OIL PRICE SHOCKS AND ECONOMIC PERFORMANCE IN AFRICA'S OIL EXPORTING COUNTRIES

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Abstract
This study adopted the Panel Structural Vector Autoregressives (PSVAR) estimating technique to empirically assess the transmission processes of oil price shocks and how they impact on 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. The study treated oil price shocks as exogenous while other variables considered as endogenous variables. The period covered in the study is 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 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 are experienced.

Keywords: Oil Price Shocks; Economic Performance; Panel SVAR, Oil Exporting.
JEL Classification: Q43, B22, F62

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 and Baimaganbetov, 2015 and Baumeister and Kilian, 2016). These studies employed different econometric techniques, consequently coming up with different results (see Hamilton 1983; Akpan, 2009 and Musibau (2015). A critical evaluation of these studies reveals a bias in focus on developed oil importing countries. A further review of these studies shows that while some of the scholars believe that oil price shocks is a blessing, others believe it is a curse (see Akpan, 2009; Olomola, 2010; Ushie, Adeniyi and Akongwale, 2012, Hamilton, 2013). Hooker (1996) also asserts that there was no 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 and Olomola, 2010). Hamilton (1983) and

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Hamilton (2013) claim that a rise in oil prices has been acknowledged as one of the primary causes of economic recession. Similarly, 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 remain inconclusive and more importantly when consideration is given to a group of countries with similar economic characteristics (see Akpan, 2009 and Olomola, 2010).Therefore, this problem leaves us with the objectives of determining 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. The fact that literature on oil price shocks/economic performance nexus within the oil exporting developing economies is limited, leaves one in doubt as to whether oil price shocks really play any significant role on economic performance or not (see Mehrara and Mohaghegh (2011); Ushie, Adeniyi and Akongwale, 2012, Hamilton, 2013). 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 various empirical research works with varying methodological techniques. It differs from those in the existing literature by shifting focus from the developed oil importing countries to developing Africa's oil exporting countries to examine the relationship between oil price shocks and economic performance within the monetary framework transmission process. This 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, has not been used in any study relating to oil price shocks. Though the methodology is adopted from Kutu and Ngalawa (2016) but this study deviates from theirs by differencing its variables. In view of this, the study contributes to energy literature in such a way as to emphasize the relationship between oil price shocks and economic performance.

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 measurement of variables. Estimation and results were presented in section five and lastly section six summarizes and concludes the study.

2. Literature Review and theoretical issues

The relationship between oil price shocks and macroeconomic variables have been viewed in different ways. Studies such as Bjornland (2008) indicate 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 term of interest rate structure, Ushie, Adeniyi and Akongwale (2002) and Musibau (2015) assert that the transmission mechanism comes through the systematic response to monetary policy. Contrary to this, and supporting the submission of various economists, Olomola (2010) and Hamilton (2013) assert that oil has fallen its potentials and that the growth rates of oil economy underperform**,** though this claim has almost become a presumption. With regards to inflation, studies like Hamilton (1983), Hathaway (2009) and Hamilton

(2013) 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 a significant role in determining variations in output which consequently stimulate economic activities. 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 it enhances higher economic activity among the oil exporting countries (see Majid, 2006; Lescaroux and Mignon, 2008). Kamin and Rogers (2000) assert 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 a 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 (see Darby, 1982; Hamilton, 1983; Bjornland, 2008; Jimenez-Rodriguez and Sanchez, 2005 and Kilian, 2010).

Similarly, using Vector Autoregressive (VAR) estimating technique to examine the relationship of oil price and economy, Papapetrou (2001) reveals a negative effect of real oil price changes on industrial production and employment. Bjornland (2008), Jimenez-Rodriguez and Sanchez (2005) opine that Norway has benefited from increased oil prices, displaying temporary higher growth and reduced unemployment rates. Similarly, Hooker (2002) shows a long-run 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), it was shown that there is negative effect of oil prices on the country's welfare. Some studies such as Cunado and 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 analyses 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, oil price shocks negatively affect Spanish 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 tilts towards that oil price shocks positively impact economic performance (See Salai-I-Martins and Subramanian, 2003; Kaldor and Said, 2007). In a different study, Aleisa and Dibooglu (2002) note that Saudi Arabia oil policy influences world inflation and 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. The finding of the study show 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 empirical studies carried out on the relationship between oil price shocks and economy growth in Africa. for instance, Olomola and Adejumo

(2006) examine the effects of oil price shocks on real exchange rate, output, money supply and inflation in Nigeria. The study 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. 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.

Enormous literature exists on the theoretical and empirical linkages between energy and economic growth for review. 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 move 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 impact 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 means the 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 (see Hamilton, 1983; Amano and Norden, 1998; 2000; Issa et al., 2008). 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.

