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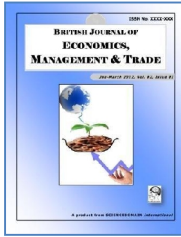
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Assymmetric Effect of Oil Price Shocks on Exchange Rate Volatility and Domestic Investment in Nigeria

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Authors' contributions

This work was carried out in collaboration between all the authors. All the authors proof read the manuscript throughout all the stages of the review process.

Research Article

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ABSTRACT

Aim: The paper aimed at examining the asymmetric effect of oil price shock on exchange rate and domestic investment in Nigeria.

Study Design: Country case study.

Place and Duration of Study: Nigeria. Time series data ranging from 1970-2010.

Methodology: This study utilised elaborate econometric analysis which tests the sensitivity of exchange rate, private investment, public investment, per capita income and industrial production to oil price shocks, using the Impulse Response Functions (IRFs) and Variance Decomposition (VDC) techniques within a Vector Autoregressive (VAR) framework.

Results: The result clearly revealed that while government expenditure exhibited immediate positive response to oil price shock, public investment, private investment and industrial production exhibited negative response to oil price shock, further confirming the evidence of "Dutch disease" in Nigeria. The variance decomposition analysis further revealed that exchange rate, government expenditure and domestic investment were mainly affected by oil shock, particularly, in the short run.

Conclusion: The study concludes that volatility in crude oil prices has negative impact on domestic investment and industrial development in Nigeria. It is recommended among other things in this study that the usual practice of sharing oil windfalls to the three tiers of government should be discouraged; rather, the central government should allocate these windfalls to priority sectors of the economy to enhance development.

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Keywords: Impulse response function; variance decomposition analysis; vector auto-regression; oil price shock; domestic investment; government expenditure; exchange rate.

1. INTRODUCTION

The abundance of natural resources, particularly crude oil, has been described as a blessing to many nations since its presence is said to spur economic growth. However, the consequences of oil price increase different amongst countries. All things being equal, oil price increase should be considered positive in oil exporting countries and negative in oil importing countries, while the reverse should be expected when the oil price decreases. Researchers have expounded on the channels through which oil price increase affects the economy [1]. Transmission mechanisms through which oil prices impact on real economic activity include both supply and demand channels. The supply side effects are related to the fact that crude oil is a basic input to production, and consequently an increase in oil price leads to a rise in production costs that induces firms to lower output. The demand-side effect of oil prices changes affects basically consumption and investment. These authors noted that consumption is affected indirectly through its positive relationship with disposable income. The magnitude of this effect is in turn stronger the more the shock is perceived to be long-lasting. Moreover, oil prices have an adverse impact on investment by increasing firms' costs.

[2]. The wake of oil price increase supply suffers as production costs rise. Given substitution between production factors, relative price changes result in a reallocation of the means of production. However, these intersectoral reallocations also generate costs (training expenses, irreversible investments, etc.) Thus, the actual impact on investment essentially depends on the expectations about the stability of oil price changes, which tend to vary over time. On the demand side, oil price shocks drive up the general level of prices, which translates into lower real disposable incomes and thus reduces demand [3]. Consumption and investment is said to be affected due changes in the demand side. Consumption is affected indirectly through its positive relationship with disposable income while investment is adversely affected indirectly because such increase in oil price also affects firms' input prices and thereby increasing their costs. Oil price changes also influence foreign exchange markets and generate stock exchange panics, higher interest rate, produce inflation and eventually lead to monetary and financial instability.

The Nigerian economy is constantly exposed to oil price shocks since oil contributes over 90% of the total revenue. The dependency of the country on crude oil revenue is amplified by the usual budgetary estimate based on forecast from the expected crude oil prices. Shortfall on oil revenue occasioned by fluctuations in international oil prices had often led to deficit in the country's budget. Such deficits are usually financed by either external or internal borrowings or through downward adjustments in sectoral budgetary allocation. However one may look at it, shortfalls from oil receipts have negative impact on the country's economic growth.

The significant effect of oil price shocks is explained by the "Dutch Disease" syndrome, a relationship that explains the decline in manufacturing sector despite increase in the exploitation of natural resources [4]. Oil price shocks have become a very important impediment to the development of growing economies. The dependence on natural resources (oil) revenues makes the national economy vulnerable to market prices. The oil dependence and the volatility of oil prices in international markets lead to significant

problems in fiscal planning, reduction in quality of public spending, and lead to financial disaster when oil prices collapse. When oil prices fall, however, fiscal budgets go into deficit, countries start taking loans leveraged against their reserves, and march unimpeded into debt [5]. Revenue generated when prices are high tends to cause “Dutch-Diseases”, high oil revenue raises exchange rates, promotes an adverse balance of payments when prices fall, reduce the incentive to risk investment in non-oil sectors like agriculture and manufacturing.

Most studies investigating the links between real exchange rate and oil prices are actually motivated from the Dutch Disease phenomena. According to the Dutch Disease phenomena, shocks to booming sector (natural resource rich sectors such as oil) leading to increases in its price will lead to more investment in this sector. In turn, more labor is needed in this sector to produce more output, and this causes labor shift from agricultural and manufacturing sector to the booming sector. As a result, competitiveness and exports of other sectors will decrease. At the same time, increased labor demand in booming sector will place an upward pressure on wages. Then, an increase in wages and price of non-tradable goods in terms of tradable will cause an appreciation of real exchange rate of the country. Based on the above analysis one can say that oil producers and oil exporting countries may have different reaction to changes in oil prices, and also exchange rate can be an effective policy instrument in managing oil price shock, especially in oil producing countries, particularly there is a no strong causal nexus from oil price to exchange rate [6].

