Crude Oil Price Shocks, Monetary Policy and Output Growth in African Oil Producing Countries

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Abstract:

This study examined the interrelationships among monetary policy transmission mechanism, oil price shocks and output growth in the selected African oil producing countries. Data for the study were sourced from World Development Indicators published by the World Bank and International Monetary Fund (World Economic Outlook). The study employed Structural Vector Autoregressive (SVAR) as estimation techniques. Findings from the SVAR Impulse Response Functions revealed that the over-dependence on exploitation of oil by African oil producing countries without a corresponding diversification and switching to alternative sources of energy leads to ineffectiveness of oil economies in Africa to confront and combat some negative impacts of global oil price shocks. Findings from the study equally showed that the economies of oil producing countries in Africa are prone to shocks from the US real interest rate which represents the foreign interest rate. Finally, the study also showed that the expansionary monetary policy (in which interest rate is reduced to stimulate investment) is more effective in compensating and offsetting the negative effect of the decline in global oil price in the selected African oil producing countries.

Keywords: monetary policy; crude oil price; economic growth; structural vector autoregressive; African oil producing countries.

JEL Classification: E52; O47; Q41.

Introduction

For a long time, the prevailing arguments among development economists is the issue of Dutch disease in the resource rich economies. There is a broad consensus among various empirical studies that many countries that are rich in natural resources display poor economic performance than the less resources endowed economies (Olomola 2007, Bulmer-Thomas 1994, Sachs and Warner 1997). For instance, in the past four decades, members of the Organization of Petroleum Exporting Countries (OPEC) have been experiencing stunted GDP growth (Gylfason 2017). In some African oil producing countries, the story is the same as enormous resources generated from oil have not been translated to their overall economic development (World Bank 2016, IMF 2016). The prevalence of unemployment, poverty and excessive importation of manufactured goods, decay infrastructures, inadequate power and energy supplies and low human development index are pointers to the position of World Bank and International Monetary Fund.

One of the most widely used macroeconomic policies, especially in improving output performance in many countries, is monetary policy (Jordi and Mark 2007). However, the fluctuations in crude oil price have continued to aggravate monetary policy dynamics in most Africa's oil producing countries (World Bank 2016). Considering the monetary policy uncertainty as a result of crude oil price shock which has some implications on the overall output performance of the Africa's oil producing countries, this study therefore contributes to the literature by investigating empirically the interrelationships among monetary policy transmission mechanism, oil price shocks and output growth of the selected Africa's oil producing countries.

1. Literature

Jones and Paul (2005) examined how oil price shocks affect the output growth of selected Middle East and North African (MENA) countries that are either exporters or net importers of oil commodities. They employed a Structural Vector Autoregressive (SVAR) model to focus explicitly on World oil prices and the real GDP over the period of 1960-2003. Findings from their impulse response results suggest that the effects of the world oil price on GDP of Algeria, Iran, Iraq, Jordan, Kuwait, Oman, Qatar, Syria, Tunisia and United Arab Emirate (UAE) are positively and statistically significant. However, for Bahrain, Egypt, Lebanon, Morocco and Yemen, they did not find a significant impact on oil price shocks.

Apere and Ijomah (2013) examined the effect of oil price shock on monetary policy in Nigeria by applying Structural VAR model between 1970 and 2010. Their results revealed that there is a long-run relationship involving oil prices, inflation rate, treasury bill rate, exchange rate, interest rate and money supply in Nigeria. The results further revealed that an unexpected oil price shock is followed by an increase in inflation rate and decline in exchange rate and interest rate in Nigeria.

Mwabutiwa and Bittercourt (2016) studied the evolution of monetary policy transmission mechanism in Malawi between 1980 and 2010 using a time varying parameter vector Autoregressive (TVP-VAR) model with stochastic volatility. The study evaluated how the responses of real output and general price level to bank rate, exchange rate and credit shocks had changed over time, since Malawi adopted financial reforms in 1980s. The findings revealed that inflation and real output response to monetary policy shocks changed over the period under the research work.

Mutuku and Koechi (2015) examined the joint impact of fiscal and monetary policy shocks on some fundamental macroeconomic indicators in three emerging African economies: Ghana, Nigeria and South Africa. By employing Vector Autoregressive (VAR) method to explain the relationships among real GDP, Inflation and Trade, their results showed that the impacts of fiscal policy shocks were more pronounced and significant than monetary policy shocks. Macroeconomic variables were seen to respond considerably to both contractionary and expansionary fiscal policy shocks in these countries.

