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RESPONSE OF SELECTED MACROECONOMIC VARIABLES TO OIL PRICE SHOCKS IN NIGERIA

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ABSTRACT: The question of how the exchange rate, oil revenue, inflation rate and other macroeconomic variables respond to oil price shocks in Nigeria has generated tremendous interest among economic scholars for decades. This study examines the responses of the exchange rate, inflation rate, oil revenue and government expenditures as macroeconomic variables to oil price shocks in Nigeria using time series techniques of the Vector Autoregressive (VAR) model, cointegration test, Impulse Response Function (IRFs) and Variance Decompositions (VDCs). The result of the cointegration test suggests the presence of cointegration among variables. The estimated VAR model affirms the response of shocks in the macroeconomic variables. The results have shown that the oil price shocks have a significant response to macroeconomic variables in Nigeria. The response of the inflation rate to global oil price shocks is positive, indicating that an increase in oil price leads to an increase in the inflation rate in Nigeria; in contrast, the response of the exchange rate to oil price shocks is negative, indicating that an increase in global oil price leads to depreciation of exchange rate and fall in oil revenue thereby affecting government expenditure negatively in Nigeria. Hence, the study recommends that appropriate measures be taken, such as capacity utilization of the oil sector, and the Nigerian government should emphasize stable macroeconomic policies as well as diversification of the economy

Keywords: Oil Price Shocks, Macroeconomic Variables, VAR Model, Nigeria

INTRODUCTION

Oil and gas, as well as other biofuels, are the major contributory sources of revenue and employment opportunities in Nigeria and have contributed more to the economic growth and development for many decades. The oil price shocks have an effect on every other Nigerian macroeconomic variable, especially oil GDP, exchange rate volatility, interest rate, inflation rate, government expenditure, and oil revenue through the sales of crude oil at the international market. There are other such as inflation rate, exchange rate, interest rate, stock prices, government expenditure, oil GDP, household consumption, economic size, net export, and even economic growth rate, which all positively or negatively respond to global oil price shocks. İt is, however, noted that the exchange rate response to oil price shocks comes as a result of an increase in oil price leading to a rise in money supply and demand for money since there are more money after the sales of crude oil than appreciation of exchange rate of US dollar over Nigerian Naira since the crude oil prices are exchanged in foreign currency, thereby leading to a rise on consumer and producer price indices.

However, the response of inflation rate to oil price shocks could be seen through the demand-side and supply-side channels framework whereby in demand-side shock, an increase in oil price leads to a fall in consumption and investment patterns of households and firms, thereby leading to a rise in the cost of living that negatively affects consumer price index as well as a rise in inflation in Nigeria. While the response of inflation rate to oil price shocks through the supply side channel is when there is an increase in oil price leads to a rise in the marginal cost of production, which leads to a fall in capacity utilization and output level, the worker will demand higher wages which will complement an increase in the cost of living that will subsequently allow firms to lay-off some workers so as to maintain the same profit margins (Buhari, et al. 2023*)*. İn addition, the response of oil revenue and government expenditure on oil prices can be seen through the inability of the Nigerian government to fulfil its quota in producing over 2 million barrels per day occasioned by the activities of Niger Delta militants through pipelines vandalism, oil theft and illegal oil refineries in Nigeria's oil-producing states which leads to dwindling of oil GDP and oil revenue that has a multiplier effect on government expenditures and budget implementation so as to meet its financial obligations as and when due.

The trend patterns in prices of global oil in the past years reached its record nominal high of US $98.94bpd in 2014 and a sharp drop to US $46bpd in August 2015, down to less than US $40 a barrel in 2016, leading to deep concern about its implications on economic activities and macroeconomic variables within and outside Nigeria (Buhari, 2020). However, the Covid-19 pandemic era in 2020, coupled with the Russia – Ukraine war in 2022, which caused a lot of energy crises, also impacted negatively on every macroeconomic variable in the world as well as the world oil price shocks that led to a fall in the price of oil at international oil market to less than $10/pb in 2020 thereby leading to negative effects on the world's economy including Nigeria's macroeconomic indicators such as exchange rate, inflation rate, oil revenue, interest rate and total government expenditure. This has forced the government of Nigeria to review its budget benchmark downward from $65 to $45.

Nigeria is known as an import-dependent economy that highly depends on foreign exchange through the sales of crude oil in order to finance its enormous expenditures. Nigeria continued to be heavily dependent on oil as a major export product, which is perceived to continue impacting all macroeconomic variables in Nigeria. Nigeria is highly affected by the oil price shocks in the global oil market despite being in the 2nd and 5th positions of oil-producing country in Africa and the World in 2022, respectively. Theoretically, if oil prices increase, it leads to a movement of labour and resources from importing to exporting countries through the terms of trade. The extent of the direct effect of an oil price increase depends on the movement of tradable to non-tradable and services sectors in the country. The rise in the price of oil leads to rise in the domestic cost of production, then the supplier price index will also increase, and the wages will also rise, thereby reducing the level of employment and level of output, which will lead to a rise in both consumer and producer price indices (Aminu & Buhari, 2018).

