IJCEAS

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume :9, Issue: 1, Year:2019, pp. 94-118
DOI: 10.5281/zenodo.3262261

OIL PRICE SHOCKS AND MACROECONOMIC INSTABILITY IN NIGERIA: EVIDENCE FROM GVAR

Nawasi Uba JIBRIL [1]

Umut HALAÇ[2]

Received: 19.12.2018, Accepted: 04.05.2019

Abstract

The study examines the relationship between oil price shocks and selected macroeconomic variables in Nigeria. It adopts a Global Vector Autoregressive (GVAR) model, which includes Nigeria's major trade partners, in examining the relationship. This provides a holistic picture of how oil price shocks are conveyed to Nigeria via the first round as well as through the spillover effects. The variables employed are Real Gross Domestic Product (y), inflation (Dp), short-term interest rate (r), money supply (ms), and real effective exchange (epeps) as the domestic variables, while oil price is included as global variable. Quarterly data were used spanning the period 1979Q2 to 2013Q1. The economies included are Nigeria, the United States, Euro Area, India, China, Brazil, United Kingdom and South Africa. The findings of the study reveal that an upsurge in oil price leads to increase in real output, money supply as well as a mild increase in the real effective exchange rates of Nigeria while inflation and short-term interest rate fall.

JEL Classification: *F41, C32, C54,*

Keywords: *Open Economy Macroeconomies, Instability, GVAR, GIRFs.*

Introduction

Energy takes a chunk part of development. In fact, the amount of energy requirement of an economy depicts how developed it is or how fast it is growing. Oil is an essential source of energy and even with the optimistic assumptions of the growth of alternative sources of energy; oil will most likely remain the leading component of energy mix. In the

[1] Graduate Student, Yaşar University, Izmir, Turkey. nawasjibril@gmail.com
[2]Assiociate Professor, Yaşar University, Izmir, Turkey. umut.halac@yasar.edu.tr, ORCID 0000-0001-7540-4219, Corresponding Author

year 2008, oil accounted for approximately 34% of world's energy needs (Natural Resources Canada, 2010) and it is projected to stand at 30% by the year 2030. Oil is an engine of growth in modern economies, the most important natural resource, needed in a wide range of production activities and also final consumption.

The shocks in oil price over the years and the attendant macroeconomic implications on economies in the world have drawn the attention of researchers; econometricians and economists alike as well as policy makers. Theoretically, increase in oil price results in shift of the terms of trade in favour of the net oil exporting economies. It induces high cost of production, since oil is a production input, and consequently rises in inflation and slows down of economic activities to net oil importer. In the net-oil exporting economies on the other hand, the upswell leads to a rise in income. This is however temporary and fades away quickly due to the slowdown in economic activities suffered by the net-oil importers (Wakeford, 2006; Majidi, 2006).

Nigeria, being an emerging market and a net oil-exporting country, is highly vulnerable to oil price upsurge due to its dependence on the resource, oil. Since the end of the country's civil war that coincided with the positive oil price shock of early 1970s and the resultant increase in revenue from the sector, the country has come to be known as a monoculture economy, neglecting other sectors. As a monoculture economy, Nigeria is excessively dependent on oil revenue, with the resource accounting for over 95% of export earnings and 85% of government revenue. The share of oil in the GDP in 2008 was 17.85% (Aliyu, 2009) and 15.85% in 2010 (National Bureau of Statistics and Central Bank of Nigeria, 2014). Additionally, Nigeria is adversely affected by oil price volatility via the importation of petrol and other refined petroleum products. The country's local refineries have been operating far below capacity since the late 1980s. It gets more than 90% of its domestically consumed petroleum products through importation (Aliyu, 2009). This has made the importation of refined petroleum products to enter the group of top imported products to the country. For instance, the share of oil in total imports for the year 2008, 2009 and 2010 stood at 26.72%, 20.84% and 34.96% for the year 2008, 2009 and 2010 respectively; and have been one of the top three most imported products (National Bureau of Statistics and Central Bank of Nigeria, 2014).

Due to the significance of oil to Nigeria and how shocks in its price have been determining real economic activities in the country, either directly or indirectly, economists and policy makers are becoming

more interested in understanding them, by undertaking research and studies, and proffering recommendations and possible solutions to cushion the effects or remove them. Such studies Olusegun (2008), Aliyu (2009), Mordi and Adebiyi (2010), Umar and Abdulhakeem (2010), Adeniyi (2011), Muhammad, Sulaiman and Kouhy (2011), Ojapinwa and Ejumedia (2012), Akinyele and Ekpo (2013), Riman, Akpan and Offiong (2013), ThankGod and Maxwell (2013), Omojolaibi (2013), Oyeyemi (2013), Olufisayo (2014) employed either similar models or different, so also with the macroeconomic variables adopted for the respective studies and have reached similar or differing conclusions in terms of the impacts of oil price shocks on the country's macroeconomic variables.

To our knowledge, this will be the first study that employs the GVAR model in order to present a more holistic approach to the understanding of the mechanism of how shocks in the global oil market are transmitted into Nigeria, by allowing for trade linkages. Going by its peculiarities as a country that imports over 90% of the petroleum products it uses domestically usually at a cost that naturally reflects international crude oil price (Obayi, Innocent and Jeffrey, 2012) and the fact that it imports virtually all the machineries and other technological inputs and as well as certain consumer goods that it uses in other industries and sectors of the economy from the oil dependent economies, investigating the transmission channels using a GVAR will produce a better revealing and more complete picture of what happens.

The rest of the paper is organized as follows. In the next section, we discuss the structure of Nigeria's international trade on the base of the important trade partners. Section 3 presents the related literature, and section 4 explains the econometric model. In section 5 we state the empirical results while the concluding remarks are provided in the last section.

Nigeria's Trade Relations

Nigeria has a long-standing trade relation with its oldest trading partners, especially the United States, United Kingdom and Europe. During colonialism, this was dominated by the activities of Britain, but after independence and especially with the commercial exploration of oil in the country, the United States has become the country's largest trading partner, especially, in terms of export. This is followed by European Union; particularly, Spain, the Netherlands, France, Germany;

and the United Kingdom. According to the calculations[3] on the base of the international trade statistics of the Nigeria, on average Nigeria's export to these countries (the United States, Spain, Netherlands, France, Germany, India, Japan, Brazil, United Kingdom and South Africa) over the period, 1996 to 2013, stood at 73.76 percent of its total export to the world.

Also in terms of imports, these countries are the major trade partners of Nigeria with Belgium replacing Spain and Japan replacing Korea in the top ten import partners of Nigeria (National Bureau of Statistics, 2014). With the rising of emerging markets like South Africa, Brazil, India and China which are soaring and becoming more and more active players in the world economy, the demand for oil has increased and these countries have come to be major trade partners of Nigeria as well -both in terms of imports and exports, with the exception of South Africa which is in terms of import- (National Bureau of Statistics, 2014). And over the years under consideration, on average major importers to Nigeria are responsible for 62.23 percent of Nigeria's imports from the world.

The foreign trade of Nigeria "particularly export" is dominated by petroleum and petroleum products, which accounts for no less than ninety five percent. The National Bureau of Statistics estimates that oil and natural gas export revenue account for 96 percent of total export revenue in 2012 (National Bureau of Statistics, 2014). This sector accounts for ninety percent of foreign exchange earnings for the country (Ignatius, 2014) and has enable it to record surplus in its balance of trade especially since the 1970s.

The United states has been Nigeria's largest trading partner for at least more than a decade until 2013 when India overtook it in terms of export destination, and China in terms of import from 2004 to 2013 excluding 2006, 2010 and 2011(National Bureau of Statistics, 2014). Since 1986, the United States had imported between 9 percent and 11 percent of its crude oil from Nigeria. This had put the country at her the fifth largest supplier of crude oil to the United States. By 2012, the import has declined by almost 50 percent from the previous year making her the sixth largest supplier. The trend continued and by 2013, Nigeria supplied marginally less than 4 percent of US crude oil imports which puts her at eight largest suppliers (National Bureau of Statistics, 2014).