Omolade and Ngalawa (2014) examined the impact of revenue on the growth of the manufacturing sector in Africa's oil exporting countries. They focused their study on six major net oil exporters in Africa, namely: Nigeria, Algeria, Sudan, Gabon, Cameroon and Egypt. By employing both static and dynamic panel data techniques, between 1970 and 2010, the findings of the study showed that the six countries did not exhibit significant country-specific effects and the existence of Dutch disease is confirmed. The study also revealed that there is a dearth of capital formation in the six countries' manufacturing sectors and the more capital-intensive the manufacturing sector is, the less the negative effect of the oil sector's dominance.

Omolade and Ngalawa (2016) in another dimension also examined the role of exchange rate regimes in determining the nature of relationship between monetary policy transmission mechanisms and manufacturing output growth in oil producing economies in Africa, Libya and Nigeria were practiced in both oil exporting countries. By employing structural VAR, the results revealed that exchange rate regime has some influences on the monetary policy transmission mechanism and its effectiveness on the manufacturing output growth instrument appears to be ineffective in promoting output growth of the manufacturing sector in Libya that practices fixed exchange rate, the reverse is the case in Nigeria.

Some of the past empirical studies reviewed in this study were more concerned with oil price shock as it affects economic growth of the oil producing countries without any emphasis on the role of monetary policy in the process. On the other hand, some studies investigated monetary policy separately and study the effect on output without clear emphasis on oil price. However, the study of Omolade and Ngalawa (2016) that studied the role monetary policy in the interplay between oil price and output performance was more focused on manufacturing sector output alone which might not reflect the entire output performance of the oil producing countries in Africa. Consequently, this study therefore contributes to the literatures by taking a holistic view of the interrelationship among monetary policy transmission mechanism, oil price shocks and output growth of the oil producing countries in Africa.

2. Methodology

2.1. Model Set-up

In the basic model set-up in this study, a four variable Structural Vector Autoregressive (SVAR) model is used. This model is similar to that used by (Demachi 2012), (Beckermans 2005) and (Kutu and Ngalawa 2015). The VAR model assumes that each of the selected African oil producing economy (comprising of Angola, Sudan, Cameroon,

Cote D'Ivoire, Nigeria, Algeria, Libya, Tunisia, Mauritania, Egypt, Republic of Congo, Gabon, Chad, Democratic Republic of Congo and Equatorial Guinea) is represented by a structural form equation as follows:

$$B(L)y_t = U_t \quad (1)$$

where: $B(L)$ is a matrix polynomial in the lag operator L, such that $B(L) = B_0 - B_1L - B_2L^2 - B_pL^p$. B_0 is a non-singular matrix normalized to have ones on the diagonal and summarizes the contemporaneous relationship between the variables in the model contained in the vector y_t. y_t is an $N\times1$ vector of endogenous variables which includes $\{WOP, USRINTR, GDPgr, RINTR\}$. U_t is an $N\times1$ vector of structural disturbances with 0 mean and $Var\ (U_t) = \theta$ $((where\ \theta\ denotes\ a\ diagonal\ matrix)$ we assume that the structural disturbances are mutually uncorrelated.

Associated with this structural model is the reduced form VAR which is estimated as:

$$A(L)y_t = \ \varepsilon_t \quad (2)$$

where: $A(L)$ is a matrix polynomial in the lag operator L, ε_t is a vector of the VAR residuals with 0 mean and $VAR(\varepsilon_t) = \sum$.

The relationship between the components of equations (1) and (2) are stated as Follows:

$$A(L) = \ B_0^{-1}B(L) \quad (3)$$

$$\varepsilon_t = B_0^{-1}U_t \quad (4)$$

By normalizing $N\times1$ diagonal elements of B_0 to ones (*i.e* unity), we need at least $n\left[\frac{n-1}{2}\right]$ restrictions on B_0 to achieve identification.

The idea behind the choice of SVAR method in this study as against the commonly used Cholesky decomposition is that the identification approach of the latter assumes only a recursive method. This recursive method has been adjudged to be prone to wrong causal ordering of variables if the researcher is interested in looking at more than just monetary shocks (Gottschalk 2001). This shortcoming can be efficiently corrected by non-recursive SVAR.

2.2. Model Identification: Non-Recursive Approach

The approach used to impose restrictions on the contemporaneous matrix of structural parameter B_0 in this study is based on the work of Demachi (2012), Berkermans (2005) and Kutu and Ngalawa (2015). In this model, the vector $[Y_t: WOP, USRINTR, GDPgr, RINTR]$ is assumed to be divided into two blocks. The exogenous vector $[X_t: WOP, USRINTR]$ is assumed to be a foreign block. The foreign variables are included to control for exogenous change in the global economic stance. The endogenous vector $[Z_t: GDPgr, RINTR]$ is assumed to be a domestic block which comprises both policy and non-policy variables. Policy variable comprises of $[RINTR]$ which is assumed to be controlled by the monetary authorities while the non-policy variable comprises of $[GDPgr]$ which is the target variable.