Nigeria is, however, endowed with abundant oil and gas resources, in which its production constituted about almost one-third of its GDP for over decades. Similarly, the immediate effect of a rise in oil price is the rise in oil revenue, then a rise in oil GDP that has short-term and long-run effects. The short-term effect is the appreciation exchange rate, then a rise in wages because of the rise in money supply in the oil sector, thereby leading to a rise in the cost of production, which leads to a reduction in the level of output and unemployment will rise as well as rise in inflation in Nigeria. In the long run, however, the rise in wages of labour in the resource and oil sector leads a movement of labour from productive because the people are

moving to oil sector since most of the investments are centred to oil and service sector due to more profits in the sector thereby leading to a shortage of goods and services from the non-oil (productive) sector which consequently leads to a domestic inflation in Nigeria. Moreover, the macroeconomic performance of Nigeria has been strongly associated with the oil sector. Although Nigeria remains second Africa's largest oil producer after Angola in 2022, the country has inadequate refining capacity, hence imports refined petroleum products to meet the local demand. Thus, the government kept subsidizing petroleum products so as to maintain its controlled price despite the changes in prices at the international oil market and the exchange rate (Bawa, Ismail, Abdullahi, Sani & Yusuf, 2020).

Nigeria is both an importing and exporting country, importing refined oil products and other products from the rest of the world, since her refineries were incapacitated and not functional since the 1990s, this led to an increase in the cost of imported fuel products, which affects its local currency by weakening Naira over Dollar, since these refined products are exchanged in foreign currency. The fall in the oil price globally at the international oil market has led to the depreciation of Nigerian currency between ₦168 in October 2015 and ₦347.52 in August 2016 which represents almost 106.7 per cent within a year; the Nigerian government also depreciated its currency from about 400 naira per Dollar up to official rate of ₦423 per USD in July, 2022 due to shocks in oil price that affecting Nigerian and the world economy respectively. However, the Nigerian inflation rate is also affected by the shocks in oil prices because both consumption and investment were adversely affected due to a rise in the oil price, which affects the disposable income of households, domestic of tradable and non-tradable goods and services. During the period under study, the year-on-year inflation rate jumped from 9.3% on the 10th of 2015 to 17.6% in August 2016, and there was also a recent increment of the inflation rate to 18.1% in July 2022 to 20.3 in December 2022.

The decline in prices of crude oil in the globe that occurred in July 2014 has negatively affected Nigeria, particularly in the areas of currency crises, inflation rate, declining government revenue, and government expenditure, and eventually threatening the ability to meet financial bounds as and when due. The price of oil came down from its all-time high between USD105.87 in 2013 and USD 98.94 in 2014 and to USD40.76 in 2016. This means that from 2013 to 2016, oil prices declined sharply by more than half (64.5%) 2016, but in 2017, the oil price started rising to $70/bpd to an ever decrease of $10/bpd in 2020 (Barkindo, 2022). The resultant impact has been a huge cause of policies and programs especially to policy makers and debate among scholars on the best policy intervention to reverse the situation.

İt is against this background that the study put forward the following research question. What is the response of selected macroeconomic variables to oil price shocks in Nigeria? İn order to answer the above research question, the following objective arises. The objective of this study is to empirically analyse the response of selected macroeconomic variables to shocks in oil prices in Nigeria.

LITERATURE REVIEW

Concept of Oil Price Shocks: According to Lippi and Nobili (2008), Crude Oil Price Shocks are a source of oil shocks that affect economic performance differently: oil price increases due to higher oil demand shocks affect output differently than oil price increases due to lower world oil supply shocks. They argued that positive oil supply shocks decrease domestic production. However, the crude oil fluctuation could be either in the oil prices or in the production process,

which positively and negatively affects macroeconomic variables and even every sector of the economy either directly or indirectly.

Concept of Exchange Rate: According to Buhari (2020), the exchange rate is the country's currency value in terms of another country's currency. It is normally expressed as the number of units/elements of a local currency which will buy one unit of another country's currency or the number of units/elements of another country's currency that will purchase one unit of a domestic currency, for example, the Naira per United States Dollar (N/USD) or US dollars per naira (USD/N). Essentially, exchange rate changes affect the prices of both imported and exported goods; and services.

Concept of Inflation: Krugman (1998) defined "Inflation" as a continuous increase in the general or average price level in the economy, usually measured through the calculation of the consumer price index. The word "persistent" is of greater importance in understanding the inflation concept. A single increase in prices is not inflation. When inflation occurs, there is a continuous increase in the price level. Prices of individual goods and services are determined in many ways. In competitive markets, the interaction of large buyers and sellers. In imperfectly competitive markets, prices are determined by producer's decisions (Friedman, 1963).

