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Research Article

Evaluating the Correlation between Specific Macroeconomic Performance and the Price of Crude Oil in Nigeria

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Abstract: The study examines the relationship between oil price shocks and some selected Nigeria's Macroeconomic variables by utilizing quarterly data for the period of 1980-2022 using a time frame of 46 years. The selected macroeconomic variables are Real Growth Domestic Product, Consumer Price Index and Real Exchange Rate. VECM was used as a technique for analysis, the results obtained from the estimation of the VECM model showed that there are long-run interdependences of oil price shocks that have a significant impact on Real Growth Domestic Product, Consumer Price Index and Real Exchange Rate in Nigeria. The study concluded, that the major source of revenue and foreign earnings to the economy is mainly from the sales of crude oil, as the economy is entirely dependent on the level of global oil prices, as such most of the macroeconomic indicators of the economy are directly or indirectly being affected by the oil price fluctuation in the economy, the study therefore Recommended that, since Nigeria doesn't have control of oil prices, it is required that government diversify the economy to reduce the adverse effect of shocks emanating from the fluctuation of global oil prices, the country should diversify its export from oil exports to non-oil export Diversification of the economy is necessary to reduce the consequences of external shocks. The diversification of the oil revenue base would be a means of minimizing reliance on crude oil and petroleum products.

Keywords: oil price; macroeconomics variables; VECM; crude oil; shocks

1. Introduction

The last twenty years have seen dramatic fluctuations in oil prices in the oil markets. Such essential energy sources' price swings are largely dependent on changes in supply over time, more so than those of any other commodity (shortage or excess). Macroeconomists have considered shifts in oil prices to be both a major source of volatility and a paradigm of global shocks that are likely to have simultaneous effects on economies since the 1970s. The increase in oil prices between the early 1970s and the early 1980s is closely linked to disruptions in the Middle Eastern countries' oil supply. The price of crude oil was 3.00 billion barrels per dollar on average closing price till the middle of the 1970s.Following the 1979 Iranian crisis, there was a significant disruption in oil supply in 1999, which led to a new wave of price increases for oil that peaked in the second quarter of 2008. The adjusted price per barrel was $99.07. First and foremost, the dramatic rise in oil consumption was brought on by the rising usage of contemporary transportation options in emerging nations, such as cars. Second, the demand for oil is rising due to the rapid industrialization that has taken place in emerging and developing nations. Thirdly, the key economic sector in emerging nations is agriculture, which includes farming and irrigation. This industry has grown increasingly industrialized and depends heavily on oil as a source of energy (Salisu & Mamman, 2022).

1.1. Significance of the Study

Crude oil exports have long been a major source of foreign exchange earnings and government income for the Nigerian economy, since they make up over 95% of export earnings and over 85% of government revenue. However, in 2008, its GDP contribution was only 17.85% (Aliyu, 2009). According to oil data, Nigeria is the country with the second-largest oil reserves on the African continent, with an estimated 36.2 billion barrels of reserves.

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Nigeria's effective oil production capacity is estimated by the Energy Information Administration (2009) to be approximately 2.7 million barrels per day. Significant reductions in oil production levels led to a severe impact on exports and a sharp decline in global oil prices in late 2008, which left the nation with enormous financial deficits. In addition, since the collapse of regional refineries in the late 1980s, the nation has been heavily dependent on imports of refined petroleum products, which has exposed it to fluctuations in oil prices. Presently, about 85% of refined goods consumed domestically are imported.