WOP stands for World Oil Price, $USRINTR$ represents the US Real Interest Rate (which captures foreign interest rate), $GDPgr$ is the Gross Domestic Product growth rate, $RINTR$ is the Domestic Real Interest Rate. The equation 5 below therefore shows the non-recursive identification approach as follows:

$$\begin{bmatrix} U^{WOP} \\ U^{USRINTR} \\ U^{GDPgr} \\ U^{RINTR} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & 0 & 1 & a_{34} \\ a_{41} & a_{42} & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon^{WOP} \\ \varepsilon^{USRINTR} \\ \varepsilon^{GDPgr} \\ \varepsilon^{RINTR} \end{bmatrix} \quad (5)$$

where: U^{WOP}, $U^{USRINTR}$, U^{GDPgr}, U^{RINTR} are the structural disturbances on the endogenous variables respectively and ε^{WOP}, $\varepsilon^{USRINTR}$, ε^{GDPgr}, ε^{RINTR} are reduced- form residual that describe the unanticipated movements of each regressor respectively.

The first two rows in equation 5 relate to World Oil Price (WOP) and United State Real Interest Rate (USRINTR) which represent foreign variables. Similar to the work of Demachi (2012), we assume that domestic shocks do not affect the external sector variables, but domestic variables are assumed to be affected by external shocks. Following the work of Berkermans (2005), we allow GDPgr in the third row to be affected by world oil price and domestic interest rate while the foreign monetary policy variable (USRINTR) do not affect it. According to the

works of Kutu and Ngalawa (2015), we assume that domestic interest rate (RINTR) in the last row is affected by the foreign variables (WOP and USRINTR).

2.3. Sources of data

This paper consists of quarterly data over the period of the first quarter of 1981 to the fourth quarter of 2017. The four variables of SVAR model include the following: World Oil Price (WOP), United State Real Interest Rate (USRINTR), Gross Domestic Product growth rate (GDPgr), Real Interest Rate (RINTR). Data on WOP was sourced from International Monetary Fund (World Economic Outlook) while data on USRINTR, GDPgr and RINTR were sourced from World Bank (WDI).

3. Results and discussion

3.1. Results of SVAR impulse response function

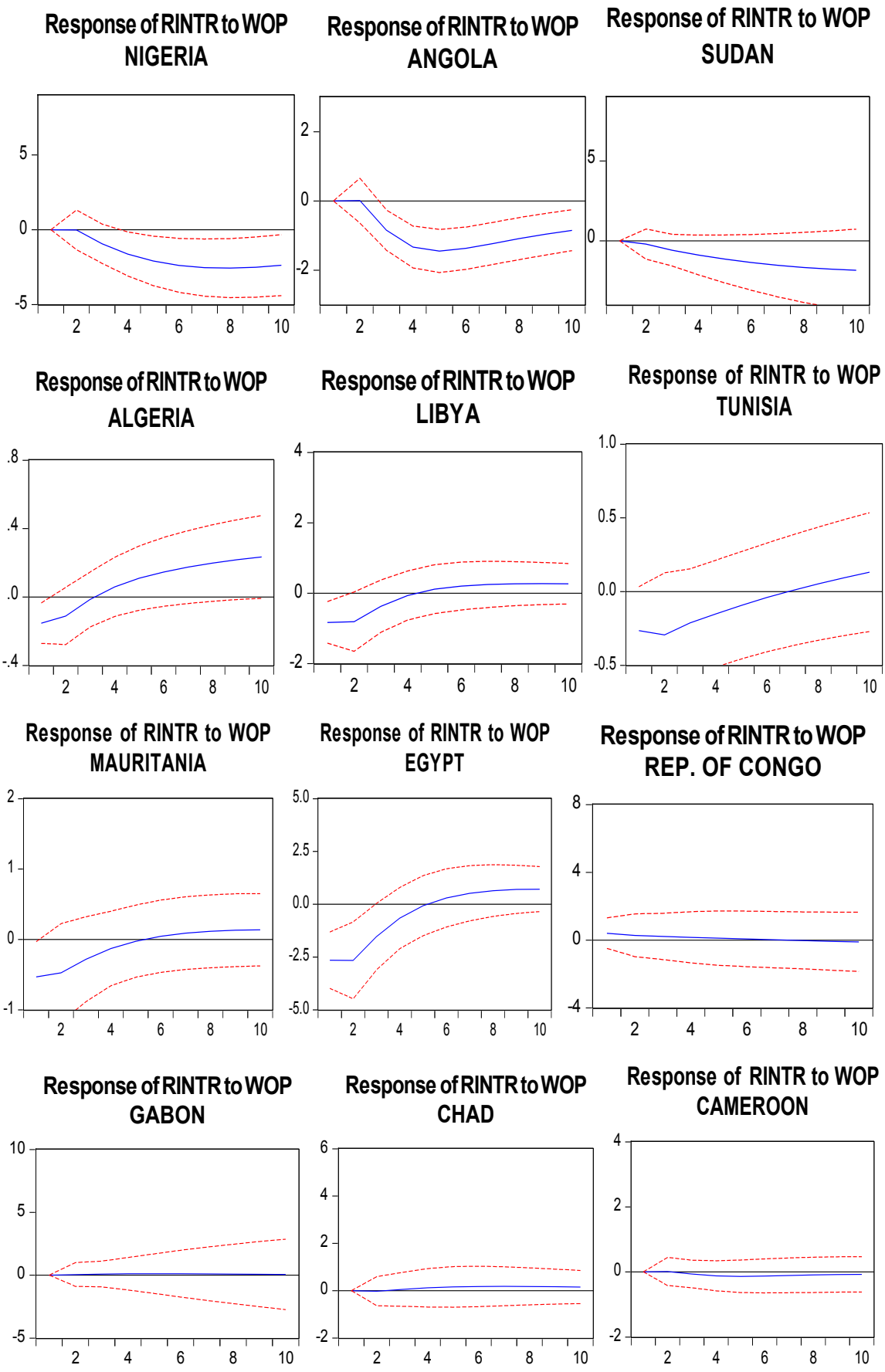
Figure 1 below showed the response of domestic interest rate to world oil price shock in the selected oil producing countries in Africa. Results from the figure revealed that the response of interest rate to a standard deviation shock from world oil price is negative and significant in Nigeria, Angola and Sudan. The reverse is the case for some countries like Algeria, Libya, Tunisia, Mauritania and Egypt as the response of interest rate to a standard deviation shock from world oil price was negative and significant initially, but later diverged towards equilibrium and eventually increased above equilibrium (positive axis) as time increases. The result is totally different in the remaining countries such as Republic of Congo, Gabon, Chad, Cameroon, Democratic Republic of Congo, Cote D'Ivoire and Equatorial Guinea as the response of interest rate to a standard deviation shock from world oil price is insignificant during the period under review.

