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Article

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GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

Crude oil price shocks and macroeconomic performance in Africa's oil-producing countries

Adeleke Omolade^{1*}, Harold Ngalawa¹ and Adebayo Kutu¹

Abstract: The study investigates the influence of crude oil price shocks on the macroeconomic performance of Africa's oil-producing countries. Eight major net oil producers, namely, Algeria, Nigeria, Egypt, Angola, Gabon, Equatorial Guinea and Congo Republic are included in the study. Sudan is excluded due to data constraints. The study covers the period between 1980 and 2016, which represents the periods with the most boom and bust movements in crude oil prices. The Hamilton Index (1996) which uses the net oil price increase is applied. The study compares the price of oil in each quarter with the maximum value observed during the preceding four quarters. This is used to derive sharp increases and declines in oil prices to capture oil price shocks. A Panel Structural Vector Auto-Regression model is adopted for analysis. The results show that the reaction of output to sharp increases and declines in oil prices differ. It is also observed that structural inflation accompanies sharp declines in oil prices more than monetary inflation, since both outputs and investment decline significantly.

Subjects: Economics; Environmental Economics; Industry & Industrial Studies

Keywords: Hamilton Index; crude oil price shocks; output performance



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PUBLIC INTEREST STATEMENT

The inability of the governments of oil-producing countries to tackle incessant negative effects of oil price shocks and the attendant negative impact on their macroeconomic performance have been a source of concern to researchers. Often, policy makers in these countries come up with policies to mitigate the negative impacts of oil price shocks but unfortunately, in the long run in most cases the policies are counterproductive. In order to provide a better understanding of how oil price movement affect macroeconomic performance of the oil-producing economies, this paper examined the effects of crude oil price shocks on macroeconomic performances of African oil-producing countries. The paper used structural vector auto-regression (SVAR) and Hamilton Index. The empirical results show that negative oil price shocks have more significant effect on output performance of Africa's oil-producing countries than positive oil price shocks. The study also confirmed exchange rate as the medium through which crude oil price shocks are transmitted to output.

1. Introduction

The macroeconomic performance of Africa's oil-producing countries has been strongly associated with the oil sector, connoting that the continent's economy is vulnerable to crude oil price shocks. The price of oil, for instance, fell from a peak of \$105 per barrel in 2014 to as low as \$37 per barrel in 2016, primarily as a result of the lifting of international sanctions against Iran in 2015, which paved way for an increase in Iranian oil exports, leading to a free fall in crude oil prices (IMF, 2016). The attendant effect of the fall in oil prices is still adversely affecting production in many of Africa's oil-producing countries. For instance, output growth in Nigeria fell by 1.1% in December 2015 to -1.2% in the first quarter of 2016, a trend that continued till the end of the third quarter (NBS, 2016). The same trend has been recorded by a group of oil-producing countries in the Central African Economic and Monetary Community (CEMAC¹). Gabon, which is a member of this economic union, recorded a fall in annual average output growth from 2.1% in 2014 to 1.3% in 2015 (IMF, 2016). This situation is also observed in most Africa's oil-producing countries.

The mechanism through which oil price movements affect output in oil-producing countries has generated widespread debate over the years. This has been anchored on the rate of decline or rise as well as the periods during which oil price changes last. Stauffer (1984), Vahid and Jabber (1997), Majid (2006) and Amuzegar (2001) have argued that the effect of positive oil price shocks on output performance of oil-producing economies usually lead to currency appreciations stimulated by an accumulation of foreign exchange earnings; and consequently, an expansion of output. The three studies also opined that the reverse tends to be the case whenever there is a negative oil price shock.

Some studies argue that the situation explained above might not be obtainable for an oil-producing country as there are some factors that can prevent the chains of reaction from happening (See Engelmann, Owyang, & Wall, 2012; Kilian, 2008). Some of these factors are availability of local refining capacity, nature of change in oil prices and level of economic diversification, among others (see Hamilton, 1983, 1996, 2003, 2008; Kilian, 2009; Kim & Roubini, 2000). These studies maintain that an oil-producing country with a narrow economic base and lack of local refining capacity might not enjoy an increase in output following a positive oil price shock and the exchange rate might not appreciate because of the country's massive importation of refined petroleum products and other goods.

Hamilton (1983, 1996, 2003, 2008), Kilian (2009) and Kim and Roubini (2000) further pointed out that output might not necessarily decline in the case of a negative oil price shock if the oil-producing country is widely diversified and has adequate local refining capacity that will ease pressure on importation, which might prevent the currency from depreciating. It has also been argued that, implying the reverse response to a positive shock as that of a negative shock might not be correct in most cases because of macroeconomic uncertainty and external cyclical changes that can cause distortions in reactions of macroeconomic variables to external shocks (See Hamilton, 2011 ; Demachi, 2012). According to this school of thought, sharp oil price declines affect oil-producing countries more than unexpected increases in oil prices. The former causes currency depreciation, and a subsequent fall in output. It is evident from the foregoing discussion that there are back and forth arguments that suggest lack of consensus on the nature of the effects of oil price shocks on output performance in oil-producing countries.

This study will be contributing to the debates discussed above. In addition, previous empirical studies on crude oil price shocks have concentrated mainly on usage of structural vector auto-regression (SVAR) to measure oil price movement but this technique has been shown to be inadequate as it cannot capture the effect of negative oil price shock (See Elbourne, 2007; Gachara, 2015; Kutu & Ngalawa, 2016). SVAR framework, which is used by these authors, uses positive shock as default. Researchers are often found of suggesting the reverse effects of positive oil price shocks as the effects of negative oil price shocks. This idea according to Demachi (2012) might not properly measure the effects of negative oil price shock, which is very crucial to the

Table 1. Ranking of Africa's big oil producers

S/N	Country	Crude oil output	Africa/World ranking
1	Gabon	240,000 bpd	9th and 37th
2	Republic of Congo	259,000 bpd	8th and 36th
3	Sudan	262,000 bpd	7th and 35th
4	Equatorial Guinea	269,000 bpd	6th and 34th
5	Libya	516,000 bpd	5th and 29th
6	Egypt	667,000 bpd	4th and 27th
7	Algeria	1,721,000 bpd	3rd and 17th
8	Angola	1,722,000 bpd	2nd and 15th
9	Nigeria	1,782,000 bpd	1st and 13th

Source: *Africanglobe* January, 2016

economic growth of oil-producing countries. This among others are areas where this study will be contributing to the existing literatures on oil price shocks and output performance especially in oil-producing economies.

The primary objective of this study, therefore, is to investigate the effects of crude oil price shocks on the output performance of Africa's oil-producing countries, with a view to ascertain how output responds to positive and negative unexpected changes in crude oil prices in these countries. The study contributes to the existing literature on the controversy surrounding the relationship between crude oil price shocks and output performance of the oil-producing countries.