1.2. Problem Statement

The volatility of the oil price and its impact on Nigerians' economic well-being are among the country's most pressing issues at the moment (Musa, Magaji, Eke, & Abdulmalik, 2022). Nigeria cannot independently convert its crude oil into petroleum products, thus it imports a large amount of refined petroleum products, giving it no control over its crude oil product. For example, the failure of the nation's four oil refineries in Port Harcourt, Warri, Delta, and Kaduna is the primary cause of the fuel shortfall. The nation continues mostly depends on the importation of refined fuel, despite the government's assertions that it has spent $6 billion on repairs (Elmi & Jahadi 2011). Because of the extreme elasticity of the oil price's impact on macroeconomic indicators, the economy reacts to even the most remote conjecture. Accordingly, prolonged oil shocks may have negative macroeconomic effects, such as fluctuations in GDP, which could make policymaking more difficult (Abdullahi et al., 2024). Therefore, it would seem that Nigeria's macroeconomic stability and sustainable development are seriously threatened by the volatility of oil prices. Nigeria's high reliance on oil as its primary source of income, along with the neglect of agriculture and other sectors in a comprehensive and sincere diversification policy, are all contributing factors to the country's inability to achieve sustainable development, a certain level of full employment, poverty reduction, solving the unfavorable trade balance, inflation problem, and high debt ratio Hussain & Salisu (2019). Decades of corruption in the oil industry, poverty, unemployment, processing and distribution costs, social conflicts in oil-producing regions leading to pipeline vandalism, oil theft, abduction of foreign oil workers, and disruptions in the supply and demand of petroleum products all contribute to the problem (Magaji & Musa, 2015).

1.3. Objective of the Study

The reason for this study is Nigeria's heavy reliance on crude oil export earnings, which account for around 95% of overall export earnings and, on average, 85% of government revenue in annual budgets. Given the present, significant fluctuations in oil prices on the global oil market, this has serious ramifications for the Nigerian economy. This study's primary goal is to experimentally investigate how changes in oil prices affect a few key macroeconomic variables in Nigeria. By using quarterly data, this study's requirement to close the gaps left by earlier studies becomes relevant.

2. Literature review

2.1. Oil Price Shocks

Oil price shocks are primarily characterized as price variations brought about by shifts in the supply or demand of the global oil market (Hamilton, 1983; Wakeford, 2006). The Organization of Petroleum Exporting Countries' (OPEC) production quotas, political unrest in the Middle East, which is an oil-rich region, and the actions of terrorist groups in Nigeria's Niger Delta have historically been blamed for supply-side interruptions that have caused these shifts. As a result, depending on the situation, the shocks could be positive (a rise) or negative (a fall).

The first oil price shock occurred in October 1973 as the consequence of the attack of Syria and Egypt on Israel, which affected industrialized economies as oil-importing countries and they swelled into stagflation (Elmi & Jahadi 2011). This exogenous shock ended and those countries had to start a long-term plan to confront future oil shocks. Iran's revolution in 1979 and then the Iraq-Iran war caused the oil price to increase. The third shock was a negative one and occurred in 1985-1986 due to the collapse of the oil market and the remarkable reduction in world oil prices. In 1990, following the Persian Gulf War and Iraq's attack on Kuwait, the world oil market faced another shock.

2.2. Macroeconomic Performance

Macroeconomic performance pertains to evaluating a country's progress in achieving the primary goals of government policy (Musa, Magaji & Salisu, 2022). The primary objective

of these policies typically revolves around enhancing the quality of life for their population. It centres on the overall economic changes, including factors like unemployment, INTR, GDP, inflation, and other related aspects (Magaji et al., 2019). This analysis encompasses all macroeconomic and microeconomic parameters that influence economic performance. In Rafindadi's (2012) definition, macroeconomic performance refers to the capacity of a country's macroeconomic policymakers to deliver services that facilitate the achievement of specific living standards. In other words, it is the capacity of a nation's macroeconomic policy makers to deliver services to its citizens, such as a substantial real GDP per capita, minimal inflation, low unemployment, and a favourable trade surplus (Wudi et al., 2021). The terms development and growth were used synonymously. Khramov and Lee (2013) found that in the 1950s and 1960s, several emerging countries achieved their economic growth goals. However, the population's living conditions did not improve, leading to persistent poverty, illiteracy, and declining health in these nations. For example, in 2010, Nigeria's GDP was recalculated, resulting in Nigeria becoming the largest economy in Africa. However, this achievement persisted despite inflation, poverty, unemployment, inadequate infrastructure, and substandard health facilities (Shaba et al., 2018).