[3] The calculations are available on request from the authors

As the United States import of Nigeria's oil decreased over the past few years, Europe's has increased. In 2011 and 2012, it increased by more than 40 percent and in 2012 it imports 44 percent of Nigeria's oil export (National Bureau of Statistics, 2014). EU is not only the largest regional trade partner of Nigeria but also the largest regional importer of Nigeria's oil. Nigeria constitutes around half of the EU exports to West Africa and nearly 70 percent of the imports. Of course, oil takes the biggest share but the EU also attracts more than 50 percent of the Nigerian non-oil exports and is a key partner, through trade and investments, in the industrialization of the country. EU absorbs about 22 percent of all Nigeria's exports, and overall accounts for 25 percent of Nigeria's trade.

Literature Review

Following the upsurge in the price of oil in the mid-1970s, such empirical studies like Bernanke (1983), Loungani (1986), Hamilton (1988), Bresnahan and Ramey (1992), Dixit and Pindyck (1994), Davis and Mahidhara (1997), Carruth, Hooker and Oswald (1998), Finn, (2000), Davis and Haltiwanger (2001), Lee and Ni (2002) began to emerge focusing mainly on the net oil importing economies, majority of which are the developed economies. The initial belief was that the first case of rising oil price was a permanent shock and this underlies Rasche and Tatom's (1977) employment of potential GNP construction in explaining the shock and proffering how an economy would adjust after it. Rasche and Tatom (1977) estimated and suggested that the 1972-74 upsurges in oil price are going to reduce long-run real GDP of the US by 7%.

Hamilton (1983), considered as the researcher that broached the studies on oil price shocks and macroeconomic instability, asserts that positive oil price shocks preceded all. Using a linear specification, he established a causal relationship between oil price shocks and macroeconomic indicators in the US. His results reveal that changes in oil price changes the unemployment (positive correlation) and GNP (negative correlation) in the US with the causality running from oil price shocks to the economic indicators. With the later oil price shocks and especially the negative shocks of the mid 1980s, the linear model failed to explain the granger causality. Mork (1989); Lee, Ni and Ratti (1995); and Hamilton (1996) then employ a non-linear methodology to re-establish the relationship and maintain the granger causality.

Kilian (2009) in a study conducted on the US economy, using a measure of monthly global real economic activity in industrial

commodity markets, decomposes oil price shocks into three components: an oil-supply shock; an oil-demand shock induced by shocks to the global demand for all industrial commodities; and oil-specific demand shocks that are specific to the global crude oil market and are driven by soar in precautionary demand for oil following an exogenous events. He employed Structural Vector Auto regression (SVAR) and treated oil price as endogenous variable. He postulated that the consequences of the demand and supply shocks in the world oil markets are different on real growth and inflation on the US economy, and that expectations from the oil-specific demand shocks play a vital role in oil price model. He concluded that the macroeconomic effect of the 2000s oil price surge was moderate because it emanated from oil-demand shock.

In a slightly contrasting findings, Blanchard and Gali (2007) in a study conducted on United State, France, United Kingdom, Germany, Italy and Japan demonstrate that the effects of oil price shocks on macroeconomic performance has decreased over time. Using Structural VAR techniques, their results indicate that prior to 1984, a 10% increase in oil price would have reduced the US GDP by approximately 0.7% over a period of 2 to 3 years; while after 1984, it would do that by about 0.25%. They posit that the effects of oil price shocks must have coincided with a large shock of a different nature: large rise in other commodity prices in the 1970s and high demand as a result of growth of productivity with the rise of the emerging economies in the 2000s. They went further to list the plausible reasons for these declines, which include decrease in real wage rigidities: a more flexible labour market, decrease in the share of oil in production and consumption, more credible monetary policies and the great moderation.

Berument and Ceylan (2005) study the impacts of oil price shocks on the output growth of some selected Middle East and North African (MENA) countries which are either net importers or net exporters of oil but cannot affect its price employing a Structural VAR framework. Using the available real GDP data for each country under the study and the global price of crude oil, over the period of 1960-2003 their impulse response analyses indicate that effects of world oil prices on the GDP of Algeria, Iran, Iraq, Jordan, Kuwait, Oman, Qatar, Syria, Tunisia and United Arab Emirates are positive and statistically significant. Furthermore, the results suggest that a standard deviation shock in oil price has a significant, contemporaneous and positive effect on the growth of the aforementioned countries and dies out for the economic growth of Qatar, Syria and Tunisia after an additional year; while, lasting for additional four years for the remaining aforesaid

economies. However, for Bahrain, Egypt, Lebanon, Morocco and Yemen, the analyses reveal that the effects of oil prices on these economies are not statistically significant.

Olomola (2006) investigated the impacts of oil price shocks on output, inflation, the real exchange rate and money supply in Nigeria using quarterly data from 1970-2004. Employing the VAR model, the results suggest that oil price shocks do not affect output and inflation substantially in Nigeria. It is also revealed that inflation rate responds to shocks in output and money supply rather than oil price shocks. However the findings demonstrate that volatility in oil price do affect the real exchange rate and is significant. As such an upsurge in oil price may squeeze the tradable sector giving rise to the "Dutch-Disease Syndrome". It is the manifestation of the volatility in the real exchange rate and money supply that leads to fluctuations of the aggregate economic activity proxied by GDP. As such, he concluded that oil price volatility is a key determinant of real exchange rate and in the long-run money supply, while money supply impacts the growth of output in Nigeria.

In a rather rare study, West African Monetary Studies (2008) attempts to investigate the impacts of oil price fluctuations on key macroeconomic convergence criteria (fiscal deficit and inflation) in ECOWAS member states, which are Sub-Saharan African economies. The GVAR methodology was adopted and the sample countries include Nigeria, Ghana, the Gambia, Benin, Burkina Faso, Cote d'Ivoire and Senegal. The results indicate that oil price shocks lag for one year before affecting fiscal deficit in all the countries under study with the magnitude and direction of the responsiveness of the fiscal deficit differing across the countries. In terms of inflation the adverse effect of upsurge in the price of oil in the world oil market on the non-oil producing countries is limited unlike with fiscal deficit. This is attributed largely to efficient monetary policies adopted by the respective countries and to a lesser extend oil subsidy provided by the respective governments, which deflects the transfer of the increase to final consumers.

Aliyu (2009) examined the effects of oil price shocks on real economic activity in Nigeria using monthly data from 1980-2007. He conducted a Multivariate VAR analysis using both linear and non-linear specifications. In contrast to Olomola (2006), he found the evidence of both linear and non-linear effect of oil price shocks on real GDP. He also found that in the non-linear specification, asymmetric oil price upsurge has positive impact on real GDP growth with a larger

magnitude than asymmetric oil price fall negatively affects the real GDP.

In a similar vein, Omisakin, Adeniyi and Omojolaibi (2009) examine the short run impacts of dynamics of energy (oil) price volatility on the macroeconomic performance in Nigeria employing a Vector Error Correction Model (VEC). They employed fiscal and monetary variables, which include GDP, energy price (proxied by oil price), government expenditure, oil revenue, money supply and inflation. The study covered the period 1970-2006. Evidence from the results of the VEC reveals that in the short run oil revenue responds positively to a change in the energy (oil) price. It shows that a 10% increase in energy price brings about 79% increase in oil revenue, 45% increase in government expenditure, 31% increase in output, 17% increase in money supply and 11% decrease in inflation in the short run.