The Dutch Disease is the most significant challenge that developing oil exporting countries are grappling with. It is on this backdrop that this paper intends to empirically identify the asymmetric behavior of oil price shock on exchange rate and domestic investment in Nigeria. Though several research abounds on the asymmetric impact of oil prices on exchange rate, output and prices in Nigeria [7, 8, 3, 9, 10] these researchers did not empirically test the asymmetric effect of oil price shock on domestic investment (public and private). This is the gap this work intends to fill since an understanding of the direction of effect of oil price on domestic investment will enable firms to determine their operational budgeting technique particularly, as it effect oil price speculation and decisions making.

1.1 Statement of Problem

Nigeria's economy is heavily dependent on natural resources: oil and gas constitutes 98% of total exports, 80% of government revenues and around 20% of GDP [11]. In spite of the enormous economic potentials in Nigeria, it has largely failed to live up to the ambitious growth projections that followed the first oil boom in the 1970s. Also, social indicators have displayed no specific tendency towards improvement such that in 2010, Nigeria was ranked 142nd out of 169 countries by the United Nations Human Development Index. Furthermore, up to 70% of Nigerians are considered to be ‘poor’ – subsisting below the national poverty line [12]. Yet the country has been adjudged as the 6th largest exporter of crude oil in the world.

Nigeria is a country suffering from the ‘Dutch Disease’ where the country is suffering in the midst of plenty [13]. Higher oil prices have adverse effects on economic performance of oil-exporting countries as they change the structure of the economy in favor of the booming oil and non-traded sectors and against the traded manufacturing and agriculture sectors. In addition, higher oil revenues during an oil boom will lead to an appreciation of the local currency, increasing imports of intermediate and consumer goods. The heavy reliance of oil-exporting developing economies on imports will in turn harm domestic industries as they cannot compete with imported goods when oil prices are high and cannot sustain their

production levels when oil prices and imports decline. Therefore, according to Dutch disease theory, a temporary foreign exchange windfall will have a detrimental rather than beneficial effect on the economy. Following the same transmission mechanism, a decline in oil price works in an opposite direction, that is contraction in the non-traded sectors and a stronger traded sector through exchange rate depreciation.

The bulk of the problems confronting oil producing developing countries like Nigeria can be grouped into – the Dutch disease and macroeconomic volatility; rent-seeking and weak governance; and conflicts and political instability [13]. The most relevant element of the resource curse, given the objectives of this project, is the Dutch Disease. The Dutch Disease is most significant and challenging for oil producing developing countries to grapple with in the short term.

The paper will adopt the unrestricted vector autoregressive model using annual data from 1970 to 2012. The purpose of the empirical analysis is to explore whether the relationship between oil prices and economic activity exists and whether asymmetric transformations of oil price changes such as oil price volatility affect this relationship. Under continuous oil price changes, an increase in oil price volatility may asymmetrically affect production, consumption and investment

1.2 Motivation of the Study

The study is motivated by conflicting observations from various researchers regarding the asymmetric effect of oil price on economic activities. First, some researchers have linked the concept of the resource curse, especially for the real exchange rate appreciation to the “Dutch disease” further predicting strong connection between oil price and real exchange rate (RER) appreciation in oil-exporting countries [14,15,16,17]. Secondly, several studies have also found a significant positive relationship between the RER and the price of oil in oil-exporting countries in Algeria, Venezuela, Canada, Norway, Saudi Arabia and Russia in nine OPEC countries [18,19,20,21,22,23].

Nigeria being not just an oil exporting country but also an importer of refined product could be said to suffer most due to volatility in oil prices. The objective of this paper is therefore to

- 1) Empirically investigate the asymmetric relationship of oil price shock on real exchange rate and domestic investment
- 2) Examine if Nigeria economy could be said to be affected by the “Dutch Disease”.
- 3) Investigate the effect of government spending on domestic investment. That is to say, what effect does government spending have in exacerbating the Dutch Diseases? This is measurable if Government expenditure does not improve domestic investment in Nigeria

2. LITERATURE REVIEW

Questions regarding the relationship between the price of oil and economic activity are fundamental empirical issues in macroeconomics. Particularly, adequate private and public domestic investments are essential conditions for increased output and improved growth in domestic economies.

While investigating the effect of oil price shock on real GDP growth on some OECD countries [1]. They distinguished between net oil importing and exporting countries. Their study focused on the relationship between oil prices and GDP growth, analyzed in terms of vector auto-regressions by using four specifications, namely a linear model and three leading non-linear specifications. Their study found evidence of non-linear effects of oil price on real economic activity, with oil prices (or a transformation thereof) having different impacts on real output when they increase than when they fall. This result contrasts with the linear approach in which oil prices are assumed to have symmetrical impacts on real activity. The results obtain from vector auto-regressions was broadly consistent with the expectation that the real GDP growth of oil importing economies suffers from increases in oil prices in both linear and non-linear models. These contrasting results for oil exporting countries can be traced to a sharper real exchange-rate appreciation. In the case of net oil importer countries, the results obtained using the optimal order of the model (i.e. four lags) indicates a positive association between oil prices and real performance.

In a more recent study on the asymmetric effect of crude oil price and exchange rate on petroleum product prices in selected sets of Northern Mediterranean Countries [24]. observed that crude oil prices increase petroleum product prices more than exchange rates do in the long run. However, exchange rate prices were observed to increase petroleum product prices in the short run more than crude oil prices did. The effect of crude oil price on petroleum product is unarguably regionally based. Prices in regional markets reflect the supply and demand balance in each market as well as the relative quantity of each commodity. Thus, the price of crude oil is typically the largest determinant of the international prices for petroleum products which are processed or refined from crude oil. This explains why the authors could find the lowest short-run asymmetric effect of exchange rate (relative to crude oil prices) in Turkey than in Greece.

While investigating the asymmetric effects of oil price shocks on economic growth of oil-exporting countries [25]: showed that oil price shocks have asymmetric effects on their economic growth; the adverse effects of higher oil prices are larger than the stimulating effects of lower prices. The paper further revealed that the effects of oil price shocks on economic performance and their transmission mechanism in oil-exporting countries are different from those of oil-importing countries. The authors concluded that in oil exporting developing countries, lower oil prices would lead to major revenue cuts and stagnation in the economy. However, higher oil prices and accompanying higher revenues do not translate to a sustained economic growth.