2.3. Theoretical Review

The macroeconomic effects of shocks to oil prices have been the subject of substantial theoretical research. The majority of these studies contended that changes in oil prices have been a significant cause of business cycle fluctuations since the mid-1970s, but they were unable to agree on the existence of an odd transmission channel that explains the mechanisms through which changes in oil prices affect the macroeconomy (Akinleye & Ekpo, 2013). Hunt et al. (2002) state that there are numerous ways in which rising oil prices might affect the economy. The first mechanism shows how income is transferred from countries that import oil to those that export it, which lowers demand globally in the countries that import oil. Due to an anticipated low inclination to consume, the fall in demand in the oil-exporting countries surpasses the growth in the oil-importing countries. Second, an increase in production input costs will have an impact on output given the level of capital stock and the assumption that salaries are relatively inflexible in the medium term (Salisu & Haladu, 2023). Furthermore, as crude oil is a necessary component of production, rising oil prices raise the cost of production. The third channel is the result of producers' and laborers' resistance to a drop in their actual earnings and profit margins. Prices and labor costs are pushed higher as a result. The definition of core inflation provides the fourth channel. When energy prices rise, the consumer price index rises as well, prompting the central bank to issue directives. According to economic theory, there are several ways in which fluctuations in oil prices might impact economic activity:

2.4. Transmission mechanisms (channels)

The literature has put forth a number of transmission routes via which changes in oil prices impact the performance of macroeconomic variables. In particular, six transmission channels – the supply-side effect, the demand-side effect (wealth transfer effect), the inflation effect, the real balance effect, the sector adjustment effect, and the unexpected effect – have been identified (Brown &Yucel, 2002; Jones, 1991; Tang et al., 2010). Impact from the supply side: Since crude oil is essential to both trade and production, rising oil prices push up the cost of both, forcing companies to cut back on output. The effects of growing oil prices on the supply side are as follows. Crude oil is categorized as a supply-side channel input since it is a basic component of production. Increases in production costs stemming from changes in domestic labor and capital inputs and decreased capacity utilization are direct effects of rising oil prices on output. Put another way, fluctuations in the price of oil affect production's marginal costs, which causes output to decline.

The Wealth Transfer Effect: Variations in the price of oil have an impact on investment and consumption through the demand-side mechanism.

While investment is directly harmed by an increase in oil prices because it indirectly impacts the price of a firm's inputs, raising their expenses, consumption is impacted by its positive relationship with disposable income. Another mechanism that captures the flow of revenue from oil-importing countries to oil-exporting countries after an increase in oil prices is the wealth transfer effect. Increases in oil prices provide oil-exporting nations with windfall profits. The transfer of income lowers consumer demand in oil-importing nations while simultaneously raising it in oil-exporting nations, albeit more proportionately due to the latter's presumed higher marginal propensity to consume. From the standpoint of a nation

that imports oil, a shock to the price of oil is felt on the demand side of the economy, leading to a decline in the desire for products and services (or consumer spending). Four complimentary mechanisms-the discretionary income effect, the uncertainty effect, the precautionary savings effect, and the operating cost effects—are how oil price shocks impact consumer spending. (Kilian, 2010).

2.5. Empirical Review

The empirical literature on the macroeconomic impacts of oil supply shocks evolved as the new state of the oil market revealed itself gradually after 1973. One of the initial beliefs following the 1973-74 price shock was that the new, higher price of oil might be a permanent feature of a changed natural resource regime. Accordingly, one recurrent theme was the aggregate economy's response to a sudden, permanent price shock. How would an economy adjust to the new circumstances?

Wilfred (2024) examined the Effect of selected macroeconomic variables on External Reserves Management in Nigeria (1981-2022) with external reserves as a dependent variable and international crude oil price movement, exchange rate volatility, inflation, monetary policy rate, public expenditure, economic growth, external debt service payment, and trade Openness as independent variables. With dataset from the Central Bank of Nigeria Statistical Bulletin and Autoregressive Distributive Lag (ARDL) model as the key estimation technique, the study found that crude price movement, economic growth, and public expenditure growth, all had positive and significant impacts on external reserves management. Exchange rate volatility, monetary policy rate and trade openness were found to have adverse and significant effects on external reserves. It is therefore recommended that effective and efficient fiscal and monetary policy measures be adopted to enhance the management of external reserves.

