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# OIL PRICE SHOCKS, EXCHANGE RATE AND NIGERIA'S ECONOMY

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**Abstract**

*The recent oil price shock and its effect on the stability of the Nigerian economy had led to a reawakening of the chosen theme. This study empirically examined the relationship between oil price shocks, exchange rate, external reserve and real GDP in Nigeria using data spanning from 1971Q1 to 2014Q4. The variables of interest were analyzed using Structural Vector Autoregressive (SVAR) Model. The impulse response functions as well as variance decomposition results were derived from the analysis. Some insightful findings emanated from the study. It was revealed that oil price shocks had negative effect on external reserve, exchange rate and economic growth. The negative effect of oil price shocks on external reserves and economic growth tended to be more significant in the long run. The findings of this study revealed that oil price shocks had a deleterious effect on the macroeconomic performance of Nigeria. An effective macroeconomic management is required to reduce the adverse effect of oil price shocks in the country.*

*Keywords: Oil shocks, Exchange Rates, External Reserves, Output Growth, Structural Vector Autoregressive Model*

## INTRODUCTION

The recent commodity price fluctuations have been a major concern to both policy makers and academics globally. A substantial fluctuation in the price of oil could have significant implication on macroeconomic variables, such as, exchange rate, external reserve and economic growth. Theories have shown that oil exporting countries may experience exchange rate appreciation when oil price rises and depreciation when oil price falls (Corden 1984; De Grauwe 1996). However, empirical findings had shown mixed evidence for the relationship between oil price,

exchange rate and their major determinants. For instance, Akram (2004) obtained a negative relationship between oil price and exchange rate in Norway. Jiranyakul (2015) revealed a positive and statistical significant impact of oil price on exchange rate movements in Thailand. Kilian (2009) argued that the impact of oil price shocks depends on the sources of oil price fluctuation. Crude oil price shocks could result from both demand and supply sides of the global market. The demand side is due to industrial expansion, speculation, availability of alternative energy sources. Supply side emanates from the Organization of Oil Exporting Countries (OPEC) policies, political unrest in oil-rich areas and the geological formation in which the oil is found.

Exchange rates of oil exporting countries are highly depended on oil price fluctuation. Hence, the adjustment mechanism depends on the source of the shocks, the exchange rate regime and the external reserve accumulation of the economy. Most oil exporting countries operate managed float exchange rate system; hence dwindle oil price in this type of regime will affect their external reserves. To a large extent, the ability of countries to manage their exchange rate depend on the level at which they have accumulated external reserve during an oil boom.

Nigeria's economy has heavily depended on crude oil export since the 1970s. Over the periods, several episodes of fluctuation in crude oil prices occurred in the international market. These frequent swings in oil prices have important implications on the exchange rate and external reserve accumulation in the country. Crude oil price fell from US$34.00 to US$17.01 per barrel between 1981 and 1985 and external reserve declined from US$4682.90 million to US$981.81 million. In the reference period, exchange rate depreciated from N0.64 to N0.99 per dollar. Recently, crude oil price declined from $111.46 per barrel in 2011 to $63.28 per barrel at the end of 2014. This development has led to substantial reduction in external reserve and a further depreciation of the exchange rate in the country.

The fall in crude oil price in the past few years has largely affected the Nigerian economy by substantially reducing government revenue. Accordingly, most of the obligations of the government to its citizenry have not been adequately met. The statutory federal allocations to the state have largely reduced. Nigerian government could not adequately finance capital project and salaries of workers especially at the state and local government levels were also not paid for several months. In light of this, Nigeria's government has to adopt measures to reduce spending. Consequently, the monetary authority devalued the naira since there was an increasingly depletion of the external reserve. Naira was devalued from N155/USD to N198.6/USD between November 2014 and March 2015 to reduce the demand of foreign exchange by the end users.

This study examines the relationship between crude oil price, exchange rate, external reserve and economic growth in Nigeria using data spanning from 1971Q1 to 2014Q4. Earlier studies generally focused on the effect of oil price on economic growth with little attention on the channels of transmission via exchange rate to external reserve. Since Nigerian budget is prepared based on the variability of crude oil price and about 75% of government revenue is derived from crude oil export; any shock in this sector could adversely affect the stability of the economy.

The organization of the rest of the paper is as follows. Section 2 is a highlight of some of the development in Nigeria's economy with emphasis on the variables of interest. Literature review appears in section 3, while section 4 provides the methodology and data sources. Model estimation and results are discussed in section 5. Lastly, section 6 presents the conclusion and some policy implications of the results.

## Nigeria's Economy: Crude Oil, Exchange Rates and External Reserves Movements

This section highlights the development in the oil sector and factors responsible for the fluctuation in crude oil prices. It provides the external reserve profile of Nigeria. Further, the movements of the exchange rate and the various exchange rate policies since the establishment of Central Bank of Nigeria are discussed.