[8], the immediate effect of positive oil price shocks is to increase the cost of production for oil importing countries. This is likely to decrease output, and its magnitude depends on the shape of the aggregate demand curve. Higher oil prices lower disposable income and this decreases consumption. Once the oil price increases are perceived as permanent, private investments also decrease. If the shocks are perceived as persistent, oil is used less in production, capital and labor productivity decreases and potential output falls [26]. Accordingly, using a structural VAR model, [8], have empirically shown that the impact of oil price shocks on output and prices is asymmetric in nature; with the impact of oil price decreasing significantly greater than oil price increase.

Using linear and non-linear specifications [3], assessed empirically the effects of oil price shocks on the real macroeconomic activity in Nigeria using the Granger causality tests and multivariate VAR analysis. The paper finds evidence of both linear and non-linear impact of oil price shocks on real GDP. In particular, asymmetric oil price increase in the non-linear

models are found to have positive impact on real GDP growth of a larger magnitude than asymmetric oil price decrease adversely affects real GDP. Furthermore, the authors utilized the Wald and the Granger multivariate and bi-variate causality tests. Results from the latter indicated that linear price change and all the other oil price transformations are significant for the system as a whole. Their Wald test indicates that our oil price coefficients in linear and asymmetric specifications are statistically significant.

[6]. Investigated the role of country specific and global factors, particularly oil price, on the real exchange rate (RER) in selected Commonwealth of Independent States (CIS), (Azerbaijan, Kazakhstan, Kyrgyzstan, Moldova, Russia, Turkmenistan, Ukraine, and Uzbekistan) over the period from 2000 to 2011. Their analysis was based on panel smooth transition autoregressive (PSTR) model, which takes into account the nonlinear dynamic adjustment of the real exchange rate towards equilibrium. Result from this study showed that there exists an asymmetric behavior of the real exchange rate when facing an over-or undervaluation of the domestic currency. The evidence also shows that oil price has significant impact on the appreciation of domestic currencies, particularly in oil and gas exporting relatively richer countries and the CIS countries has become vulnerable to global shocks.

The Dutch disease theory has also been used to explain the effect of oil price change on output growth in oil-exporting countries. Empirical evidence on Dutch disease theory is rather mixed. Although some studies provide evidence for Dutch disease in some oil-exporting countries, there are studies that do not support it. The Dutch disease mechanism is not responsible for poor economic performance in half of the countries investigated [27]. There is also an argument that tradable manufacturing sector was not necessarily contracted in some oil-exporting countries after the oil booms of the 1970s and the 1980s [28].

[29], applied the methodology of unrestricted vector auto regression model (VAR) to determine the asymmetric and symmetric effects of oil exports shock on non-tradable sector of the Iranian economy. The result of their non-linear model revealed that oil export movement caused asymmetric reaction on construction, service and other variables in the study. Impulse function result showed that the shocks in oil exports growth significantly increase construction, imports, manufacturing, index of services and real effective exchange rate. The variance decomposition result suggests that negative oil shocks have a stronger role on the economy compared to the positive one on construction. Overall, the oil rich country of Iran suffered from weak and undiversified economies, which result in the Dutch Disease.

[30], investigated the sources of macroeconomic fluctuations in oil exporting countries. Their result found that oil price shocks are the main source of output fluctuations in Saudi Arabia and Iran, but not in Kuwait and Indonesia.

Some authors have posited that volatility of oil prices is inelastic in the short-run [31,32]. Therefore, a small change in either demand or supply will require a large change in price to restore the equilibrium. Demand is inelastic since change in energy consumption requires a change in capital stock, which would take time to occur. Energy supply has a low elasticity since energy production is capital intensive and producers need time to expand production when prices rise. Indeed, it is oil price volatility that has led some countries to establish an oil reserve fund to alleviate the negative impact of volatility on their economic activities.

Furthermore, some researchers have investigated the changes in expenditure policy in oil exporting countries during boom-bust in commodity price circles and their implications for real exchange rate movement [33]. The paper applied a Dutch Disease model with downward rigidities in government spending to revenue shocks using a panel data for 32 oil exporting countries over a period 1992 to 2009. Their result revealed that, changes in current spending have a stronger impact on real exchange rate compared to capital spending. Their result further revealed that current spending is downwardly sticky, but increases in periods of boom, and conversely for capital spending. The result described above therefore raises concerns on potential adverse consequences of asymmetry on the economic performance in oil-exporting countries.

[34], used the VAR model with quarterly data from 1970 to 2003 to examine the effect of oil price shock on aggregate economic activity in Nigeria. Their finding showed that while oil prices significantly influenced exchange rate, it does not have significant effect on inflation and output in Nigeria. The conclusion drawn from the study was that an increase in the price of oil results in wealth effects which appreciates the exchange rate and increases the demand for non-tradable, a situation that would result in "Dutch Disease".

The extensive argument on the effect of oil price shock on real exchange rate prompted [35], to examine the relationship that exist between oil price and real exchange rate in Russia. The study which utilized the VAR model and cointegration technique revealed that Russian economy was influenced significantly by fluctuations in oil prices and the real exchange rates through both the long-run equilibrium condition and short-run direct impacts.

[36], also explored the possibility of a non-linear relationship between oil prices and the Norwegian exchange rates. The result from this study indicated that oil price was negatively related to the value of the Norwegian exchange rate when oil price was below US\$14.0, contrary to other findings from related studies.

3. METHODOLOGY OF RESEARCH

The study utilizes annual data obtained from various issues of the Central Bank of Nigeria Statistical bulletin over a period of 1970 to 2012. The paper identified the major variables to be specified in the model as Oil Price (defined in real terms, taking the ratio of the price of an internationally traded variety of crude (UK Brent) in US dollars to the Nigeria Consumer Price Index. Real exchange rates (measurement of RER follows the approach by [37]). Both the oil price volatility and exchange rate volatility were computed from their actual series as the annualized standard deviation of the percentage change of their values.