The influence of oil price shocks on a few macroeconomic indicators in Nigeria between 1990 and 2021 is examined by Bamaiyi (2024). Ex-post facto technique and econometric analysis are used in the study, which focuses on variables including real GDP (gross domestic product), balance of payments, unemployment, oil price, and currency rate. Assuming these variables to be endogenous, the study investigates the correlations between them using the annual Vector Autoregressive (VAR) model. For the analysis, time series data is gathered from the statistical bulletin published by the Central Bank of Nigeria. The unit root test result shows that all the variables are integrated of order one (I (1)), requiring more research to be done on the linkages between them. Over a ten-year period, the impulse response function showed how macroeconomic variables dynamically responded to shocks in the price of oil. The Granger causality test emphasizes the causal relationship between the variables, highlighting the impact of shocks to the oil price on real GDP, the balance of payments, and unemployment. According to the results, shocks to the price of oil have a major impact on a number of macroeconomic indicators, including currency rates, unemployment rates, and balance of payments. The research suggests implementing policy strategies, like diversification, promoting domestic production, and fostering an atmosphere that is conducive to foreign direct investment, to safeguard the economy from shocks to the global oil price. Furthermore, it is recommended that the government develop and strategically execute fiscal and monetary policies in order to stabilize the economy in the face of changes in the price of oil and therefore foster sustained economic growth.

Sami and Taiwo (2023) looked at the impact of production and crude oil prices on the Nigerian Gross Domestic Product. This study's methodology, which included a thorough evaluation of pertinent literature on the effects of crude oil output and prices on the Nigerian economy, was based on the conceptual review. This conceptual analysis looks at how the production and price of crude oil affect Nigeria's GDP performance from an economic, social, and environmental standpoint. Among the economic aspects that can be seen are the effects on trade balances, fiscal balances, and foreign currency earnings. In terms of social implications, millions of Nigerians are employed directly or indirectly by the oil business. Thus, changes in the quantity and price of crude oil can have an impact on living standards and employment prospects. The detrimental effects of crude oil production, transportation, and exploration on the environment are taken into consideration along with an assessment of the environmental aspect. According to this paradigm, in order for investors and policymakers to maintain sustainable growth in Nigeria, they must have a thorough understanding of how crude oil production and pricing affect the country's GDP performance.

Guntur & Shripad (2020) using quarterly data from March 31, 1999, to December 31,

2019, examine the relationship between crude oil prices and macroeconomic variables in the BRICS countries. To investigate the long-term relationship between crude oil and macroeconomic variables, an Autoregressive Distributed lag model was developed. The study discovered that the variables have a sustained association. We've also found that every nation responds to changes in oil prices in a unique way. However, it's noteworthy to note that China and India respond to fluctuations in the price of crude oil in rather similar ways. Furthermore, we've discovered that, with the exception of Russia, all of the countries under investigation are impacted by changes in the price of oil.

Ahmad et al. (2020) explains the connection between the volatility of crude oil prices and important macroeconomic variables, such as GDP, IR, interest rates, and currency rates. The study used the vector autoregression (VAR) setup with the impulse response function and the prediction error variance decomposition technique as macroeconomic policy modeling tools. The time-series data (2000–2020) were collected from South Asian countries (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka). When shocks to the price of crude oil occurred, the impulse response function's result helped to explain a significant amount of the variation observed in macroeconomic indicators. The socioeconomic status of the area is greatly impacted by even little changes in oil prices, which can have a substantial effect on macroeconomic indices. The outcome of variance decomposition shows that the region's countries respond to fluctuations in the price of crude oil in different ways, which is a reflection of their respective macroeconomic bases, autonomous policies, sectoral structures, and national characteristics. According to the findings, governmental policies should be changed to lessen reliance on oil and to promote the use of renewable and green energy sources for improved environmental outcomes and sustainable development.