### *The Development in the Crude Oil Sector*

After the discovery of oil in commercial quantity in 1956 and its exploration in 1971, crude oil has remained Nigeria's major export product. Nigeria experienced an era of oil boom in the 1970s. The price of crude oil rose from $2.70 per barrel in 1973 to $29.04 per barrel in 1983. The value of crude oil export in the reference period increased from N1,893.5 million to N7,201.2 million.

This oil boom period led to substantial decline in the non-oil traded goods notably agricultural export. The increased oil price in the international market in this period was caused by the high demand for the product by the industrial sector. Available statistics revealed that by 2013 the monetary value of crude oil production in Nigeria stood at N13,750 million (CBN, 2014). Nigeria's oil accounts for about 35% of the gross domestic product (GDP) and 90% of total export revenue. At the end of 2014, crude oil prices had fallen to $63.28 per barrel, Nigeria's government through its monetary policy committee had to devalue the naira since it could not defend the currency with the accumulated external reserve.

***Exchange Rate, External Reserves and Output Growth in Nigeria***

Several exchange rate policies have been adopted by the Central Bank of Nigeria (CBN) since its inception in 1958. Exchange rate policies can be broadly classified in two major regimes; the fixed and flexible regimes. The fixed exchange rate regime spanned from 1962 to 1986; it was in line with the CBN exchange control act while the flexible regime has been in operation from mid 1986 up till date. During the earlier period of fixed exchange regime Nigeria's Pounds were used as a medium of exchange with easy convertibility with British Pounds. The fixed exchange rate regime induced an over-valuation of the naira and increased importation of finished goods. In 1973, Nigeria's Pound was changed to Naira and was pegged to a basket of some countries' currencies which were its major trading partners.

The sudden rise in the price of crude oil in the 1970s increased the foreign exchange earnings of the country and accumulation of external reserves. Nigerian economy experienced oil glut in the early 1980s. This led to a substantial reduction in the foreign exchange receipts. At this time, the government could not sustain the operation of the fixed exchange rate regime; hence, certain policies were put in place in 1985 to deregulate the Foreign Exchange Market (FEM).

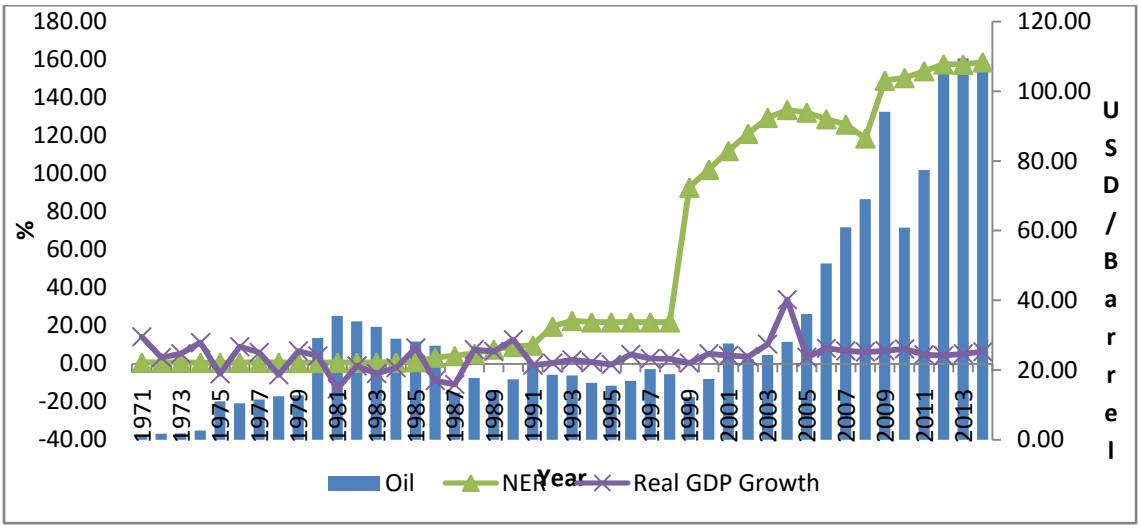
In terms of growth, Nigeria's real GDP grew steadily before the Structural Adjustment Programme (SAP) except for the period of 1980s (see table 1). A major cause of the decline in economic growth between 1981 and 1985 was the recession that followed the oil boom period of 1970s. Also, in the reference period, the external reserve of the country declined substantially due to fallen crude oil prices.