While there are many oil-producing countries in Africa, only major net oil producers/exporters will be included in the study. This is because nearly all the net oil producers appear to have a narrow economic base that is reliant on oil. Accordingly, they can be studied together in a panel. The distribution of large net oil producers in Africa is presented in Table 1 under the appendix.

It should be noted that in 2016, Nigeria lost her position as Africa's highest oil-producing country to Angola, with crude oil production falling by 67,000 barrels per day. This position was reclaimed late in 2016. Currently, Nigeria is the largest producer of crude oil in Africa. This study will focus on the nine countries listed in Table 1. The study period is limited to 1980–2016. This period coincides with the era of incessant changes in oil prices in the world hence it appears to be an ideal period to study the fluctuating effects of crude oil prices on the AOPC's economies.

2. Literature review

Several studies have examined the relationship between oil price shocks and output performance of selected countries outside Africa's oil-producing countries while some have investigated the relationship on individual countries among Africa's oil-producing countries. However, few of these studies are discussed based on their case studies.

2.1. Studies outside Africa's oil-producing countries

Joseph and Festus (2013) investigated a panel analysis of oil price dynamics, fiscal stance and macroeconomic effects: the case of some selected African countries using a panel vector autoregressive (PVAR) over the period of 1990q1 to 2010q4. The variables used in the study are oil price volatility, real gross domestic product (real GDP), fiscal deficit, gross investment and money supply shocks. The study showed that gross investment responds more to oil price volatility than fiscal deficit, real GDP and money supply. Apart from the fact that focused more on the effect of oil price on fiscal stance as against output performance which is the focus of this study, the study combined both oil producers and non-oil producers in Africa hence the findings might not reflect the situation in Africa's oil-producing countries alone.

Gachara (2015) empirically investigated the channels through which oil price shocks affect economic activity in Kenya. The variables used in the study were real exchange rate, inflation, money supply, real GDP growth and international price of crude oil over the period of 1991–2014. Employing a SVAR model and granger causality tests, the study found that there exists a bi-directional causality between real exchange rate and inflation in Kenya; and that there is a unidirectional causality from inflation to real GDP and from real GDP to real exchange rates. The study found that crude oil price shocks have a significant effect on Kenya's macroeconomic performance. The study was carried out on Kenyan economy which is not among Africa's oil-producing countries and again, the conventional SVAR was used which might not be able to capture negative shocks.

Charfeddine, Klein, and Walther (2018) examined whether the time difference affects the impact of oil price changes on US GDP growth. The study replicated empirical findings of prominent studies and found that the proposed oil price measures have a dissipating effect with recent data up to 2016Q4. Second, the study further re-examined the issue and provided evidence that oil price decreases affect the GDP growth, when taking into consideration mixed data sampling technique. Finally, it puts particular focus on non-linearity and a possible instability and showed that combining Markov switching and mixed data sampling models allowed to identify different regimes permanently changing with the Great Moderation. The study was able to capture the oil price movements using various non-linear measures such as Mork (1989), Hamilton (1995, Hamilton, 2003) and Lee, Ni, and Ratti (1995). However, the focus of the study was on USA which is a developed economy with less dependence on the oil sector. Therefore, their results might not reflect the situations for oil-producing countries in Africa which are mainly developing economy with huge dependence on the oil sector that account for almost 80 percent of their foreign exchange earnings.

Kim, Hammoudeh, Hyun, and Gupta (2014) analysed the effect of oil price shocks on China's economy with special interest in the response of the Chinese interest rate to those shocks. Using different econometric models, (i) a time-varying parameter structural vector autoregression (TVP SVAR) model with short-run identifying restrictions, (ii) a structural VAR (SVAR) model with the short-run identifying restrictions and (iii) a VAR model with ordering-free generalized impulse response VAR (GIR VAR), the study found the response of the Chinese interest rate to the oil shocks is not only time varying but also showing quite different signs of responses. Specifically, in the earlier sample period (1992:4–2001:10), the interest rate showed a negative response to the oil shock, while in the latter period (2001:11–2014:5) it showed a positive response to the shock. Given the negative response of the world oil production to an oil price shock in the earlier period, the shock is identified as a negative supply shock or a precautionary demand shock, thereby the negative response of the interest rate to the oil shock was deemed as economy boosting. The positive response of interest rate to the oil shock in the later period, given that this shock is identified as a positive world oil demand shock, gave evidence that stabilization of inflation is one of the main objectives of China's monetary authority, even though the current main objective of the monetary policy is characterized as "maintaining the stability of the value of the currency and thereby promoting economic growth." Finally, the variance decomposition results revealed that the oil price shock becomes an increasingly important source in the volatility of China's interest rate. The study failed to capture negative oil price shock because it used the conventional SVAR, which is programmed to examine positive shock alone. Again, Chinese economy is less dependent on oil sector and it is bigger and stronger than Africa's oil-producing economies. In addition, the behaviour of interest rate to oil price shocks was given priority as against output performance. Therefore, their findings might not apply on Africa's oil-producing countries.

Jiménez-Rodríguez and Sánchez (2004) assessed empirically the effects of oil price shocks on the real economic activity of the main industrialized countries OECD. Multivariate VAR analysis was carried out using both linear and non-linear models. The latter category includes three approaches employed in the literature, namely, the asymmetric, scaled and net specifications. The study found

evidence of a non-linear impact of oil prices on real GDP. In particular, oil price increases are found to have an impact on GDP growth of a larger magnitude than that of oil price decreases are found to have a negative impact on economic activity in all cases but Japan. Moreover, the effect of oil shocks on GDP growth differs between the two oil-exporting countries in our sample, with oil price increases affecting the UK negatively and Norway positively; declines with the latter being statistically insignificant in most cases. However, apart from the fact that the study did not capture the negative oil price shocks to the output of these countries, it also combined both advanced economies which are oil producers and non-oil producers. The findings again might not be suitable for Africa's oil-producing countries that are less developed.

2.2. Studies on Africa's oil-producing countries

Berument and Ceylan (2005), for instance, analysed how oil price shocks affect output growth of selected Middle East and North African countries that are either exporters or net importers of oil commodities. They used an SVAR model, focusing explicitly on world oil prices and real GDP over the period of 1960–2003. Their impulse response analysis suggests that the effects of the world oil prices on the GDP of Algeria, Iran, Iraq, Jordan, Kuwait, Oman, Qatar, Syria, Tunisia and UAE are positive and statistically significant. However, for Bahrain, Egypt, Lebanon, Morocco and Yemen, they did not find a significant impact. Apart from the inclusion of non-oil producers among the sample in the study, the conventional SVAR approach only was used which might not be able to account for precisely the response to negative oil price shocks.

Rotimi and Ngalawa adopted the Panel SVAR (P-SVAR) 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 suggested that strong monetary control measure should be put in place whenever positive shocks in oil are experienced. However, the study failed to capture the responses to negative oil price shocks, which has been described as more important to the oil-producing economies. Implying the reverse effect of the response to positive oil price shock to mean that of response to negative oil price shock has been shown to be misleading and giving conflicting interpretations.