Miamo & Achuo (2021) revisit the resource curse hypothesis by examining the nexus between crude oil prices and economic growth for a panel of 32 Sub-Saharan African countries from 1980 to 2017. Employing the panel vector autoregression (VAR) estimation technique, we found evidence of a significant positive effect of crude oil price on economic growth both in the short run and long run. However, after splitting the panel into net oil exporters and importers, the results for net oil importers remain consistent with those obtained for the whole panel, unlike those for net oil exporters revealing a positive and negative effect of crude oil price on economic growth in the short-run and long-run periods, respectively. This confirms the resource curse hypothesis for oil-exporting countries under consideration. Moreover, we found evidence of bidirectional causality between crude oil prices and real GDP. Consequently, to boost economic growth in Sub-Saharan Africa, various governments should encourage economic diversification, and increase investments in human capital in view of enhancing the development of the oil sector by ensuring an efficient management of oil revenues, as well as intensifying the fight against corruption.

Omolade, Ngalawa and Kutu (2019) investigate the influence of crude oil price shocks on the macroeconomic performance of Africa's oil-producing countries. Eight major net oil producers, namely, Algeria, Nigeria, Egypt, Angola, Gabon, Equatorial Guinea and Congo Republic are included in the study. Sudan is excluded due to data constraints. The study covers the period between 1980 and 2016, which represents the periods with the most boom and bust movements in crude oil prices. The Hamilton Index (1996) which uses the net oil price increase is applied. The study compares the price of oil in each quarter with the maximum value observed during the preceding four quarters. This is used to derive sharp increases and declines in oil prices to capture oil price shocks. A Panel Structural Vector Auto-Regression model is adopted for analysis. The results show that the reaction of output to sharp increases and declines in oil prices differ. It is also observed that structural inflation accompanies sharp declines in oil prices more than monetary inflation since both outputs and investment decline significantly.

Plakandaras (2017) study the time-varying effect of macroeconomic shocks in the determination of house prices in the U.S. and the U.K. housing market, employ time-varying Vector Auto-regression models using Bayesian methods covering the periods of 1830-2016 and 1845-2016 respectively. From the examination of the impulse responses of house prices on macroeconomic shocks, the study found that technology shocks dominate in the U.S. real estate market, while their effect is unimportant in the U.K. In contrast, monetary policy drives most of the evolution of the U.K. house prices, while transitory house supply shocks are unimportant in either country.

Therefore, this study aims to look at the relationship between certain macroeconomic performances and with price of crude oil in Nigeria and the objective of the study is to

evaluate the correlation between specific macroeconomic performance and the price of crude oil in Nigeria.

3. Methods and Materials

3.1. Types and Sources of Data

Conventionally, for a time series study, secondary data is normally employed to establish the necessary link or otherwise among the variables of interest, the data sourced from the National Bureau of Statistics (NBS) publications, Central Bank of Nigeria (CBN) Annual Report and Statistical Bulletin, World Bank and International Financial Statistics (IFS) of the IMF.

3.2. Techniques of Data Analysis

The study used the Unit Root Test Vector error correction model and cointegration, Unit root test or rather checking the order of integration among the variables of interest gained prominence in time series studies since Augmented Dickey-Fuller (ADF) test (1979, 1981) was developed and later it extended and the test assumed that errors terms are statistically independent and have a constant variance, other methods of testing for the existence of unit root problem was developed by Phillips-Perron (PP) test (1988), which takes into account for serial correlation and Heteroscedasticity. Another test for unit root was developed by Kwiatkowski-Phillips-Schmidt-Shin (KPSS) in 1992, the test assumed the null hypothesis (Ho) to be stationary, unlike ADF and PP which assumed the null hypothesis as non-stationary.