As part of the policies of the SAP that was introduced in 1986, the Federal Government of Nigeria deregulated the foreign exchange market and introduced the second tier foreign exchange market. In the second tier foreign exchange market, the determination of the Naira and the allocation of foreign exchange were based on the market auction system. Exchange rate depreciated from N0.71 per dollar before the deregulation to N3.31 per dollar in 1986. In 2000, the Naira further depreciated against the dollar after the introduction of the Interbank Foreign Exchange Market; at this time, the exchange rate stood at N102 per dollar (see figure 1). During the period of deregulation, external reserves increased largely and the country's real GDP responded to the deregulation policies of the federal government. Consequently, some policies were put in place in the FEM.

One of the notable developments in the FEM between 2001 and 2002 was the introduction of Dutch Auction System (DAS) in 2002 due to excessive depletion of external reserve. The CBN determines the amount of foreign exchange to be sold under the DAS. Other developments in FEM were the introduction of the Wholesale Dutch-Auction System (W-DAS) in

2006 and Retail Dutch-Auction System (R-DAS) in 2009. The increased demand for foreign exchange by end users coupled with a gradual reduction in crude oil price in the international market necessitated further depreciation of the exchange rate in 2014. Statistics show that external reserve fell heavily in 2013 and 2014, though positive growth in real GDP was recorded (see Table 1).

Figure 1: Crude Oil Prices, Exchange Rate and GDP Growth




Source: Constructed by the author based on data from Central Bank of Nigeria

Table 1: External Reserves, Crude Oil Prices and NER

| Years | External Reserve USD Million | Crude Oil Price USD/ Barrel | NER (N/$) | Growth rate of External Reserve (%) | Real GDP Growth Rate (%) |
|---|---|---|---|---|---|
| 1971-1975 | 1238.56 | 5.53 | 0.63 | 145.24 | 5.79 |
| 1976-1980 | 3014.29 | 20.32 | 0.63 | 16.13 | 4.05 |
| 1981-1985 | 1549.53 | 30.13 | 2.93 | -5.20 | -2.59 |
| 1986-1990 | 3863.21 | 17.01 | 13.74 | 47.80 | 1.45 |
| 1991-1995 | 4472.18 | 17.16 | 21.89 | 12.26 | 0.50 |
| 1996-2000 | 5571.04 | 19.29 | 52.09 | 36.91 | 3.26 |
| 2001-2005 | 12512.30 | 32.44 | 125.58 | 32.92 | 11.15 |
| 2006 | 37456.09 | 61.00 | 128.65 | 56.15 | 8.21 |
| 2007 | 45394.31 | 69.04 | 125.83 | 21.19 | 6.83 |
| 2008 | 58474.38 | 94.10 | 118.57 | 28.81 | 6.27 |
| 2009 | 77152.31 | 60.86 | 148.90 | 31.94 | 6.93 |
| 2010 | 37358.71 | 77.38 | 150.29 | -51.58 | 7.84 |
| 2011 | 32639.80 | 107.46 | 153.86 | -12.63 | 4.86 |
| 2012 | 43830.00 | 109.45 | 157.50 | 34.28 | 4.28 |
| 2013 | 42850.00 | 105.87 | 157.31 | -2.24 | 5.39 |
| 2014 | 37220.33 | 63.28 | 158.55 | -13.14 | 6.31 |

Source: Compiled by the author, based on data from CBN, OPEC and WDI

## LITERATURE REVIEW

### Theoretical Literature

The theoretical relationship between oil price shocks and economic activities changes overtime due to several episodes of oil price fluctuations and their implications for real sector variables. There is no clear theoretical conclusion on the effect of oil price changes on economic performance. Some studies have emphasized the role of exchange rate in the transmission of oil prices to macroeconomic variables.

One of the insightful theories on the relationship between commodity prices, exchange rate and macroeconomic variables was developed by Dornbush (1987) using a partial equilibrium framework. This theory assumes an exogenous movement in the nominal exchange rate. The exchange rate movement and the near flexible money wage interact to produce cost shocks for some firms in the domestic and foreign countries, hence leads to a wide adjustment in prices.

Real exchange rate variability plays a major effect on the Dutch disease hypothesis; this involves the adverse effect of the discovery of natural gas on Dutch manufacturing companies which led to the subsequent appreciation of real exchange rate (Corden, 1984). The hypothesis indicates a positive relationship between oil prices and real exchange rates. The assumption of an exogenous exchange rate and sticky wages diminishes the empirical validation of this theory. Zeitz (1992) considered a macroeconomic model to determine how income and price elasticities of import demand are affected by oil price shocks and exchange rate changes. The general conclusion of the model shows that a rise in oil price increases in absolute terms the income and price elasticities of non-oil import demand. The model provides a useful framework in the prediction of the reaction of income-price elasticities for non-oil import demand to the changes in exchange rates. Hamilton (2008) used demand and supply framework to establish market clearance in the petroleum products market and emphasized the role of price and income elasticities in oil price shocks.