Apere and Ijomah (2013) examined the effect of oil price shocks on monetary policy in Nigeria between 1970 and 2010 using an SVAR model. The findings revealed that there is a long-run relationship involving oil prices, inflation rates, Treasury bill rates, exchange rates, interest rates and money supply in Nigeria. It is further revealed in the study that an unexpected oil price shock is followed by an increase in inflation rates and a decline in exchange rates and interest rates in Nigeria, which is consistent with Olomola (2006). However, the interest of the study was more centred on monetary policy response to oil price shocks and not output performance.

Employing cointegration and an SVAR model, Musa (2015) used quarterly data to analyse the impact of oil price shocks on the growth of the Nigerian economy over the period 1970–2011. Impulse response functions (IRFs) and variance decomposition from the SVAR model indicate that the response of oil prices and unrest to economic growth (RDGP) depicts long-run impact on economic growth. The study further revealed that oil prices, exchange rates, agricultural output and unrest contain important information in predicting the future path of economic growth in Nigeria. The study however failed to capture the response to negative oil price shocks.

Olomola (2006) analysed the effect of oil rents on economic growth in oil exporting African countries using a panel data regression analysis for the period 1970–2000. The study used data

from 47 oil exporting countries including and 13 non-oil exporting countries. The findings of the study revealed that there is evidence of resource curse in oil exporting countries, including oil exporting African countries. It is also shown that exchange rates and the Dutch disease syndrome do not explain the resource curse in these countries, and that the absence of democracy in oil exporting countries hinders economic growth. Apart from the fact that the study combined both non-oil and oil producers in Africa, regression analysis was used which might not be able to explain the responses of output to oil price shocks.

2.3. Summary of gaps in the literature/critics of the past studies

It will be noted that none of these research works focused on the assessment of the boom and burst as well as sharp declines that have characterized oil price movements over the years. This behaviour of oil price has been shown to be very germane to the macroeconomic performance of oil-producing economies. This is because it disrupts their policy framework each time it occurs and in most cases, they are tackled with wrong policy ideas, which may aggravate the negative impacts of these unique oil price movements on their macroeconomic performance during the period. Again, they have all used SVAR which can only capture positive shock while the negative shock or sharp decline that portends serious implications on the output performances of these oil-producing countries were not given adequate priorities in the studies. Consequently, this study will employ techniques that will be able to measure these sharp jumps and declines in oil price and also accommodate the effect of negative oil price shocks.

3. Methodology

The primary objective of this study is to investigate the effect of crude oil price shocks on output performance of Africa's oil-producing countries. The study employs a P-SVAR model for analysis. This approach enables us to study the interaction and responses of various macroeconomic variables to crude oil price shocks. Hooker (2001) posited that it is wrong to assume that negative oil price shocks will always produce the reverse effect of positive oil price shocks. He maintained that at times, a negative shock might not produce the reverse effect of a positive shock due to macroeconomic disturbances that are accounted for by the stochastic variable, consequently preventing negative shocks from producing a reverse effect all the time (Demachi, 2012). To capture oil price shocks, we employ the Hamilton Price Index.

3.1. Derivation of oil price change Hamilton price index

The literature on SVARs has often concentrated on positive shocks, with the implication that negative shocks will have a symmetric effect. However, many studies have shown that negative and positive oil price shocks may have asymmetric effects (See Adeniyi, 2011). One of the ways of doing this is via the Hamilton Index (Hamilton, 1996). To critically examine the monetary policy response within a short-run period, the study derives the oil price change via the Hamilton Index process. The process enables us to explain the policy reaction and assess policy direction to sharp increases and decreases in international oil prices which have implications for oil-dependent economies like Africa's oil-producing countries. The Hamilton Index (1996) has been found to be superior to Mork (1989) and Hamilton (1983) in measuring oil price movements. According to Hooker (2001), neither the linear relation between oil prices and output proposed by Hamilton (1983) nor the asymmetric relation based on oil price increase alone as advocated by Mork (1989) is consistent with observed economic performance over the last decade.

Furthermore, Hamilton (1996) agreed with Hooker and found out that the majority of increases in oil prices since 1986 have been followed immediately by even larger decreases. Therefore, he proposed to compare the current price of oil with the price level of the previous year rather than only compare it with the price level of the previous quarter; he introduced the "net oil price increase" (NOPI). The NOPI compares the price of oil each quarter with the maximum value observed during the preceding four quarters. If the price of oil in quarter t is lower than it had been at some point during the previous four quarters, the series is defined to be zero for date

t (Hamilton, 1996, 217). This also applies to net oil price decrease. Oil price exhibited the characteristics explained under the Hamilton 1996 condition during the period under investigation hence, the usage in this study. Hamilton applied this method on the data after 1986; it showed that individual price increases were simple corrections to earlier declines except for the time during the Gulf War, which was followed by the first recession in the US. However, Mork (1989) has been faulted by many authors as it focused on the asymmetric effect of oil price shocks which many studies have found that oil price movements in most oil-producing countries are symmetric and not asymmetric as used by Mork (1989) (See Adeleke & Harold, 2017; Charfeddine et al., 2018; Demachi, 2012; Myronovych, 2002)

The Hamilton Index (H1) has been applied in many studies including Ahmed and Wadud (2011) and Demachi (2012). The H1 extracts the net increase in oil prices and the inverse of H1 (invH1) extracts the net decrease in oil prices in a direct opposite manner. The process is described as follows:

$$H1_t = \{(oilprice_t - maxoilprice) > 0, 0 \text{ for } (oilprice_t - maxoilprice) \leq 0\} \tag{1}$$

$$InvH1_t = \{(oilprice_t - minoilprice) < 0, 0 \text{ for } (oilprice_t - minoilprice) \geq 0\} \tag{2}$$

where, *maxoilprice* is the maximum oil prices within the last one year and *minoilprice* is the minimum oil price within the last one year. The oil price used the natural log of the Brent crude oil price.

The two Hamilton price index, both the H1 and Inverse H1, will be used separately in the SVAR model to examine the reaction of macroeconomic variables and policy response within a relatively short period of time.

3.2. The panel-SVAR model

The structure of the SVAR is based on the major subdivisions of the variables in the model. The first variables are oil price and the Hamilton Index. This is a clear departure from what is common in the many empirical studies where prices only are used instead of their behaviour (fluctuations), which has been identified as very germane to output performance of oil-dependent economies (Ojo & Alege, 2012). The next sets of variables are other policy variables such as exchange rate and inflation rate. The output variables are the last sets of variables in the SVAR and they comprise capital stock and GDP growth rate.