The reason for divergent findings from these results might be due to different monetary policy regimes adopted by some of these countries. A careful assessment of some countries like Nigeria, Angola and Sudan revealed that these countries employed expansionary monetary policy by reducing interest rates. A decline in interest rate therefore stimulates investment and thus an increase in output growth rate even during a decline in the global oil price. Increase in earnings from high output growth is sufficient enough to compensate any negative impacts of a fall in global oil price. No wonder the response of domestic interest rate to world oil price shock is negative and significant in these three countries (*i.e.* Nigeria, Angola and Sudan). This finding is in line with the work of (Taiwo 2011). Also, in the same findings, a critical observation of some countries like Algeria, Libya, Tunisia, Mauritania, and Egypt proved that these countries adopted contractionary monetary policy caused by increasing interest rate in the later period of these countries. The increase in interest rate discourages potential investors thereby leading to a decline in output growth. Decline in the output growth will be insufficient to offset some of the negative outcomes that arise during a decline in the global oil price in these countries. Moreover, the insignificant response of domestic interest rate to world oil price shock in the remaining countries like Republic of Congo, Gabon, Chad, Cameroon, Democratic Republic of Congo, Cote D'Ivoire and Equatorial Guinea might be attributed to the pegged exchange rate policy employed by these countries. This fixed exchange rate regime often constraints the monetary authorities to establish independent monetary policy through the variability of interest to regulate some of the negative shock of oil price fall (Gancia and Malet 2007).

Figure 2 depicted the SVAR Impulse Response of output growth (GDPgr) to a standard innovation from World Oil Price (WOP) in the selected oil producing countries in Africa. findings from the SVAR impulse response function results showed that the response of output growth (GDPgr) to a standard deviation shock from World oil price (WOP) was initially positive and significant but later diverged to negative axis in some countries like Nigeria, Algeria, Libya, Tunisia, Mauritania, Egypt, Republic of congo, Gabon, Chad, Democratic Republic of Congo and Equatorial Guinea. This finding might be hinged on the two price cycle regimes that are associated with the global oil price, that is, global oil price fall and global oil price increase. These findings corroborate the assertions of Bjornland (2009) that an oil price decrease is expected to have a negative impact on oil producing countries while a rise in the global oil price is expected to have a positive impact on oil producing countries.

However, findings from the same SVAR impulse response function recorded different results for Angola, Sudan, Cameroon and Cote D'Ivoire, as the response of output growth (GDPgr) to the shocks coming from World oil price is positive and significant throughout the period reviewed in this study. These findings might be attributed to some of the strong measures adopted by these countries to reduce the level of over-reliance on oil global market by identifying, exploring and switching to alternative sources of energy. This might have helped these countries in great term to compensate and offset some of the negative impacts of a decline in the global oil price. As a result of these laudable projects, several biofuel plants were established in these countries, with several plantations of Jatrophia oil seeds, cassava and Molasses on thousand hectares of land (Mitchell 2011).