The methodology in this paper follows the step highlighted below

- Test unit root of four time series;
- Construct seven-variable VAR model;
- Johansen cointegration test;
- Dynamic simulation (impulse response function and variance decomposition);

In order to check the time series properties of the variables used in the model, the paper apply the unit root tests. The paper utilizes the Augmented Dickey Fuller (ADF) and the Phillips Perron (PP) unit root test to investigate the order of integration of the variables in the model. The Augmented Dickey-Fuller (ADF) unit root test consists of running a regression of the following form [38]:

$$\Delta y_t = a_0 + \gamma t + a_2 t + \sum_{i=2}^p \beta_i \Delta y_{t-i+1} + \varepsilon_t$$

Where $\gamma = -1 \left[- \sum_{i=2}^p a_i \right]$, $\beta_i = \sum_{j=2}^p a_j$, p indicate the lag length and t represent the trend

If the estimated coefficient γ is equal to zero, the equation is in first differences and contains a unit root. In the ADF test, the rejection of the null hypothesis implies stationarity. If the calculated ADF statistic is higher than McKinnon's critical value then the null hypothesis cannot be rejected and it may be concluded that the considered variable is non-stationary, i.e. it has at least one unit root. Consequently, the procedure needs to be repeated after transforming the series into first differences [39].

Next, the study investigates the response of macroeconomic variables to symmetric and asymmetric innovations in oil prices, we use an unrestricted vector autoregressive model (VAR) [39, 40, 41]. According to the authors, the VAR model provides a multivariate framework where changes in a particular variable (oil price) are related to changes in its own lags and to changes in other variables and the lags of those variables. The VAR treats all variables as jointly endogenous and does not impose a priori restrictions on structural relationships. Because the VAR expresses the dependent variables in terms of predetermined lagged variables, it is a reduced-form model. Once the VAR has been estimated, the relative importance of a variable in generating variations in its own value and in the value of other variables can be assessed (Forecast Error Variance Decomposition (VDC)). VDC assesses the relative importance of oil price shocks on the volatility of other variables in the system. The dynamic response of macroeconomic variables to innovations in a particular variable (e.g., here oil prices and oil market) can also be traced out using the simulated responses of the estimated VAR system (Impulse Response Functions (IRF)). Thus, the IRF allows us to examine the dynamic effect of oil price shocks on the Nigerian economy. Our unrestricted vector autoregressive model of order p is presented in equation:

$$y_t = A_1 y_{t-1} + \dots + A_p y_{t-p} + Bz_t + \varepsilon_t$$

Where y_t is a vector of endogenous variables, z_t is a vector of exogenous variables, A_i and B are coefficient matrices and p is the lag length. The innovation process ε_t is an unobservable zero-mean white noise process with a time invariant positive-definite variance-covariance matrix. The VAR system can be transformed into a moving average representation in order to analyze the system response to real oil price shock. That is

$$y_t = c + \sum \Phi_i y_{t-i} + \varepsilon_t$$

where y_t is a $(n \times 1)$ vector of endogenous variables, c is a $n \times 1$ vector of constants, Φ is a $(n \times n)$ matrix of coefficients, and $i=1, \dots, p$ is the number of lags. ε_t is $(n \times 1)$ vector of error terms with zero mean and the variance Ω . The error terms in the above reduced form VAR model contain shocks to the endogenous variables in the structural VAR model. The advantage of the VAR model is that it allows for interactions among all endogenous variables capturing the complex dynamics in the economy and estimates the impact and long run effects of shocks to each variable on itself and other variables. This is particularly important in our

context as oil price shocks can affect output growth directly and indirectly through other variables such as inflation and real exchange rates.

Endogenous variables included in the model are growth in domestic investment (private and public) as the main variable of interest, real per capita, and real exchange rates, government expenditure and index of industrial production. A change in oil price has a direct effect on GDP in oil-exporting countries through a shift in both aggregate demand and aggregate supply [25]. The system of equations in the VAR model takes into account all direct and indirect effects of oil price changes on the output growth through estimation of interactions among endogenous variables.

In our unrestricted VAR models, the vector of endogenous variables, according to our first Cholesky ordering, consists of real oil price (oilp, oilp+, oilp-), real government expenditures (govexp), real industrial production, (lindp) real per capita (lrgdp), real effective exchange rate (reex), and real domestic public investment (ripp) and real domestic private investment (rdpvi)

$yt = [oilp; govexp; rgdp; reex; lindp; ripp, rdpvi]$

The innovations of current and past one-step ahead forecast errors are orthogonalised using Cholesky decomposition so that the resulting covariance matrix is diagonal.

This assumes that the first variable in a pre-specified ordering has an immediate impact on all variables in the system, excluding the first variable and so on.

In the first set of ordering, the real oil price changes are ranked as a largely exogenous variable, especially for the case of Nigerian economy. The export quantity for Nigeria crude oil is determined by its level of domestic production which is significantly influenced by the frequency of workers strikes, civil unrest, militancy in the Niger Delta region of the country, and oil bunkering activities while export quota are predetermined by the OPEC criteria, domestic consumption and investment in oil fields. Furthermore, demand for crude oil is largely determined by global economic growth, energy intensity within industrialized economies, speculator operations in oil markets, expectations of other key oil producers about current and future developments of the market, international oil companies' decisions on liquidation of their stocks and finally, the policy of key oil consumers on strategic petroleum reserves [40]. Therefore, oil prices are an exogenous factor for the Nigerian economy. We expect that significant shocks in oil markets affect contemporaneously the other key macroeconomic variables in the system.