Cashin, Mohaddes and Raissi (2014) using a GVAR model; encompassing over 90% of world GDP, 85% of world oil consumption, and 80% of world proven oil reserves; conducted a study on 36 countries and two regions consisting of both the oil importing and the oil exporting countries. Their aims were to distinguish macroeconomic effects of supply-driven oil price shocks from the demand-driven oil price shocks on the countries and regions under study. In addition to this, they study the persistence of the macroeconomic effects of the shocks across countries and the real as well as financial variables. The conclusion is that, a supply-driven oil price shocks has different macroeconomic consequences to a demand-driven oil price perturbation. Following a supply-driven oil price surge, the oil importing countries experience a long-lived decline in economic activity; while, the impact is favourable for the oil exporting countries with large proven oil reserves. In the case of the oil demand disturbance, cross countries differences are absent as the results indicate. The results reveal that almost all the countries included in the sample experience a long-run inflationary pressures, an increase in real output, a rise in interest rates, and a fall in equity prices.

Methodology

The study covers the period 1979Q2 to 2013Q1. This period extends the time of major positive oil price shocks since the great depression. The GVAR model adopted for the study is large and includes the major trade partners of Nigeria. The countries and region included are South Africa, Brazil, China, India, United Kingdom,

United States and the Euro Area, which comprises of Belgium, France, Germany, Italy, the Netherlands and Spain.

The variables included in the GVAR model are real output (y), inflation (Dp), money supply (Ms), short term interest rate (r) and real effective exchange rate (epeps), based on consumer price index, which are country-specific (domestic) variables. The global variable is oil price (poil) which enters in only the United States VARX* model as endogenous variable. All the other variables are included in the respective countries' and region's VARXs* both as domestic and the weakly exogenous foreign variables (also, foreign-specific variables are the starred variables: y*, Dp*, Ms*, r* and epeps*) with the exception of epeps which enters the US VARX* as weakly exogenous foreign variable and enters other countries and region as domestic variable only. This is because the US dollar exchange rate is determined outside the US model. The weakly exogenous foreign short term interest rate (r) is not included in the US model given the importance of the US financial variables in the global economy; it is unlikely to be long-run forcing to the US-specific counterpart domestic variable.

The method of data collection employed in this study involves the gathering of secondary data spanning the period 1979Q2 to 2013Q1. The UK Brent oil price is adopted for global oil price as done by Aliyu (2009). The data were linearly seasonally adjusted after which their respective logs are taken. The variables included in individual VARX* model are tabulated below in table 1.

Table 1: Variables included in individual VARX* model of the GVAR

	Domestic	Foreign	Domestic	Foreign
Real GDP	y_{it}	y_{it}^{*}	$y_{us,t}$	$y_{us,t}^{*}$
Inflation	Dp_{it}	Dp_{it}^{*}	$Dp_{us,t}$	$Dp_{us,t}^{*}$
Money Supply	Ms_{it}	Ms_{it}^{*}	$Ms_{us,t}$	$Ms_{us,t}^{*}$
Short term rate	r_{it}	r_{it}^{*}	$r_{us,t}$	$r_{us,t}^{*}$
Real effective exchange rate	$epeps_{it}$			$epeps_{us,t}^{*}$
Oil price		$poil_{it}^{*}$	$poil_{us,t}$	

The GVAR model is presented as in Pesaran, Schuermann and Weiner (PSW) (2004); and Dees, di Mauro, Pesaran and Smith (DdPS) (2007). We begin by estimating individual country's Vector Autoregressive (VAR) model augmented by weakly exogenous foreign variables VARX*($p_i q_i$), where $p_i q_i$ are the lag order of the domestic

IJCEAS
International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume :9, Issue: 1, Year:2019, pp. 94-118

variables and both foreign weakly exogenous foreign variables and global variables I(1). The lag orders ($p_i q_i$) can vary amongst countries and are selected by mininimizing the Akaike Information Criterion (AIC) in this study. The maximum lag order is set to 2. Two is chosen because of the data limitations (the observations for the study are 40) as a higher lag order requires much larger observations[4].
The VARX*(2, 2) framework with country-specific variables, foreign-specific variable, global variables, constant (intercept) and a trend is presented below,

$$x_{it} = a_o + a_{1t} + \delta_{i1} x_{i,t-1} + \delta_{i2} x_{i,t-2} + \Lambda_{i0} x^*_{it} + \Lambda_{i1} x^*_{i,t-1} + \Lambda_{i2} x^*_{i,t-2} + \Gamma_{i0} d_t + \Gamma_{i1} d_{t-1} + \Gamma_{i2} d_{t-2} + u_{it} \quad (1)$$

where i= 1,2,3,.....N is the number of economies and t= 1,2,3,.....T is the time. x_{it} is a $k_i \times 1$ vector of country-specific domestic variables for country *i*, x^*_{it} is a $k_i^* \times 1$ vector of foreign-specific variables of country *i* and u_{it} is is a process with no serial correlation but with weak dependency across sections.

To construct the foreign variables, fixed trade weights or time-varying trade weights are employed to compute the foreign variables as weighted averages of corresponding domestic variables. The foreign variables are computed as,

$$x^*_{it} = \Sigma_{j=0}^{N} w_{ij} x_{ij}$$

where w_{ij} are trade weights which show the trade share of country *j* (where *j*=1, 2, 3 ...N) in the trade of country *i* (average of imports and exports). The weights are predetermined and satisfy the condition $\Sigma_{j=0}^{N} w_{ij} = 1$ and $w_{ii} = 0$ (ie, the summation of trade of country *i* with its *j* partners is 1, while the trade with itself adds up to 0).

The number cointegrating relations are also determined which shows the long-run relations of the variables. To determine it, a Vector Error Correction (VEC) model augmented with foreign variables (VECX*), which includes both the short-run and long-run relations, is presented as shown below,

$$\Delta x_{it} = c_{i0} - \alpha_i \beta_i' \left[z_{i,t-1} - \gamma_i (t-1) \right] + \Lambda_{i0} \Delta x^*_{it} + \Gamma_i \Delta z_{i,t-1} + u_{it}, \quad (2)$$

[4] See DdPS (2007)

where $z_{it} = (x'_{it}, x'^{*}_{it})$. α_i is a $k_i \times r_i$ matrix with speed of adjustment coefficients and β_i is a $(k_i + k_i^*) \times r_i$ matrix of the cointegrating vectors. The rank of both α_i , β_i is r_i. The r_i error-correction terms of equation (2) can be rewritten as

$$\beta_i' (z_{it} - \gamma_{it}) = \beta'_{ix}\, x_{it} + \beta'_{ix^*}\, x^*_{it} - (\beta_i' \gamma_i)_t \,, \qquad (3)$$

If β_i is partitioned as $\beta_i = (\beta'_{ix}, \beta'_{ix^*})'$. Then, cointegration is possible inx_{it}, between x_{it} and x^*_{it}, and between x_{it} and x_{jt} when $i \neq j$.

During the estimation of the VECX* models for each country, x^*_{it} is treated as long-run forcing for domestic variables, which means that foreign variables affect domestic variabes in the long term but the domestic variables do not affect foreign variabes in the long run. However, contemporaneous correlations between the variables are permitted.