Figure 1. Response of Real Interest Rate to World Oil Price in the Selected Oil Producing Countries in Africa



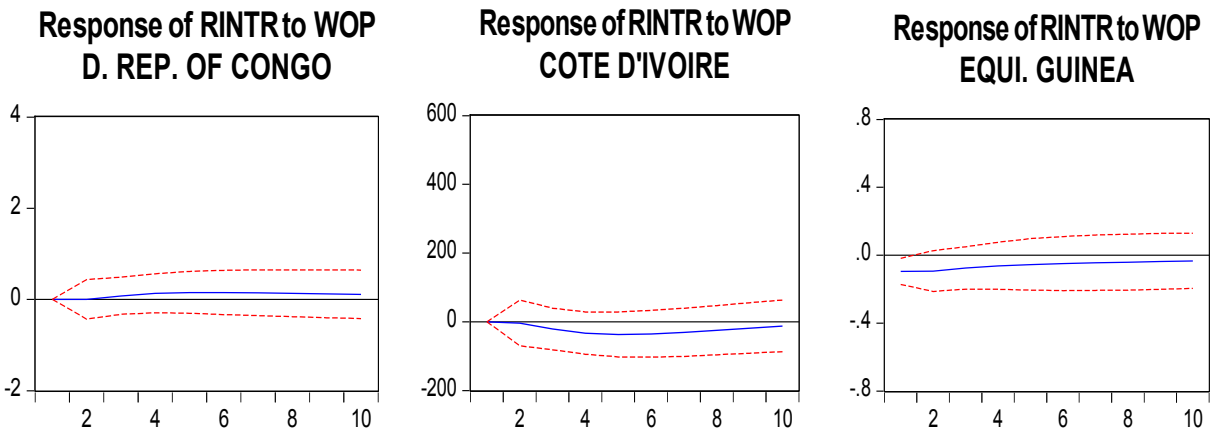
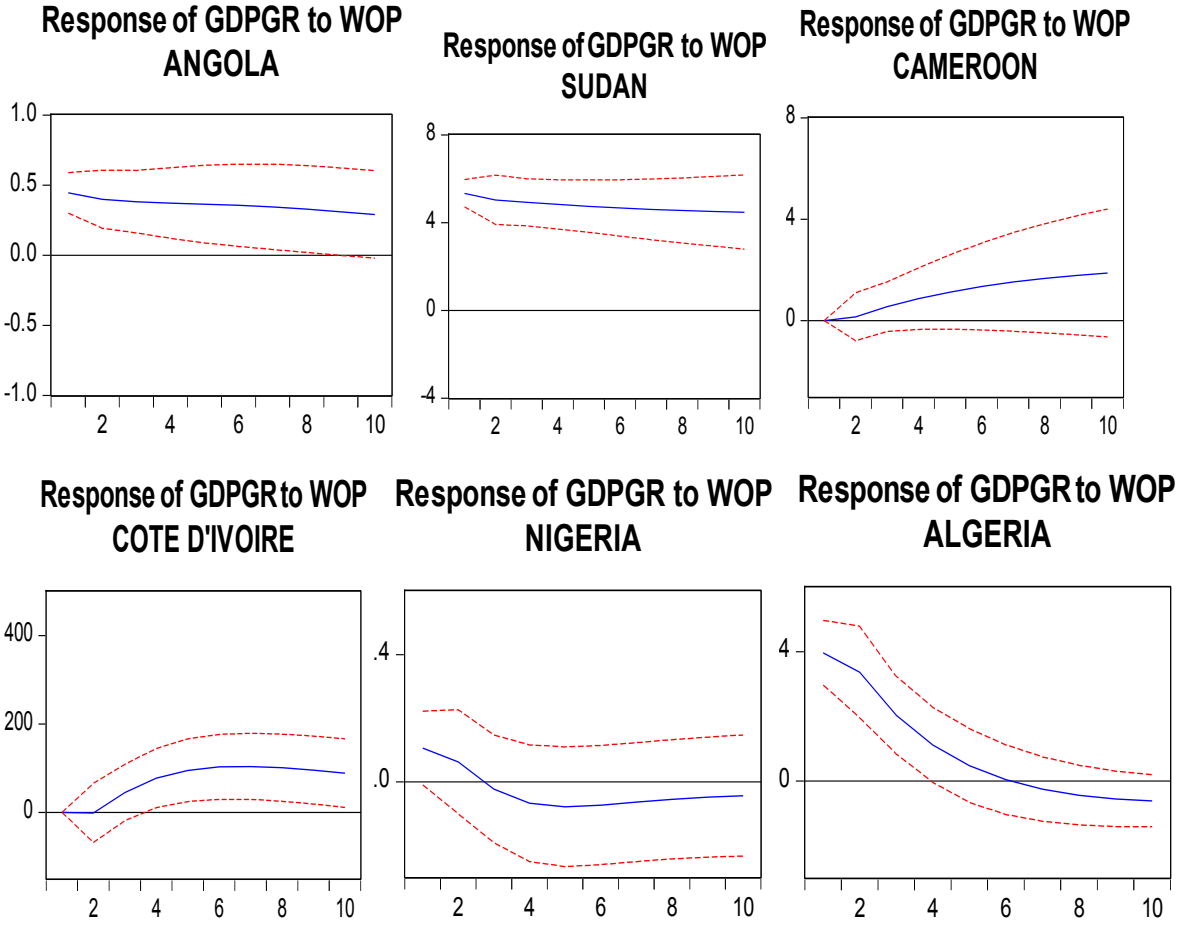