The second variable in the ordering is government expenditures. Government expenditures can be broadly defined as current and capital consumptions. Current expenditures cover recurrent expenditures (e.g., payments of governmental employees, subsidies, and so on.), whereas capital expenditures aim to add, rather than maintain, the physical and material assets of an economy. The relevance of government expenditure in the model originates from the fact that Governments in most oil-exporting countries undertake large social programs; expand the public sector by increasing the number of government employees, and pay generous subsidies to different sectors when the oil market is favorable. However, they cannot cut back those programs quickly when their revenues fall as oil prices plummet. Government's high expenditures during oil booms and its deficit, which is mostly financed by the central banks, during oil busts, contribute to higher prices and inflation

To check whether the assumptions of our VAR model are met, it is necessary to carefully choose the lag length in the model. The lag length is selected based on the AIC (Akaike's Information Criterion) [38]. The model will be misspecified when lag length is too small. The more lags, the more parameters we need to estimate and the less biased our results would be. The model will be over-parameterized if the number of lags is too large. Selecting the lag order is simply to understand that we find p such that $A_i = 0$ for all $i > p$ in the VAR model.

To test the long-run cointegration of four time series, the study will implement the Johansen cointegration test. Consider the following equation.

$$\Delta y_t = \alpha_0 + \alpha_{t-1} + \sum_{i=2}^p \alpha_i \Delta y_{t-i} + \varepsilon_t$$

$$\text{Where } \alpha = -1 \left[- \sum_{i=2}^p a_i \right], \beta_i = \sum_{i=2}^p a_i,$$

The number of cointegration vectors (r) is determined by the maximum eigenvalue test and the trace test [38]. Both tests are based on the likelihood ratio test. When λ trace and λ_{max} conflict, we should choose the number of the cointegration vector based on λ_{max} , because "the λ_{max} test has the sharper alternative hypothesis.

Based on the methodology so far used, it is however still difficult to know whether oil price shock has asymmetric effect on exchange rate and investment growth in Nigeria. To overcome this difficulty, it is necessary to employ the impulse response and the variance decomposition tests. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables, while variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. In other words, the variance decomposition provides information about the relative importance of each random innovation in affecting the variation of the variables in the VAR.

4. RESULTS AND DISCUSSION

4.1 Unit Root Tests

As mentioned above, the first step in performing the Granger causality test is to study the stationarity of the time series used in the analysis and to establish the order of their integration. the unit root test was performed using the ADF (Augmented Dickey-Fuller) and Philips Perrone (PP) test. The result is presented in Table 1 below.

Table 1. Unit root test for stationarity

Variables	LEVELS		1 st DIFFERENCE					
	Test with Intercept		Test with intercept and trend		Test with intercept		Test with intercept and trend	
	ADF	PP	ADF	PP	ADF	PP	ADF	
PP								
GOVEXP	-2.8674	-2.8698	-2.5680	-2.5855	-5.0742	-5.0685	-5.0108	-5.0060
RDPVI	-1.8191	-1.7973	-1.9840	1.9427	-3.8794	-3.8215	-3.5892	-3.6350
RIPP	-2.3306	-2.3306	-0.9887	-0.8758	-3.8565	-3.8384	-4.3745	-4.3745
REEX	-4.7077	-4.7017	-4.8327	-4.7765				
LRGDP	-1.1747	-0.8881	-4.0603	-3.8445	-6.4537	-8.1380		
OILP	-4.6039	-4.3351	-4.8973	-4.3026				
LINDP	-4.5412	-4.5908	-5.0518	-5.1777				
CV* (1%)	-3.6055	-3.6055	-4.2050	-4.2050	-3.6104	-3.6104	-4.2118	-4.2118
CV* (5%)	-2.9369	-2.9369	-3.5266	-3.5266	-2.9389	-2.9389	-3.5297	-3.5297

The lag length was determined by Schwartz Information Criteria (SIC)

Source: Author's computation

The result above suggest that Real Exchange Rate, Oil Prices and Industrial development were stationary at their levels , while , Government Expenditure, real private investment, real public investment, and real gross domestic income were stationary after first differencing.

4.2 Cointegration Analysis

Having established that all the variables in the model are stationary the study then moves on to test for the short and long run relationship using the Johansen Cointegration test. The Johansen Cointegration test allows us to determine how exchange rate and investment (Public and Private) reacts in the long run to volatility in oil prices. The result of the Johansen cointegration test is reported in Table 2 and 3 below.

Table 2. Unrestricted Cointegration Rank Test (Trace)

Hypothesized	Trace		0.05	
No of CE(s)	Eigenvalue	Statistics	Critical Value	Prob**
None*	0.775301	158.3600	125.6154	0.0001
At most 1*	0.609200	100.1332	95.75366	0.0241
At most 2	0.521796	63.49040	69.81889	0.1441
At most 3	0.355774	34.71944	47.85613	0.4629

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** MacKinnon-Haug-Michelis (1999) p-value

Source: Eviews 7 output

Table 3. Unrestricted Cointegration Max-Eigenvalue Test

Hypothesized No of CE(s)	Eigenvalue	Max-Eigen Statistics	0.05 Critical Value	Prob**
None*	0.775301	58.22678	46.23142	0.0017
At most 1	0.609200	36.64282	40.07757	0.1160
At most 2	0.521796	28.77096	33.87687	0.1802
At most 3	0.355774	17.14850	27.58434	0.5672

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** MacKinnon-Haug-Michelis (1999) p-value

Source: Eviews 7 output

To consider the hypothesis that the variables are not cointegrated ($r=0$) against the alternative of one or more cointegrating vectors ($r>0$), it is necessary to look at the values of λ TRACE. The result of the trace statistics indicates the value of λ TRACE equal to each number of the cointegrating vector: λ TRACE (0) = 158.36, λ TRACE (1) = 100.13, and λ TRACE (2) = 63.49. Since the value of λ TRACE (0) and λ TRACE (1) exceeds the critical value of (125.61) and (95.75) (respectively, at the 0.05 significance level, we can reject the null hypothesis of two cointegrating vectors ($r=2$) and accept the alternative hypothesis of the existence of two cointegrating vectors ($r>2$) at the 0.05 level.