Construction of the VAR model follows the conventional method where the primitive/structural model is specified, thus,

$$y_t = A_1y_{t-1} + A_2y_{t-2} + \dots + A_p y_{t-p} + \mu_t \tag{3}$$

where:

y_t represents an $nx1$ vector containing n endogenous variables;

A_i are $(n \times n)$ matrices coefficients, $\forall i = \{1, 2, \dots, p\}$;

and μ_t is an $nx1$ vector containing error terms.

Though the error is $\mu_t \sim iid N(0, \Omega)$, the errors possess a tendency of correlating contemporaneously in all the equations.

There are pn^2 parameters in the A matrices. Equation 20 can be rewritten using the lag operator L which is selected through $L^k x_t = x_{t-k}$, where x is a group of exogenous variables and k is the lag length. The equation becomes:

$$A(L)y_t = \mu_t \tag{4}$$

where:

$$A(L) = A_0L^0 - A_1L^1 - A_2L^2 - \dots - A_pL^p$$

where $A_0 = I$ (identity matrix). It is required that $A(L)$ lies inside the unit circle for stationarity to be ensured.

3.2.1 Variance Decomposition and Impulse Response Functions (IRFs)

Analysis of the VAR will be carried out using variance decomposition and IRFs. Both variance decomposition and IRFs are computed by re-specifying the autoregressive (AR) function. The two of them evolve through the process described as follows:

$$A(L)\mu_t = y_t \tag{5}$$

where y_t represents a stationary stochastic process in the system, L is the lag operator, and μ_t is a white noise error term. The theory also requires that root $\det(1-A(z)) = 0$ should have a modular greater than 1. In this case, $\det(1-A(z))$ is invertible. The interpretation of our VAR is based on the vector moving average (MA) presented in the following form:

$$y_t = \theta_t + \sigma(L)\mu_t E(\mu_t) = 0 \tag{6}$$

$$E(\mu_t\mu_{t-k}) = Q, |k| = 0 \tag{7}$$

$$E(\mu_t\mu_{t-k}) = Q, |k| \neq 0 \tag{8}$$

where Q represents the covariance matrix sample, θ_t is predictable perfectly while the matrix of coefficients $\sigma(L)$ using lag 0 is the identity matrix.

Equation 7 can be normalized to generate the IRFs and at the same time forecast the error decomposition. Nonetheless, the variance decomposition adopted is equal to the MA.

3.3. Model identification

The nature of the SVAR requires imposition of adequate restrictions so as to identify the orthogonal structural components of the error terms that are present in the shocks. Note that this is at variance to the standard recursive Cholesky orthogonalization. The non-recursive orthogonalization of the error terms produced through this process is used for the IRFs and variance decomposition.

For clarity, assume that y_t comprises a vector of endogenous variables. For example, say the k^{th} element of endogenous variables in our model where $\sum E[v_t\psi_t]$ is the residual of the covariance matrix. Therefore, our identification procedure follows:

$$Av_t = B\mu_t \tag{9}$$

where v_t and μ_t are vectors with lag length k , v_t is the observed residual and μ_t represents the unobservable structural innovations. A and B are $k \times k$ matrices which are to be estimated. Innovation μ_t is assumed to be orthogonal in nature. Accordingly, the covariance is an identity matrix $E[\mu_t\mu_t'] = I$. Imposition of restrictions on A and B is made possible due to the orthogonal assumption of μ_t . hence we have:

$$A\sum A' = BB' \tag{10}$$

The link between the reduced form and the structural form of the VAR model is presented as follows:

$$B(L) = B_0 + B^+(L) \tag{11}$$

$$A(L) = -B_0^{-1}AB^+ \tag{12}$$

$$\Sigma \triangleq B_0^{-1}AB_0^{-1} \tag{13}$$

Equation 11 is the structural form divided into contemporaneous correlations i.e. B_0 and $B^+(L)$. The former represents correlations at lag zero while the later represents correlations at all strictly positive lags. Equation 12 separates each reduced form coefficient into its structural counterpart B_0 , identified through the reduced form, $\Sigma \triangleq E[\mu_t\mu_t^t]$, and the diagonal covariance matrix of the structural form, $A = E[v_t v_t^t]$ as shown in Equation 11.

Furthermore, due to the vulnerability of long-run restrictions to serious misspecification problems, we use a contemporaneous restriction on the B_0 matrix to identify the shocks as shown in Equation 12 since this study is interested in short-run and medium-term responses (see Leeper, Sims, and Zha, 1996; Elbourne, 2007). The PSVAR model was developed following the work of Demachi (2012) and it is identified according to equation 14.

$$\begin{bmatrix} V_t^{oilp} \\ V_t^{oilpv} \\ V_t^k \\ V_t^{gdpgr} \\ V_t^{infr} \\ V_t^{msgr} \\ V_t^{exr} \\ V_t^{intr} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ B_{21}^0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ B_{31}^0 & 0 & 1 & 0 & 0 & 0 & 0 & B_{38}^0 \\ B_{41}^0 & 0 & B_{43}^0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & B_{53}^0 & B_{54}^0 & 1 & B_{56}^0 & 0 & 0 \\ B_{61}^0 & B_{62}^0 & 0 & 0 & B_{65}^0 & 1 & B_{67}^0 & 0 \\ B_{71}^0 & B_{72}^0 & B_{73}^0 & B_{74}^0 & B_{75}^0 & B_{76}^0 & 1 & 0 \\ 0 & 0 & 0 & 0 & B_{85}^0 & B_{86}^0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{oilp} \\ \mu_t^{oilpv} \\ \mu_t^k \\ \mu_t^{gdpgr} \\ \mu_t^{infr} \\ \mu_t^{msgr} \\ \mu_t^{exr} \\ \mu_t^{intr} \end{bmatrix} \tag{14}$$

There are eight variables in the SVAR model. Oil price (oilp) occupies that row 1 while the two forms of oil shocks oilpv, which are H1 and InvH1, occupy row 2. Both the oil price and its derivatives namely H1 and InvH1 are used as the exogenous variables. They both put external pressure on the economy, which is predominantly dominated by import dependent, and primary goods production countries (Demachi, 2012). According to Becklemans (2005), the transmission of the international shock to the domestic economy can be very rapid. Consequently, an oil price increase H1 is the one driving itself while decrease in oil price InvH1 usually follows previous period of a rise in oil price so it depends on H1 (See Demachi, 2012, Engelmann et al., 2012; Kilian, 2008). Rows 3 and 4 describe the VAR residuals that describe the non-policy variables, namely GDP growth rate (*gdpgr*) and capital (*k*). However, interest rates, money supply, exchange rates and inflation rate are policy variables which are ultimately in the control of the monetary authorities. The disturbance term μ , is a vector of reduced form disturbances to all the variables in the model (foreign and domestic variables). The position of the variables in the model describes the way they influence themselves in the identification scheme. For instance, the non-zero element B_{ji}^0 in the matrices shows that variable j influences variable i contemporaneously. The first row which belongs to the oil price shows that it responds to its own lagged values while row two which is for oil price volatility shows that it only responds contemporaneously to oil price as indicated by B_{21}^0 . Again, the two rows further describes how both variables respond slowly to monetary policy shocks, which is due to information and planning delays or the expected lags faced by policy makers (See Sims, 1986; Bernanke, 2008; Becklemans, 2005; Vonnak, 2005).