DePrratto *et al* (2009) developed a semi-structural New-Keynesian model of an open economy based on the IS-LM framework. The model shows that oil price changes can have temporary and persistent effects on output via the supply and demand sides of the economy. Three major channels were identified. An increase in oil prices shift the IS curve (demand side), this affect the Philip's curve through inflationary effects (supply side) and affect the growth rate of potential output (output effect). However, this analysis undercut the role of exchange rate in the transmission of oil price changes to the monetary and real sectors of the economy.

**Empirical Evidences**

Empirical studies on the effect of oil prices on the macro economy have provided different results on the relationship. Some studies have shown that an oil price increase had positive effect on the growth of an economy (Shafi and Hua, 2014; Jiranyakul, 2015). Others have concluded that increase in the price of oil could have detrimental effects on macroeconomic performance (see for instance, Hamilton, 1983; Gosh *et al*, 2009; Elder and Serletis, 2010). The findings largely depend on whether the economies in question are oil exporting or importing and the degree of their dependency on oil. Some studies in the U.S. provide some striking conclusions on the subject. In an insightful paper, Hamilton (1983) revealed a strong causal and negative relationship between oil price and real GNP; oil price was found to have contributed to some of the U.S. recession. Hamilton and Hererra (2004) established that monetary policy measures may not have strong effects in reducing oil price shocks. In a similar study on the U.S economy, Raymond and Rich (1997) employed the Markov State Switching approach to analyze the effect of oil price shocks on post war business cycle fluctuations. It was revealed that the behaviour of oil prices has been a contributing factor to the slow growth of output. However, the movement in oil prices has not been a major determinant in the slow growth process of the U.S.

Gosh *et al* (2009) employed error correction model to determine the effect of oil price shocks on U.S. economic growth. The finding was that oil prices reduced GDP which supported the argument of Hamilton (1983). In a similar study, Lee *et al* (1995) argued that oil prices could have greater impact on real GNP in an environment where oil prices are less volatile than in an environment where oil prices fluctuation are persistent. It was further posited that a positive normalized shocks largely affect growth while negative normalized shocks pose no effect on output growth in the U.S. Hillard (1998) shows that a significant part of oil prices uncertainty in the U.S. was due to adjustments within the energy sector and not within the rest of the economy. Gronwald (2008) found that consumer and import prices are also affected by oil price increases. The impact of oil price shocks on real GDP growth in the U.S. was largely attributed to the oil price shocks of 1973-74, 1979 and 1991.

A non-linear approach was adopted by Akram (2004) to investigate the relationship between oil prices and exchange rates in Norway. Evidence from the study revealed a negative relationship between exchange rates and crude oil prices. The study conducted by Elder and Serletis (2010) showed that volatility of oil prices has a negative effect on consumption and aggregate output. The effect of oil price uncertainty was found to exert statistically significant effect on durable consumption and fixed investment.

Jiranyakul (2015) examined the relationship between real oil price and real effective exchange rate using Autoregressive Distributed Lags model. It was reported that an increase in real oil price volatility leads to increase in real exchange rate volatility which has harmful effects on trade. The study revealed no evidence of cointegration and causality among the variables.

Miguel *et al* (2003) analyzed the effects of oil price shocks on the characteristics of the business cycle and welfare. The paper revealed a negative and statistically significant effect of an increase oil price on welfare in Spain. Oil price shock was estimated to account for more than half of the aggregate fluctuations in the Spanish economy. In a panel study of 21 countries using multivariate threshold model, Huang (2008) investigated the factors affecting the response to the impact of positive oil price shock. It was shown that as an economy becomes more developed and acquires lower ratio of energy use in its industry and transportation sectors, the threshold of tolerance becomes greater. Shafi and Hua (2014) found that imports, exports, inflation and interest rate have statistically significant impact on Russian real effective exchange rate in the long run and short run. The results indicated that a rise in oil price has a positive effect of GDP of the country.

In a study conducted on OECD economies, Jimenez-Rodriguez and Sanchez (2004) showed an evidence of a non-linear impact of oil prices on real GDP. In the oil importing countries, oil price was found to have a negative impact on economic activities. Oil price increase was found to affect UK negatively and Norway positively.

On MENA countries, Berument *et al* (2010) employed Structural VAR (SVAR) technique to examine how oil price shocks affected their output growth. The findings suggested that the effect of oil price increases varies across the selected countries. It was positive on the outputs of Algeria, Iran, Libya and United Arab Emirates. The impact was not statistically significant on output of Egypt, Israel and Tunisia. Oil supply shocks resulted to lower output growth; the effects of oil demand shocks on output were however positive.