To ensure the reliability of the coefficient of the Normalized Cointegrating model, the study employed the AR root stability test. The estimated VAR will be assumed to be stable if all the roots have modules less than one and lies inside the unit circle. The result of the AR test is thus presented in Table 4 below

Table 4. Stability test

Roots of Characteristic Polynomial	
Endogenous variables: OILP GOVEXP RDPVI RIPP LRGDP REEX LINDP	
Exogenous variables:	
Lag specification: 1 2	
Date: 07/17/13 Time: 10:03	
Root	Modulus
-0.271406 + 0.874772i	0.915908
-0.271406 - 0.874772i	0.915908
0.423414 + 0.692297i	0.811514
0.423414 - 0.692297i	0.811514
0.764985	0.764985
-0.172893 - 0.688402i	0.709781
-0.172893 + 0.688402i	0.709781
-0.677956 - 0.127353i	0.689814
-0.677956 + 0.127353i	0.689814
-0.022952 + 0.596915i	0.597356
-0.022952 - 0.596915i	0.597356
-0.213417 - 0.522042i	0.563981
-0.213417 + 0.522042i	0.563981
-0.217109 + 0.121272i	0.248683
-0.217109 - 0.121272i	0.248683

VEC specification imposes 6 unit root(s).

The result of the AR stability test satisfies the stability condition of the module in Table 4 since no root lies outside the unit circle.

The cointegrating equations of the normalised Johansen equation is presented in Table 5 below.

Table 5 Normalised Johansen Equations

Cointegrating coefficients						
CointEq1						
OILP	RDPVI	RIPP	LINDP	REEX	LRGDP	GOVEXP
1.000000	-3.696788	-1.395124	72.41920	-7.119779	6.145539	-0.438721
CointEq2						
1.000000	-12.136061	-0.200427	-10.48859	0.569357	-0.193086	0.314551

The cointegrating equations of the normalised Johansen equation were derived among oil price volatility, real domestic private investment, real public investment, industrial production, real exchange rate, real per capita income and real government expenditure. Thus, the normalised cointegrating equation above becomes

$$\text{Oilp} = 279.12 + 12.136\text{RDPVI} + 0.200\text{RIPP} + 10.488\text{LINDP} - 0.569\text{REEX} + 0.193\text{LRGDP} - 0.314\text{GOVEXP}$$

The analysis of this study will focus on the result obtained in equation 2 since it reflect the theoretical expectation analysed previously in the study. The result indicates that a 10 per cent decrease in international oil price volatility will cause the domestic exchange rate to decrease by 56 per cent. This result conforms to the result obtained previously by some authors in Nigeria [7,]. This result further conforms to economic theory that a decrease in oil price volatility should evoke a corresponding decrease in exchange rate volatility in every economy. The result also observed that a 10 per cent decrease in oil price volatility will result to an increase of 20 per cent and over 100 per cent increase in both domestic investment and public investment respectively in Nigeria. The result is not surprising since it also conforms to [8], who both traced the effect of a reduction in investment to be usually through a reduction in disposable income of economic agents. When economic agent perceive that the volatility in oil prices might be long and permanent, they reduce their present consumption, capital and labor productivity decreases and potential output falls. Volatility in oil prices was observed to exert negative effect on government expenditure. A 10 percent increase in oil price volatility will reduce government expenditure by 31 percent. This result cannot be doubted since government often resorts to external borrowing or drawing from the external reserves to fund shortfall in budgetary expenditure. Volatility in oil prices has both negative and positive effect on government spending. Negative effect will arise if there exist short falls on expected receipt from crude oil sales, especially, when such shortfalls are below the budgetary forecast. In such circumstances government will either resort to external or internal borrowings, drawings from the external reserve funds or internal readjustment of budgetary estimates to sectors, in other to meet up domestic demands. Positive effect of oil price volatility will cause the government to experience windfalls in their receipt from crude oil sales, which of course evoke increase spending by government.

4.3 Impulse Response Function Analysis

Impulse response functions are dynamic simulations showing the response of an endogenous variable over time to a given shock. In this regards Fig. 1 below present the impulse response function result of the dynamic response of Government Expenditure (GOVEXP), real exchange rate (REEX), public investment (RDPVI), private investment (RIPP), Industrial production (LINDP) and Real National Income (LRGDP) to oil price shocks (OILP) for a 12-year horizon.

