatility: Origins and Effects*. World Trade Organization Working Paper ERSD-2010-02.

Kutu, A.A. & Ngalawa, H. (2016). Monetary Policy Shocks and Industrial output in BRICS countries. SPOUDAI. *Journal of Economics and Business*, 66(3), pp. 3-24.

Lamazoshvili, B. (2006). *Effects of Oil Price Shocks on Oil-Importing Developing Economies*: The Case of Georgia and Armenia, Policy brief No E14/06.

Lescaroux and Mignon (2008). *On the Influence of Oil Prices on Economic Activity and Other Macroeconomic and Financial Variables*. CEPII Working Paper.

Levin, A.; Lin, C.F. & Chu, S.J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics,* 108, pp. 1–24.

Majid, A. (2008). *The contribution of oil sector to Arab economic development.* OFID Pamphlet Series, No. 23, pp. 45-90.

Mehrara, M. & Mohaghegh, M. (2011). Macroeconomic Dynamics in the Oil Exporting Countries: A Panel VAR study. *International Journal of Business and Social Science*, Vol. 2, No. 21, Special Issue–November 2011, p. 288.

Miguel C.B. Manzano, & Martin-Moreno, J.M. (2003). Oil Price Shocks and Aggregate Fluctuations. *The Energy Journal,* 24(2).

Mishkin, F.S. (2001). The transmission mechanism and the role of asset prices in monetary policy. No. w8617. *National Bureau of Economic Research*.

Nezir, Kose & Baimaganbeto, S. (2015). The Asymmetric Impact of Oil Price Shocks on Kazakhstan Macroeconomic Dynamics: A Structural Vector Autoregression Approach. *International Journal of Energy Economics and Policy,* 5(4), pp. 1058-1064.

Ngalawa, H. & Viegi, N. (2011). Dynamic effects of monetary policy shocks in Malawi. *South African Journal of Economics,* 79, (3), pp. 244-250.

Olomola, P.A. (2010). Oil Wealth and Economic growth in Oil Exporting African countries. AERC Research Paper 170. *African Economic Research Consortium*, Nairobi. September, 2007.

Olomola, P.A. & Adejumo, A.V. (2006). Oil price shock and macroeconomic activities in Nigeria. *International Research Journal of Finance and Economics*, 3, pp. 28-34.

OPEC. (2015). Annual statistical bulletin. Organization of Petroleum Exporting Countries (OPEC), Geneva, Switzerland.

Rosser, J.B. & Sheehan, G.R. (1995). A Vector Autoregressives Model for Saudi Arabian Economy II. *Journal of Economics and Business*, 47(1), pp. 79-90.

Sala-I-Martin, Xavier, & Subramanian, Arvind. (2003). Addressing the Natural Resource Curse: An Illustration from Nigeria. *National Bureau of Economic Research Working Paper*.

Tay, Anthony S. (2006). *Mixing Frequencies: Stock Returns as a Predictor of Real Output Growth*. Working Paper No. 34, Singapore Management University, Economics and Statistics https://mercury.smu.edu.sg/rsrchpubupload/7469/Tay_2006.pdf.

Ushie, V.; Adeniyi, O. & Akinwale, S. (2012). Oil revenues, institutions and macroeconomic performance in Nigeria. *CSEA Working Paper,* No. 02, pp. 67-89.