Once the individual country's VARX* are estimated, they are stacked together to build the GVAR model, solving all the economies' endogenous variables ($k = \Sigma_{i=0}^{N} k_i$) simultaneously in the global system.

$$A_{i0} z_{it} = a_{i0} + a_{i1t} + A_{i1} z_{i,t-1} + A_{i2}\, z_{i,t-2} + u_{it} \,, \qquad (4)$$

with $A_{i0} = (I_{ki}\,, -\Lambda_{i0})$, $A_{i1} = (\Phi_{i1}\,, \Lambda_{i1})$ and $A_{i2} = (\Phi_{i2}\,, \Lambda_{i2})$. Then derive the identity

$$z_{it} = W_i x_i, \qquad (5)$$

where $x_t = (x'_{0t}\,, x'_{1t}, \ldots\ldots, x'_{Nt})$ is a $k_i \times 1$ vector of endogenous variables and W_i is a $(k_i + k_i^*) \times k$ link matrix. W_i is constructed from the country-specific trade weights w_{ij} . Use the identity to rewrite equation (4) into

$$A_{i0} W_i x_t = a_{i0} + a_{i1t} + A_{i1} W_i x_{t-1} + A_{i2} W_i x_{t-2} + u_{it} \qquad (6)$$

For a model of the endogenous variable x_t , the individual country models are stacked together to obtain

$$G_0 x_t = a_0 + a_{1t} + G_1 x_{t-1} + G_2 x_{t-2} + u_t \,, \qquad (7)$$

where

IJCEAS
International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume :9, Issue: 1, Year:2019, pp. 94-118

$$G_0 = \begin{bmatrix} A_{00}W_{00} \\ A_{10:}W_1 \\ A_{N0}W_N \end{bmatrix}, a_0 = \begin{bmatrix} a_{00} \\ a_{10} \vdots \\ a_{N0} \end{bmatrix}, a_1 = \begin{bmatrix} a_{00} \\ a_{10} \vdots \\ a_{N0} \end{bmatrix}, G_1 = \begin{bmatrix} A_{01}W_0 \\ A_{11} \vdots W_1 \\ A_{N1}W_N \end{bmatrix},$$
$$G_2 = \begin{bmatrix} A_{02}W_0 \\ A_{12:}W_1 \\ A_{N2}W_N \end{bmatrix} \; and \; u_t = \begin{bmatrix} u_{0t} \\ u_{1t} \vdots \\ u_{Nt} \end{bmatrix}$$

Equation (7) is then pre multiplied by G_0^{-1}, since G_0 is a known non-singular matrix. The GVAR(2) model is

$$x_t = b_0 + b_{1t} + F_{1t}x_{t-1} + F_2x_{t-2} + \varepsilon_t, \qquad (8)$$

where $b_0 = G_0^{-1}a_0, b_1 = G_0^{-1}a_1, F_1 = G_0^{-1}G_1, F_2 = G_0^{-1}G_2 \; and \; \varepsilon_t = G_0^{-1}u_t$.

This model is solved recursively, usually with no restrictions on the covariance matrix. $\Sigma_\varepsilon = \mathrm{E}(\varepsilon_t\varepsilon_t')$.

The idiosyncratic shocks ε_t are correlated across countries/regions. More specifically,

$$\mathrm{E}(\varepsilon_{it}\varepsilon_{jt}') = \begin{cases} \Sigma_{ij} & for\ t = t' \\ 0 & for\ t \neq t' \end{cases}$$

From above, the GVAR model allows for interdependence through three channels: (I) Contemporaneous interrelations of domestic variables, x_{it}, with foreign-specific variables, x_{it}^*, and their lagged values, (II) the dependence of domestic variables, x_{it}, on global variables, d_t, and their related lagged values, and (III) the contemporaneous dependence of shocks in country *i* on the shocks in country *j*, u_t.

To estimate the GVAR model, trade weights are computed which are used to construct the country-specific foreign variable. With regard to this study, these are the trade shares amongst countries which show the share of trade between Nigeria and her major trade partners included in the study. Fixed trade weight is adopted for the study on the grounds that the changes in the trade weights tend to be gradual and the countries included have been Nigeria's major trade. The trade data used cover the period 1980 to 2013. The weight is computed as the average of import and export of bilateral trade between countries based on US dollar GDPs.

Also, other tests such as impact elasticities, which are the feedback, of foreign-specific variable to its domestic counterpart are carried out. In similar vein, statistics such as persistence profiles, which demonstrate movements in the co-integrating vectors after a shock to the system and converging to zero in the long term to illustrate that the system returns to its long-run equilibrium; and structural breaks are estimated to ascertain the robustness of the model.

Empirical Findings

The computed as well as estimated findings are analyzed and interpreted in line with Pesaran et al. (2004) and Dees et al. (2007).

The Table 2 below displays the trade weights of the countries and region included in the GVAR model of the study. The trade weight is computed as the share of export and import of individual country/region with its partner depicted in column such that a column and not a row add up to one. We can deduce from the table that the US trade dominates other region/countries included in the model in terms of trade with Nigeria. It accounts for 33% of the trade with Nigeria. It is followed by Euro Area which accounts for approximately 30% of the total trade with Nigeria. India and China fall behind Euro Area reporting about 12% and 10% respectively. In total the three countries and the Euro Area are responsible for 85% of trade with Nigeria in the model.

On the other hand, Nigeria's share of world trade is small as explained in previously. This is evident in the trade weight reported below. Nigeria accounts for approximately 3%, 2%, 1%, 4%, 1% and 1% of the trade with the US, Euro Area, India, China, Brazil, UK and South Africa respectively in the model.

Table 2: Weight Matrix (based on fixed weights)

Country	Brazil	China	Euro Area	India	Nigeria	South Africa	UK	US
Brazil	0	0.069	0.050	0.034	0.080	0.024	0.013	0.057
China	0.294	0	0.276	0.278	0.095	0.252	0.103	0.426
Euro Area	0.322	0.359	0	0.303	0.301	0.355	0.668	0.336
India	0.039	0.065	0.050	0	0.119	0.081	0.024	0.046
Nigeria	0.040	0.009	0.023	0.058	0	0.037	0.007	0.030
South Africa	0.011	0.031	0.027	0.050	0.034	0	0.026	0.013
UK	0.039	0.054	0.316	0.061	0.044	0.098	0	0.093
US	0.253	0.413	0.258	0.217	0.325	0.152	0.158	0

Computed by the authors using GVAR 2.0

IJCEAS

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume :9, Issue: 1, Year:2019, pp. 94-118

- *Weak Exogeneity Tests*

The weak exogeneity test of the country-specific foreign variables and the global variable in relation to the long-run parameters of the conditional model used in building the GVAR framework is carried out in line with Johansen (1992) and Harbo et al (1998). The test is an F-test with 95% critical values. The weak exogeneity assumption is accepted for all the variables except the money supply variable in the Euro Area model and the money supply variable in the South African model. Given the significance level assumed here, even if the weak exogeneity assumption were true in all cases, we would expect up to 5% rejections of the total test (Cashin et al., 2012). As reported here, the 5% of the test, 40, is 2[5].

- *Unit Root Tests*

The tests have critical values of 95%, which are -3.24 and -2.55 for regressions with trend and regressions without trend respectively. This battery of tests supports the unit root hypothesis in general with only few cases where it is rejected. With regards to the domestic variables, the unit root hypothesis for inflation is rejected for India, Nigeria, South Africa and China. Also the domestic short-term interest rate(r) for India, UK, US, Brazil, India and South Africa are rejected. Furthermore, for South Africa, China, Euro Area and UK the unit root hypothesis for inflation is rejected.

In the sphere of the foreign variables, the unit root hypothesis is rejected for Brazil in its inflation model. Additionally, the unit root hypothesis with no trend is rejected for Brazil, Euro Area, India, and UK, US in their respective real effective exchange rate models.[6].

- *Lag Order Selection and Cointegrating Relations*

The lag orders are selected by AIC with the authors setting the maximum lag of 2 for both the domestic and foreign variable (p_{max_i} and q_{max_i} respectively). The result of the VARX* order and the cointegrating rank are presented in table 3 below,

[5] The results of weak exogeneity test are available on request from the authors
[6] The results of unit root test are available on request from the authors

Table 3: VARX* Order of Individual Models and Cointegration Relations

	VARX* Lag Order		Cointegrating relations
Country	p_i	q_i	r_i
Brazil	1	1	2
China	2	2	3
Euro Area	2	1	1
India	2	2	1
Nigeria	2	1	2
South Africa	2	1	1
UK	2	2	1
US	2	2	2

Computed by the authors using GVAR 2.0

The cointegrating statistics are based on Trace Statistics with 95% Critical value. It can be deduced from the table that the AIC favours the VARX*(2, 2) for most countries/region included in the study[7].