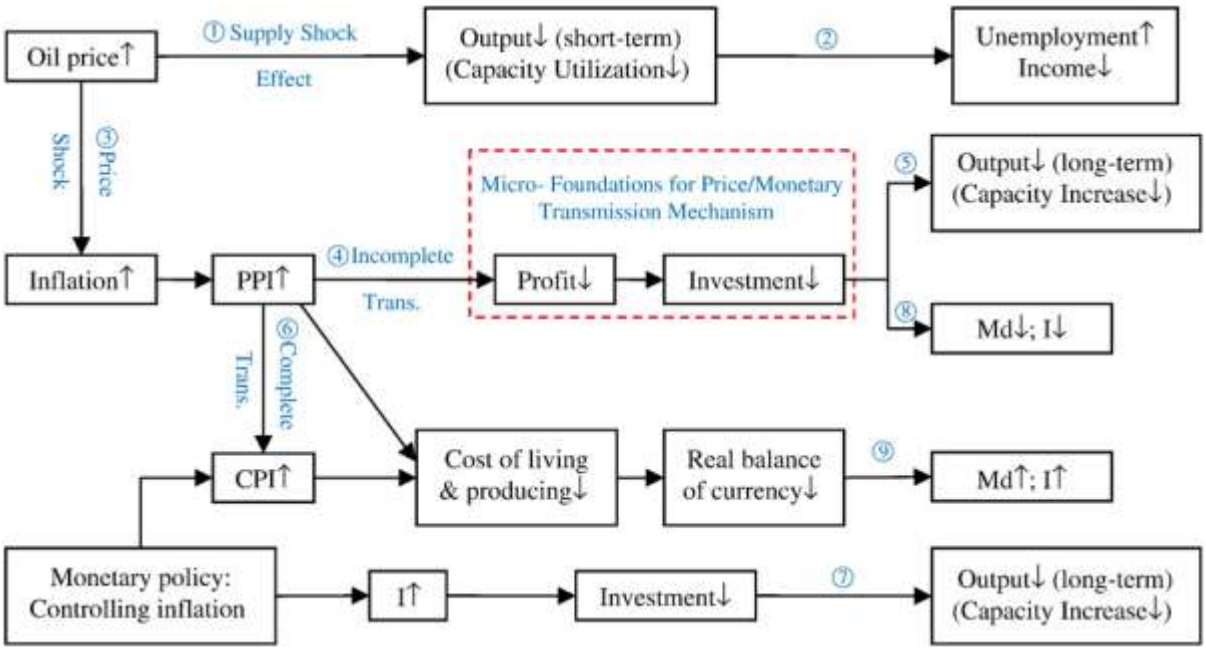
Concept of Oil revenue: It is defined as a form of government revenues earned after the sales of crude oil at the international oil market, which gives the government of a country the means (resources) to finance both capital and recurrent expenditure for the benefit of its citizens in a country. According to Keynes (1936), a change in government revenue would have a positive/negative impact on growth. An increase in oil revenue could be in two ways: either through increasing the payment rate by existing taxpayers or increasing the number of taxpayers. The combined effects of the shocks in oil prices that brought about an influx of petrodollar oil revenue and the appreciation of the domestic exchange rate also have had effects on the domestic prices of products and services in Nigeria.

Concept of Government Expenditure: Usman and Buhari (2018) define government expenditure as total government spending on both recurrent and capital expenditures. Recurrent expenditure refers to government expenditures on day-to-day activities such as payments of workers' salaries and wages, retirees 'pensions, fuelling machines and equipment, and other recurrent spending. By capital expenditure, we mean the government spending on white elephant projects such as: building road networks, rail networks, stadia, hospitals, housing estates, and rest of others.

Theoretical Framework

The macroeconomic responses to oil price shocks in Nigeria can be explained by using both supply and demand channels. According to economic theory, crude oil price changes affect real economic activity through both supply and demand channels. Supply-side effects could be explained based on the fact that oil is an important input in production. Therefore, crude oil price increases reduce the demand for crude oil, decreasing the productivity of other input factors, which induces firms to lower output. The supply side is on the argument that rising oil prices are evidence of disruption in the productive techniques within the economy, thereby leading to a decline in the level of output. This indicates that a rise in the cost of production per average unit of output leads to a slowdown in the growth rate of product and profitability. The demand side shocks are derived from the based-on oil price changes that affect both consumption and investment decisions. Consumption is negatively affected because a rise in

oil price changes disposable income and the domestic price of tradable goods. Investment is negatively affected because such rise in oil price thus affects firms' input prices and thereby increases their costs. The demand side effect depicts that a rise in oil prices could lead to a decrease in consumption, investment and expenditure prices.



The response of inflation to oil price shocks could be seen through demand-side and supply-side channels whereby in demand-side shock, an increase in oil price leads to a fall in consumption and investment patterns of households and firms, thereby leading to a rise in the cost of living that negatively affects consumer price index as well as a rise in inflation in Nigeria. While the response of the inflation rate to oil price shocks through the supply side channel is when there is an increase in oil price leads to a rise in marginal cost of production which leads to a fall in capacity utilisation and output level, the worker will demand a wage-price spiral or demand a higher wages which will complement an increase in cost of living that will subsequently allow firms to lay-off some workers so as to maintain the same profit margins. İn addition, the response of oil revenue and government expenditure to oil prices can be seen through the inability of the Nigerian government to fulfil its quota in producing over 2 million barrels per day occasioned by the activities of Niger Delta militants through pipelines vandalism, oil theft and illegal oil refineries in Nigeria's oil-producing states which leads to dwindling of oil GDP and oil revenue that has a multiplier effect on government expenditures and budget implementation so as to meet its financial obligations as and when due.

Empirical Literature

Buhari et al. (2023) empirically examine how shocks in oil prices affect Nigeria's inflation and exchange rate using yearly time series data from 1981 to 2021, applying the NARDL (Nonlinear Autoregressive Distributed Lags) technique. The findings demonstrate that, both in the short and long terms, global oil price shocks have a significant impact on the exchange rate and inflation rates. Specifically, the response of oil price shocks to inflation rates is positive, indicating that rising oil prices cause Nigerian inflation to rise, while the response of oil price shocks to exchange rates is negative, indicating rising global oil prices cause Nigerian interest rates to rise and the exchange rate to depreciate.