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 fifty-four 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, Africa's prospects and potentials for further oil search discoveries remain remarkably positive. Africa's oil reserves, production and export, in the overall 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 (2016) data classification benchmark. OPEC classified the oil exporting countries into three segments based on their production and output capacity. The total output of these countries constitutes 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. Sources of Data and measurement of variables

4.1 Data and sources of data

Following Bernanke, Gertler and Watson (2004) and Kutu & Ngalawa (2016), this study relies on quarterly data for the period spanning 1980:1 to 2015:4. The choice of starting date of the data is influenced by the period that has some of the needed data for this study. The choice of the cut-off date is considered long enough to capture some of the latest shocks in the global oil price (see Iwayemi and Fowowe, 2010; Chaudourne, Feve and Guay, 2014). Data have been sourced from Organization for Economic Cooperation and Development (OECD), OPEC, World Bank (WB), International Monetary Fund (IMF), the United States Energy Information Administration (US EIA), International Labour Organization (ILO) and the World Development Indicator (WDI).

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 and well distributed among the nations of African (OPEC, 2016).

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 has been selected as the benchmark in this study because it is widely accepted and the fact that it is the most traded on the foreign exchange market (see Ibrahim and Amin, 2005; Kim, Hammoudeh, Hyun and Gupta, 2017; Mahboub and Ahmed, 2017).

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. As noted by Wang, Zhu, & Wu (2017), it functions as 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)*

Also, referred to as money stock, money supply includes safe assets, such as cash, coins, and balances held in both savings and checking accounts that individual and businesses can use to make payments or/and hold as short-term investments. M2 is employed for this study 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. The M2 enables us to determine and assess the process through which the monetary authorities employ operating tools of monetary policy to achieve their targets (see Kutu and Ngalawa, 2016).

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 (Wang, Zhu, & Wu, 2017; Kim, Hammoudeh, SeogHyun and Gupta, 2017).

4.2.7 ***Unemployment Rate (UNE)***

An unemployed person refers to someone who is currently not working but is willing and able to work for pay, currently available to work and has actively searched for work but could not find one. Unemployment rate therefore is the proportion of the work force that is not engaged. It is introduced as a variable enhancing the GDP of a nation (Mahmoud and Mohammed, 2012). Therefore, it measures how oil price shocks transmits to GDP.

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 PSVAR, 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 $PSVAR$ 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 PSVAR has the same structure as $PVAR$ models in the sense that all variables are assumed to be endogenous and inter-reliant, except for those identified as exogenous. This model assumes that the six domestic performance variables of each country cannot affect the world oil prices. The $PSVAR$ is built with the same logic applied in the standard $PVAR$ except for the structural restrictions, which are imposed on the former, making it a different and much stronger tool for addressing macroeconomic policy. The $PSVAR$ 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:

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

where λ represents an invertible $(\upsilon\times\upsilon)$ matrix that describes the contemporaneous relationship among the variables employed; Φ_{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 PSVAR 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 can 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:

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

This can be represented as,

$$\lambda^{-1}\Omega_{io} = C_i,\ \lambda^{-1}\Psi_1 \dots\dots \lambda^{-1}\Psi_p = D_i \dots\dots D_p,\ \lambda^{-1}\mathrm{M} = \alpha \text{ and } \lambda^{-1}\Delta\varepsilon_{it} = \mu_{it} \quad (3)$$

We therefore transform equation 3 to derive equation 4:

$$\Phi_{it} = C_i + D_1\Phi_{it-1} + D_2\Phi_{it-2} + \cdots \dots\dots\dots + D_p\Phi_{it-p} + \alpha\theta_t + \mu_{it} \quad (4)$$

However, equation (1) differs from (4) in that the first is called a PSVAR or primitive system where all variables have contemporaneous effects on each other while the second is called a reduced form of PSVAR or a PSVAR 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 (4) can be expressed in a short form shown in (5):

$$\Phi_{it} = C_i + \lambda(L)\Phi_{it} + G(L)\theta_t + \mu_{it} \quad (5)$$

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

$$\Phi_{it} = (gdp, une, exr, inf, ms, int) \quad (5.1)$$

$$\theta_t = (op) \quad (5.2)$$

Equation (5.1) embodies the vector of the oil exporting countries that are treated endogenous variables as used in the study. Equation 5.2 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 (6) and (7) are similar because both are reduced form PVARs derived from the primitive PVAR system of equation (1) 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 to impose restrictions in matrices λ and Δ in the system of equations (6) and (7). Given that equation (6) equals equation (7).