- *Persistence Profiles*

In a total of 13 Cointegrating Vectors (CV), only US CV1 has profile that overshoots. This adjusted within the time horizon. The convergence rate is high for most of the models as they converge and reach equilibria quickly. Out of the 13 cointegrating vectors, 8 converge to equilibria in approximately 2 years or less. Brazil CV2 shows the fastest rate of convergence of 12 months (1 year), while China's CV1 shows the slowest of 86 months (approximately 7 years).To buttress the proof provided above by Persistence Profile that the global model estimated is stable, the eigenvalues of the GVAR model is estimated. The result reported reveals that the GVAR model is stable as no value of the eigenvalues of the GVAR model exceeds unity[8].

- *Generalized Impulse Response Functions (GIRFS) Analysis*

To analyse the dynamic nature of the GVAR model, how shocks are transmitted from world oil market and from one economy to another as well as how long it takes before the shocks die out, GIRFs is employed. The discussion of the results focuses on two years, although the graphs present up to 10 years. The presentation of the remaining

[7] The diagnostic tests results are available on request from the authors

[8] The results of the Persistence Profiles and Enginvalues are available on request from the authors

quarters is to reveal when an economy returns to equilibrium after an external shock from the global oil market and its trading partners that has impacts on the economy. Two years is a reasonable time horizon over which the model reveals plausible results[9] for short-run dynamics. To avoid the problem of changing error variance, all the GIRFs figures analysed were computed using sieve bootstrap as in the case of structural stability and are thus presented with their bootstrap estimates and their associated 90% confidence bounds.

As the also study focuses on shocks propagated from Nigeria's trade partners to Nigeria after an oil price shocks, only the GIRFs graphs of the respective economies under consideration with respect to shocks in any particular variable to Nigeria are presented and analysed. The implications of four different external shocks are examined. These are:

(I) a one standard error positive shock to oil price.
(II) a one standard error negative shock to the output of all of Nigeria's trade partners.
(III) a one standard error shock to Nigeria's major importer's inflation.
(IV) a one standard error positive shock to United States short-term interest rate.

The Figure 1 below captures the behaviors of Nigeria's macroeconomic variables employed in the study, which proxy the economy, to a one standard error positive shock to oil price and one standard error negative shocks to the real output of the economies included in the model. It also displays the time profiles, when the variables start to approach and eventually reach equilibrium.

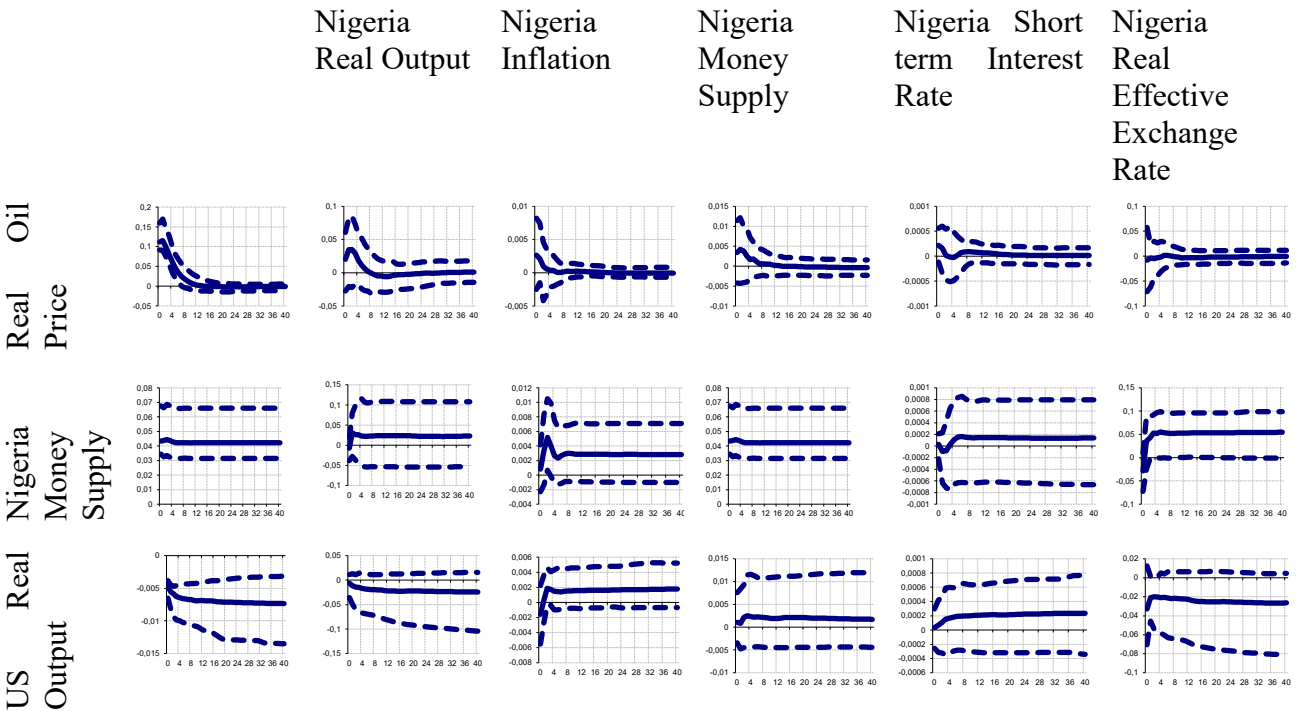
A positive shock to oil price on impact leads to a rise in oil price up until the 3rd month after which it continually falls until it converges to equilibrium. On impact, the shock on oil price has positive effects on the real output, this conforms to studies such as Aliyu(2009), and Omisakin, Adeniyi and Omojolabi (2009). The increase in real output peaks at the 9th month after which it began to adjust. On impact, the response from money supply is also positive, leading to a rise in money supply that peaks at the 1st quarter just as the real oil price. The response by inflation is rather marginal until after the 2nd quarter. The real effective exchange rate rises on impact gradually with a standard error positive oil price shock until the 5th quarter. With oil, being the

[9] See Dees et al. (2007)