Third and fourth rows describe the goods market equations. The zeros describe nominal rigidities (Elbourne, 2007). B_{31}^0 and B_{38}^0 indicates that capital stock responds contemporaneously to interest rates and oil prices while B_{41}^0 and B_{43}^0 describe the contemporaneous responses of GDP growth rate to oil prices and capital stock (See Kutu and Ngalawa, 2015).

Rows 5 and 6 of the matrix represent the inflation rate and money supply growth rate, respectively. Coefficients B_{53}^0 , B_{54}^0 and B_{56}^0 allow for contemporaneous relationships among capital stock and GDP growth rate, and money supply growth rate on one hand, and the rate of inflation on the other. The assumption of the contemporaneous response of inflation to output shocks is consistent with Vonnak (2005) and Bernanke, (2008). Money supply growth rate occupies row 6 and it responds instantaneously only to oil price, oil price volatility, inflation rate and exchange rate. The basic idea underlying the SVAR approach for money supply growth rate is that not all changes in the monetary policy stance reflect a systematic response to variations in the state of the economy (Sousa & Zaghini, 2013). This is the reason for the sluggish response to capital stock, GDP growth rate and interest rate.

Row 7 shows that the exchange rate is set in a competitive market and thus responds contemporaneously to all the variables in the system, while the interest rate as a policy variable only responds to inflation rate and money supply growth rate as shown by B_{85}^0 , and B_{86}^0 , respectively.

4. Results

The analysis begins with the exploration of the statistical properties of the variables which is necessary to investigate the suitability of the data on the variables for the estimating techniques. The application of the SVAR is dependent on the level of stationarity of the variables included in the model. According to Elbourne (2007), Bernanke (2008), Blanchard and Riggi (2009), all variables in the SVAR are required to be stationary. Consequently, this study assesses the stationarity of the variables by conducting the panel unit root test.

4.1. Panel unit root test

Various studies such as Kutu and Ngalawa (2016), Omolade and Ngalawa (2014), among others, have suggested the use of more than one method of panel unit root test to ascertain the order of integration of the variables to be included in a particular model. For this study, both the IPS and ADF methods of Panel unit root test are adopted. Their results are presented in Table 2.

It is evident from Table 2 that all the variables are either stationary in levels or after first differences. The two methods of panel unit root tests give the same levels of integration for each variable. Furthermore, the results indicate that apart from the GDP growth rate that is stationary in levels, all other variables in the table are stationary after first differences i.e. they are integrated of order one I(1).

4.2. Crude oil price shocks

Investigating the effect of crude oil price shocks on the output performance of Africa's oil-producing countries requires an investigation of two different perspectives of oil price shocks, viz, H1 and InvH1. The two variables are presented in Figure 1.

Figure 1 shows the graphical presentation of different shocks in crude oil prices. The figure shows that there is a clear distinction between the two Hamilton Index oil prices under review. It should be noted that the net increase in crude oil prices during the period is extracted to form the H1 while the net decrease is extracted to form the invH1. Both indices explain a situation where there is a sharp jump or fall in the oil price which oil price shocks might not be able to capture since they use positive standard deviation alone. However, the output response in Africa's oil-producing countries is expected to be different to different price indices of crude oil. This forms the major focus of this study.

Table 2. IPS and ADF Panel unit root tests

Variables	Panel unit root test method			
	Im, Pesaran and Shin IPS		ADF Fisher	
	IPS statistics	Order of integration	ADF Fisher statistics	Order of integration
EXR	-4.83,137	I(1)	72.6952	I(1)
GDPGR	-2.90,034	I(0)	32.0765	I(0)
INFR	-10.7917	I(1)	153.383	I(1)
K	-12.0515	I(1)	180.775	I(1)
MS_GDP	-7.85,609	I(1)	103.678	I(1)
OILP	-10.1089	I(1)	137.279	I(1)
INTR	10.7917	I(1)	153.383	I(1)

Source: Author's computation

Figure 1. Crude oil price shocks/movements.

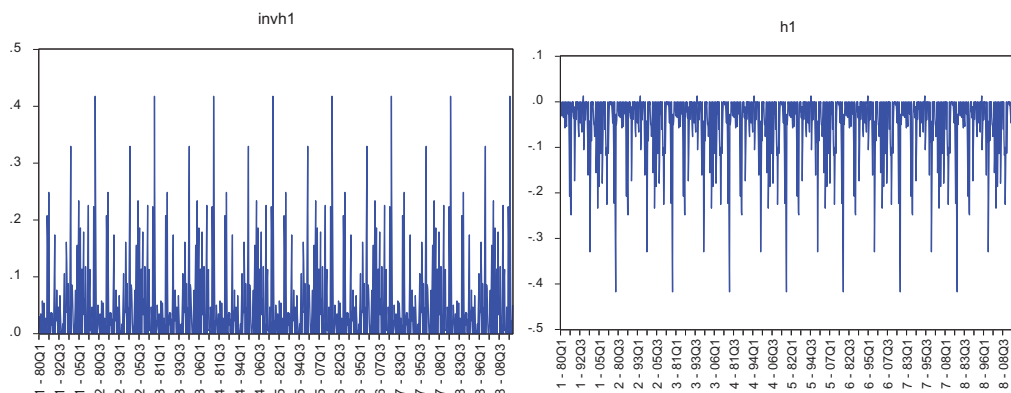
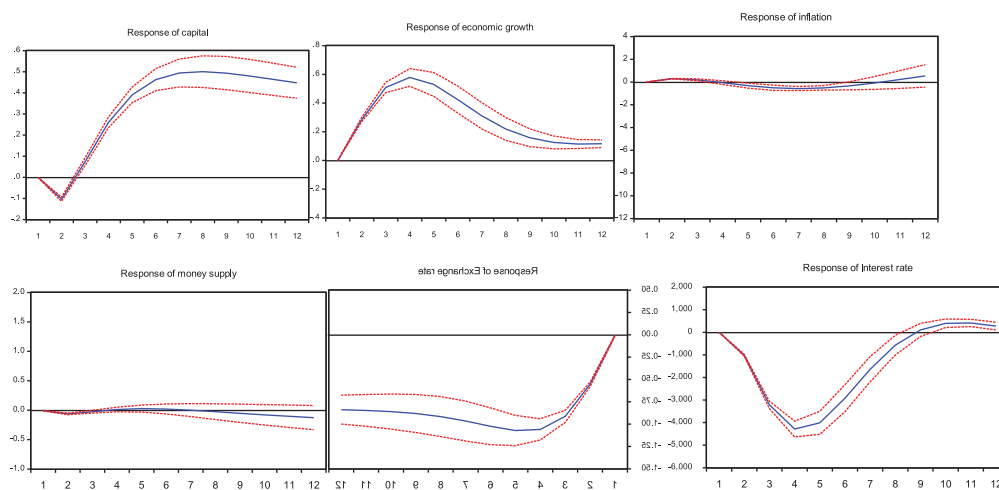