Eric (2020) empirically examines the responses of the consumer price index (CPI) to international oil price shocks in the pre-, and pre-and post-2008 global financial crisis in Nigeria. The study used the Structural Vector Autoregressive model to analyse monthly data from 2000M01 to 2019M12. The impulse response functions showed that for pre- and post-crisis periods, oil price shocks have a positive impact on CPI. This effect was an insignificant direct perpetual increase in pre-crisis CPI before use up. However, the study adopted various theoretical literature to explain different kinds of models, such as supply-push and demand-pull factors. The change in the prices of oil as a result of an increase in demand is said to bring about a wealth transfer impact in oil-exporting economies and an inflation outcome in oil-importing economies. Meanwhile, changes in the prices as a result of positive changes in the supply of the commodity translate to supply-side shock effects.

Ahmad et al. (2020) investigate the Dynamics of Oil Price and Exchange Rate: What Can We Learn from China and India? The paper tries to examine the variability of global oil and foreign exchange markets and their spillover. The study considers the currencies/paper monies of two major oil-importing countries (India and China) from January 1, 2013, to October 31, 2019. However, the paper above has tried to conduct descriptive statistical analysis and use the Generalized Autoregressive Heteroscedasticity (GARCH) model for econometric analysis.

Apere (2017) empirically investigated the co-relationship between oil price fluctuations and inflation in Nigeria using quarterly data from the period 1980:1 to 2015:4. Vector autoregressive econometric model was adopted in analysing the data for this research with the analysis carried out; the Lag length selection, VAR stability tests, VAR LM test for serial correlation, the Impulse Response Functions (IRFs) and the Forecast Error Variance Decomposition (VDCs). The study depicted that the response of inflation to oil price change is that as prices of oil fall, then inflation decreases and is stable, and a positive price of oil results in a stable negative inflation rate. Hence, the relationship between inflation and oil price fluctuation is negative due to the following variables: crude oil price (COP), inflation rate (INFL), and exchange rate (EXCHR).

METHODOLOGY

Secondary data was used for this study. The study used annual time-series data on oil prices and some selected macroeconomic variables. Secondary data covered the macroeconomic variables' yearly transactions for 42 years (1981 – 2022) for each macroeconomic variable, which was obtained from the National Bureau of Statistics (NBS) and the Central Bank of Nigeria (CBN). The oil price is the Brent crude oil price, which was also obtained from the US Energy Information Administration (EIA). The data collection focused on the following variables: exchange rate, inflation rate, oil revenue, and government expenditure, which are the selected macroeconomic variables.

Model Specification

The specification of VAR model is as follows:

$$Y_t = C + \sum_{i=1}^{k} \Phi_i Y_{t-1} + u_t \text{----------} 3$$

p

i=i

Where: Y_t is a column vector of four (4) variables or $Y_t = (y_{it}- - - Y_{ct})$, is a (4 × 1) vector of the variables, therefore Y_t = (Oil price Increase, oil Price Decrease, Maximum Oil Price and structural Equation of Oil Price) modelled in terms of her past values. Φ_i are k x k matrix with coefficients to be estimated or Φ_i are (4×4) is a matrix of coefficients (Exchange Rate, Inflation Rate, Government Expenditure and Oil Revenue), C is a k x 1 vector with constants and ϵ_t is a vector of white noise processes, that is $U_t = (U_{it}- - - U_{kt})$ is a (4 × 1) of K-dimension white noise with zero means that is $E(U_t) = 0$. Where the covariance matrix Ω is assumed to be positive definite and p is the order of autoregression. The study was relied on variance decompositions and impulse-response functions to evaluate the nature of interactions among the variables.

Where:

Y_t= (OIL_PRICE$_t$, EXCH_RATE$_t$, INFL_RATE$_t$ OIL_REVENUE$_t$, GOVT_EXP$_t$)----*4*

OIL_PRICE$_t$ = Oil Price

EXCH_RATE$_t$ = Exchange Rate of the Naira

INFL_RATE$_t$ = Inflation Rate

OIL_REVENUE$_t$ = Oil Revenue

GOVT_EXP$_t$ = Government Expenditure

't'= Time Period.

et = Error Term assumption to be normally distributed with zero mean and constant variance.

C = k x 1 vector of constants

Σ = Summation of exogenous variables at time 't'

Y_{t-i} = Lag of endogenous variables.

$U_t = N_1 – N_5$ are the impulse, innovations or shocks

$\Phi_i = \alpha_1 – \alpha_5$ Parameter to be estimated

It should be noted that estimated results of the VAR model, such as (1), are more easily interpreted in its moving average representation, from which we may generate variance decomposition (VDC) and impulse response functions (IRFs).

Apere's (2017) model was modified because it used three variables, while this study considers five variables that can be impacted by oil price shocks.

The model is therefore specified in a matrix form as follows:

This equation can be expanded by applying the Choleski decomposition results in a recursively identified structural VAR model:

$$Y_t = \begin{Bmatrix} \Delta OILPMN \\ \Delta OILPMX \\ \Delta OILPS \end{Bmatrix} = \begin{Bmatrix} \Delta EXCR_{t-1} & \Delta INFR_{t-1} & \Delta OILR_{t-1} & \Delta GEXP_{t-1} \\ \Delta EXCR_{t-1} & \Delta INFR_{t-1} & \Delta OILR_{t-1} & \Delta GEXP_{t-1} \\ \Delta EXCR_{t-1} & \Delta INFR_{t-1} & \Delta OILR_{t-1} & \Delta GEXP_{t-1} \end{Bmatrix} \begin{Bmatrix} \varepsilon_{t-1}\, MN \\ \varepsilon_{t-1}\, MX \\ \varepsilon_{t-1}\, ST \end{Bmatrix}$$

Where:

Y_t = is a column vector of observation at '*t*' of all the variables in the model, i.e.