Figure 2. Response of GDP growth rate to World Oil Price Shock in the selected oil producing countries in Africa



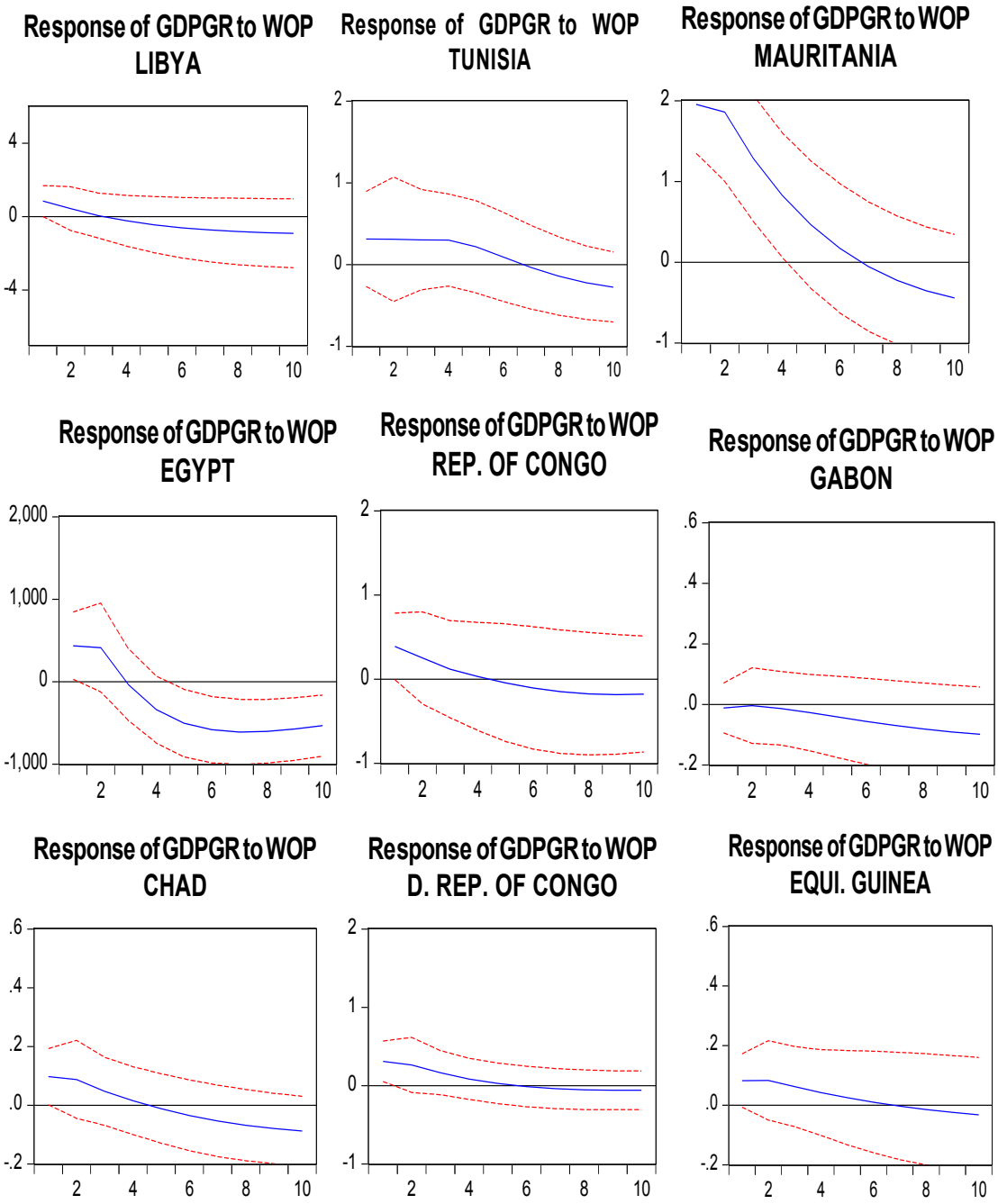
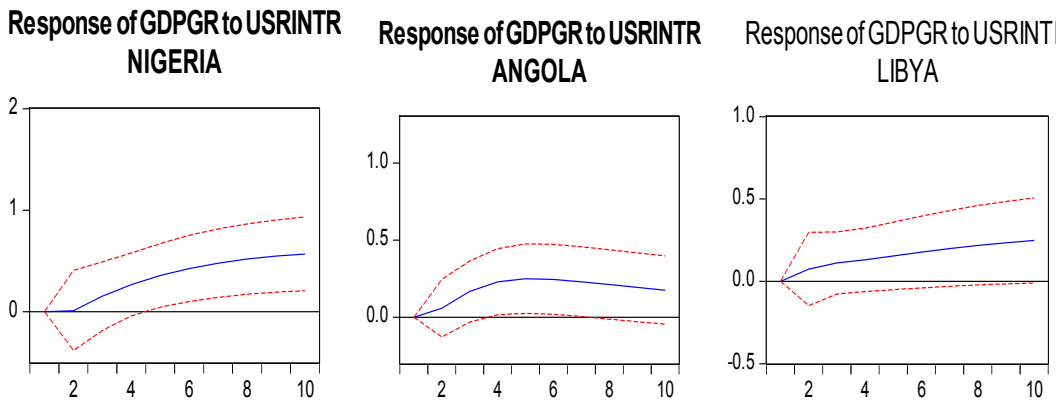
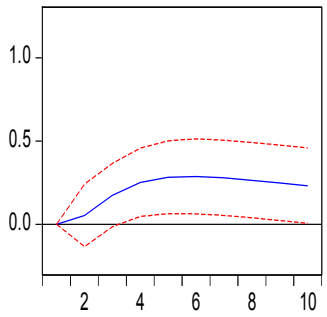