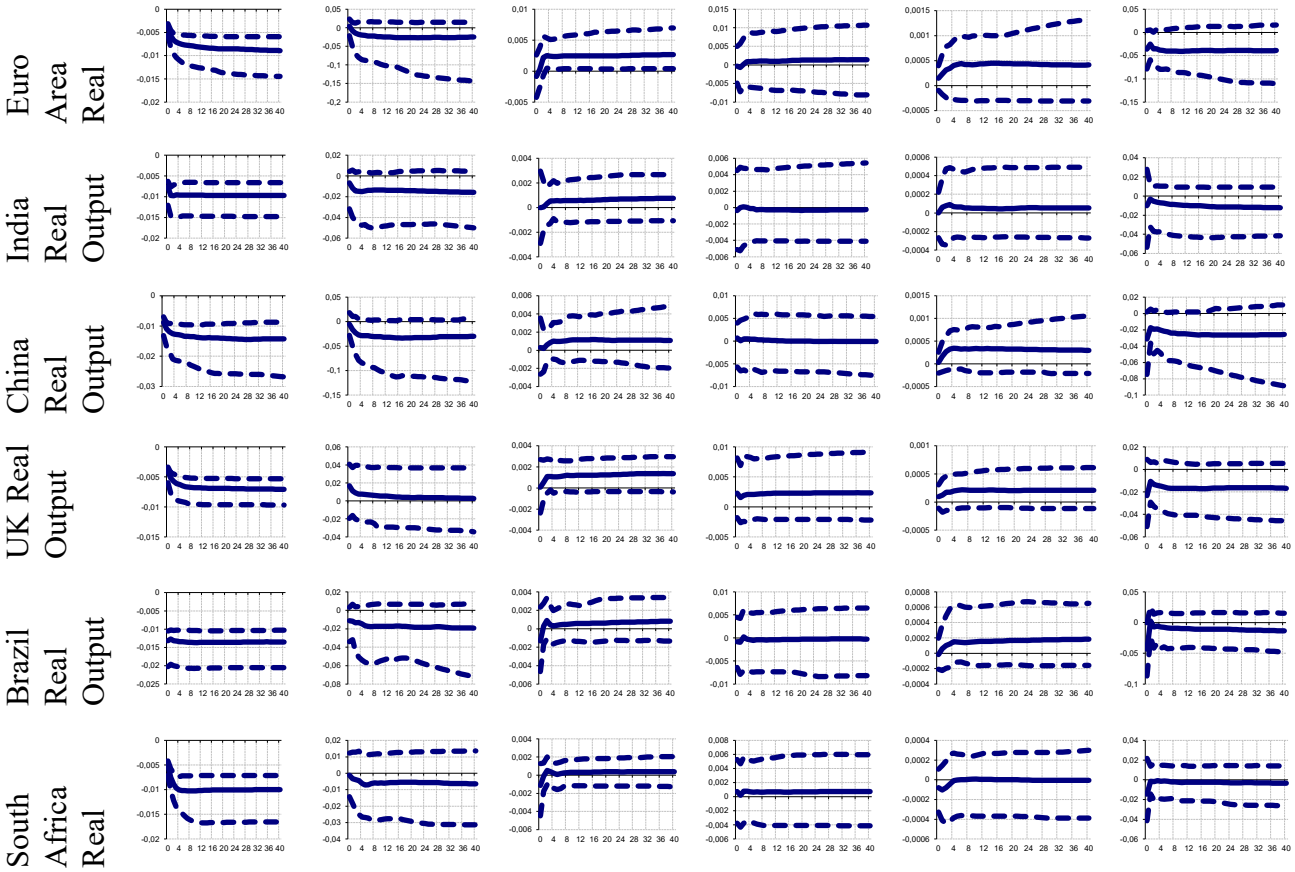
largest export commodity and foreign exchange earner for the country, positive oil price shock (rise), means a decline in the competitiveness of the Nigerian economy as the real effective exchange rate rises.

The real output rises through a number of media. As the major foreign exchange (forex) earner for the country, a positive oil price shocks means more forex that could be used to finance the raw and intermediary inputs needed in other sectors of the economy to drive growth. Government rises which enables it to undertake projects that drive growth and development. Foreign direct investment also surges after a positive oil price shock as foreign investors are lured into the economy especially to the oil and gas sector. The excessive monetization of oil receipt explains the rise in money supply. Just as exposed in the studies of Omolola (2006), Akpan (2009), Adeniyi (2011), Fasanya and Onakoya (2013), positive oil price shocks affect inflation negatively as presented here. Rather, the excessive monetization of oil receipts and the action of the apex bank of the country after an oil price shock, which lead to rise in money supply, induce the rise in inflation in Nigeria.

Figure 1: GIRFs – shock on oil price and real output



International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume :9, Issue: 1, Year:2019, pp. 94-118



This can be discerned from the rise of money supply after a positive oil price shocks and the consequent rise in inflation after a rise in money supply as depicted in Figure 1 below. Short-term interest rate declines as expected with the immediate monetization of the proceeds from oil sale. This increases the money supply, hence, creating a pressure on the interest rate that drives it down.

The results of a one standard error negative shock to the respective economies' real outputs reveal that the reaction of the real output and inflation of Nigeria varies in magnitude and persistence but not in direction. The shocks induce a fall in Nigeria's real output and a rise in inflation (stagflation). On impact, the real output of Nigeria, with regards to the negative shock from the real output of the aforementioned economies, drops with the speed of adjustment and time differing between countries and region. This is very interesting as it depicts that a fall or slowdown of global economic growth, represented by the countries and region included in the model, which adversely affects the

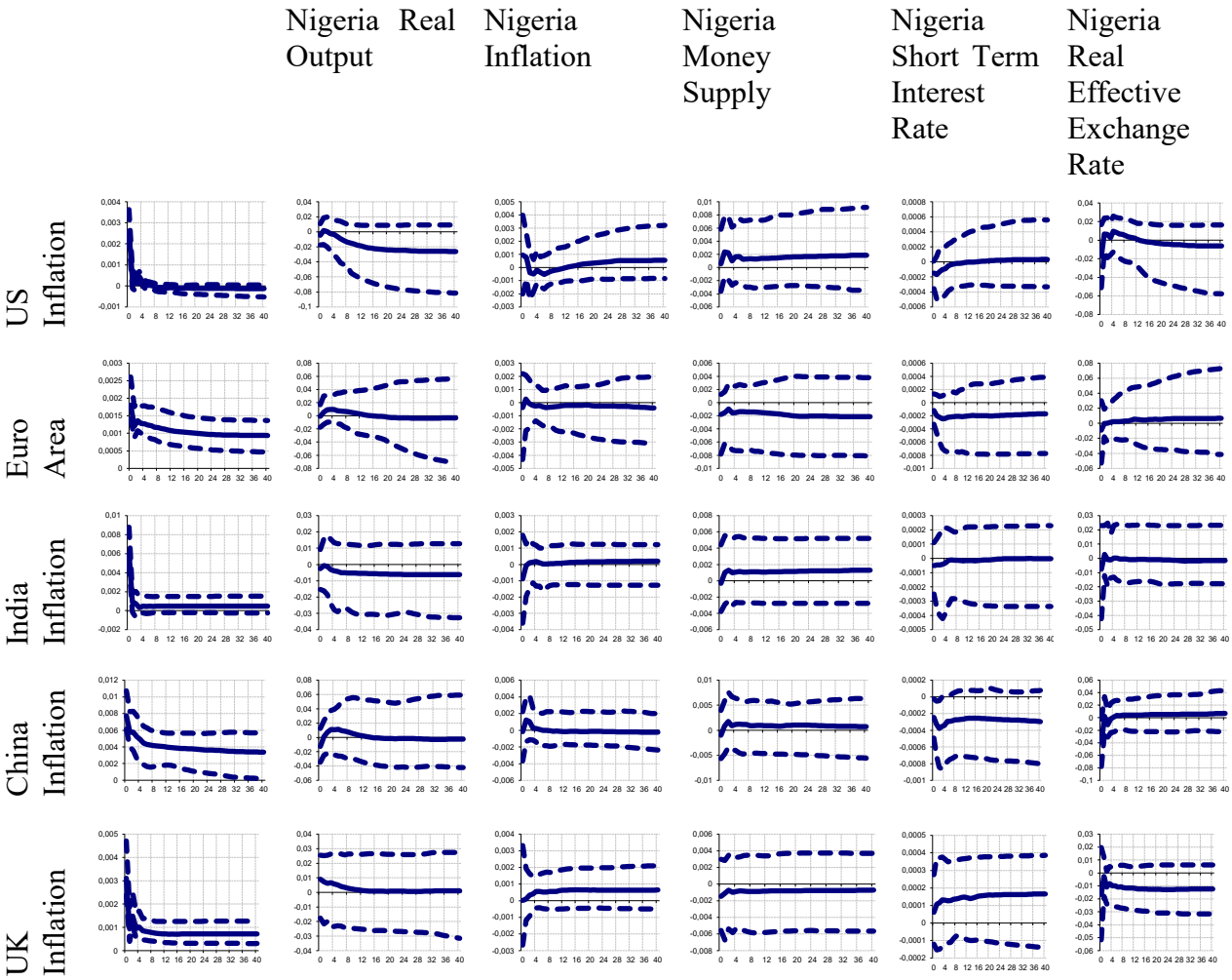
demand for commodities[10] including oil, causes economic downturn in Nigeria. The results show that with a negative innovation (shock) to the country's trade partners' real output with the exception of UK, oil price falls. This is further worsening as oil is the major foreign exchange earner for the country and it depends on import for most if not all inputs as well as consumer products it uses. This explains the foreign exchange crisis and recession the country has plunged into since the later part 2016. With regards to the reaction of money supply to a negative innovation in its trade partners' real output, it falls except for India. Short-term interest rate rises expect for South Africa and the real effective exchange rate rises as the country's trade partners experience fall in their respective real output. This is in line with our expectations since imports become dearer during economic downturn consequently leading to a loss in the competitiveness of Nigeria.