Akpan (2009) found a positive relationship between oil price changes and government expenditure in Nigeria. A significant appreciation of exchange rate was reported due to oil price increase. The results show a marginal impact of oil price increase on industrial output growth. These results imply that oil price increase could lead to exchange rate appreciation for an oil exporting country. On the other hand, exchange rate depreciation could be expected from dwindled oil prices. The study by Aliyu (2009) indicated that oil price shock and appreciation in the level of exchange rate increases the real economic growth in Nigeria. Most of the studies conducted have neglected the role of external reserve and inflation in the transmission of oil price shocks on economic growth. This empirical enquiry will examine the importance of these variables in the transmission channel.

## RESEARCH METHODOLOGY

### Theoretical Framework

#### *Oil Price and Exchange Rate*

The starting point of the theoretical model is to establish the relationship between oil price shocks and exchange rate. Dutch disease hypothesis shows a positive relationship between real exchange rate and real oil prices. Since oil is an exportable commodity in Nigeria, a rise in the real price of oil has a positive effect on wealth, hence, the spending effect and real exchange rate appreciation. However, a fall in oil price causes a decline in spending and real exchange rate depreciation. Oil price rise can be caused by an increase in demand over supply in the international market and discovery of new oil reserves. Thus, suggesting increase in potential levels of profitable output.

$$oilp = \Delta(rer\pm) \quad (1)$$

Equation (1) shows that a rise or fall in real oil price ($oilp$) could lead to real exchange rate $(rer)$ appreciation and depreciation respectively.

#### *Oil Price Shock and the Macroeconomy*

The point has been made that negative oil price shocks implies real exchange rate depreciation. In an economy that operates a managed float exchange rate system with oil as an exportable commodity, a fall in real oil price would deplete external reserves since the monetary authority relies on the external reserve to keep exchange rate fairly stable.

Barsky and Kilan (2002) employed Gordon (1984) type model to show that oil price shock can be inflationary by reducing industrial production which could generate stagflation. Further, oil price shock could have a long-term implication for economic growth. For an oil exporting country, a fall in crude oil price causes substantial decline in oil revenue, hence, capital accumulation fall. This occurs especially for a small open economy that depends majorly on imported capital. Therefore, dwindle oil price negatively affects government expenditure and economic growth.

### Unit Root

Since this study entails the use of time series data, it is essential to conduct unit root test of variables to be used. The Augmented Dickey-Fuller (ADF) unit root test technique is adopted to determine the stationarity properties of the time series variables. ADF statistic test the null

hypothesis that a series ($Y_t$) is non-stationary by calculating a t-statistics for $\varphi = 0$ against the alternative hypothesis that $\varphi < 0$ in the following equation:

$$\Delta Y_t = \alpha + \beta t + \theta Y_{t-1} + ... + \varphi_\rho \Delta Y_{t-\rho+1} + u_t \quad (1)$$

$Y_t$ represents each of the variables to be tested for unit root. Once the computed ADF value is obtained it can be compared with the critical value of the Dickey-Fuller statistics.

**Estimation Technique**

The Structural Vector Autoregressive Model (SVAR) technique is adopted for this study because it enables to determine the effect of different regimes of exchange rate on general macroeconomic performance in Nigeria. This technique SVAR is useful to determine how the economy responds to structural shocks that emanate internally and externally. VAR technique was introduced by Sims (1980) and extended by Sims and Zha (2005), Blanchard and Quah (1988). Blanchard and Perotti (2002) used the SVAR procedure to document the effect of fiscal policy shocks on taxes and output. Some studies, for instance, Christanio *et al* (2005) and Berument *et al* (2010) have used SVAR to analyze the impact of shocks on macroeconomic variables. The SVAR helps to determine how one standard deviation shock in the error term of a variable affects other endogenous variables in the model. It can be used to forecast the extent of error variance of variables that is due to oil price shocks. The model considered for this study assumes that the Nigerian economy can be represented by a structural equation as follows:

$$A(L)X_t + B(L)Y_t = U_t \quad (2)$$

The $A(L)$ and $B(L)$ are $n \times m$ and $n \times k$ matrices respectively. $X_t$ is an $n \times 1$vectors of exogenous variables and $Y_t$ is $k \times 1$ vectors of endogenous variables. $U_t$ is an $n \times 1$ vectors of random structural disturbances.