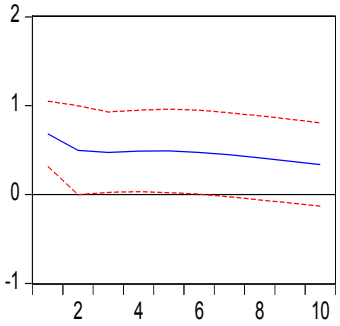
Figure 3. Response of Output Growth (GDPgr) to Foreign Interest Rate (USRINTR) Shock in the Selected Oil Producing Countries in Africa



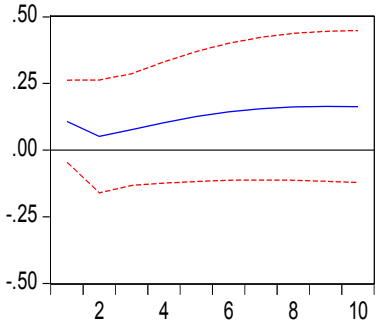
Response of GDPGR to USRINTR
ALGERIA



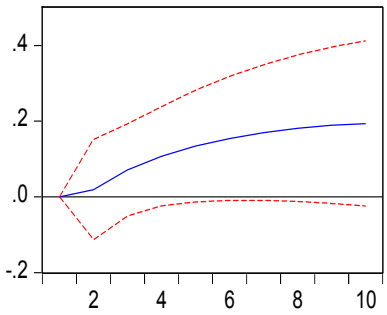
Response of GDPGR to USRINTR
SUDAN



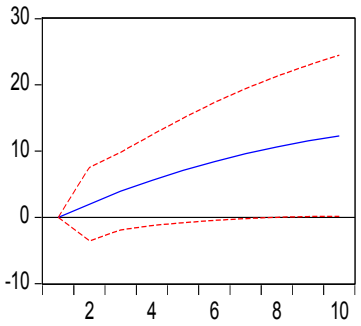
Response of GDPGR to USRINTR
TUNISIA



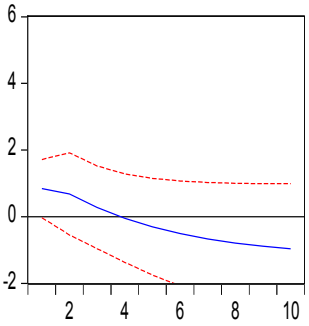
Response of GDPGR to USRINTR
MAURITANIA



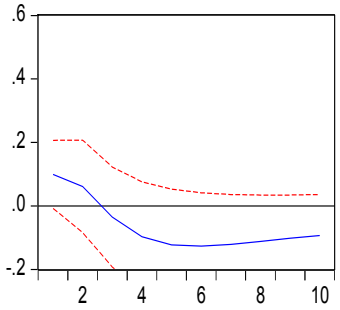
Response of GDPGR to USRINTR
EGYPT



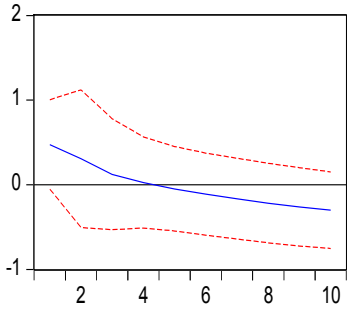
Response of GDPGR to USRINTR
REP. OF CONGO



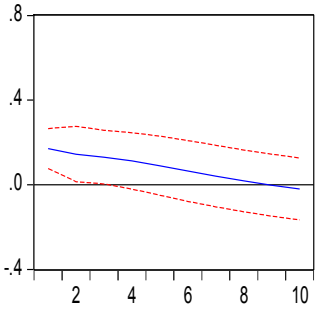
Response of GDPGR to USRINTR
GABON



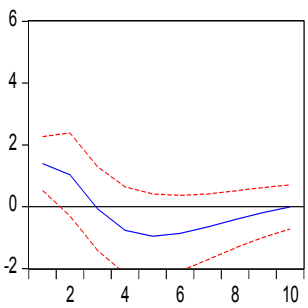
Response of GDPGR to USRINTR
CHAD



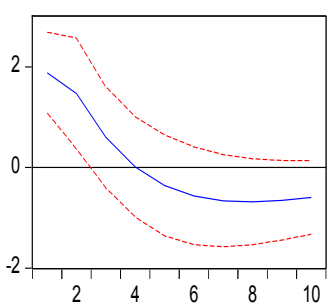
Response of GDPGR to USRINTR
CAMEROON



Response of GDPGR to USRINTR
D. REP. OF CONGO



Response of GDPGR to USRINTR
COTE D'IVOIRE



Response of GDPGR to USRINTR
EQUI. GUINEA

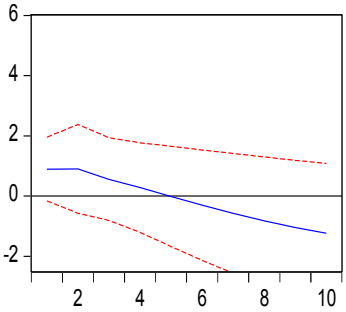


Figure 3 above showed the response of GDP growth rate to US real interest rate shock in the selected oil producing countries in Africa. Results from the figure revealed that a standard deviation shock from US real interest rate has positive and significant impact on output growth (GDPgr) throughout the period under review in some African countries such as Nigeria, Angola, Libya, Algeria, Sudan, Tunisia, Mauritania and Egypt. This finding might be linked to the type of Exchange rate policy being practiced in these countries which can either be pure floating exchange rate or managed floating exchange rate policy. These exchange rate policy regimes make it easy for these countries to employ automatic adjustment of monetary policy to regulate and confront any shock coming from foreign interest rate, this will therefore insulate their output from being affected negatively during recession period. (Gancia and Malet 2007)