$$\lambda = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ c_{21} & 1 & 0 & c_{24} & 0 & 0 & 0 \\ 0 & c_{32} & 1 & 0 & 0 & 0 & 0 \\ c_{41} & 0 & c_{43} & 1 & 0 & 0 & 0 \\ c_{51} & c_{52} & c_{53} & c_{54} & 1 & c_{56} & 0 \\ 0 & c_{62} & c_{63} & c_{64} & c_{65} & 1 & c_{67} \\ c_{71} & c_{72} & c_{73} & c_{74} & c_{75} & 0 & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{OP} \\ \mu_{it}^{GDP} \\ \mu_{it}^{MS} \\ \mu_{it}^{EXR} \\ \mu_{it}^{INF} \\ \mu_{it}^{INT} \\ \mu_{it}^{UNE} \end{bmatrix} = \quad (6)$$

$$\Delta = \begin{bmatrix} b_1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_2 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_5 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_6 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_7 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{OP} \\ \varepsilon_{it}^{GDP} \\ \varepsilon_{it}^{MS} \\ \varepsilon_{it}^{EXR} \\ \varepsilon_{it}^{INF} \\ \varepsilon_{it}^{INT} \\ \varepsilon_{it}^{UNE} \end{bmatrix} \quad (7)$$

Equations (6) and (7) present the restricted matrixes. The first matrix, equation (6), represents the λ-matrix which pertains to the non-recursive restrictions in the model and the second matrix, equation (8), represents the Δ-matrix known as a diagonal matrix. The terms μ_t^{OP}, μ_{it}^{GDP}, μ_{it}^{MS}, μ_{it}^{EXR}, μ_{it}^{INF}, μ_{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: ε_t^{OP}, ε_{it}^{GDP}, ε_{it}^{MS}, ε_{it}^{EXR}, ε_{it}^{INF}, ε_{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) and Kutu & Ngalawa (2016) suggesting that the PSVAR needs $2p^2 - 0.5p(p+1)$ or 70 restrictions must 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 PSVAR 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 is necessary 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 based on 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 (see Berkelmans, 2005; Kutu and Ngalawa, 2016). 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 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. A 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 (see Ngalawa, 2011). All lag order selection criteria suggest lag 7 as most suitable for the model. There are also similar studies that guide this study (see Elbourne, 2007; Sharifi-Renani, 2010; Kose and Baimaganbetov, 2015; Kutu and Ngalawa, 2016). 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 which also lies inside the unit circle. This indicates that the estimated VAR procedure is stationary. 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.

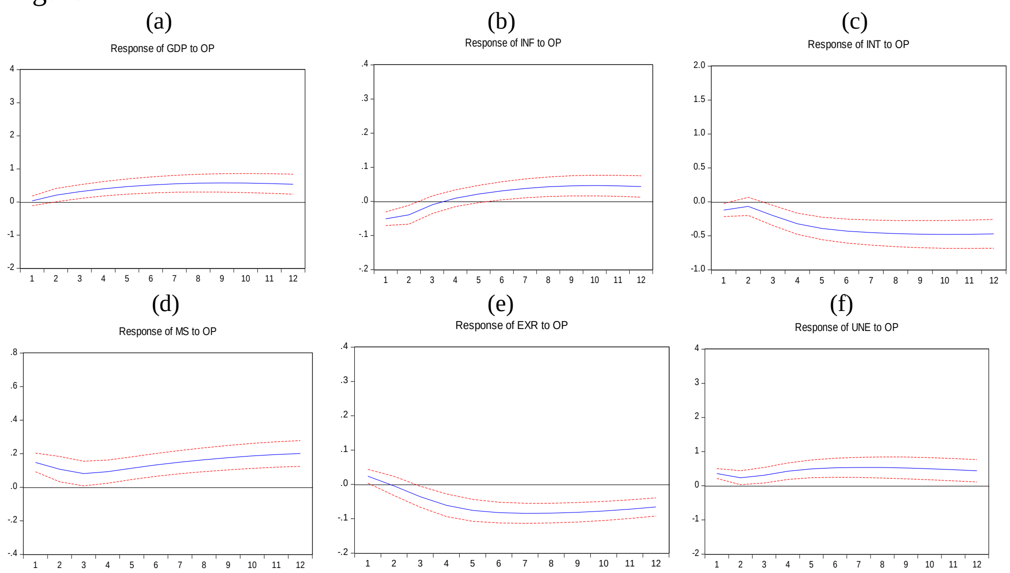
5.2.3. ***Impulse response function of interest rate to oil price shocks***

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 there is long-run cointegrating relationship 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 cause 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 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 shows that the 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 shows that unemployment declines when more job opportunities are created from oil proceeds.

From the foregoing, the overall responses of the variables to structural one standard innovation in oil price reveal that the variables are not just significant but 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 5.3.1 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 account for less than 0.05% fluctuation in GDP in period three. As is evidenced from the table, 2.7%, 2.8% and 1% fluctuation in GDP are respectively accounted for by oil price, money supply and exchange rate during the third period. During this period, OP and MS 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. Apart from 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 5.3.2 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 on 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 5.3.3 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 on 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 5.3.4 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 5.3.5 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

The result of the variance decomposition of unemployment rate shown on table 5.3.5 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 PSVAR 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. Stemming from our findings, further research based on the net oil importers in Africa may be a useful line of research to pursue. Comparing the role of oil shocks on economic performance across oil exporting and importing African economies can offer insights into the ways in which oil shocks shape economic performance in Africa.

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