The contemporaneous structural parameter and the restrictions are imposed in the order as follows:

$$\begin{bmatrix} U_{OILP} \\ U_{EXRE} \\ U_{RER} \\ U_{INF} \\ U_{RGDP} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ \beta_{21} & 1 & 0 & 0 & 0 \\ \beta_{31} & \beta_{32} & 1 & 0 & 0 \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & 0 \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{OILP} \\ \varepsilon_{EXRE} \\ \varepsilon_{RER} \\ \varepsilon_{INF} \\ \varepsilon_{RGDP} \end{bmatrix} \quad (3)$$

Where, $U_{OILP}, U_{EXRE}, U_{RER}, U_{INF}\ and\ U_{RGDP}$ are the structural disturbances of oil price, external reserves, real exchange rate, inflation and real GDP. The model satisfies the assumption of $E(U_t) = 0,\ Var(U_t) = \delta^2$ and $\varepsilon_{OILP},\ \varepsilon_{EXRE}, \varepsilon_{RER}, \varepsilon_{INF}\ and\ \varepsilon_{RGDP}$ are the reduced-form residuals. The restrictions on the structural parameters in the matrix are imposed following studies, such as, Sims (1999), Lee and Ni (2002) and Muhammad *et al* (2011). Identification of the variables in equation 3 follows their response to shocks.

**Data Sources**

This study uses secondary data collected from the publications of various organizations and agencies. Data on crude oil prices are collected from International Monetary Fund's International Financial Statistics while nominal exchange rates and external reserves were collected from the Central Bank of Nigeria (CBN) statistical bulletin. The data on Nigeria's Gross Domestic Products (GDP) were gathered from World Bank's World Development Indicator (WDI). Real exchange rate was obtained by adjusting for relative prices between United States Consumer Price Index and Nigeria Consumer Price Index.

**ANALYSIS AND DISCUSSION OF RESULTS**

The result of the unit root test is presented in table 2. Critical values of the t-statistics are reported to determine whether the null hypothesis that variables have unit root would be rejected. The t-values show that external reserves (EXRE), Inflation (INF) and real GDP growth (RGDP) are stationary at levels. Nevertheless, oil prices (OILP) and real exchange rate (RER) are stationary at first difference. The results obtained suggest that SVAR can be used to estimate the model. Further, impulse response function and structural variance decomposition can be derived from the SVAR's estimation.

Table 2: Augmented Dickey-Fuller Test.

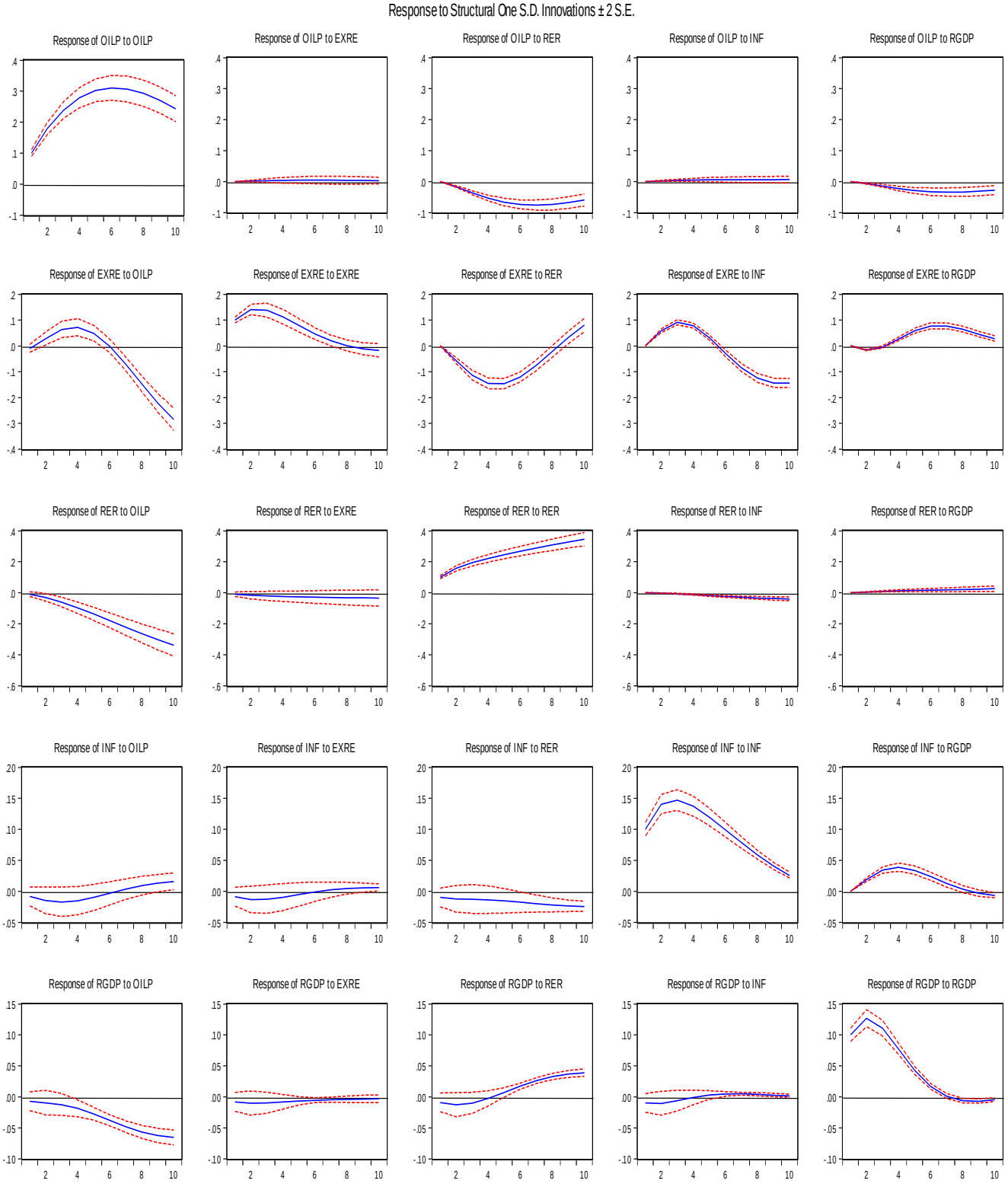
| S/No. | Variables | ADF Statistics with constant at levels | Critical value at 5% | ADF Statistics with constant at first difference | Critical value at 5% | Order of integration |
|---|---|---|---|---|---|---|
| **1** | **OILP** | -1.379762 | -2.931404 | -5.465736 | -2.933158 | **I(1)** |
| **2** | **EXRE** | -5.002315 | -2.933158 | -7.444835 | 2.935001 | **I(0)** |
| **3** | **RER** | -0.005837 | -2.931404 | -5.699306 | -2.933158 | **I(1)** |
| **4** | **INF** | -3.887260 | -2.931404 | -5.962497 | -2.938987 | **I(0)** |
| **5** | **RGDP** | -5.688763 | -2.931404 | -8.789922 | -2.935001 | **I(0)** |