On Figure 2, a one standard error positive shock to Nigeria's major import partners in the model is examined to capture the effect of inflation, since transmission of inflation via trade is through importing it from the trade partner. These economies are the United States, Euro Area, India, China and the United Kingdom. With regards to short-term interest rate, only a one standard positive error shock of the United States interest rate is considered given the dominance of the United States in the world. With the exception of UK, a one standard positive shock to inflation of the economies leads to a rise in Nigeria's real output. The inflation of Nigeria rises on impact until the 2nd to 4th quarters. The magnitude depends on the originating economy with US having the highest as suspected. Furthermore, the adjustment of the inflation mirrors the US's. In response to inflation shock from all the economies, the domestic short-term interest rate of Nigeria falls except for shock from the UK. The money supply and the real effective exchange rate of Nigeria rise on impact after a positive shock to the trade partners' inflation. The effects of a one standard positive error shock to Nigeria's trade partners' inflation on Nigeria presented in the study reveal that inflation in Nigeria if not domestically originated by the activities of the major economic players in the country such as the central bank and the government, may be imported but caused by indirectly by a positive oil price shocks through the money supply.

[10] See Larusso and Pieroni (2015), where they show that major oil price movements since the mid 1970s have come from demand side

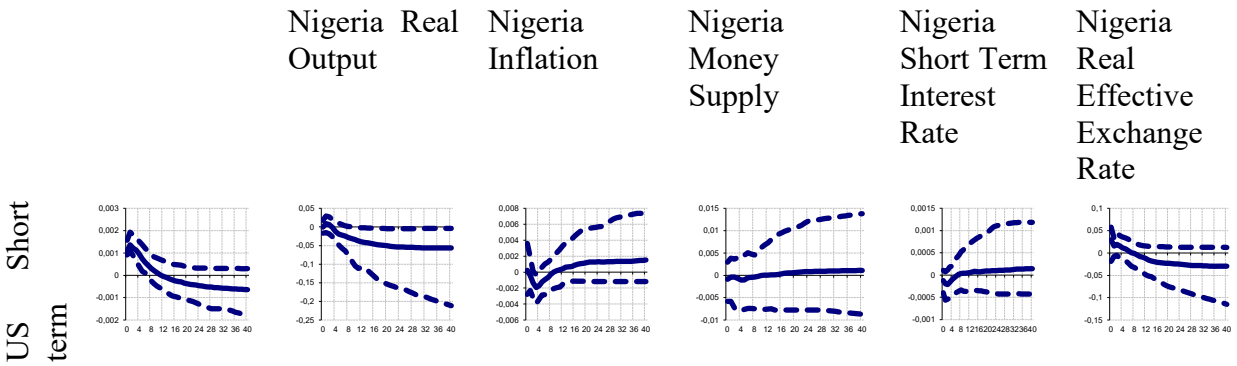
International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume :9, Issue: 1, Year:2019, pp. 94-118

Figure 2: GIRFs – shock on inflation



On Figure 3, with regards to a standard positive error shock to the United States short-term interest, short-term interest rate in Nigeria drops until the 2nd quarter. On impact, real output of Nigeria rises and peak at 3rd. Inflation and Real effective exchange rate decline while money supply rises. This reveals that, even though, the economy's financial linkage to the world has been little, it is affected by changes in the United States short-term interest rate which leads to increase in money supply and availability of fund to drive rise in real output. Furthermore, it shows the economy's financial linkage to the world and the monetary policies inter linkages between Nigeria and the US.

Figure 3: GIRFs – shock on US Interest Rate



Conclusion

Based on the findings of the study, it could be concluded that the Nigerian economy is volatile to oil price shocks, directly through rise in the price of the product in the world market and indirectly through trade linkages with its major trade partners. The findings reveal that oil price shocks cause macroeconomic instability in Nigeria, thereby posing a great threat or the destabilization of economic management and planning in the country. In line with the traditional belief that positive oil price shock (rise in oil price) would lead to increase in real output of a net-oil exporting economy, the study reveals that this is true also for Nigeria as a net oil exporter. The study further reveals that with fall in the real output of the trade partners of Nigeria, the real output of Nigeria falls even as inflation rise. Money supply rises after a positive oil price shock consequently leading to rise in inflation. Furthermore, inflation is imported from the major trade partners. Real effective exchange rate of Nigeria rises after a positive oil price shock, negative output shock to the country's partners and positive shock to inflation of the country's partners. As a result, the country loses its trade competiveness.

All in all, the results are not surprising as Nigeria is a commodity exporter and a very small player in the global economy arena. The findings thus paint an erratic future for Nigeria, a small open economy that depends largely on oil for foreign exchange and imports the raw and intermediary goods it uses in production, after an oil price shock that affects the economy through the first-round effects as well as the spill-over effects. Since, Nigeria does not affect or influence the macroeconomic variables of the trading partners; on the whole, the policy makers need to focus on the policies that will cushion not only the first-round effects but also the spill-over effects. The

macroeconomic structure needs to be strengthen through diversification of the economy, fiscal discipline, credible monetary policies, alternative source of earning foreign exchange and saving the proceeds of oil during boom so as to be able to cushion any bust in the future such as the persistent fall of the global price of oil due to increase in oil production in the United States since late 2014 and the slowdown of global economic growth. The Nigerian macro economy is shocked by a factor (oil price) that is outside the direct control of policy makers. The policy implication is that the authority's ability to influence the movements in oil price is limited. The authority may however reduce the impacts of this shock by targeting the macroeconomic variables. Money supply can be targeted especially through fiscal discipline and appropriate monetary policies to counter the effects of the shock. Reduction in the monetization of oil receipt (fiscal discipline), aggressive savings of proceeds from oil booms in future is advised to withstand the vicissitudes of oil price shocks. Saving the oil receipt for raining days is strongly recommended so that in the advent slow down in global economic growth fall in oil price and can serve as the cushion or shock absorber.

References

Adeniyi, A.O., Oyinlola, A. and Omisakin, O.A. (2011). "Oil Price Shocks and Economic Growth in Nigeria: Are threshold Important?" *Energy Review*, 35(4), 308-333.

Akinyele, O.S. and Ekpo, S. (2013). "Oil Price Shocks and Macroeconomic Performance in Nigeria" Economia Mexicana, 2, 565-624.

Akpan, E.O. (2009). "Oil Price Shocks and Nigeria's Macroeconomy" *Annual Conference of CSAE Conference*, Economic Development in Africa.

Aliyu, S.U.R. (2009). "Oil Price Shocks and the Macroeconomy of Nigeria: A Non-Linear Approach" *MPRA Paper*, No: 18726.

Bernanke, B.S. (1983). "Irreversibility, Uncertainty, and Cyclical Investment" *Quarterly Journal of Economics*, 98, 85–106.