This finding is quite different in the remaining countries like Republic of Congo, Gabon, Chad, Cameroon, Democratic republic of Congo, Cote D'Ivoire, Equatorial Guinea as the responses of output growth (GDPgr) to shocks coming from USRINTR was initially positive but later diverged to negative axis as time increases in these countries. Reason for this finding might be due to the fixed exchange rate policy adopted by these countries. This type of exchange rate policy always restraints these countries called the Central African Economic and Monetary Community to employ automatic adjustment of monetary policy to repel the shocks coming from the foreign interest rate during recession. This therefore have negative impacts on the output growth of these countries (Hegert 2010).

Conclusion

Based on the results of SVAR impulse response function which showed that the response of output growth (GDPgr) to the foreign interest rate shock is significant in the selected African oil producing countries. According to this finding, this study therefore concludes that the economies of oil producing countries in Africa are prone to the shocks from the US real interests which represent the foreign interest rate. Moreover, based on the negative and significant responses of output growth (GDPgr) to the shocks coming from world oil price shock in some African oil producing countries, this study therefore concludes that over-dependence on exploration of oil by oil producing countries without a corresponding diversification and switching to alternative sources of energy brought about ineffectiveness of oil economies in Africa to confront and combat some negative impacts of global oil price shocks. Finally, based on the results of the SVAR impulse response function in this research work, it is therefore concluded that expansionary monetary policy (in which interest rate is reduced to stimulate investment) is more effective in compensating and offsetting the negative effect of the decline in global oil price in the selected African oil producing countries.

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