The impulse response function of the SVAR is depicted in figure 2. In the first row, an internal shock on oil price shows a positive and significant response in the time period. Expectedly, the response of oil price to real exchange was negative and significant. An interesting result was obtained from the response of external reserves to crude oil price which is depicted in the second row; external reserve responds positively to oil price shocks up to the fifth period, thereafter, shocks on oil prices negatively affected external reserves. This suggests that negative oil price shocks (fall in crude oil price) would result to the depletion of external reserve in the long run. Further, the response of external reserve to real exchange rate was positive in the short term and medium term and became negative in the long term (see fig. 2). This implies that external reserves depletion leads to devaluation of exchange rate in the periods. The operations of monetary authority in Nigeria over the years had followed these findings. A plausible explanation for this is because of the managed float exchange rate system which operates in Nigeria; the monetary authority draws from the external reserve to stabilize the exchange rate.

Similarly in the third row, the response of real exchange rate to a standard deviation shock in oil price was negative and significant especially at the end of the period. It indicates that dwindled oil price resulted to exchange rate depreciation in the period under study. This finding is in line with theory and the results obtained by Akram (2004). The responses of shocks on inflation to oil prices, external reserves and real exchange rate are negative. Additionally, inflation responded positively to real GDP growth.

A striking result emerged in the last row; here, real GDP growth responded negatively to oil price shock. This result is insightful, since Nigeria's economy depends mainly on crude oil price, structural shocks on the price of crude oil could slow down growth in the economy. These findings are supported by wide range of empirical findings, notably, Hamilton (1983), Lee *et al* (1995) and Gosh *et al* (2009), among others.

## Figure 2: Impulse Response Function Graphs



The results of the Structural Variance Decomposition (SVD) are given in table 3. The prime interest of this discussion is the shocks to external reserves, real exchange rates, inflation and real GDP explained by innovation in oil price. It can be deduced that 7.6% and 39.0% of the variation in external reserve are explained by innovations in oil price in the fifth and tenth periods respectively (see table 3).

This implies that external reserves decline as more shocks occur on the prices of crude oil. Further, 15.1% and 36.6% variation in the real exchange rate are explained by oil price in the fifth and tenth periods, respectively. Also, inflation is marginally affected by innovations in oil price; this is obvious in the results of its structural variance decomposition. The responses of real GDP explained by innovation in oil prices are 2.9% and 24.1% in the fifth and tenth periods respectively. This shows that 24% of the variation in real GDP growth could be attributed to oil price changes.