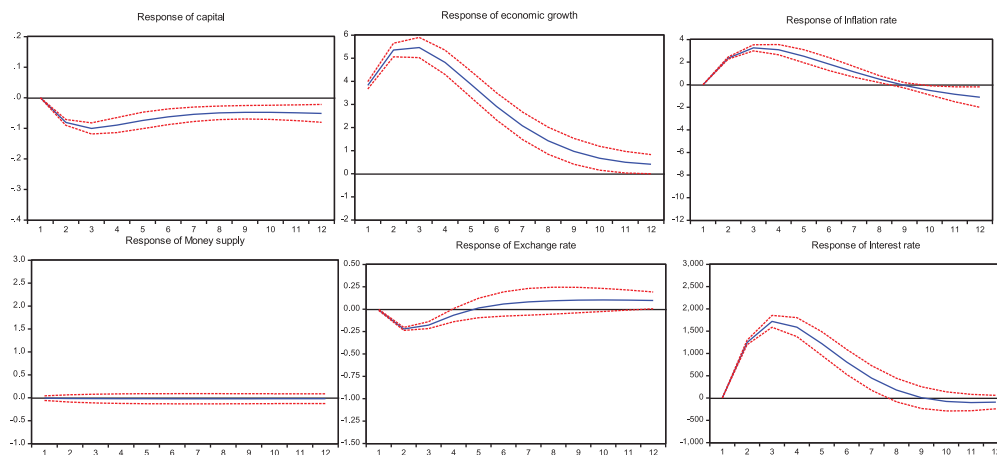
Figure 2. Responses to Hamilton Index H1.



4.3. Impulse response functions

The responses of output growth of Africa’s oil-producing countries and other macroeconomic variables to unexpected changes of different forms of crude oil price indices are presented and explained through IRFs as explained in Figures 2 and 3.

Figure 3. Responses to Inverse Hamilton Index InvH1.



It is noted that the reactions of the variables to an H1 shock are almost similar to what past empirical literatures have reported about reactions of same variables to oil price (See Joseph & Festus, 2013; Kutu & Ngalawa, 2016). This is because an oil price shock is denoted as an unexpected increase in oil prices, which is computed as a positive one standard deviation of oil prices. However, there are still some slight differences in the behaviours of the variables to the H1 shock. For instance, it brings about a significant and sustained rise in both capital and output of Africa's oil-producing countries. Again, the sharp rise in oil prices as measured by H1 fails to lead to a significant rise in inflation rate as opposed to what we observe under the oil price shock in studies like (Kutu & Ngalawa, 2016). The same thing is noticed on money supply. However, the currency appreciates and the interest rates decline significantly following an H1 shock.

The inverse Hamilton measures a net decrease in oil prices. We, therefore, use it to capture the reactions of output and other variables to a sharp fall in oil prices. The study results show that the responses of the variables in the model are not necessarily the opposite of responses to positive oil price changes, as usually opined by studies that make use of SVARs. There are, nonetheless, some variables that respond in the directly opposite direction to that observed following a positive oil shock. For instance, a sharp decline in oil price causes capital formation and output growth to fall significantly. Inflation rates follow the same behaviour. That is, they rise at the beginning and later falls. Again, while a positive oil price shock causes money supply to rise significantly, a sharp decrease in oil price does not have a significant impact on money supply. However, it causes the exchange rate to depreciate and interest rate to rise significantly, an impact that is persistent over a longer period unlike its reaction to a positive oil price shock where it shows a non-significant response.

4.4. Variance decomposition of output performance of Africa's oil-producing countries

This explains the contributions of each shock to the behaviour of output growth in Africa's oil-producing countries. It is divided into two using the two Hamilton price indices.

Tables 3 and 4 compare the influences of various forms of oil price movements on output performance in Africa's oil-producing countries. The results show that H1, which is Hamilton's measure of a net increase in oil prices, has the highest influence on the behaviour of output in Africa's oil-producing countries. The implication of this is that out of the two derivatives of oil prices to measure its shocks, H1, which is the net increase or jump in oil prices, has the greatest influence on outputs in Africa's oil-producing countries, more than the net decrease in oil price.

5. Discussion and conclusions

The findings of this study may lead to important conclusions on the debate relating to the influence of crude oil price shocks on economic performance of Africa's oil-producing countries. As pointed out

Table 3. Output performance and Hamilton INVH1

PERIOD	OILP	InvH1	K	GPPGR	INF	MS/GDP	EXR	INTR
3	31.26,276	40.40,092	0.097624	28.19,244	0.000468	0.044801	1.37E-05	0.000976
6	63.01217	21.13,547	0.286,786	15.44,942	0.001591	0.111,636	5.66E-05	0.002868
9	65.18,884	19.36,404	0.953,435	14.29,866	0.002901	0.182,515	6.68E-05	0.009534
12	66.73,183	19.06925	1.464,925	12.51,104	0.003390	0.204,812	0.000107	0.014649

Table 4. Output performance and Hamilton H1

PERIOD	OILP	H1	K	GPPGR	INF	MS/GDP	EXR	INTR
3	8.280,712	80.06471	0.042137	11.58,685	0.000251	0.024915	2.83E-06	0.000421
6	21.83,543	72.89,241	0.093352	5.135,716	0.000571	0.041581	1.39E-05	0.000933
9	24.14,858	70.89,276	0.303,254	4.588,773	0.000968	0.062611	1.65E-05	0.003032
12	25.26,684	69.74,481	0.511,945	4.394,531	0.001222	0.075504	3.52E-05	0.005119

in the first section, there is still no consensus on how oil price shocks affect output performance in Africa's oil-producing countries. The debate surrounds the fact that oil price shocks cannot capture in totality the effect of oil price movements on the output performance of an oil-producing economy. This study makes several findings that contribute to the existing literature.

First, it is evident from the analysis that the behaviour of oil price shocks is different when the Hamilton Index (H1) and Inverse Hamilton Index (InvH1) are used. The graphical analysis shows that the net increase in oil price, which is H1, shows a conspicuously different pattern from InvH1, which captures a sharp decline in oil prices. The implication of this is that the reaction of output performance to the different shocks is also different.

Second, comparing the results from this study with some similar studies on oil price shocks, it is evident that the behaviour of output and other macroeconomic variables in the SVAR model in response to oil price and H1 shocks is nearly the same albeit with some slight differences. This might be due to the fact that an oil price shock measures a positive standard deviation in oil prices, and hence it is similar to an oil price jump. Nonetheless, the study results indicate some slight differences in the responses of output and other macroeconomic variables.