Y= (OIL_PRICE_t, $EXCH\_RATE_t$, $INFL\_RATE_t$ $OIL\_REVENUE_t$, $GOVT\_EXP_t$)

ΔOILPMN = Minimum Oil Price,

ΔOILPMX = Maximum Oil Price,

ΔOILPST = Structural Equation of Oil Price Shock

This study is conducted by modifying and adopting the work of Apere (2017) in the field of social sciences after slight modifications in his model. The model of Apere (2017) was modified on the fact that Apere used three variables (crude oil price, inflation rate, and real exchange rate) by using VAR model in quarterly time series data from 1980:1 to 2015:4 in his study titled "Crude Oil Fluctuation and Inflation in Nigeria". The modifications, however, affect the period and study variables; that is, this study considers annual time series data from 1981 to 2022 with the oil price and the selected macroeconomic variables (exchange rate, oil revenue, inflation and government expenditure) in carrying out the study.

RESULTS AND DISCUSSION OF FINDINGS

Tests for Stationarity Results

Table 1 Unit Root Tests

Variables	Levels (5%)	Critical Values (5%)	1st difference (5%)	Orde 1
Loil_price	-2.379	-3.527	-6.235	I(1)
Exchang_rate	-0.068	-3.527	-4.777	I(1)
Inflation_rate	-3.096	-3.553	-5.744	I(1)
Loil_revenue	-0.544	-3.527	-5.564	I(1)
Lgovt_expend	-0.403	-3.530	-7.970	I(1)

Source: Computed by the researchers using E-Views 9 (2024)

The ADF statistics in Table 1 showed that all the variables are not stationary at a level of 5% critical values. Consequently, the levels in the series will generate spurious results if used for information. The table also shows the order of integration for oil price and selected macroeconomic variables that the variables are to be integrated of order one, with a maximum lag of 9 and lag length for all the variables; still, the inflation rate has to be changed to 12 maximum lags in order to be integrated of order one so as to fit in VAR model for the study. All the variables are now at first different, indicating that the series are not stationary at their level forms (*p*-value > 0.05).

Johansen Cointegration Test

Table 2 Johansen Cointegration Results

Null Hypotheses	Trace Statistics	C.V (5%)	Max- Eigen statistics	C.V (5%)	Variables
$r = 0^*$	108.631	88.804	43.976	38.331	Loil_price
$r \leq 1^*$	64.654	63.876	23.980	32.118	Exch_rate
$r \leq 2$	40.674	42.915	20.135	25.823	Infl_rate
$r \leq 3$	20.539	25.872	10.949	19.387	Loil_revenue
$r \leq 4$	9.590	12.517	9.590	12.517	Lgovt_exp

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

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-values

Source: Computed by the researchers using E-Views 9 (2024)

However, since all variables are integrated in the same order, the Johansen cointegration test is performed, and the results are in Table 2. The result showed that the trace value exceeded the critical value, and there is one cointegrating equation(s) at the 5 per cent significance level. At the same time, the max eigenvalue indicates no cointegrating equation. As may be observed from the table, the trace statistic indicates the presence of cointegrating vector. From these results, the study concludes that there must be a unique cointegrating vector governing the long-run relationship among the variables. The study then proceeds to estimate a VAR on the first difference for the oil price and selected macroeconomic variables in the following section.

Optimal Lag Structure

Table 3 VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-449.2017	NA	62574.64	25.23343	25.45336	25.31019
1	-264.6954	307.5106	9.009453	16.37197	17.69156*	16.83254
2	-230.0134	48.16936	5.728753	15.83408	18.25334	16.67847
3	-209.5569	22.72954	9.301906	16.08649	19.60542	17.31469
4	-153.0071	47.12482*	2.680525	14.33373	18.95232	15.94574
5	-106.2063	26.00044	2.301843*	13.12257*	18.84083	15.11840*

* Indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion

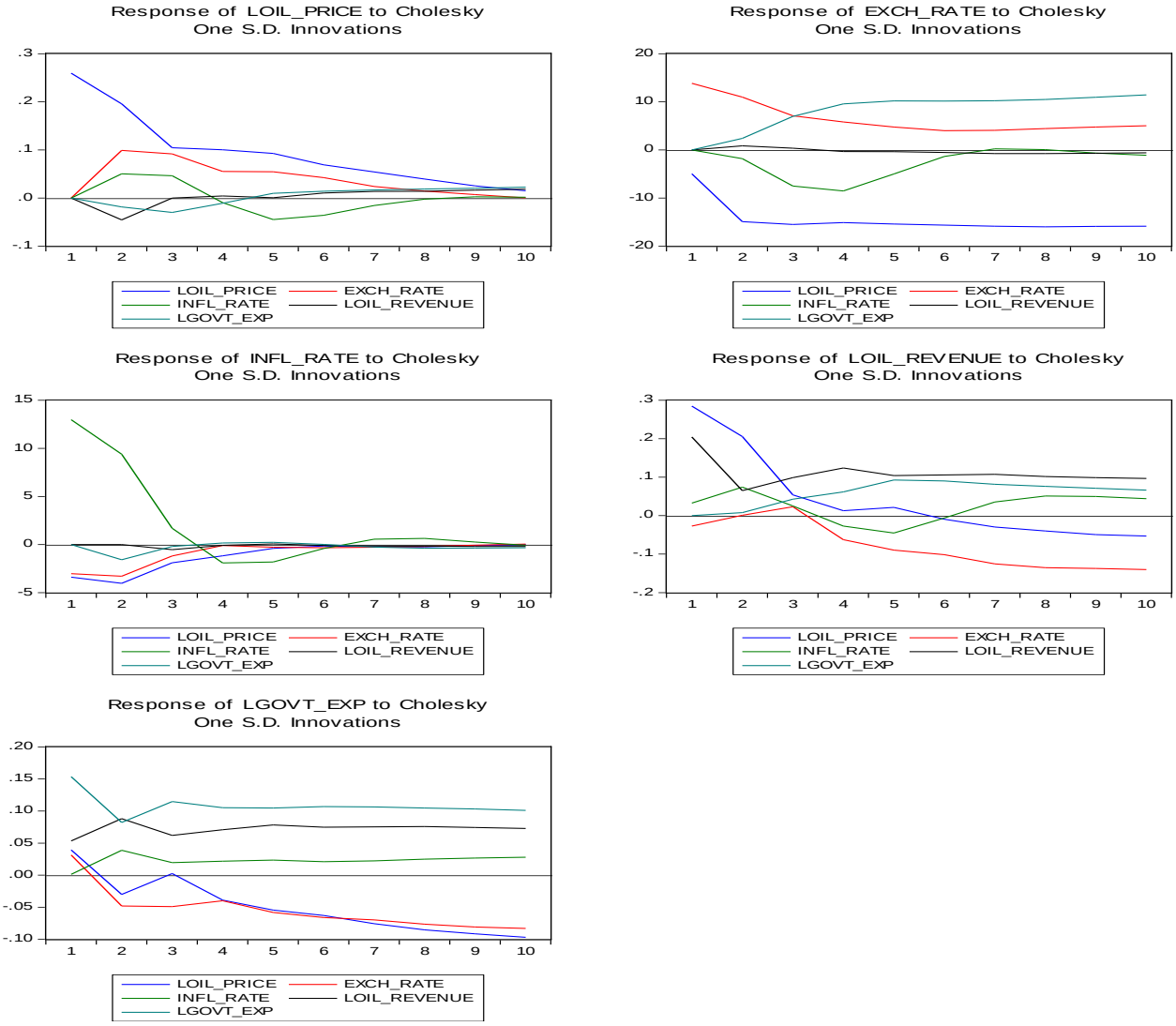
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Computed by the researchers using E-Views 9 (2024)

The result in Table 3 shows the maximum lag length determination estimated via the lag order selection criteria. The result shows that the optimum lag is lag five (5) since most of the criteria – FPE, AIC, and HQ- showed the fifth lag to be the optimum lag length for which the VAR (5) model was estimated.

Impulse response functions for Oil price and Selected Macroeconomic Variables

An impulse response function depicts the effect of a one-time shock to one of the innovations/shocks on current and future values of the endogenous variables. İt is also showed the responses of macroeconomic variables due to oil price shocks in Nigeria.



Source: Computed by the researchers using E-Views 9 (2024)

Figure 1: Impulse Response Functions

Figure 1 shows a combined graph of responses of macroeconomic variables to oil price shocks, which examines the long-run dynamic interactions among these variables; the research generates impulse-response functions from the estimated VAR. From the second graph, the study shows the response of exchange rate to Cholesky oil price shocks as when the oil price falls within the negative region of a graph, from -5 to -15 and does not up to it reach 10 period on horizontal line, then the response of exchange rate starts coming down from 15 to 5 on Y-axis and did not die up to it reaches 10 periods on horizontal line (X-axis); indicating that the oil price and exchange rate are moving on the different directions, that is, as oil price raises, leads to depreciation of exchange rate since Nigeria is both an importing and exporting nation, importing refined oil products and other products from the rest of the world due to her incapacitated refineries.

However, the response of inflation due to oil price shocks from third graph is as oil price starts rising from -5 on Y-axis up to 0 level on X-axis and did not die until it reaches period 10 on X-axis, thereby leading to a fall of inflation rate from 15 on Y-axis to negative region and it starts rising to positive region and did not die until period 10 on X-axis; meaning that as oil price falling slowly leads to rapid falling of inflation since the money supply falls which leads to fall in demand on consumption and investment decision of households and firms under the periods of study.

From the fourth graph, however, as oil price started coming down up to negative region on Y-axis and did not die until it reaches period 10 on X-axis, while the oil revenue responds by coming down from Y-axis and keeps maintaining the constant or straight line up to period 10 on X-axis, which depicts that as an oil price falls at global oil market leads to a fall on Nigeria's oil-GDP and oil revenue that has a multiplier effect on government expenditure and annual budget implementation in the country as we can see from graph fifth whereby the curves or plots of oil price, oil revenue and government expenditure are moving in the same direction within the positive region and did not die until it reaches period 10.