Augmented Dickey fuller equation model (ADF) is here specified as:

$$\Delta y_t = \alpha_o + \alpha_1 + \delta y_{t-1} + \sum_{i=1}^{k} \beta_1 \Delta y_{t-1} + \varepsilon_t \quad (1)$$

Where α_0 and α_1 are a constant and deterministic trends, Δ is a differencing operator, ε_t is a serially uncorrelated error process and it requires that $\delta < 1$, if $\delta = 1$ then there is a unit root in the variable

3.3. Co-integration test

Because of the inadequacy of the differencing method, testing of the model co-integration is critical for the VECM. The Johanson test of co-integration was employed to test for co-integration in the model. This test permits more than one co-integrating relationship, so, it is more generally applicable.

There are two types of Johanson tests, either with trace or with eigenvalue, and the inferences might be a little bit different. The null hypothesis for the trace test is that the number of co-integrating vectors is $r = r^* < k,$ vs. the alternative that $r = k$. Testing proceeds sequentially for $r^* = 1, 2,$ etc. and the first non-rejection of the null is taken as an estimate of r. The null hypothesis for the *maximum eigenvalue* test is as for the trace test but the alternative is $r = r^* + 1$ and, again, testing proceeds sequentially for $r^* = 1, 2,$ etc., with the first non-rejection used as an estimate for r.

3.4. Vector Error Correction Model

To express the relationship between the variables with an ECM model, which will now have the advantage of including both short-run and long-run information. The error correction model (ECM) shows how much of the disequilibrium is being corrected over a period, it is called the adjustment effect. ECM model measures the correction from disequilibrium of the previous period, which has a very good economic implication, Furthermore, it resolves the problem of spurious regression because it eliminates the trend in the variable involved.

Error correction model is specified as

$$\Delta y_t = \alpha_o + \beta_1 \Delta X_1 - \pi \hat{U}_{t-1} + \varepsilon_t \quad (2)$$

Where β_1 is the impact multiplier (short run effect) this measures the immediate effect on change in X_1 will have on a change in y_t on the other hand π is the feedback effect or adjustment effect, and how much of the disequilibrium being corrected.

3.5. Model Specification

The models are stated as:

$$Y_t = (ROP, RGDP, CPI, REXH)$$

$$ROP = f(REXH, CPI, RGDP) \quad (3)$$

Where ROP is the real oil price

REXH is the real exchange rate

CPI is consumer price index

RGDP is real gross domestic product

For econometric model

$$ROP_t = \alpha_o + \alpha_1 REXH_{t-1} + \alpha_2 CPI_{t-1} + \alpha_3 RGDP_{t-1} + u_{t-1} \quad (4)$$

Where α_o is the intercept

t is present time

t_{-1} is lag or previous time impact

$\alpha_1 - \alpha_3$ is coefficient or parameters

U_t is error term at the present time

4. Results and Discussion

For the study to achieve its objective which is the evaluation of the correlation between specific macroeconomic performance and the price of crude oil in Nigeria, data was sourced from Central Bank of Nigeria (CBN) Statistical Bulletin, 2023, and was analyzed using E-views. Version 10. The results are shown using the unit root test in table 1 below.

Table 1. Unit root tests

Variables	Level				1st difference			
	ADF (Prob. Value)	PP (Prob. Value)	KPSS	Status	ADF (Prob. Value)	PP (Prob. Value)	KPSS	Status
RGDP	2.333 (0.1)	2.40063 (0.142)	0.1211	Not Stationary	13.2101 (0.000)	13.2101 (0.000)	0.064321	Stationary
OP	2.0822 (0.25)	2.2973 (0.175)	0.7181	Not Stationary	12.8040 (0.000)	-12.77825 (0.000)	0.067314	Stationary
EXR	2.5623 (0.10)	2.7002 (0.075)	0.6573	Not Stationary	13.038 (0.000)	13.0352 (0.000)	0.069559	Stationary
CPI	2.1317 (0.23)	2.5572 (0.103)	0.418	Not Stationary	13.557 (0.00)	13.5509 (0.000)	0.062344	Stationary

Source: computed by the author using E-views. Version 10 (2023).