Both shocks cause the currency to appreciate and output to rise significantly. However, the effect of a sharp jump in oil prices on capital and other variables are different from that of oil price shocks. A sharp jump in oil prices has a large positive effect on capital and subdued effect on inflationary pressure, probably due to an equally subdued response of money supply. The response of money supply to oil price shocks, on the other hand, is significant.

The response of output to oil price shock in the analysis is a clear indication of existence of Dutch Disease in Africa's oil-producing countries. According to Bresser-Pereira (2013), "Dutch disease is a country's chronic exchange rate overvaluation caused by the exploitation of abundant and cheap resources, whose production and export is compatible with a clearly more appreciated exchange rate than the exchange rate that is internationally competitive with the other business enterprises in the tradable sector that use the most modern technology existing worldwide". The response of exchange rate to oil price shocks makes the currency to appreciate and hence causes positive effects to output. However, the resultant output is not sustainable because it is a product of Dutch Disease effect. The tradable sector in Africa's oil-producing countries which should have participated in the output generation is not doing well because Africa's oil-producing countries' economy is less diversified relying majorly on the oil sector. It should be noted that Dutch Disease is a structural phenomenon that creates obstacles to industrialization.

Furthermore, Dutch disease is a market failure that generates negative externalities in the economy's other sectors of tradable goods and services, preventing those sectors from developing. In recent years, precisely within the period under investigation, the growth of the manufacturing sector has not been impressive and this is largely due to the effect of negative externalities. The sector relies heavily on importation of both capital goods and raw materials thus promoting negative terms of trade which further portend grievous danger for the economy balance of payment.

It is also evident from the findings that the reaction of output to oil price as well as the exchange rate is an indication of another symptom of market failure which manifest in the existence of a difference between the exchange rate that balances intertemporal the country's current account and the exchange rate that enables the existence of efficient economic sectors of tradable goods and services other than the commodities benefiting from Ricardian rents. This study has shown the prevalence of the oil sector in Africa's oil-producing countries and the significant reliance of the economies on the oil rent which is highly susceptible to volatilities in oil price.

It can be concluded from this result that the effect of oil price jumps on the rate of inflation is relatively lower when compared with the effects of oil price shocks on inflation in some past studies. This is probably because monetary policy becomes more effective in the latter case. According to Demachi (2012), the sharp rise in price brings more sensitization and proactiveness from the monetary authorities than oil price shocks. The observed reaction of selected variables to oil price shocks is similar to Kutu and Ngalawa (2016). Kutu and Ngalawa (2016), however, did not investigate reactions to a sharp jump in oil prices.

Third, for the inverse Hamilton Index, InvH1, the reaction of output and other variables is clearly different to the reaction from H1 and oil price shocks. However, the reactions are not direct opposite to each other. It is observed that the InvH1 shock causes both output and capital to fall significantly, which is directly opposite to what we noticed under the H1 shocks.

The study, therefore, concludes that it is wrong to suppose that the behaviour of inflation is symmetric to oil price shocks, as assumed in most studies. This is because in both cases, inflation rises significantly following a positive oil price shock. This may be due to the fact that the value of domestic currency in Africa's oil-producing countries depreciates and causes imports to be more expensive, and since many of Africa's oil-producing countries largely depend on importation of inputs of finished goods, domestic inflation is triggered (See Omolade and Ngalawa, 2014)

The study also shows that money supply does not respond significantly to an InvH1 shock. If the response was symmetric, then a significant fall in money supply should follow an InvH1 shock. The study shows that a fall in oil prices has an insignificant effect on money supply, consequently leading to an equally insignificant response in the rate of inflation. This suggests that inflation may not necessarily be a monetary phenomenon (only), but a structural outcome (as well).

This conclusion brings to the fore the inflation policy of some Africa's oil-producing countries where inflation is tackled from a monetary perspective alone by raising the rate of interest. Evidence from this research shows that monetary authorities' obsession with interest rates as a tool for fighting inflation may be misleading because it presupposes that inflation is on the whole a monetary phenomenon. This study, however, reveals that the asymmetric response of macroeconomic variables to certain shocks suggests that inflation in Africa's oil-producing countries may be driven by structural rigidities.

Finally, findings in this study have further explained the prevalence of Dutch Disease in the oil-producing economies. This is evident in the effects of oil price shocks on output and exchange rate. The implication of this on the tradable sector of the oil-producing countries is that it affects the domestic factors prices and thus squeezing out the tradable sector. This portends more negative effects on their macroeconomic performance. However, literatures have shown that these implications are more severe

on the tradable sector that is less capital intensive. Unfortunately, this is the characteristics of the oil-producing countries' tradable sector. It is again imperative that Africa's oil-producing countries need to be largely diversified to be able to overcome the problem of Dutch Disease which is manifested in the over-reliance on the oil sector of the economy. The appropriate policy response to volatility of oil price should be the one that will promote investment in the tradable sector and non-tradable sector of the economy. This will go a long way to limit the dependence of the economy on oil sector and importation of both consumer and capital goods which has aggravated the problem of terms of trade.