Table 4 Impulse Response Functions (IRFs)

Horizon (Annually)	LOIL_PRICE	EXCH_RATE	INFL_RATE	LOIL_REVENUE	LGOVT_EXP
1	0.259	13.847	12.966	0.204	0.153
2	0.195	10.959	9.389	0.065	0.082
3	0.104	7.088	1.678	0.098	0.114
4	0.100	5.813	-1.921	0.123	0.105
5	0.092	4.757	-1.809	0.104	0.104
6	0.068	3.995	-0.422	0.105	0.106
7	0.054	4.056	0.544	0.107	0.106
8	0.039	4.415	0.628	0.101	0.104
9	0.025	4.746	0.250	0.098	0.103
10	0.015	5.010	-0.066	0.096	0.100

Cholesky Ordering: LOIL_PRICE, EXCH_RATE, INFL_RATE, LOIL_REVENUE, LGOVT_EXP

Source: Computed by the researchers using E-Views 9 (2024)

Table 4 shows the reaction of the exchange rate (Exch_rate) due to shocks in the oil price (Loil_price) present for a short time period, but after that, it stabilizes at 13.847% but started-ups and downs to less than 4% in the 6th year. Also, for the inflation rate (Infl_rate), response to shocks in the oil price (Loil_price) begins at 12.966% in the first year and negatively started coming down to the 4th year period at -1.921% and keeps fluctuating down to -0.066% after 10th year which is insignificant. However, for Oil revenue (Loil_revenue), response to shocks in the oil price (Loil_price) starts from the first year at 0.204% to downward at 0.096% for the final year (10th year). In addition, for Government expenditure (Lgovt_exp), response to shocks in the oil price (Loil_price) starts at 0.153% from the first year to downwards, sloping as a result of its shocks down to 0.1% after 10-year horizons. In this case, the impact is positive, which means that the shock in one variable makes a positive reaction to the other one.

Variance Decompositions of Oil Price and Selected Macroeconomic Variables

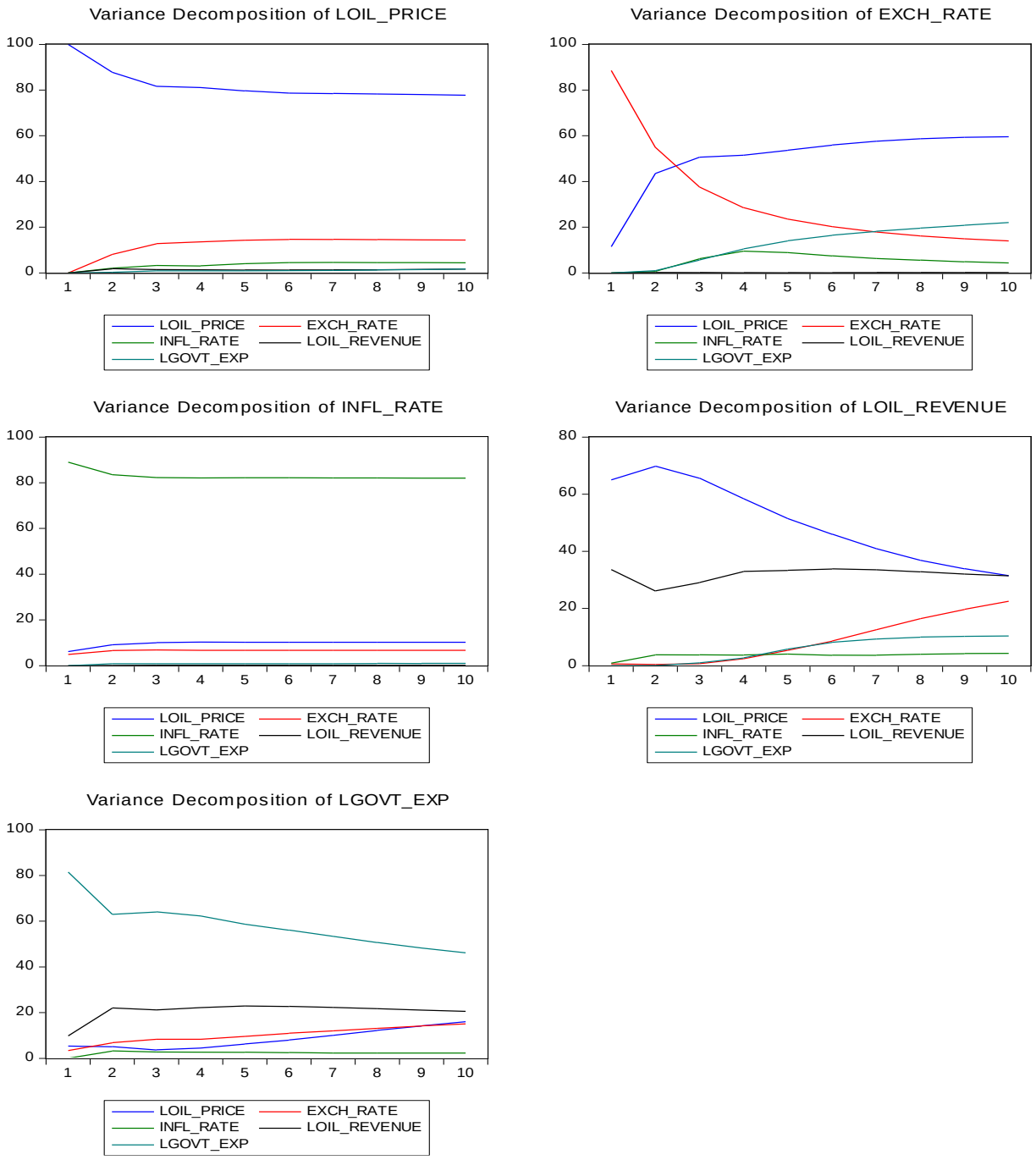
While impulse response functions depict the changes of a shock to one endogenous variable onto the selected variables in the VAR, Variance Decompositions separate the variation of an endogenous variable into the component shocks to the VAR. Thus, the Variance Decompositions provide information on the relative importance of each random innovation in affecting the variable in the VAR.