From the results obtained in Table 1, it seemed necessary to test the stationarity of the variables at their first difference since the variables were not stationary at levels. The result of these difference series is presented in the three-unit root tests in table 1 above. The result suggests that after differencing the series, the null hypothesis of non-stationarity in each of the series can be rejected at a 5% level of significance. Thus, the series are now integrated into order 1, that is they are I(1).

4.1. Order of Lag Selection Criteria

The choice of the lag length is a crucial part of empirical research based on the Vector autoregressive (VAR) model since all inferences in this model hinge on the correct model specification. The procedure requires that the choice of deterministic variables and maximum lag length (k) be such as to prevent serial correlation in the disturbance processes both within each equation of the VAR and also across equations. Table 2 presents the appropriate lag length for the Unrestricted Vector Auto Regression Estimates.

Table 2. Order of lag selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ

0	-473.3425	NA	0.001612	4.921057	4.988435	4.948340
1	394.0956	1690.163*	2.48e-07*	-3.856655*	-3.519763*	-3.720238*
2	401.2520	13.64885	2.72e-07	-3.765484	-3.159078	-3.519933

* 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 researcher using E-views. Version 10.0

Based on the order of selection criteria given in Table 2, one lag has been selected for the estimation of the VAR model. The selected lags are based on AIC and HQ test statistics and also the fact that the lags have been able to satisfy the OLS assumptions of no serial correlation, and constant error variance (homoskedasticity).

4.2. Johansen Co-integration

The long-run relationship among variables is a crucial part of empirical research to estimate the VECM model. The Johansen cointegration test is conducted to test the long-run relationship between the variables and see if the variables are cointegrated and when the variable will be at equilibrium. Table 3 shows the summary of the Johansen Cointegration test.

Table 3. Johansen Cointegration Table

Trace test			
No. Cointegration Equation	**Statistic**	**5 % critical value**	**Prob**
None *	51.51512	47.85613	0.0218
At most 1	48.03282	47.85613	0.0481
At most 2	10.96000	15.49471	0.2140
At most 3	2.008474	3.841466	0.1564
Maximum Eigenvalue			
No. Cointegration Equation	**Statistic**	**5 % critical value**	**Prob**
None *	25.38387	27.58434	0.0932
At most 1	15.17125	21.13162	0.2771
At most 2	8.951529	14.26460	0.2902
At most 3	2.008474	3.841466	0.1564

Source: computed by the researcher using E-views version 10 (2023)

Table 3 shows the unrestricted Johansen Co- -integration Rank Test. The test hypothesized No Co integration equations. From the probability, values are less than 0.05, which means that rejecting the Null Hypothesis of No Cointegration among the variables. The trace statistic is more than the 0.05 critical values at none. The result from the two tests therefore means there is at one Co-integration relationship among variables and we cannot accept the null hypothesis that there is no co-integrating equation at 0.05 levels. Thus, this outcome confirms the presence of a long-run relationship among the variables of our model. As such, we estimate the Normalized co-integrated coefficients and VECM models.

4.3. VECM Long Run Analysis

Having established the fact that there is a long relationship between the variables using the Johansen Co-integration test. The next step is to estimate the VECM long-run relationship between the co-integrating variables. Table 4.5 below presents the VECM long-run estimates of variables.

4.4. Vector error correction model (VECM) Analysis

After analyzing the long-run relationship between the variables, the study further estimates the short-run relationship between the variables illustrated in Table 4 with a delta sign showing the changes with the lag operators that effect the dependent variable.

Table 4. Results of Vector Error Correction Model (VECM)

		Dependent Variable = D(LOGRGDP)	
Variables	**Coefficients**	**Standard error**	**t-statistics**
D(LOGOP(-1))	-0.023380	0.01129	-2.07047
D(LOGCPI(-1))	-0.152099	0.12301	-1.23645
Constant	-0.015211	0.02238	-0.67970
ECT_{t-1}	-0.337843	0.06653	-5.07805

Note: *** Statistical significance at the 1 per cent levels, **Statistical significance at the 5 per cent levels, * Statistical

significance at the 10 per cent levels.
Source: computed by the author using E-views. Version 10 (2023)

The result shows that lag values of real growth in the previous year can be described as statistically influential factors that positively affect current real GDP in the short run. A 1% increase in the value of the real GDP insignificantly changes the current real GDP by approximately 0.29%.