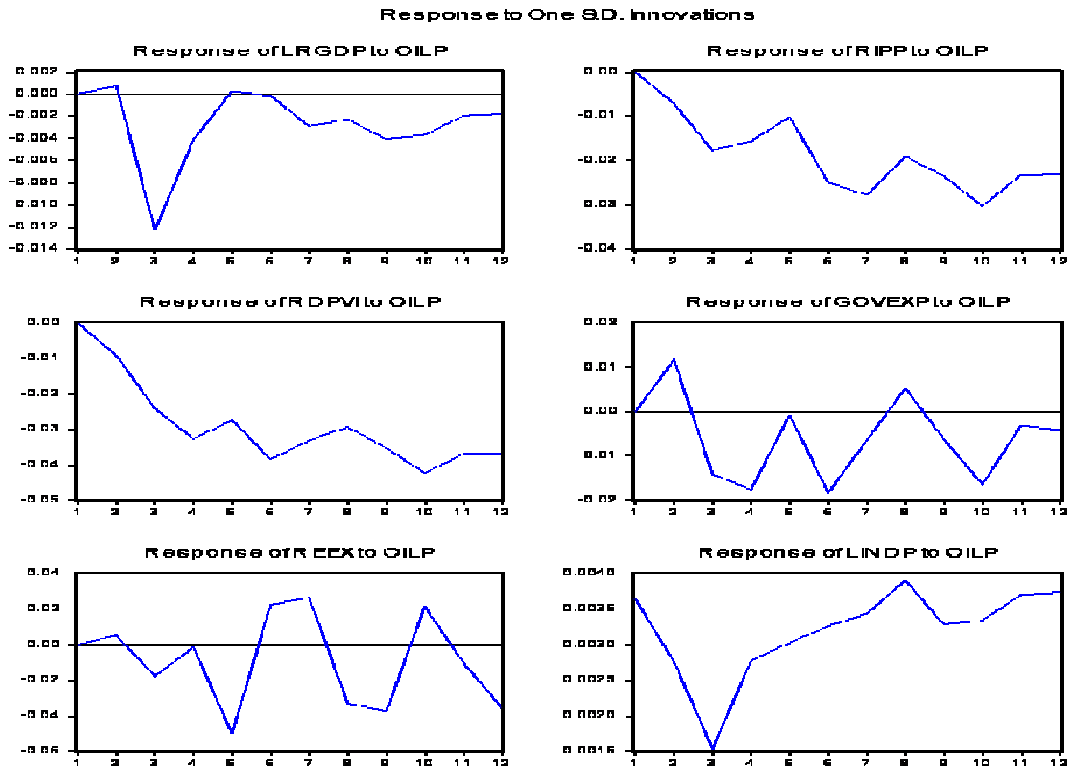


Fig. 1. Impulse response function result

Source: Eviews 7 output.

The result indicates that government expenditure exhibited immediate positive response to oil shock but became negative after the second period. However, government expenditure continued to fluctuate negatively to oil shock until 7th-year when it became positive again. This result is a reverse of the result obtained by [42], where government expenditure was observed to be positive with oil price shock in Malaysia.

Public investment, private investment and industrial production all exhibited negative response to oil shock and decreasing further as the year went by. The result confirms the fact that Nigeria economy suffers from the “Dutch disease”, a situation where an increase in oil revenue does not correspondingly reflect an increase in domestic growth. The “Dutch disease” syndrome is also witnessed in the response of domestic growth (LRGDP) to innovations in oil price. The study revealed that a one-standard deviation of symmetric

innovation exerts a positive impact of 0.02% on domestic growth in the 1st period and thereafter became negative in the second period. This result is in line with the results obtained by [42], but contradicts with the result obtained by [3, 10, 41], whose result did not show any evidence of resource cause in Nigeria.

Exchange rate responded positively to oil price shock in the first period but became negative in the second period. The result indicate that movement in oil prices can result to a appreciation of the exchange rate in the short-run, but a depreciation of the exchange rate in the long-run. This result amplifies the fact that oil price shock has important implication on the persistent fluctuations of domestic currency and thus should be a strong policy issue of discourse for the Nigerian government.

4.4 Variance Decomposition Analysis

Variance decomposition analysis provides the tool to determine the relative importance of the study.

The result of the variance decomposition over a 24-quarter time horizon is summerised in Table 6 below.

Table 6. Result of Variance decomposition analysis

Variance decomposition for GOVEXP

Period	S.E	GOVEXP	RDPVI	RIPP	REEX	LRGDP	OILP	LINDP
1.	0.237777	100.0000	0.000000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.389110	55.12190	35.34439	4.46772	1.02095	2.28739	1.12449	0.63313
12	0.478830	45.18938	42.61897	6.05914	2.08700	2.45413	1.05074	0.54051
18	0.542862	37.74793	49.16958	7.07726	2.08615	2.38804	1.03404	0.49698
24	0.594307	33.00717	53.63714	7.70161	1.96543	2.23209	1.01238	0.44415

Variance decomposition for RDPVI

Period	S.E	GOVEXP	RDPVI	RIPP	REEX	LRGDP	OILP	LINDP
1	0.213308	62.66628	37.33372	0.000000	0.00000	0.000000	0.000000	0.000000
6	0.554460	53.25621	38.22208	3.244095	1.13606	0.785292	2.236000	1.120254
12	0.930468	52.22501	38.26584	4.338648	0.89878	0.696737	2.338276	1.336699
18	1.213940	51.75146	38.02777	4.757775	0.81483	0.720868	2.464539	1.462752
24	1.449789	51.55828	37.91894	4.969638	0.78855	0.735605	2.513225	1.515762

Variance decomposition for RIPP

Period	S.E	GOVEXP	RDPVI	RIPP	REEX	LRGDP	OILP	LINDP
1	0.237353	41.36272	31.66527	26.97200	0.00000	0.000000	0.000000	0.00000
6	0.712627	50.75010	21.88662	22.15417	2.44192	1.615099	0.454772	0.69731
12	1.130257	50.61449	24.01559	20.43534	1.95490	1.451142	0.679086	0.84945
18	1.446020	50.42131	24.46588	20.08802	1.81775	1.465097	0.793293	0.94865
24	1.712102	50.36789	24.65030	19.90357	1.77229	1.474407	0.840402	0.99113

Variance decomposition for REEX

Period	S.E	GOVEXP	RDPVI	RIPP	REEX	LRGDP	OILP	LINDP
1	0.916812	10.06289	0.151386	0.027997	89.75773	0.00000	0.000000	0.00000
6	1.541369	15.49667	10.18007	3.081771	66.80304	3.68786	0.245371	0.50321
12	2.167415	20.93584	13.38086	2.213989	59.99787	2.73536	0.311662	0.424586
18	2.582603	21.51161	14.10495	1.683435	59.56026	2.52208	0.269582	0.348079
24	2.897105	21.21625	14.11221	1.383236	60.40016	2.35970	0.239372	0.289063

Variance decomposition for LRGDP

Period	S.E	GOVEXP	RDPVI	RIPP	REEX	LRGDP	OILP	LINDP
1	0.037914	10.60761	9.093378	0.202541	5.02900	75.06746	0.000000	0.000000
6	0.082002	32.61304	8.640975	1.135018	5.83262	46.95665	4.330162	0.491529
12	0.102509	29.95112	7.422005	1.194986	4.41502	52.98678	3.613219	0.416859
18	0.118149	28.23316	6.548927	1.235037	3.69236	56.65909	3.250289	0.381158
24	0.131657	27.14778	6.015448	1.271271	3.25177	58.90797	3.040816	0.364940