Table 5 Variance Decompositions for LOIL_PRICE and Macroeconomic Variables

Horizon (Annually)	S.E.	LOIL_PRICE	EXCH_RATE	INFL_RATE	LOIL_REVENUE	LGOVT_EXP
1	0.259	100.000	88.500	88.992	33.589	81.442
2	0.346	87.744	54.831	83.542	26.097	62.966
3	0.377	81.627	37.527	82.268	29.038	64.019
4	0.394	81.102	28.464	82.103	32.922	62.289
5	0.411	79.614	23.520	82.208	33.314	58.718
6	0.421	78.647	20.251	82.180	33.774	56.021
7	0.426	78.441	17.903	82.136	33.577	53.363
8	0.429	78.302	16.196	82.085	32.819	50.662
9	0.430	78.068	14.934	82.037	32.068	48.268
10	0.432	77.747	13.966	81.997	31.391	46.136

Source: Computed by the researchers using E-Views 9 (2024)

Initially, in Table 5, at the 1-year horizon, all forecast error variances in LOIL_PRICE are explained by their innovations at 100 per cent. In comparison, all the explanatory variables of macroeconomic variables started from 0 per cent. The decrease in the price of oil was about 59.59% and 4.34% of EXCH_RATE forecast error VDC, which is explained by the LOIL_PRICE and INFL_RATE, respectively. However, LOIL_PRICE and EXCH_RATE contribute 10.2% and 6.7% for the variation in the forecast error of INFL_RATE due to the rise in oil price, respectively. From the result in Table 5 shows that the variations in the forecast error of LOIL_REVENUE after 10 years as results of contributions by LOIL_PRICE and LGOVT_EXP to 31.46% and 10.36% due to maximum oil price shocks respectively. It can also be seen from Table 5 for LGOVT_REVENUE, where LOIL_PRICE and LOIL_REVENUE contribute 15.99% and 20.51% for the variations in the forecast error respectively.



Computed by the researchers using E-Views 9 (2024)

Figure 2: Variance Decompositions (VDCs)

Figure 2 of VDC was used as an alternative method to examine the effect of oil price shocks on selected macroeconomic variables (exchange rate, inflation rate, government expenditure and oil revenue). It depicts the forecast error variance for any variable in a system as explained by innovations to each variable over a series of time horizons. Normally, own variable shocks try to explain most of the error variance, although the shock would also influence other variables in the system. In this case, the VDC validate the significant role played by LOIL_PRICE in accounting for shocks in these macroeconomic variables namely: EXCH_RATE, INFL_RATE, LOIL_REVENUE, and LGOVT_EXP. İt is also shown the

results of shocks of macroeconomic variables due to oil price shocks during the study period in Nigeria.

However, the second graph in Figure 2 above shows the shocks as the oil price tends to increase from 10 to 60 levels, and then the exchange rate tends to have a downward slope from 90 to 10 rate, which indicates an inverse relationship between oil price and exchange rate. From the third graph of variance decompositions, forecast error depicts that the shocks of inflation rate to oil price is very wide as oil price maintains less than 10 forecast error then inflation rate remains on 90 forecast error does not die till it reaches period 10. The fourth graph, however, shows that as oil price tends to have downward sloping from about 70 to 40 on horizontal line and did not die till it reaches period 10, then the oil revenue tends to have a shock from 35 to 30 and starts moving upward slowly up to 40 and did not die till at period 10. Lastly, the innovations of government expenditure show that there is a fall in government spending from about 80 to 50 due to a fall in oil price at the global oil market to less than 20 and did not die till it reaches period 10 on the horizontal line.

Conclusion and Recommendations

From the research findings, the study is carried out to investigate whether or not a response exists among oil price shocks and selected macroeconomic variables and to examine the various oil price shocks with the implications on the Nigerian economy; hence, the study adopts the VAR model with Impulse Response Functions (IRFs) and Variance Decompositions (VDCs) to measure the shocks and responsiveness of both global oil price and some selected macroeconomic variables. İt therefore, affirmed that the response of the exchange rate to oil price shocks has an inverse relationship between oil price and exchange rate, indicating that the oil price and exchange rate are moving in different directions, that is, as oil price raises, leads to depreciation of exchange rate since Nigeria is both an importing and exporting nation, importing refined oil products and other products from the rest of the world dur to her incapacitated refineries. Furthermore, the response of inflation rate, oil revenue and government expenditure to oil price shocks are positive but insignificant: meaning that as oil price falling slowly leads to rapid fall of inflation since the money supply falls which leads to a fall in demand on consumption and investment decisions of households and firms as well as a fall on Nigeria's oil-GDP and oil revenue that has a multiplier effect on government expenditure and annual budget implementation in the country under the periods of the study.

However, based on the results, the following were recommended: first, efforts geared towards developing the oil sector locally by making its refineries are operate at full capacity so as to reduce dependence on foreign currency (US Dollar over Naira) so as to make an appreciation of exchange rate, controlling inflation, rise in oil revenue and oil GDP to complement government expenditure in Nigeria. Second, to assist the federal government and CBN in achieving lower inflation and a stable exchange rate towards economic growth targets, the Nigerian government should formulate and implement diversification of the economy.

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