The past value of the exchange rate is positive and statistically insignificant at 5% affects real growth in the short run. A 1% increase in the value of the EXR insignificantly changes the current real GDP by approximately 0.103%.

The past value of the consumer price index is negative and statistically insignificant at 5% affects real GDP in the short run. A 1% increase in the value of the CPI insignificantly decreases current real GDP by approximately 0.15%. The value of the ECM is negative and statistically significant. The estimate of the lagged ECM is -0.337843. This indicates that short-run deviations towards the long run would be corrected by 33.8% in the real GDP function. This implies it would take almost two years and nine months to reach the stable log-run equilibrium path in the level of the real GDP model in the case of Nigeria. Empirically, this implies that for any disequilibrium in the system, the system will automatically adjust itself back to the equilibrium position after two years and nine months.

4.5. Residual Diagnostics

Residual diagnostic check tests have been conducted for the lag selected to ensure that the selected lags are free of serial correlation and heteroskedasticity and that the residuals of the selected lags are normally distributed. Based on the residual serial correlation test result using the LM test, given in Table 5, the null hypothesis of no serial correlation for all the lags at a 5% level given the LM statistics and the probability values of greater than 0.05 could not be rejected.

Table 5. Residual diagnostics

Lags	**VAR Residual Serial Correlation LM Test**		**VAR Residual Heteroskedasticity Test**			**VAR Residual Normality Test**			
	Lm-Stat	Prob	Chi-square	Df	Prob	Component	Jarque-Bera	Df	Prob
1	16.42998	0.4234	76.29339	100	0.9627	Joint	130054.4	8	0.0000

Source: computed by the researcher using E-views. Version 10.0 (2023).

Similarly, the test for heteroskedasticity indicates that the residuals are homoscedastic given the chi-square of 76.29339 with the probability value of 0.9627 which makes it impossible to reject the null hypothesis of homoscedasticity. Jarque-Bera test for the normality of the residual indicates that there is a departure from normality. This is evident from the Jarque-Bera statistics for the joint test and the probability value of 0.000 which is less than the critical value of 0.05 at the 5% level of significance.

5. Conclusions

The result obtained from the estimation of the VECM model has shown that there is a long-run interdependence of oil price shocks and this has a significant impact on Real Growth Domestic Product, Consumer Price Index, and Real Exchange Rate in Nigeria. The major source of revenue and foreign earnings to the economy are mainly from the sales of crude oil, the economy is entirely dependent on the level of global oil prices, and as such most of the macroeconomic indicators of the economy are directly or indirectly being affected by the oil price fluctuation in the economy. From the outcomes acquired in Table 1, it appeared to be important to test the stationarity of the factors at their most memorable contrast since the factors were not fixed at levels. The consequence of these distinction series is introduced in the three-unit root tests in Table 1 above. The outcome proposes that subsequent to differencing the series, the invalid speculation of non-stationarity in every one of the series can be dismissed at a 5% degree of importance. Hence, the series are presently incorporated into request 1, that is they are I (1).

Since Nigeria does not have the power to control oil prices in the world market, it is required that the government diversify the economy to reduce the adverse effect of shocks emanating from the fluctuation of global oil prices. The country should diversify its exports from oil exports to non-oil exports. Diversification of the economy is necessary to reduce the consequences of external shocks. Again, diversify the oil revenue base as a means of

minimizing reliance on crude oil and petroleum products. E.g. embarking on sustainable policies that could help to improve agriculture and industries, will further shield the economy from the impact of oil price shocks on the economy, and thus prevent the negative effect of the shocks from attaining a statistical significance level.

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