Berument, H. and Ceylan, N.B. (2005). "The Impact of Oil Price Shocks on the Economic Growth of the Selected MENA Countries". *Bilkent University Working Papers*

Blanchard, O.J. and Gali, J. (2007). "The Macroeconomic Effects of Oil Shocks: Why are the 2000's so different from the 1970's" *National Bureau of Economic Research*, Working Paper 13368.

Bresnahan, T.F. and Ramey, V.A. (1992). "Output Fluctuations at the Plant Level" *NBER* Working Paper, 4105.

Cashin, P., Mohaddes, K., and Raissi, M. (2012). "The Global Impact of Systemic Economic and MENA Business Cycles" *IMF Working Paper*, WP/12/225.

Cashin, P., Mohaddes, K. and Raissi, M. (2014). "The Differential Effects of Oil Demand and Supply Shocks on the Global Economy" *IMF Working Paper*, WP/12/253

Central Bank of Nigeria. (2014).
Available at: http://statistics.cbn.gov.ng/cbn-onlinestats /DataBrowser.aspx

Davis, S.J., and Haltiwanger, J. (2001). "Sectoral Job Creation and Destruction Response to Oil Price Changes" *Journal of Monetary Economics*, 48, 465-512.

Dees, S., Di Mauro, F., Pesaran, M.H. and Smith, L.V. (2007). "Exploring the International Linkages of the Euro Area: A Global VAR Analysis" *Journal of Applied Econometrics,* 22, 1 – 38.

Dixit, A.K. and Pindyck, R.S. (1994). *Investment under Uncertainty*. New Jersey. Princeton University Press.

European Commission. (2007). "Nigeria and the European Union Trade for Development: An Introduction to the Economic Partnership Agreement (EPA)" Luxembourg.

European Commission. (2014). "European Union, Trade in Goods with Nigeria". Luxembourg.

Hamilton, J.D. (1983). "Oil and the Macroeconomy since World War I" *The Journal of Political Economy,* 91(2), 228-248.

Hamilton, J. D. (1988). "A Neoclassical Model of Unemployment and the Business Cycle" *Journal of Political Economy*, 96, 593-617.

Harbo I., Johansen S., Nielsen B., and Rahbek A. (1998). "Asymptotic Inference on Cointegrating Rank in Partial Systems" *Journal of Business and Economic Statistics*, 16, 388–399.

Ignatius, E.U. (2014). "The Dominance of Oil Investment and Food Security in Nigeria under the President Obasanjo Civilian Administration" *Mediterranean Journal of Social Sciences*, 5(9), 515-521.

Johansen, S. (1992). "Cointegration in Partial Systems and the Efficiency of Single-Equation Analysis" *Journal of Econometrics*, 52, 231–254.

Kilian, L. (2009). "Not All Oil Price Shocks are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market" *American Economic Review,* 99(3), 1053-1069.

Lee, K., Ni, S., and Ratti, A. (1995). "Oil Shocks and the Macroeconomy: The Role of Price Variability" *Energy Journal*, 16(4), 39-56.

Lee, K. and Ni, S. (2002). "On the Dynamic Effects of Oil Price Shocks: A Study Using Industry Level Data" *Journal of Monetary Economics*, 49, 823–852.

Loungani, P. (1986). "Oil Price Shocks and the Dispersion Hypothesis" *Review of Economics and Statistics*, 58, 536-539.

Majidi, M. (2006). "Impact of Oil on International Economy" *International Economics Course*, Centre for Science and Innovation Studies.

Mordi, O.N.C. and Adebiyi, A.M. (2010). "The Asymmetric Effects of Oil Price Shocks on Output and Prices in Nigeria using a Structural VAR Model" *Central Bank of Nigeria, Economic and Financial Review*, 48(1).

Mork, K. (1989). "Oil Shocks and the Macroeconomy when Prices Go Up and Down: An Extension of Hamilton's Results" *Journal of Political Economy*, 97, 740-744.

Muhammad, Z., Suleiman, H. and Kouhy, R. (2011). "Exploring the Oil Price-Exchange Rate Nexus for Nigeria" *FIW Working Paper*, 71.

National Bureau of Statistics. (2014). Foreign Trade Statistics. Available at: http://www.nigerianstat.gov.ng/nbslibrary/economic-statistics/international-trade

National Bureau of Statistics. (2014). Revised and Final GDP Rebasing Result by Output Approach. Available at: http://www.nigerianstat.gov.ng/nbslibrary/economic-statistics/gross-domestic-product

Natural Resource Canada. (2010). "The Importance of Crude Oil". Available at: http://www.nrcan.gc.ca/energy/publications

Obayi, A.O., Innocent O.E. and Jeffrey E.I.E. (2012). "The Domestic and International Implications of Fuel Subsidy Removal Crisis in Nigeria" *Kuwait Chapter of Arabian Journal of Business and Management Review*, 1(6), 57-80.

Ojapinwa, V.T. and Ejumedia, E.P. (2012). "The Industrial Impact of Oil Price Shocks in Nigeria: (1970- 2010)" *European Scientific Journal*, 8(12), 113-126.

Olufisayo, O. A. (2014). "Oil Price and Stock Market: Empirical Evidence from Nigeria" *European Journal of Sustainable Development*, 3(2), 33-40.

Olusegun, A. O. (2008). "Oil Price Shocks and the Nigerian Economy: A Forecast Error Variance Decomposition Analysis" *Journal of Economic Theory*, 2(4), 124-130.

Olomola, P. A. (2006). "Oil Price Shock and Aggregate Economic Activity in Nigeria" *African Economic and Business Research*, 4(2), 48-61.

Omsakin O., Oluwatosin A., and Omojolaibi A. (2009). "A Vector Error Correction Modelling of Energy Price Volatility of an Oil Dependent Economy: The Case of Nigeria" *Pakistan Journal of Social Sciences*, 6(4), 207-213.

Omojolaibi, A.J. (2013). "Does Volatility in Crude Oil Price precipitate Macroeconomic Performance in Nigeria?" *International Journal of Energy Economics and Policy*, 3(2), 143-152.

Oyeyemi, M.A. (2013). "The Growth Implication of Oil Price Shocks in Nigeria" *Journal of Emerging Trends in Economics and Management Sciences*, 4(3), 343-349.

Pesaran, M.H., Schuermann, T. and Weiner, S.M. (2004). "Modelling Regional Interdependencies using A Global Error-Correcting Macroeconometric Model" *Journal of Business and Economic Statistics*, 22(2), 129-162.

Rasche, R.H. and Tatom, J.A. (1977). "The Effects of the New Energy Regime on Economic Capacity, Production, and Prices" *Federal Reserve Bank of St. Louis Review*, 59(4), 2-12.

Riman, B.H., Akpan, S.E. and Offiong, I.A. (2013). "Exchange Rate Volatility and Domestic Investment in Nigeria" *British Journal of Economics, Management and Trade,* 3(4), 513-532.

Thankgod, O.A. and Maxwell A.I. (2013). "The Effects of Oil price Shock on Monetary Policy in Nigeria" *International Review of Social Sciences and Humanities*, 5(1), 58-66.

Umar, G. and Abulhakeem, A.K. (2010). "Oil Price Shocks and the Nigerian Economy: A Variance Autoregressive Model" *International Journal of Business and Management,* 5(8), 39-49.

Wakeford, J. (2006). "The Impact of Oil Price Shocks on The South African Macroeconomy: History and Prospects" Conference on Accelerated and Shared Growth in South Africa: Determinants, Constraints and Opportunities, South Africa.

West African Monetary Agency. (2008). Impact of Petroleum Price Fluctuations on Key Convergence Criteria in ECOWAS Member States. Available at: http://www.amaowama.org/fr/Publications/Oil%20Impact%20Study%20Progress%20Report%20DRO.pdf