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Note

1. Communauté Économique et Monétaire de l'Afrique Centrale (Central African Economic and Monetary Community)—CEMAC.

References

- Adeleke, O., & Harold, N. (2017). Oil price movements, exchange rate and Nigerian manufacturing sector growth: A short-run analysis. *Investment Management and Financial Innovations*, 15(3), 329–342.
- Adeniyi, O. A. (2011). Oil price shocks and economic growth in Nigeria: Are thresholds important? *Journal of Economics and Business Studies, Redeemers University*, 4(7), 43–78.
- Ahmed, H. J. A., & Wadud, I. K. (2011). Role of oil price shock on macroeconomic activities: An VAR approach to the Malaysian economy and monetary responses. *Energy Policy*, 39(5), 8062–8069. doi:10.1016/j.enpol.2011.09.067
- Amuzegar, A. (2001). OPEC as Omen. *Journal of Foreign Affairs*, 77(6), 95–129. doi:10.2307/20049133
- Apere, O., & Ijomah, A. M. (2013). Macroeconomic impact of oil price levels and volatility in Nigeria. *International Journal of Academic Research in Economics and Management Sciences*, 2(4), 15–25.
- Becklemans, L. (2005). *Credit and monetary policy: An Australian SVAR* (Reserve Bank of Australia Research Discussion Paper Series, No. 1), 2–9.
- Bernanke, B. (2008). *Alternative explanation of the money-income correlation* (NBER Working Paper Series, No. 1842), 1–62.
- Berument, H., & Ceylan, N. (2005). Effects of exchange rate risk on economic performance in Turkey. *Applied Economics*, 36(23), 2429–2441. doi:10.1080/0003684042000287637
- Blanchard, O. J., & Riggi, M. (2009) *Why are the 2000s so different from the 1970s? A structural interpretation of changes in the macroeconomic effects of oil prices* (NBER Working Paper 15467).
- Bresser-Pereira, L. C. (2013). The value of the exchange rate and the Dutch Disease. *Brazilian Journal of Political Economy*, 3, (33), 371–387. doi:10.1590/S0101-31572013000300001
- CBN. 2017. Statistical Bulletin, Vol. 21, Central Bank of Nigeria, Abuja, December.
- Charfeddine, L., Klein, T., & Walther, T. (2018) *Oil price changes and US real GDP Growth: Is this time different?* (Working Paper Version 2.0 - Page 1), May 28, 2018
- Demachi, K. (2012). *Effects of crude oil volatility and change on the Nigerian economy* (MPRA Paper No. 41413). doi:10.1094/PDIS-11-11-0999-PDN.
- Elbourne, A. (2007). The UK housing market and the monetary policy transmission mechanism: An SVAR approach. *Journal of Housing Economics*, 17(8), 65–87. doi:10.1016/j.jhe.2007.09.002
- Engelmann, K. M., Owyang, M. T., & Wall, (2012). *Where is an oil shock?* (MPRA Paper No. 31383). doi:10.1094/PDIS-11-11-0999-PDN
- Federer, J. P. (1996). Oil price volatility and the macroeconomy. *Journal of Macroeconomics*, 18(1), 1–26. doi:10.1016/S0164-0704(96)80001-2
- Gachara, A. (2015). Channels through which oil price shocks affect economic activity in Kenya. *International Journal of Energy Economics and Policy*, 3(2), 143–152.
- Hamilton, J. D. (1983). Oil and the macroeconomy since world war II. *Journal of Political Economy*, 91(2), 228–248. doi:10.1086/261140
- Hamilton, J. D. (1996). This is what happened to the oil price-macroeconomy relationship. *Journal of Monetary Economics*, 38, 215–220. doi:10.1016/S0304-3932(96)01282-2
- Hamilton, J. D. (2003). What is an oil shock? *Journal of Econometrics*, 113, 363–398. doi:10.1016/S0304-4076(02)00207-5
- Hamilton, J. D., 2008, *Understanding crude oil price* (NBER Working Paper, 14492).
- Hamilton, J. D. (2011). Nonlinearities and the macroeconomic effects of oil prices. *Macroeconomic Dynamics*, 15(S3), 364–378. doi:10.1017/S1365100511000307.
- Hooker, M. A. (2001). What happened to the oil price macroeconomy relationship? *Journal of Monetary Economics*, 38, 195–213. doi:10.1016/S0304-3932(96)01281-0.
- IMF. (2016). *International Monetary Fund economic report: Africa focus*. Special Issue, No.49, 1–29.
- Jimenez-Rodriguez, R., & Sanchez, M. (2004). Oil price shocks and real GDP growth: Empirical evidence for some OECD countries. *Applied Economics*, 37, 201–228. doi:10.1080/0003684042000281561.
- Joseph, B., & Festus, A. (2013). Oil price dynamics, fiscal stance and macroeconomic effects in Nigeria. *Interdisciplinary Journal of Contemporary Research in Business*, 4(1), 149–155.
- Kilian, L. (2008). Exogenous oil supply shocks: How big are they and how much do they matter for the U.S. Economy? *Review of Economics and Statistics*, 90 (2), 216–240. doi:10.1162/rest.90.2.216

- Kilian, R. E. (2009). Macroeconomic priorities. *American Economic Review*, 93(1), 1–14.
- Kim, S., & Roubini, N. (2000). Exchange rate anomalies in the industrial countries: A solution with structural VAR Approach. *Journal of Monetary Economics*, 45(3), 561–586. doi:10.1016/S0304-3932(00)00010-6
- Kim, W. J., Hammoudeh, S., Hyun, J. S., & Gupta, R. (2014). Oil price shocks and China's economy: Reactions of the monetary policy to oil price shocks. *Energy Economics*, 62, 61–69.
- Kutu, A. A., & Ngalawa, H. (2015). Monetary policy shocks and industrial sector performance in South Africa. *Journal of Economics and Behavioral Studies*, 8(3), 26–40.
- Kutu, A. A., & Ngalawa, H. (2016). Monetary policy shocks and industrial sector performance in South Africa. *Journal of Economics and Behavioral Studies*, 8(3), 26–40.
- Lee, K., Ni, S., & Ratti, R. A. (1995). Oil shocks and the macroeconomy: The role of price variability. *Energy Journal*, 16, 39–56. doi:10.5547/ISSN0195-6574-EJ-Vol16-No4-2
- Leeper, E., Sims, C., & Zha, T. (1996). *What does monetary policy do?* *Brookings Papers on Economic Activity*, 27(2), 1–78.
- Majid, A. (2006). *The contribution of oil sector to Arab economic development*. OFID Pamphlet Series, No. 23, 45–90 doi:10.1016/j.jhsb.2006.08.003
- Michel, C. S. (2013). Monetary policy effectiveness under the CEMAC area: Empirical evaluation. *International Journal of Advances in Management and Economics*, 2(4), 55–64.
- Mork, K. A. (1989). Oil and the macroeconomy when prices go up and down: An extension of Hamilton's results. *Journal of Political Economy*, 91, 740–744. doi:10.1086/261625
- Musa, K. (2015). *Diagnosing Dutch-Disease: Does Russia have the symptoms?* (IMF Working Paper No. 102), 14–32. doi:10.3389/fninf.2015.00014
- Myronovych, A. (2002) *Impact of oil price fluctuation of the Ukrainian economy* (Masters of Arts in Economics Thesis), National University of "Kyiv-Mohyla.
- NBS. (2016). *National bureau of statistics: Annual abstract* (No.21), 3–32.
- Ojo, Y., & Alege, P. (2012). *A business cycle model for Nigeria*. Paper presentation at the African Econometric Society Conference 2009 Abuja, Nigeria doi:10.1094/PDIS-11-11-0999-PDN.
- Olomola, P. (2006). *Oil wealth and economic growth in African oil exporting countries* (AERC research paper, No. 170), 23–45. doi:10.1016/j.jnutbio.2006.02.005.
- Omolade, A., & Ngalawa, H. (2014). Oil revenue and manufacturing sector growth in Africa's oil-exporting countries. *Journal of Economic and Financial Sciences*, 7(3), 925–944.
- Sims, C. A. (1986). Are forecasting models usable for policy analysis? *Quarterly Review of Federal Reserve Bank of Minneapolis*, 10(1), 2–16.
- Stauffer, M. E. (1984). *Xtivre2: Stata module to perform extended IV/2SLS, GMM and AC/HAC, LIML and k-class regression for panel data models*. Retrieved from <http://ideas.repec.org/c/boc/bocode/s456501.html>.
- Vahid, K., & Jabber, P. (1997). *Political and economic reform in the Muslim World*. New York: Globicom.
- Vonnak, B. (2005). *Estimating the effects of Hungarian monetary policy within a structural VAR framework* (Magyar Nemzeti Bank Working Paper Series, No.), 1–37.



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