Variance decomposition for OILP

Period	S.E	GOVEXP	RDPVI	RIPP	REEX	LRGDP	OILP	LINDP
1	0.583855	1.06E-05	3.504565	0.109242	18.01846	0.008550	78.35918	0.00000
6	1.809331	60.43618	13.51697	1.284592	8.926687	6.109025	8.761862	0.96468
12	2.149986	59.35848	11.75552	1.710220	13.30651	6.398849	6.617687	0.85273
18	2.347963	57.75093	10.64681	2.022806	16.17801	6.967404	5.631351	0.80269
24	2.515626	57.13679	9.521969	2.192042	18.01750	7.437433	4.931182	0.76307

Variance decomposition for LINDP

Period	S.E	GOVEXP	RDPVI	RIPP	REEX	LRGDP	OILP	LINDP
1	0.008486	5.376458	3.551521	1.101829	18.11702	17.16386	31.84233	22.8469
6	0.035424	44.87716	21.57122	6.821388	4.879471	6.327931	6.978613	8.54421
12	0.059535	46.25637	23.86908	8.144287	2.409547	5.493707	6.208787	7.61822
18	0.078558	46.78934	24.78956	8.531031	1.581402	5.124737	5.886277	7.19765
24	0.094108	47.01319	25.24449	8.686947	1.379416	4.934425	5.740731	7.00079

Variance decomposition shows how much of the variation in exchange rate and domestic investment are due to the variations of the included variables in the model, including the oil shocks.

A look at the table revealed that the fluctuations of GOVEXP are explained mainly by GOVEXP shocks and RDPVI shocks, in the long run. Government expenditure (GOVEXP) accounts for 100% in the 1st period. Its proportion decreases continually until it reaches 33 % in the 24th period. Public consumption expenditure (RDPVI) shock accounts for less than 1% in the first year. Its proportion increases over time and reaches 53.6% in the 24th period. The result shows that in the long run public consumption expenditure shock account for the major variation in government expenditure.

The fascinating fact about the result is that fluctuations in industrial development (LINDP) in Nigeria are mostly accounted for by exchange rate shock and oil price shock. The result shows that fluctuations in oil prices and exchange rate have immediate impact on industrial development in Nigeria. Exchange rate shock accounts for 18.12% variation in the 1st period and decreases to 1% in the 24th period. Also oil price shock accounts for 31.84% in the 1st period and decreases to 5% in the 24th period. This result depicts that exchange rate shock and oil price shock has a short-run effect on industrial development in Nigeria. Furthermore, we observe that variations in the economic growth were mostly accounted for Government expenditure shock (GOVEXP) and Exchange rate (REEX). While Government expenditure shock accounted for 10.6% variation in the 1st period and increases to 27.14 in the 24th period, exchange rate shock accounted for 5.02% in the 1st period and further decrease to 3.25% in the 24th period. The result summarises that GOVEXP shock and REEX shock have major short term impact on economic growth. This result upholds the view of [1].

5. CONCLUSION

Oil revenue has been said to play contradictory role in the economic growth of oil exporting countries. While researchers agree that higher oil prices bring in extensive capital, leading to higher investment in physical and human capital in oil-exporting countries. On the other hand, oil windfall can lead to an exchange rate appreciation and deindustrialization which are harmful to growth. A decline in oil prices would also lead to a halt in investment projects undertaken during the oil boom and stagnation in economic activities, monetized budget deficit, and inflation.

This paper had set forth to examine the asymmetric effect of oil price shock on exchange rate and domestic investment in Nigeria using the reduced form unrestricted VAR model. Preliminary test proved that all the variables in the model were stationary after first differencing and the cointegration test revealed that a long-run relationship does exist between the variables.

The impulse response function result clearly revealed that while government expenditure exhibited immediate positive response to oil shock, public investment, private investment and industrial production all exhibited negative response to oil shock and decreasing further as the year went by. The result confirms the fact that Nigeria economy suffers from the "Dutch disease", a situation where an increase in oil revenue does not correspondingly reflect an increase in domestic growth.

The variance decomposition analysis revealed that variation in exchange rate and domestic investment (private and public consumption expenditure) were mainly affected by shock of oil prices in Nigeria. Although the response was basically observed to be in the short-run, the spread of the effect in oil price shock was also witness in the depreciation in the country's currency and deterioration of the growth of the industrial sector.

The results above have the following policy implication for the country. Firstly, the continual dependence of the country on windfalls from oil revenue has negative and retarding effect on the country, particularly as it affects the industrial sector. It is important that government should be able to provide public goods without relying necessary on oil revenues. Dependence on oil revenue forecast in the preparation of the annual budget has often resulted deficit budgeting particularly during periods of uncertainty in oil receipts arising from global crisis in oil production.

Secondly, it is imperative for the central government to transform excess crude oil revenues into physical capital and infrastructure rather than distribute the windfalls to the state and local government, who might not necessarily invest these funds into productive uses. This will strengthen the industrial base of the economy, promote production of more tradable goods for export and increase economic growth.

Thirdly, it might be necessary for the country to accumulate assets during periods of oil boom in a reserve fund and draw from it during bust seasons. This will serve as a buffer fund wherein the government can depend on without securing huge external borrowing for domestic investment.

While we commend the government authorities in Nigeria for the recent sanitization of the Nigeria National Petroleum Corporation (NNPC) and bringing to bare the sharp obnoxious practices in the fuel subsidy saga, the paper further recommend that the issue of corruption in government, accountability and transparency in governance should be held in high regards. Without a competent bureaucracy and strong democratic institutions that safeguard the interests of the citizenry, implementing policies that will improve the investment climate would remain a challenging one.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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