In the third row, second column, the result of the variance decomposition reveals that 19.3% of the shocks to external reserves are explained by variation in inflation. This suggests that increases in general price level could lead to substantial variation in external reserve in the country. Since Nigeria depends largely on importation, devaluation of exchange rate can result to increase in price of basic commodities and an ample amount could be drawn from external reserve to service the country's importation.

An important implication can be drawn from the shocks to external reserves explained by innovations in real exchange rates. In the fifth and tenth periods, 36% and 20% of the variation in external reserves are explained by real exchange rate dynamics. Also, the results obtained indicate that the country's inflation is affected by the real exchange rate variation, especially in the long run (see the fourth row of the SVD). This result is expected since exchange rate directly affects general price level. More importantly, a country that relies heavily on imported goods would experience inflation during exchange rate depreciation.

Consequently, about 7.6% of the variation in real GDP is being explained by innovations in real exchange rates in the tenth period. This figure shows that real GDP growth could be largely affected by variation in real exchange rate.

Table 3: Structural Variance Decomposition

| Horizon (Years) | OILP | EXRE | RER | INF | RGDP |
|---|---|---|---|---|---|
| Shocks to OILP explained by innovations in: | | | | | |
| **1** | 100.0000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| **5** | 96.20154 | 0.014795 | 3.176866 | 0.028834 | 0.577969 |
| **10** | 94.29668 | 0.015858 | 4.708136 | 0.038023 | 0.941305 |
| Shocks to EXRE explained by innovations in: | | | | | |
| **1** | 0.990099 | 99.00990 | 0.000000 | 0.000000 | 0.000000 |
| **5** | 7.638820 | 41.72564 | 36.29933 | 11.60384 | 2.732374 |
| **10** | 39.00014 | 16.26917 | 20.04494 | 19.32561 | 5.360133 |
| Shocks to RER explained by innovations in: | | | | | |
| **1** | 0.795600 | 0.982222 | 98.22218 | 0.000000 | 0.000000 |
| **5** | 15.15951 | 0.935258 | 83.44579 | 0.261096 | 0.198348 |
| **10** | 36.58588 | 0.655899 | 61.92936 | 0.578313 | 0.250551 |
| Shocks to INF explained by innovations in: | | | | | |
| **1** | 0.640309 | 0.790505 | 0.975933 | 97.59325 | 0.000000 |
| **5** | 1.015486 | 0.607797 | 0.931572 | 92.88719 | 4.557954 |
| **10** | 1.241955 | 0.556919 | 2.756189 | 91.20852 | 4.236422 |
| Shocks to RGDP explained by innovations in: | | | | | |
| **1** | 0.515974 | 0.637005 | 0.786427 | 0.970897 | 97.08970 |
| **5** | 2.926451 | 0.789152 | 0.819885 | 0.537806 | 94.92670 |
| **10** | 24.05476 | 0.682196 | 7.637973 | 0.478838 | 67.14624 |

## CONCLUSION

This study empirically investigates the relationship between crude oil price, exchange rate, external reserve and economic growth in Nigeria. The recent oil price shocks and the consequent economic crisis in oil exporting countries had necessitated an empirical enquiry of this type. Time series data employed in the study were tested for stationarity. Consequently, the variables were estimated using SVAR technique; impulse response function as well as variance decomposition results were obtained from the analysis. Some striking findings emerged from the impulse response function and variance decomposition estimation.

Evidence from the impulse response functions revealed that negative oil price shocks had detrimental effect on macroeconomic performance in the country. Sudden fall in the oil price has a negative and significant medium and long term effects on external reserve. Also, exchange rate responded negatively to oil price shocks. It was found that substantial decline in crude oil price had led to depreciation in exchange rate in the periods under study. Further, negative oil price shocks adversely affected real GDP growth rates up to tenth period. The results of the variance decomposition corroborate the ones obtained from the impulse response functions. Overall, findings from this study showed that negative oil price shocks pose deleterious effect on macroeconomic variables in Nigeria. The transmission channel of crude oil

price shocks to economic performance is through external reserves, exchange rate and inflation. The impact on Nigeria's economy is large due to its dependency on crude oil.

Policy lessons that can be drawn from these findings are three folds. First, it is necessary for Nigeria's economy to be diversified since shocks in crude oil price had deleterious effect on macroeconomic variables in the country. Second, government pursuit of managed float exchange rate is desirable to ensure a substantial increase in the external reserve without significant damage of the exchange rate of the country. Third, an effective management and stabilization of crude oil price by Organization of Petroleum Exporting Countries (OPEC) could reduce the adverse effect of its shocks on economic performance of Nigeria.

Further studies may include more macroeconomic variables such as investment and government expenditure in the analysis of oil price shocks and the economic performance. This study involves time series data analysis; future studies could consider more countries and employ a panel data procedure. Usually inference drawn from time series analysis might be different from a panel analysis.

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